From EgoCity To EcoCity:
An Ecological, Complex Systems Approach To Humans And Their Settlements

Volume II
Supporting Materials

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1 APPENDIX A: WRITING CONVENTIONS

a). PARTICIPANT OBSERVER ANECDOTES, ABBREVIATIONS, SYMBOLS

In a number of places the symbol " ¥ " appears to indicate statements of opinion that are made on the basis of personal observation through direct and active participation. These are offered in the spirit of (often considerable) personal experience. They are nevertheless explicitly based on personal interpretation or 'clinical impression' of the state of affairs alluded to, are 'anecdotal', and not presented with supportive evidence, although they are often presented in support of other defended statements, or used to suggest that a principle useful to one discipline may also be available to another.

"§" indicates information derived from personal field work, interview or other direct experience: a statement of fact that I have checked or established personally. The source is not always mentioned, sometimes for privacy reasons.

"EPP", meaning "Ecological Paradigm Proponent", is widely used as an abbreviation. It refers to holders of what remains a non-mainstream world view in the range from Deep Ecology to Urban Ecology. It represents a definite and apparently growing subset of western civil society. It does not neatly align with Left or Right, but with concern for eco-social viability and well-being in the context of optimal planetary/biospheric function. It is not necessarily a homogeneous group, and where I claim a trend in beliefs, actions, intentions of other characteristics, the statement is on a similar basis to '¥' above: I am not in a position to research this, nor would I, as I believe time would be better spent in closer appraisal of on-the-ground outcomes.

b). USE OF FIRST PERSON PRONOUN

First person pronouns are used in descriptive sections of the dissertation to avoid ungainly, old-fashioned terms such as 'this author'. However in situations where a distinction needs to be made between other cited authors and the writer as an author, that term is used, with the intention of differentiating 'this' from the other author(s) mentioned.

c). GENDERED THIRD PERSON PRONOUNS & OTHER CONVENTIONS

Where not otherwise expressable, random switching between third person singular pronouns has been used to avoid the obnoxious option of using the plural. Except where direct quotations use a different convention, apostrophes are used as follows: ' . . . ' indicates conscious selection for a specific purpose: the labelling of a term or phrase under discussion, the non-specific use of terms referred to in cited text, the introduction of jargon, or indication of special use of the term enclosed. " . . . " indicates either a direct quotation or the title of a book or paper.

Many quotations from the pre-feminist era use the old genderist global terms such as 'he' and 'man'. These are labelled *[sic]* on the first instance only for any quotation.

'Contracted from' preceding a quotation indicates a précis, using key author's phrases, remaining faithful to author's intent and sentence meaning, but condensed. As distinct from 'transcribed from', which indicates a full quotation in different format, such as text-to-table.

d). USE OF CAPITALS

Capitals are used for proper nouns, to refer to formal disciplines and formal theory or recognised theoretical constellations, and for technical jargon where a definition narrower than general usage is intended. For instance 'Parent' indicating Parent Ego State (Transactional Analysis), indicates the personality element derived from external sources ('Exterpsyche'), such as parent figures and external life conditions.

e). USE OF NORTH-SOUTH, EAST-WEST, DC/LDC/MDC/ODC

As an Australian moving in an international field, I experience as objectionable the strong Euro-centrism and North-hemispherism in the terms in current use to describe countries of different levels of development ('North/South'). I have on several occasions bought Northern hemisphere residents a gift of the inverted world map with Australia at centre. Assigning Australia to 'the South' only aligns with that euphemism for 'underdevelopment' in so far as it applies to our First Nation. I avoid these terms. I occasionally use the apparently wicked term 'third world'. I most often use the terms DC, LDC and MDC or ODC (developing-, less-, more-, over- developed country), which appear to express the required meaning.

f). UNITED STATES ENGLISH SPELLING

Despite a severe temptation to correct this, the original spelling has been left intact in quotations.

g). PHOTOGRAPHY

Photographs are all taken by me unless otherwise cited.

h). TAPESTRY

This dissertation 'walks the talk' of Complexity and is consciously Counter-Reductionist. It can be viewed as a sea of data from which a story emerges, or a Backcloth or tapestry woven from many strands. 'Links' indicate the web-nature of this document. Text is supported by several other strands, many of which are mini stories in their own right, including footnotes, tables and figures, background information and papers, tools, databases, glossary, references and images.

i). (W)HOLISM

Approximately one in ten dictionaries recognises this spelling (for instance Macquarie). It is less alienating that 'holism', and better conveys the Complementary notion of wholeness. See Complementarity Theory.

j). AUTHOR'S COMMENTS

[Italic in square brackets] indicates (this) author's comments or contributions/additions to other authors' lists or points made, that may otherwise interrupt another discussion.

k). BIBLIOGRAPHY

Some entries are repeated with different year codings (eg 1990, 1990a) for technical reasons.

l). SECTION SUMMARIES OF THEORY

Starting with Section 4, the theoretical division of Volume I (preceding the Unified Human Settlement Ecology division), has Summaries at the end of each functional subsection. It is recommended that these be read first to give a general orientation to these sections, before proceeding with the body of the text. These sections form a synthesis of the Complexity Theory upon which it is argued that a coherent Theory of Human Settlements should be based.

These Summaries and other sections of summary character are:

<u>4 Models & Mindscapes</u>

- 4.2.7 Concepts & Questions
- 4.3.4 Bridges from Theory to Practice
- 4.4.6 Human Settlement Ecology & Metaphor

<u>5 Subatomic Theory</u>

- 5.6 Subatomic Theory

<u>6 Ordering Principles</u>

- 6.6 Ordering Principles

<u>7 Hypercyclic Systems Theory</u>

- 7.9 Summary: Complexity Theory

<u>8 Hierarchy & Scale</u>

- 8.9 Synthesis: A Theory of Scale: Ecological & Other Hierarchies

<u>9 Unified Ecology & its Extension to Human Settlements</u>

- 9.2.1 Scale: General Review

<u>11 Confluence</u>

- 11.2.7 Summary: Learnings (OCW Case Study)

<u>12 Conclusion</u>

- 12.2 Answering the Research Questions.

2 APPENDIX B: FIGURES & TABLES

2.1 INTRODUCTION: KEY TO APPENDICES B-E

The following items are grouped separately from Volume I for reasons of space and ease of access. Many are present as source backups to the text, as knowledge extensions for cross-disciplinary understanding, as demonstrations of the similarity of thinking coming from different disciplinary origins, and as a potential resource if Unified Human Settlement Ecology were to be used in a teaching situation. In many cases it has been hard to know whether to assign the category 'Background', as they are nearly all background for some purposes, and some are more 'background' than others, but the assignment really belongs with the reader. In a discipline of uncertain pedigree, I can not know who that will be. Within Appendices, Volume II is arranged in the order of mention in the text.

As explained in Volume I, Figures and Tables are labelled conventionally, followed by code strings indicating the category of item: Background Information (BI), Conceptual Exercise (CE), Contribution to Model (CM), Eco-Logical Strategies or Principles (ES), Field Research (FR), Research Report (RR). For the reader's convenience I have constructed a bookmark that doubles as an orientating code key.

Other items coded in Volume I are the Unified Human Settlement Ecology (UHSE) conceptual tools (Tool), Databases (DB), longer Background Papers (BP) and Declarations & Charters (D&C).

Separate Appendices house (B) Figures & Tables, (C) Tools, (D) Databases, (E) Background Papers and (F) Declarations & Charters. The small Databases, representing the Field Work and the Sustainable Strategies Collation, both mainly early phase, contain information influential on later Theory Development. Background Papers are theoretical background, cross-disciplinary extension essays, or represent small topics or pieces of peripheral research carried out as background work while thinking through the dissertation. Declarations & Charters are present for completeness and optional reference.

Appendix B sections are preceded by Contents Lists for those sections.

2.2 APPENDIX B: FIGURES & TABLES

(ITEMS IN BRACKETS MARK VOLUME I ORDER, BUT ARE NOT LOCATED IN THIS APPENDIX)

2.2.1 PRELIMINARY PAGES

CONTENTS

2.2.2 INTRODUCTION

CONTENTS

2.2.3 METHODOLOGY

CONTENTS

PRELIMINARY PAGES

(Plate 1: Context - The Living Earth)

INTRODUCTION

(D&C 6.1: Istanbul Declaration on Human Settlements)

(D&C 6.2: The Newcastle Declaration)

(D&C 6.3: The Earth Charter)

METHODOLOGY

(Tool 3.3: Information Spider: Traffic Reduction through Urban Design)

Figure 1: FRBT: Master Questionnaire

CHARACTERISTICS OF THE COMMUNITY

NAME OF DEVELOPMENT

LOCATION

Country, State, City,/Town,/Suburb

INFORMANT(S) & ROLES/ QUALIFICATION TO SPEAK FOR DEVELOPMENT; CONTACT ADDRESS; ALL PHONE NUMBERS & FAXES & EMAIL IF ANY

Anyone Involved Can Speak For The Development But Nature Of Relationship Is Needed; Good To Have Information From Visioning Group And Also Less Involved Residents

CATEGORY

City/ Rural City/ Part City/ Centre City/ Sector/ Group Suburb/ Suburb/ Locality/ Block/ Housing Group/ Co-Housing/ Single Dwelling/ Rural Community/ Other

"GREENFIELDS" SITE OR RETROFIT/ REDEVELOPMENT

TIMESCALE

Years Established/ Present Progress/ Projected Approx. Start & Completion Dates

POPULATION PRESENT OR PLANNED INCLUDING STAGING

POPULATION DENSITY

Persons Per Acre Or Hectare (Please Specify Which Measure Used); Number Of Households Total; Percentages Of High, Medium & Low Density

SOURCE AND TRANSMISSION OF THE VISION

VISION & CONCEPTION

Author{S} Of Vision; Concept Development By?, Nature Of Vision/ Philosophy;

Iterated; Updating Of Vision; Replacement Of Vision

SECTORAL/ SOCIO-ECONOMIC ORIGINS OF FOUNDERS

(Expressed As Income Transfer, Blue Collar, White Collar, Merchant, Real-Estate Developer, Professional {Specify Which}, Retired {Please Specify From Which Vocation If Known}, Other--Please Explain)

PEOPLE WORKING ON TEAM: SIZE OF CORE GROUP; KEY PEOPLE

Names, Positions, I/D For Followup

SOCIO-ECONOMIC MIX OF RESIDENTS OR PROPOSED RESIDENTS

[Expressed As Approximate Percentage Proportions] Income Transfer, Blue Collar, White Collar, Merchant, Professional, Retired {Please Specify From Which Socio-Economic Group If Known}, Other--Please Explain

HOW ARE THE RESIDENTS INVOLVED?

ORIGIN OF RESIDENTS

Source Of New Residents: General Public By Advertisement/ Other; A Particular Interest Group; Other

PRE-DESIGN PUBLIC EDUCATION

Type, People Targeted, Approx. Numbers Contacted; Type Of Education Process; Material Presented; Public Meetings {How Many?}; Self Education Of Leader Group {If Remarkable}

PRE-DESIGN PUBLIC CONSULTATION

Method Of Identification Of Potential Residents: Already Known, Surrounding Community Consulted, Public Housing Waiting Lists Consulted, Advertising, Other; Types Of Consultation: Public Meeting, Search Conference, Large/Small Survey, Invited Interest Groups, Other {Specify}; Issues Listing & Prioritisation By Residents Pre Design

SYSTEM FOR PUBLIC INVOLVEMENT

No Formal System, Inclusion Of Representatives On Decision-Making Body, Development Small Enough To Include All Residents In Project Management, Regular Meetings/Briefings {Frequency?}, Decision Making: Consensus Models {Definition Of Consensus}, Democratic Voting Systems, Mixed, Delegated, Taken Care Of By Vision-Holder{S}, Other {Please Specify}

COMMUNITY-BUILDING SYSTEM ONCE ESTABLISHED

Process Planning By Leader Group, New Residents Packages, Community Development Officer{S}, Community Meetings, {Frequency}, Involvement In Decision-Making Structure, Design-In Of Informal/Formal Meeting Places, Social Events, Educational/ Activity Groups, Community Task Forces, Interpersonal Relationship Processing Groups, Conflict Resolution Strategies {Details Of Interest}, Resident Mediator, Electronic Communication Systems, Local Radio Station, Other

TYPE(S) OF EQUITY OF RESIDENTS

Separate Ownership, Collective Ownership, Rental {From Whom}, Strata Title, Land Trust; Freehold; Leasehold; Shareholding {Present Cost Per Share; Number Of Shares Per Person/ Per Family; Governance & Justice Systems?}

HOW WAS IT/WILL IT BE PAID FOR AND BUILT?

FUNDING SOURCES

Especially Mention Creative Financing Strategies, Ethical Finance; Finance From Mixed Govt/ Private Or Other Combinations, Developer; Development Value Capture And Finance For Low Income People; Sweat Equity; Government/ Big Business/ Global Aid Sources; Need For Special Purpose Funding & Sources {Eg. Clean up Toxic Sites, Earthquake Damage Etc.}

LABOUR SOURCE FOR BUILDING

Ordinary Commercial, Stakeholders Self Build {Paid/Unpaid}, Lets System, Other

DESIGNING THE VISION

SITE DESIGN: MATCHING DESIGN TO ECO-SYSTEM: INDICATE METHOD IN DETAIL

What were the initial steps taken to effect this? Use of GIS {geographical information system}, use of computers: modelling; use of intuition based on site geography and /or other details {which details?}, Application of theoretical concepts, thematic axes etc., Overlay techniques, threshold analysis, ultimate environmental threshold, Bioregion analysis; carrying capacity estimates, flora & fauna studies, water catchment mapping, geological survey, ground water studies, other

EIS (ENVIRONMENT IMPACT STATEMENT)

EIA performed as part of planning requirement, EIS not required/ not done, formal EIA {assessment} done voluntarily, EIA irrelevant, EIA done before/ after plans drawn up/ integrated into planning, other
HIA? EIA? SIA?

WHAT IS IT LIKE THERE?

BUILDING MATERIALS TYPES & SOURCES

Local {which/what/where}, distant: concrete, glass, bricks, tiles, timber {virgin forest/plantation/ recycled paper}, plastics {type, new,/recycled}; second-hand items

INDOOR MATERIALS

Toxicity; softwoods; hardwoods; glass; paints; plastics; furnishings; flues; gas

UNIFORMITY OF DESIGN & MATERIALS

Individual uncoordinated, self-build, individual coordinated, developer-designed & coordinated, other

PRIVACY & PSYCHO-SPIRITUAL SPACE &COMMUNITY RESOURCES

Private space available to individual: personal private space, low-use wild places, "power places", "sacred sites", places of worship, not considered in overall design, other; personal territory for families/individuals: sleeping area only, accommodation: co-housing with assigned private space, separate house/apartment/flat; separate land, garden {small/large}, play areas {type, privacy from adults, supervision by adults, other}; community-provided withdrawal places/quiet places, meditation facilities; formal/informal meeting places; cafes; restaurants; health centres; alternative health centres; market; single shops; shopping centres (sizes:); provision for adolescents {what?}; Provision for old people {what?}. Provision for family recreation {what?}; Exercise facilities {what?}: Cycling, walking, running, team sports, indoor sports, swimming, other

RESOURCE POOLING

Income, equipment {types}, labour {L.E.T.S. or other schemes, task forces}, tasks: washing, cooking, shopping, transport, gardening, sewing, building, repairs & maintenance, child care, elderly care, other {what}

WHAT ECO-SENSITIVE INFRASTRUCTURE STRATEGIES HAVE BEEN USED?

TYPE OF TRANSPORT SYSTEM & STRATEGIES

Status of cars, where parked, individual or community ownership, reduction strategies, public transport strategies: rail, light rail, tram, large bus, small bus, taxi, private ride-sharing schemes, priority lanes, public ownership of vehicles for hire/ use, time to public transport, frequency; other; percentage use of public transport as proportion of total private trips, traffic calming, description of bicycle path and bicycle/car integration system: bicycle traffic lights, separation from traffic; pedestrianisation pattern, provision for mobilisation of elderly, disabled, parents with young children, goods delivery system; connections with outside centres/ distant places

ENERGY

Grid, generated by: oil, coal, cleaned coal, coal gas, natural gas, hydro, wind, solar, salt-electro, tidal, biomass {type}, other; co-generation (based on what, source to how many households/ buildings); individual generation: wind, solar thermal, photovoltaic; biomass/compressed waste, tidal, salt-electro; piped natural gas, coal gas, methane, wood other; presently or intended; passive solar housing/ building design (briefly list or describe strategies favoured).

SELF SUFFICIENCY

Percentage of food grown on site; use of Permaculture, greenhouses; percentage of energy generated locally; income sources: extent of local industry development and types of industry: large mono-industry, cottage industry, service industry, other; income transfer proportion

WATER SYSTEM

Source(s) of water, mono or dual system (white/grey), aquifer recharge measures, stormwater management: destination of excess runoff, natural/ artificial wetlands, rainwater tanks with/ without diverter, with/without council subsidy; identification & management of contamination issues

SEWERAGE SYSTEM

Sullage/ sewage separation, recycle {specify type/use}, sewerage system - household system {type, methane disposal} local processing {size of group serviced per processing unit, destination of products}, distant/centralised, sludge destination/ use, effluent destination/ use & mode of transport

WASTE REUSE & RECYCLING

Domestic garbage sorting: at source, centrally; kerbside collection: mixed, sorted {categories available: paper, organic/ kitchen, garden/ mulching offered, ferrous metals, non-ferrous metals, oil, chemicals, glass, toxic, dangerous, general "hard" rubbish, other; industrial waste details {will come back and examine in detail if a large issue in this development} details of reuse of interest, discharge {of what?} To: atmosphere, sea, river, land unsealed, land sealed, incinerator - high temp/ low temp; contaminated land an element of development

WHAT GOT IT OFF THE GROUND (Story of Implementation)?

GATEKEEPERS

Powerful people/ organisations who/ which had/ have to be got on side in order to implement, such as finance sources, local, state, federal departments (etc.) Directors of government departments, government finance committees, ministers & members of parliament, particular planning authorities, EIAs, power authorities, utilities; public acceptance; government policy; other: please explain

OBSTACLES:

Human: social, equity, consensus, conflict, dissent, intolerance, health, safety, nutrition, occupational, employment; technical: pollution, transport, housing, materials, energy; economic/ finance; environment/ eco-system: water, air, soil, geology, biota; political: policy, party politics, legal issues, environment movement, public dissent, media, other

SOLUTIONS TO OBSTACLES Which solution applies to which obstacle

CRUCIAL STRATEGIES FOR IMPLEMENATION

What made the difference between just talking about the project and actually getting it off the ground?

QUALITY OF LIFE COMPARED WITH EXPERIENCE IN ORTHODOX COMMUNITIES

SATISFACTION WITH LIFESTYLE

Assessment of success in applying ESD principles

Key features, creative solutions, features for imminent solution, non-ideal features, bad features, apparently insoluble problems

LEARNINGS/ WISDOM FOR FUTURE

More on Philosophical Underpinnings

Anthropology
Culture
Psychology.

(DB 4.1: Research Journey: Places & Learnings)

Figure 2: FRBI: Form Letter Extract

LISTS OF INTERESTS

PRIMARY INTEREST

(Philosophical, process and social aspects of the development along with outcomes):

- Intentional "eco-" or "alternative" communities established some time ago, preferably 10-15+ years
- "Organic" developments based on Christopher Alexander's "pattern language" or similar systems (user- designed)
- Urban villages, especially "eco-villages" but also interested in what not to do
- New or old housing developments claimed to be ecologically sustainable
- State-of-the-art new or retrofit housing developments which include ecological principles
- State-of-the-art new or retrofit housing developments which include strong social equity principles
- Government or developer-driven ("top down") ecologically sustainable communities
- Urban or suburban developments using extensive public participation ("bottom up")
- Community-driven housing, co-housing, cooperative housing or community development
- Fully integrated, stand-alone (not dependent on national energy, water or sewerage grids) developments
- Urban Permaculture, community gardens, urban greenhouses or other forms of substantial local urban food production; substantial integrated, working urban Permaculture designs
- Advances in high density or medium density suburban developments (also interested in examples of what not to do)
- Contaminated land reclamation to residential standard
- Environments designed to encourage wholistic and preventive ("high level wellness") health and safety, especially pedestrianised localities and strategies to remove or discourage cars
- Car-dependent places which have managed to drastically reduce car use
- Canal developments, especially in swampland areas (not expected to be "sustainable")

TECHNICAL INTEREST

(Radical examples being sought):

- Non-toxic housing
- Passive solar housing design
- Innovative housing/ "intelligent" or "smart" housing
- State-of-the art transport planning (especially traffic calming, car discouragement or removal, bicycle and pedestrian- favouring arrangements, light rail systems)
- Urban strategies for stormwater capture and recycling
- Designing for water conservation
- Alternative (renewable) energy generation (eg. wind, solar thermal,, solar photo-voltaic, biomass, geo-thermal, fuel cells, co-generation systems
- Advanced recycling
- On-site sewage treatment and recycling.

Figure 3: FRBI: EcoCommunity Short Assessment Sheet

ECOCOMMUNITY DIAGNOSIS

LOCATION OF DEVELOPMENT

CONTACT PERSONS AND RELATIONSHIP TO DEVELOPMENT

PERSON 1

PERSON 2

PERSON 3

ADDRESSES, PHONE NUMBERS, FAXES & EMAIL ADDRESSES

PERSON 1

PERSON 2

PERSON 3

POPULATION OF DEVELOPMENT

PRESENT PROJECTED

AREA OF DEVELOPMENT DENSITY

VISION BY WHOM?

SUMMARY OF VISION/ THEME

APPROXIMATE DATE OF START OF CONCEPT:

OF COMPLETION STAGE ONE:

OF COMPLETION WHOLE PROJECT:

IN WHAT WAYS IS THIS AN ECO-DEVELOPMENT?

- TRANSPORT
- ENERGY
- WATER
- SEWERAGE
- WASTE
- MIXED DEVELOPMENT (WORK NEAR HOME)
- COMMUNITY DEVELOPMENT (COMMUNITY PARTICIPATION)
- SELF-SUFFICIENCY (ENERGY, FOOD, ECONOMIC, WATER, MATERIALS)
- RESOURCE/ SHARING
- DESIGN RESPECTING ENVIRONMENTAL THRESHOLDS
- CONSERVATION/RESTORATION OF NATURAL SYSTEMS
- ABORIGINAL/OTHER HISTORICAL/HERITAGE
- OTHER

WERE PRELIMINARY ASSESSMENTS REQUIRED OR DONE VOLUNTARILY:

HIA SIA EIA

HOW IS THIS DEVELOPMENT ECONOMICALLY VIABLE?

LOCAL ECONOMIC & EQUITY SYSTEMS

CREATIVE FINANCE

2.2.4 EARLY FINDINGS

CONTENTS

EARLY FINDINGS

Table 1: FRES: Swedish EcoVillage: Adjustment of Strategies Over Time

	Original Definition 1987; Concept 'An Ecovillage'	1993	Reasons
Technological Solutions	Composting toilets	Walgaast toilet (separates urine & faeces).	Both end up as fertiliser by different processes.
Forest-Derived Energy	Woodchips	Compressed pellets from sawmills.	Woodchips have a heavy fungal load due to temperature & humidity of storage requirements, causing lung problems in timber workers.
Heating Systems	Several furnaces required if village low density.	More condensed village, one furnace, solar cells on roof of common house.	Energy efficiency
Number of Houses	50-70	30	Demand plus what could be placed on the given site; need to accommodate meeting places for adults and children and not damage the forest.
Agriculture	Self-sufficiency; 3ha food production area.	Kitchen gardens plus large plots for some only; field set aside for cooperative gardening; local farmers to supply some.	Not all wanted to grow food; steady income for local producers.
Traffic	Always intended co-travelling: not formulated early on.	Easy to use phone + an information programme to book a place in a car going somewhere; solid agreements about use of minibuses at specific times on specific routes; local cooperation: opportunities re sports, hikes, fishing; decreased commuting from encouraging home work; imports of some commodities in bulk (food, some energy, meat, bread, eggs all delivered to common house); LETS and other types of local exchange.	Decreased costs per person, minimum emissions. Studied Swedish transport statistics and found journey-to-work , service & long distance travel are not the problem (<1/3): short-distance, free-time travel is nearly half of all travel. Difficult to organise free-time travel cooperatively, but felt to be so important that the effort is being made. Assessed as an information problem to be solved.

(Information from Per-Eric Siljestam, Planning Administrator, City of Stockholm, 1993).[§]

This Table demonstrates by the types of issues discussed, the levels of eco-social consciousness and intellectual flexibility often required in setting up EcoVillages *de novo*. This is a very thoughtful, reflective and democratic lifestyle. Fashion following and blind Individualist or Consumer mindsets provide a major challenge. How might such a carefully-conditioned, consumerist population be persuaded to change even slightly, in the direction of making a difference? The first step, according to most interviewees, is to demonstrate what to do and why, and how to do it.[§]

(Plate 2: Collage: Blå Kilde Gärde)

Table 2: FRRRES: Danish Research (A): Framework

	Herning	Kjellerup	Hvidovre	Jægerspris
Commune Description Populations 01/96	Very large, provincial, mid Jutland, 1/2-1/3 still working on farms Population 57,965 Area 541 km^2	Very large municipality, mid Jutland Population 13,419 Area 255 km^2	Suburb of København, very dense Population 48,730 Area 22 km^2	Small population North Sjælland (Zeeland) Population 19,552. Area 40
Economic	Rich, successful, development +++; few poor	Fairly poor/limited options; Low population	Lower middle & upper working class	Poor, non-farming; many commute to cities, esp. Frederickswerk.
Community Attitude	Wow! let's act!!	Sceptical, conflictual *[sic]*	Anonymous (large scale urban)	No tradition for involvement, but open-minded.
Community Self Esteem	Very positive, active, self-made, hard-working	Traditional		
Housing Style	Single family	Single family	Apartments & single family	Single family
Family Character	2-income, large cars			
Relationship to Children	Little time for, even though important to them: occupied by sport or sitting at home			
Relationship to Neighbours	Low interaction	Social control (positive & negative)	Low interaction	Medium interaction
Relationship to Schools	Keen to back up local school	School = community centre; took over local government policy-making on garbage due to political incapacity	13 schools, often large with ±60 commuting teachers (non-local)	Teacher concern re proposed landfill; concern re how to work with environmental education for action in schools; project-oriented teaching adopted.
Community Activities	Especially in the past: joint projects - get a container, hold parties (work together little)	Strong local organisation, needed new theme for get-togethers, now provided by ecology and pressuring local government		
Relationship to Municipality	Work with, eg to make local Green Centre	Seen as 'the enemy' to be pressurised on performance rather than partnered		Close partnership between technical departments of local government and children; Supported by local politicians.
Project Type	Green Centre: demonstration of ecological techniques, ecological gardening, composting, water conservation; building dome (to clean water)	Expertise in garbage and related subjects relative to parochial scale Public meetings at school Test-families in pilot garbage scheme	Children & teachers become experts and advisers for local society on garbage, water saving etc.; information collection & database, local project initiation (eg on local housing estate), assist concrete local action plans, knowledge of local policy, politics, technical options; offer pupils' work to start up; Class specialisation in different areas of knowledge	Project-oriented teaching: pupils define subject, teachers are consultants; learn from experience, minimal guidance; New model: choose 3 schools, split up (34) classes & recombine in neighbourhood groups attached to society - all ages mixed, all placed near own dwelling; Planning & realising periods; Parents & locals invited to join the work; high priority on dialogue.
Local Problems/ Issues	Local conservation strategy demonstration; fulfil need to meet (social needs); access to single family suburbs; accessing local reality (conflicts, politics, conditions, social realities, tendency to not be involved)	Poor performance of municipality, especially around garbage & recycling		Solution of problems re locality, lifestyle, environment, traffic, social life, land use, locations for common activities, meeting places, seeking buy-back of common land.

Table 3: FRRRES: Danish Research (B): Outcomes

Benefits to Children	Taught social relevance of their suggestions. Appreciation of budget issues. Learning how to argue for something, how to organise & get people in to help with things. Self-sufficiency. Role definition for young people within community: motivation to stay in future lives. Child solutions tend to be non-traditional, low cost – affirmed.
Problems	Limited time of project. Differing senses of time between 10 year olds and government departments. Communication issues due to differences in position (all except Kjellerup). Structural issues, especially re differences between schools, local government & everyday life:. Process orientation vs division of day into topics. Parental expectations re basic learning. Local level political activity required of teachers. Teachers' work conditions: union demands, time, lack of pay for extra work involved (varies with teacher). To have child partners, must accept their position, affirm their ideas, allow them real influence without putting up with 'rubbish'. Buck-passing between local government departments - often 3-4 departments involved: needs intra-LG cooperation (most LG improving, accepting multi-disciplinary nature of environmental issues); most of Denmark has this democratic structure by tradition - flats, organisations, schools - "a very different story in Sweden".

Theoretical Issues	Such projects for effectiveness need to be bottom-up; this one started from above (framework development), then local players invited to join; liaison between university, schools, departments, focused programme to meet local goals, which university then backed up. A transcendent form, hopefully initiated from below in future. This was a demonstration project, but now spreading, and the four different approaches had also developed over 3 years. Turning out to be a very good way to evolve local processes and increase child competence in the real world (eg suicide is about feeling of loss of personal control). Uni. goals were political (sustainable society), educational (ecology), academic (consultation techniques & processes). Schools: educational (competent, democratic individual). Local government: community building, capacity building, communication with & feedback from community, suicide reduction, youth issues, many social goals, technical. Community: inclusion, life options. Community are real experts on local conditions. Conclusion that eco-social solutions need to be far more local (neighbourhood) - local government knowledge is still too general for meaningful change. Community development needs a theme, and to work with one thing at a time, step-by-step. Ecology is an excellent theme because ongoing and with universal relevance. Local differences in response demonstrate the crucial role of local interpretation to environmental solutions. Key educational experience affirms children's suggestions, teaches how to defend projects through budget debates, check for real social relevance, argue for positions, dialogue with others, initiate & organise assistance from other people. Local informal social debates involve many people, heal alienation & fear. 2-3 month programme invites locals into schools for days or weeks of non-organised contact & activity; debate to establish issues first, solve problems later, real problems, planning period. If adopted into school work, will become an annual event. If backed up by local government, technology people, local politicians, can officially invite people to join, a serious & real business. Proportion of school time allocated: 3 days/week at start for preparation, then one day/week in discussion with invited people; then 1 month planning; then several weeks at 3 days/week (school hours) to work on it (older children have conflict with exam times). In economic rationalist context, competing for scarce resources, need to pick up presently neglected social possibilities. Govt. has removed many roles formerly performed by local people. A solution is to take many of these back in a community-building process. This may require review of local regulations (eg composting, suburban presence of pigs, poultry; old Danish laws allowing hooved but forbidding cloven-hooved animals).
National/ International Context & Trials	Danish planning law requires substantial public involvement; local government 4-year plans require 3-month suggestion period, 3 months public comment. Model presented as EEC project with applications in France, United Kingdom & Portugal. Expression varied in major ways according to country/culture. Portuguese project the most similar to Danish, but simplified to use children as messengers to influence parents: not a remarkable strategy. United Kingdom did big surveys with questionnaires seeking extent of environmental knowledge; school children used this information to rewrite questionnaires. Nothing changed. France worked with museums: children went to museums for experiential learning, attempting to raise consciousness of children & parents: inconclusive at reporting (comment: "Danish museums have been like that for years!").

(Source Tables 2&3: Interview Dr Birgitte Hoffman 09/93).

These Tables report the so-called 'Quark Cooperative Programmes'.

Figure 4: FRRR: The Good News – Noteworthy MFP Australia Projects

MFP PROJECTS

Information provided by former senior staff member, Email communication Wednesday, 29 March 2000.

"Heres *[sic]* a few off the top of my head. There are literally hundreds like this - all small and inconspicuous. I will have some more in a few days."

FUNDED:

Ozone depleting substances study for Australia - working in conjunction with CSIRO Melbourne, developed data for on-forwarding to Tokyo for compilation into global data base. Funded by MFP Australia and MACAJ (friends of MFP) in Japan.

Development of ozone depleting substances airborne monitoring capability with Australian personnel at Technology Park. Can't remember name of company - Australian Air something - Now part of Defence Teaming Centre.

Construction and equipping of $4 million Ian Wark Research Institute at University of SA. For info on them and what they do - search on IWRI.unisa.edu.au. <http://www.iwri.unisa.edu.au/>†

Assisted establishment of Defence Teaming Centre (British Aerospace, Motorola, CAE MRad, Vision Systems, Hawker de Havilland et al) at Technology Park.

Funded 10 visits by US team developing Cluster Based Economies (previous successes Silicon Valley and Austin, Texas) which culminated in adoption of this model of industry development by DIST/EDA.

Designed and project managed construction of the Barker Inlet, Range Road and Magazine Creek wetlands at Gillman, Dry Creek < Wingfield in South Australia (the largest CONSTRUCTED wetlands in the world).

Construction and initial development of Science Park attached to Flinders University and Technology Park, University of SA.

Funded feasibility study and compulsory land acquisition leading to Mawson Lakes residential development JV with LMC.

Funded 50% of annual salaries for numerous professors and associate professors at various Adelaide based Universities.

Funded water quality monitoring and development of equipment by University of Adelaide.

Funded initial budget for CRC Water Quality and Treatment (UniSA/AWQC Bolivar).

Designed, established private financing and project managed initial investigations which led to construction of Bolivar Virginia Pipeline.

Funded study by CSIRO groundwater into aquifer properties on Northern Adelaide Plains Aquifer to determine 'drawdown' created by Virginia irrigators and increasing salinity from sea and feasibility of winter injection of disinfected treated effluent from Bolivar Pipeline Scheme.

Part funded 1994 CSIRO / NATO CCMS conference in Adelaide on Soil Contaminants in the Asia Pacific Region.

ALSO:

Funded R&D by Flinders University to establish biodegradation rates for starch based polymers used for 'plastic' bags and utensils in Europe (MATER-Bi).

Funded Happy Valley Council (now DC Onkaparinga) for $5K to trial biodegradable starch polymer bags for green waste collection and shredding.

Funded several NATIONAL packagers of frozen bait to trial biodegradable starch based polymer bags for frozen bait to avoid litter problem and asphyxiation of dolphins and other mammals encountering plastic bait bags.

Funded Poly products P /L in South Australia for production trials using 100kg of starch polymer to modify plastic extrusion plant to suit starch polymers. Resulted in more widespread availability/use/adoption of this product.

Funded $25K R&D and project management expenditure to 'compost' 35,000 m3 of buried sheep at Levels Stock paddocks to convert to humus - bulk of which has been sold. This led to decision by Flinders Uni. to become involved in composting several thousand tonnes of dead tuna fish at Port Lincoln following devastating storm which destroyed sea based farm stock. The expertise developed over the 2 year program provided Flinders University with the impetus to establish Flinders Biotechnologies Pty Ltd which offers similar services throughout Asia Pacific region.

Funded and assisted with firing tests for bricks made with sewage sludge - resulting in 30% reduction in energy requirements (FALZON and Hallett Brick Industries). Subsequently discontinued when fluoride emissions were encountered by adjacent landowners and EPA wanted sludge use discontinued to avoid visible smoke generation during brick firing - although no fluoride was present in sewage sludge). Now smoke is invisible and complaints have dropped off 99%.

† "This research institute, located in Adelaide, South Australia, conducts a range of fundamental and applied research into minerals and materials science and technology. It specialises in particle and material surfaces." (and trains post-graduate students) Source: website: IWRI.unisa.edu.au/.

Author's Additions

Telemedicine

Port Adelaide revegetation with community assistance

Social Issues Descriptors for Development (Social Issues Team)

Total Catchment Management

Sustainable Development Database

Financial backing for Mawson Centre for Environmental Studies third world scholarships

Salisbury-Virginia Pipeline

Industrial Ecology Audit

Transport & Environment Arts Project (three programmes linking the linkages between social, environmental and transport issues: "The Osborn Station Public Art Program", "The Community Workshop Program" and "The Port Parade Schools Program"). Set up in partnership between MFP and Port Community Arts Centre, community, schools and artworkers

New Haven Village step-up project

A 65-building, 5-acre, medium density development under control of the SA Housing Trust.

Incorporating 30% reduction energy usage, higher renewables contribution to energy supply, 30% reduction CO_2, passive solar design, grey water and storm water reuse, xeriscape gardens, solar HWS, geothermal air conditioning (in-ground heat exchange), building to a price ($120,000 maximum), blurring of public-private boundaries, giving semi-private extension of private land, automatic drip irrigation, remote metering, shared metering, common trenching of utilities.

Table 4: RRES: Barriers to Urban Ecology

Barrier	Strategy
Belief Systems • Doubting a problem exists • Supporting status quo	• Consciousness raising campaigns • Public participation in decision making • Demonstration projects • Incentives, disincentives
Knowledge • Ignorance of environmental issues (developers, planners, builders, tradespeople, academics, public)*f* • Lack of experience & eco-social practical knowledge*f*	• Special courses; integral to usual courses • Improved eco-social education all levels; central focus for Jerrabomberra development • Eco-social investigation & built environment experimentation = core of Jerrabomberra concept • Different research tasks in different areas of Jerrabomberra Valley development
Fear • Of change*f* • Of financial loss*f*	• Make change safe, incremental, reversible, socially rewarding, cost-effective; incentives • Create change by using 'the converted' to implement first demos • Present full cost scenario (education), full cost pricing, disincentives
Communication • Poor inter- & intra-government communication • Opaque Government (poor, controlling and secretive communication with citizens)*f*	• Task-related multi-government multi-disciplinary project teams • Decision-maker education (similar to European Eco-Counsellor training) • Combined Inter-governmental & Inter-departmental policy coordinating body • 'Glass' Government (transparent)
Exclusive Processes • Exclusion of residents from planning and decision process: authoritarian system*f* • Exclusion of environmentalists from planning and decision process • Immutable plans precede public involvement	• Public participation, small scale participatory democracy, small scale decision making, round tables, charrettes, residents & environmentalists in task groups • Early public participation and public consultation, before and during design phase
Financial Structures • Sunk capital • Cross subsidisation against ecological solutions and behaviours • Rewards for inappropriate practices • Taxation structures disincentive • Low income funding problems • Mistrust of long term market	• Expose all cross subsidy; rearrange to favour eco-social goals • User pays, financial incentives & disincentives • Creative finance, Community Land Trusts, land banking • Government seed funding • Government guarantees • Compensation • Retrofit
Urban Laws, Regulations, Policy*f* • Difficulty for innovative projects	• Review all legislation • Replace with modular, functional law system in plain English • Community Title Legislation (ACT) • All building codes functional, avoid rigid specifications • Re- & de-zoning • Policy leverage favouring ESD • Educate public that 'community' does not mean 'commune' (ie hippies)
Existing Structural Limitations*f* • Mental • Physical (urban form)*f* • Attachment to cars	• Education, demonstration projects • Rezoning for mixed use, higher density; long range strategic planning which re-moulds urban form • Analyse car advantages (including psychological satisfaction elements) and provide by other methods

(Elle,Andersen,Drewes & Danielsen 1992: 8) Elle's 'Scenario Workshop' findings indicated by *f* in column 1. Column 2 derived from collected responses in Jerrabomberra Valley National Ideas Competition (Rounsefell 1994c: 46).

(Plate 3: Collage: New Haven: The MFP 'Step-Up' Project)

Table 5: CM: ESD vs ECD

ESD/RCD	ECD
Tends top-down with developer or government Drivers	Tends bottom-up with local semi-top-down firesoul
Resources oriented	People & Nature oriented
Controlling	Enabling emergence, 'gardening'
Economics driven Anthropocentric	Values driven Biocentric
Environment & resource focus	Ecosystem focus
Environment external to human activity	All scales connected, humans embedded in ecosystems
Linear, compartmentalised, reductionist	Cyclic, holistic, complex
Specialist	Generalist plus special interest
Tends towards sterility, tidiness, simple order	Lively, messy, creative, webby
Technofix for symptoms Technofix for toxicity; Biocooptation	Preventive activity; seeks systemic health, healing; Biomimicry Looks for underlying causes for remediation, ways to link functions
Metaphors: building, machine, modularity	Metaphors: web, organism, evolution
Question: "How much can we exploit this before the whole thing collapses?" HOW TO USE (EFFICIENTLY)?	Question: "How can we best align with Nature in the way we live?" HOW TO HEAL AND ENHANCE?
'A place for everything and everything in its place' 'we can't afford NOT to develop' (Control, Markets, Profits)	'To allow, to forbid but not to require' 'Walk your talk' 'Walk the land and let it speak to you' (Synthesis, Meeting Needs Lightly)

(People committed to ECD also use RSD strategies, but avoid the conceptual narrowness).

(Plate 4: Collage: Urban Ecology Australia)

(BP 5.1: Helsinki Paper on MFP-Australia)

(Plate 5: Collage: MFP Aspirations)

Table 6: FR: MFP Newsclips: The Bad News

Date, page	Title	Newspaper, Author	Comment
30/11/'95: 4	**High-tech city rocked as CEO resigns**	The Australian John Kerin	Resignation of CEO Ross Kennan after MFP Board lost confidence in his ability to deliver required goals
1/12/'95: 1-2	**Deliver or else, MFP warned: Threat to axe project: "either we get runs on the board or there is no funding"**	Adelaide Advertiser Paul Starick. Michael Foster	Effort by then Infrastructure Minister Olsen to force progress following "shock resignation" of CEO Ross Kennan. Accompanied by 500-person poll which showed 55% opposition, 31% should continue, 14% uncertain.
2/12/'95: 9	**MFP staff face deadline: Do-or-die campaign planned**	Adelaide Advertiser Paul Starick	Effort by acting CEO Bill Steele to attract public attention to the many projects in train, seeking popular support *[more progress was made by this acting CEO than all other incumbents: senior staff pers.comm.]*
21/5/'97: 1	**Still not sure what MFP means? Under its present Olsen-led revival, MFP seems to mean... Many Fingers in Pies**	The City Messenger Adelaide Jeremy Pudney	"There is now hardly a major project in Adelaide that the MFP, newly revived under John Olsen, is not involved in."
3/7/'97: 6	**MFP chief to be questioned**	Adelaide Advertiser Phillip Coorey	Re Dr. Webber and the AABC
5/7/'97: 1	**MFP pay, trips cost $54m... but no key projects yet delivered**	Adelaide Advertiser Phillip Coorey	The New Haven Project is never mentioned as an MFP project in such articles, nor the telemedicine startup, pioneering catchment management, startup funding for numerous major technological projects, Industrial Ecology…
1/7/'97: 3	**MPs investigate MFP consortium**	Adelaide Advertiser Phillip Coorey	State's highest paid public servant Dr. Robert Webber, head of AAPB departs without achieving goals nearly 3 years after given $4.6m budget for this purpose (>$3m spent).
13/8/'97: 1-2	**MFP dies: long live the city** **"The MFP has been**	Adelaide Advertiser Greg Kelton	Announcement of radical revision of MFP concept formal end of MFP as a quasi-governmental organisation.

Date, page	Title	Newspaper, Author	Comment
	scrapped - and a powerful new development corporation responsible for driving development in the city will take over."		
13/8/'97: 12	**Nothing going nowhere**	Adelaide Advertiser Editorial	Positive comment on demise of the "MFP as such".
14/8/'97: 3	**MFP boss: it had an image of failure**	Adelaide Advertiser Paul Starick, Anthony Keane, Greg Kelton	MFP to continue under the auspices of the new Department of State Development. Opposition comment: "it's a political stunt...before the election...conned into believing (the Premier) has abolished the MFP...will continue to....spend exorbitant amounts of money on staff, perks and travel - under a different name...(with) far greater scope for abuses because it would not be scrutinised by three parliamentary committees." (Kevin Foley).
20/8/'97: 20	**Project boss for the MFP**	Adelaide Advertiser Regina Titelus	Shift of focus to Torrens Domain Project development, Adelaide, with appointment of Trevor Rose ex-BHP as director; after "demise" of MFP proper.
26/1/'98: 4	**This was to be a city. Now it will never be.**	Adelaide Advertiser Paul Starick	Total cost "to the taxpayer" of $100,000,000 since 1990. Site switched to Mawson Lakes in 1994, with delay. Environmental testing and site preparation at Gillman continued for development in 10 years. Cost millions. 340ha constructed wetlands but "land reclamation problems frustrated further development." Value of Mawson Lakes: $850m; joint venture between SA Government and Delfin Property Group; for 3500 homes, 10,000 population, 120,000sq.m. commercial & industrial. Use for Gillman must be found. Under consideration. Adequater demand questioned. No more "pie- in-the-sky ideas that only soak up taxpayers' dollars" (Shadow Treasury spokesman). Housing unlikely due to remediation costs. Needs Government input.

Link: Background Papers: MFP Australia: Helsinki Paper

(Plate 6: Collage: MFP Reincarnation 1994)

2.2.5 MODELS & MINDSCAPES

CONTENTS

Table 7: CM: Characteristics Required of an Ecological Model

Characteristics Required of Model
Provide a framework for an 'ecological approach' to human communities
Provide a generic approach that encourages but does not require an ecological attitude (to enable comparison of ideal and current practice)
Locate humans and their settlements within the natural world
Assist in reconceptualising the human relationship with Earth *'as if the eco mattered'*, *'as if people mattered'* (and indeed also *'as if the ego mattered'*
Allow the translation of ecological knowledge into a human dominated context
Take account of complex, dynamic, nonlinear and evolutionary aspects of relatedness
Provide an understanding of the place of mechanistic explanation within the complex world
Provide concepts for working with process and complexity
Take account of all scales and translation from one scale to another
Take account of time issues
Allow for structural and functional aspects
Connect the ecological and the social; internalise the 'externalities'
Take account of relationship issues such as values, ethics, politics and policy
Suggest new approaches to the solution of eco-social problems
Be compatible with scientific research and current practice
Support Eclecticism and the practical reality of Conceptual Pluralism
Build on known strengths of other approaches
Maximise opportunity for creative problem solving
Provide an educational and integrative framework for planners, policy makers, urban designers, academics, students
Co-orientate multi-disciplinary communication
Provide a framework for implementation and evaluation of eco-integrative strategies
Locate the author's work on a framework which allows translation across disciplines and subject areas.

Link: Elements of Ecological Model Contributed by UHSE Approach.

Table 8: CM: Purposes of Models

Purpose	High Generality Conceptual Models	High Precision Analytical Models	High Realism Impact Analysis Models	Moderate Generality Moderate Precision Indicator Models
Qualities	Highly idealised, address basic questions about limits of systems in ecological context, few state variables	Balance between mechanistic, small scale high flux & general whole system, noise damping; closely fit existing data	Accurate representation of underlying processes of a specific system; dynamic, nonlinear, evolutionary	Model overall magnitude & direction of change; aggregate measures of system performance
Examples	Simple linear & non-linear economic & ecological models eg Holling's Four Box model; Brown & Roughgarden's ecological economy model, most macro-economic, economic growth models & evolutionary games	Hannon & Joiris economic input-output models for ecosystems (use of indicator variables); Duchin resource-refuse analysis for industry; Klein large econometric models predicting short-run behaviour of economy	Coastal physical-biological-chemical models (Wroblewski & Hofmann); coastal landscape dynamics (Costanza, Sklar & White)	Standard Gross National Product, green Net National Product (Mäler); indicators of ecosystem health (Costanza, Norton & Haskell); microcosm systems analysis: ecosystem performance indices (Taub)
Scale	Macro	May shorten time frames and simplify relationships	Site specific, micro	Macro
Resolution	Low	High	High space & time	Low
Generality (broad range of system behaviours represented in one model)	High	Low	Low	Moderate
Realism (qualitatively realistic)	Low	Low	High	Low
Precision (quantitatively precise)	Low	High	Moderate	Moderate

(Based on Costanza, Wainger,Folke & Maler 1993: 547).

Table 9: CM: Ellen's Ecosystem Approach to Anthropology

Characteristic Focal Points in Ecological Anthropology	Explanatory Comments
Monism	Single system functioning: explicit basis for analysis. Culture is equivalent to behaviour systems in other species. Relationships between species associated through food webs is analysed as positive (mutualist), negative (parasitic or predatory) or neutral (commensalist). Rule: behaviour can't exist in ecological isolation. Axiom: environment is reciprocally & complexly bound to behaviour.
Complexity	De-reification of culture & social structure: multiple variables are recognised. Web model of causation rather than single gross or key 'master' variable. **Link: Background - Paper: Problem of Cause**.
Connectivity and Mutual Causality	Interaction: mutual relationship between environment & behaviour, often asymmetrical. Avoids determinist-possibilist fallacy.
Process	Integrated approach, analyses whole system impacts, avoids traps of simplistic analogy. Focus on interaction of variables. Sensitivity to life cycle analysis.
Populations as Analytical Units	Humans studied as an ecological population or territorial group with common trophic relations (energy inputs). Useful since are approximately bounded units. Identified by niche occupied. Problems in analysing culture or society in terms of niche, predation, disease, adequacy of function, adaptation, biology, physics. Population often correlates with these. **Link: Criteria under UHSE, especially Population & Community.** Ecological approach implies an inter-niche exchange of goods, materials, people, genes etc between populations. Deals less well with intangibles. Boundary definition issues. Need to distinguish larger scale populations (eg regional population). *[Note: ongoing issues related to globalisation, including ecological footprint. This is not a problem so much with the model as with the actual ecosystem, as real boundaries and constraints are overcome by technology.]*
Frameworks for Description & Analysis	New approaches: bioregional analytical units which encompass spatial & temporal aspects, replace rigid cultural boundaries.

(After Ellen 1982: 75-9).

(BP 5.2: Transactional Analysis as a Multi-Scale Model for the Social Sciences)

Table 10: CM: Metaphysical Archetypes: Substance Pluralism vs Substance Monism

	Ontology	Proponents	Epistemology Methodology	Characteristics	Social Effects	Environmental Effects
Mechanism	• Substance Pluralism • Context for modern Atomism • Realist • Matter is primary • Motion causes all forms and processes • Recognises kinetic energy, all else is 'occult'	• Kepler • Galileo • Descartes	• Measurement, maths, quantitative • Science of mechanics, mathematical method • Philosophy primarily mental; Vortex Theory; Mechanism; Reductionism	• God gave Mathematics (Geometry); matter described by Geometry • Laws cover all phenomena • Clockwork universe • Determinist • Objectivist: splits subject & object • Mind-body Dualism • Incorporates Atomism • Mentioned particles	• Cosmology of Science is Cosmology = Myth, Science supersedes Cosmology: thus destroys Cosmology (redundant) Fact-value split • Mind/spirit - body split; body = machine; body = bad; body = burden; body alienated • Design for Geometry, efficiency *[control is paramount]*	• World is dead • Reality is grim; Nature lurks; moral indifference to Nature • Therefore dominate Nature; ruthless Capitalist exploitation • Formal Utilitarian landscapes • Recent 'sugary' Mythology of 'freely choosing individuals' covers same ruthlessness
Atomism	• Substance Pluralism • Atoms are primary units • Atom is solid unit, real • All else = aggregations of atoms • 3 types: -mechanistic -dynamic (internally driven) -alegal (random, non-deterministic) • Realist	• Newton • Revival of ancients: Gassendi, Democritus, Lucretius • (Locke) • Hobbes	• Newton denounced Cartesian Physics • World has a fundamental mathematic • Maths Methodology (later Quantitative Chemistry) • Reductionism • Mechanism • Newtonian Atomism	• Individualist • Materialist • Reductionist • Value is subjective • Self interest drives everything • Individualism is antisocial so contract with State/Soverign to enforce Morality if not espoused in self interest (fear rules)	• Social Atomism • Materialism, free enterprise, competitive self interest • Body-matter alienation: mind/values equated, values performance-driven, including body function (machine) • Detachment from self, especially body, animal & meaningful self: isolation, alienation, cynicism, angst • Lives arbitrary, meaningless • Subjectivism	• Nature is separate • Nature is indifferent to us, blind, dead • Matter is passive • Nature is matter in motion • Therefore possess, exploit Nature • The fittest survive; too bad about the rest

	Ontology	Proponents	Epistemology Methodology	Characteristics	Social Effects	Environmental Effects
Monism	• Substance Monism • Substance is unitary • Unit is organism-in-environment • Nested self system • Realist	• Mathews • Ecological philosophers • Deep ecologists *[• Green Theory of Value proponents (Goodin 1992)*	• Many eschew Science as related to Atomism *[Neo-Primitivism]* • Science is useful • Science is not literal Truth • 'Appropriate' technology, research; qualitative research ¥	• Flow; oceanic continuum • Ripples create diversity *[Webs & networks]*	•Mind-body integration; body therapies, 'grounding' therapies; *[• Wholistic Medicine, Clinical Ecology]* • Integration of intellect, emotions, aesthetics, spirit, ecosystem in self • Cosmological rehabilitation efforts • Nature Romanticism (18C) and social movements (eg child, slave & animal rights; utopian yearnings) in reaction to loss of meaning; counter-cultures	• Nature is very high in telos, spirit, agency • Humans are in a web of relationships with other humans & Nature • Harmony with Nature sought • Inclusive approach • Collectivism.

(Based on Mathews 1991: 7-47).

(BP 5.3: Working with Vague Information: q-Analysis & Fuzzy Logic)

Table 11: RRCM: Entry 101 - Patterns for Sustainability

Consensus of Vision	Control of the Economy	Use High Energy Products
Make Sure Everyone Understands the Issues	Ecological Balance of Trade	No Supply Lines in or Pipelines Out
Create a Sense of Identity and Continuity	Use Real Indicators	Keep Roof Water for Drinking
Set Sustainable Time Horizons.	Reduce, Reuse, Recycle	Localise Food Production
The City as a Natural Ecosystem	One Systems Output is Another Systems Input	Encourage Endemic Foods
Repair the Damage	Kerbside Recycling	Create a Sustainable Physical Infrastructure
A Fair Share of the Biomass	Waste Management for Future Resource "Mining".	No More New Subdivisions
Set Viable Population Limits	Localise Sewage Treatment and Recycling.	Spaces at the Centres
Y.I.M.B.Y.	Sustainable Dying	Appropriate Public Transport
Successful Practical Projects	Living Machines	Increase Densities
Ecological Evaluation Systems	Sewerage Processing as a Work of Art.	Variety of Size, Quality, Forms, Types and Functions of Buildings in Every Area
Develop an EcoCost Budget for Proposed Developments	Diversify and Integrate Resource Procurement	Cohousing Schemes
Minimise EcoCost of Buildings	Timber Supply as Urban Planting	Smaller Houses
Make Buildings Better	Integrate Natural Ecologies with Urban Use Patterns	Negotiation Principles for Removal of Fences
Land Tenure	Reuse Redundant Land	Transport
Environmental Cost of Land Occupation	Develop Bioshelters for Land Regeneration	The Problem with Cars is ...
Land Tax as a Transition Mechanism	Community Gardens	Pedestrian Ways
Sustainability Covenants	De-Pipe Street Stormwater Disposal	Reduce Traffic Path Distances - More Short Cuts and No Dead Ends
Biodiversity and Habitat Preservation and Recovery	Network of Advisors and Technicians	Bike Paths
Create a Sustainable Society	Developer Training Systems	Low Speed Vehicle Ways
Sustainable Governance	Designer Training Systems	Local Area Business Network
Social Justice Infrastructure	Builder Training Systems	Develop Telecentres and Telecottages
Glass Bureaucracy	User Training Systems	Electronic Bulletin Board and Trading Wide Access
Community Participation	Eliminate Super Voltage Grids	Information Superhighways
Create a Sustainable Economy	Localise, Integrate and Diversify Energy Generation	Communication
Base the Monetary System on Sustainable Resource Base	Change Energy Use & Generation to minimise Peak Loadings	Making it Possible

(Source: Entry 101: JVNIC 1994).

(D&C 6.4: Principles from the Charter of the New Urbanism)

(BP 5.4: The Problem of Cause)

(Plate 7: Collage: Metaphor in Built Environment)

Table 12: CMCE: Metaphoric Potential for Ecological Paradigm

Words for Information-Rich, Multi-Myth World	Resilient, reciprocal, emergent, development *[as distinct from growth]*, ebb & flow, cultivate, seed, harvest, potential, fittingness, both/and.
Concepts for Social/ Environmental Policy	Things take time, nurturing, maturing, growth, fulfilment, decline, death, unique, unpredictable. *Life cycle, long-term, medium term, very long term*
From Ecology	You can't do just one thing, diversity, resilience, competition <u>and</u> collaboration, carrying capacity, vulnerability, cyclicity, continuity, time for development. *Web, threshold, evolution, emergence, dynamic.*
From Music	Counterpoint, dissonance, harmony, mixed voices and instruments, themes and variations. *Orchestrate.*
Learning-related	Discovery, exploration, adventure, questing, knowledge, insight, new experience, risk, vulnerability, error, accomplishment.
Further Additions from this Author	*Emergence, unfolding, (Barry Commoner's aphorisms), satisfier/pseudo-satisfier, needs-based, synthesis, Complementary, integration, synchrony, synchronicity, pulsation, creative, x-/y-/z-thinking, perspective, fuzzy, connectivity, connectedness, connectance, relative disconnection, constraints, reinforcing/balancing feedback, positive/negative feedback, thresholds, instability zones, organising principles, journeys, webs, intangibles, backcloth & traffic, association with, barrier-thinking, bridge-building, return time, mastery, permeable boundaries, turbulence, language, signal. trigger, self-organise, I-thou, diversity, diverse ecologies, divergence, convergence, interference field, interference pattern, adhocracy, open system, balance point, adjustment, orchestration, catalysis, healing.*

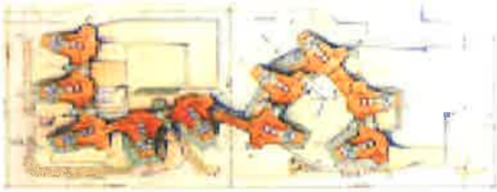
(Text-sourced from Michael 1995: 477, *Author*).

Table 13: ES: Strategies for Learning Approach to Ecological Management

Strategy	Explanation
Use the Metaphoric Power of Language	Natural process, reciprocal reality construction
Use Myth Reinforcement to Encourage Learning	'Community of learners', revisit Enlightenment Myths from older participants, 'learning how to learn', 'explorers'
Acknowledge Uncertainty and Embrace Errors	See text
Minimise the Learner's Sense of Vulnerability	See text
Use Facilitators Rather than Chair Persons	Chairperson's role is to suppress openness and group processes, resulting in frustration and obscuration
Introduce Training in Group Personal Skills	Bad habits: avoiding feelings by focusing on 'the facts', interruption, poor listening, withdrawal, resistance to all suggestions, long-windedness, putting-down other participants, scapegoating Skills needed: active listening, giving constructive feedback, receiving feedback, understanding need for support of group for sharing feeling-level issues, *appropriately targetted creative processes*
Provide Short-Term Reinforcement/ Rewards/ Rituals	Especially for long-term, ongoing processes. *Regular reporting of process indicators.*
Reinforce Learning Mode by Becoming Educators	Walk the talk, open to learning, conscious incorporation of educator role, model the learning style, choose appropriate metaphors – deliberately construct reality version, affect the language of stakeholders
Use Disasters & Crises as Learning Occasions	What-if scenarios, seed new Metaphors while unstable, reframe, simulation through scenario and gaming.

Text headings verbatim and selective text summary (Michael 1995: 474-84)*[Author]*.

Figure:5: ES: The NMB Bank, Amsterdam



NMB BANK HEADQUARTERS AMSTERDAM

FROM MACKENZIE, 1991: 59
"GREEN DESIGN: DESIGN FOR THE ENVIRONMENT"

This building in South-East Amsterdam, was designed with people in mind as well as energy and other sustainability issues. Compare its organicity with the mechanistic stolidness of Darmstadt Passivhaus in Collage: Metaphor. Features include:

<u>Community</u>: Collaborative, integrated design procedure: all consulted before the project was decided on, including engineers, landscape designers and architects, employees.

<u>Elements</u>: Traffic noise & wind are deflected by the sloping walls; heat loss thus reduced. Natural light enhanced by design & internal reflection system. Windows openable by employees; windows only 25% of wall area, but lighting artificial only 30% over all. Water: internal system using rainwater, emitted by sculptures.

<u>Genius Loci</u>: warmth: natural materials (wood, marble, copper), few rightangles (enhances harmony, creativity).

<u>Biotics</u>: Plants & gardens are major features indoors, covering carparks & views from centre.

<u>Organism</u>: Employees use central stairs for exercise and social networking opportunity (lifts minimised, saving substantial costs). Building is a series of towers in 'S' formation, each tower colour-differenced and unique, and work areas integrated psychologically, housing 20-40 employees per floor. Absenteeism has dropped and new employees cite the building as a strong reason for their attraction to the job.

<u>Ecocycles</u>: Energy efficiency is top priority (considered one of world's most efficient). No air conditioning. Heat-recovery circulation system is based on computer-controlled energy transfer equipment, using gas-fired central heating (80%), large solar collector and all southern windows collecting heat to water tank storage, transferred as required. Cool nocturnal air is recirculated through the day. Concrete structure is thermal mass.

<u>Connectivity</u>: Towers are separate, reflecting organisational divisions, but an internal road connects all levels, and houses all general services, small shops, restaurants and sunlit atria.

(Mackenzie, 1991: 56-59).

Table 14: CM: New Orders in Society

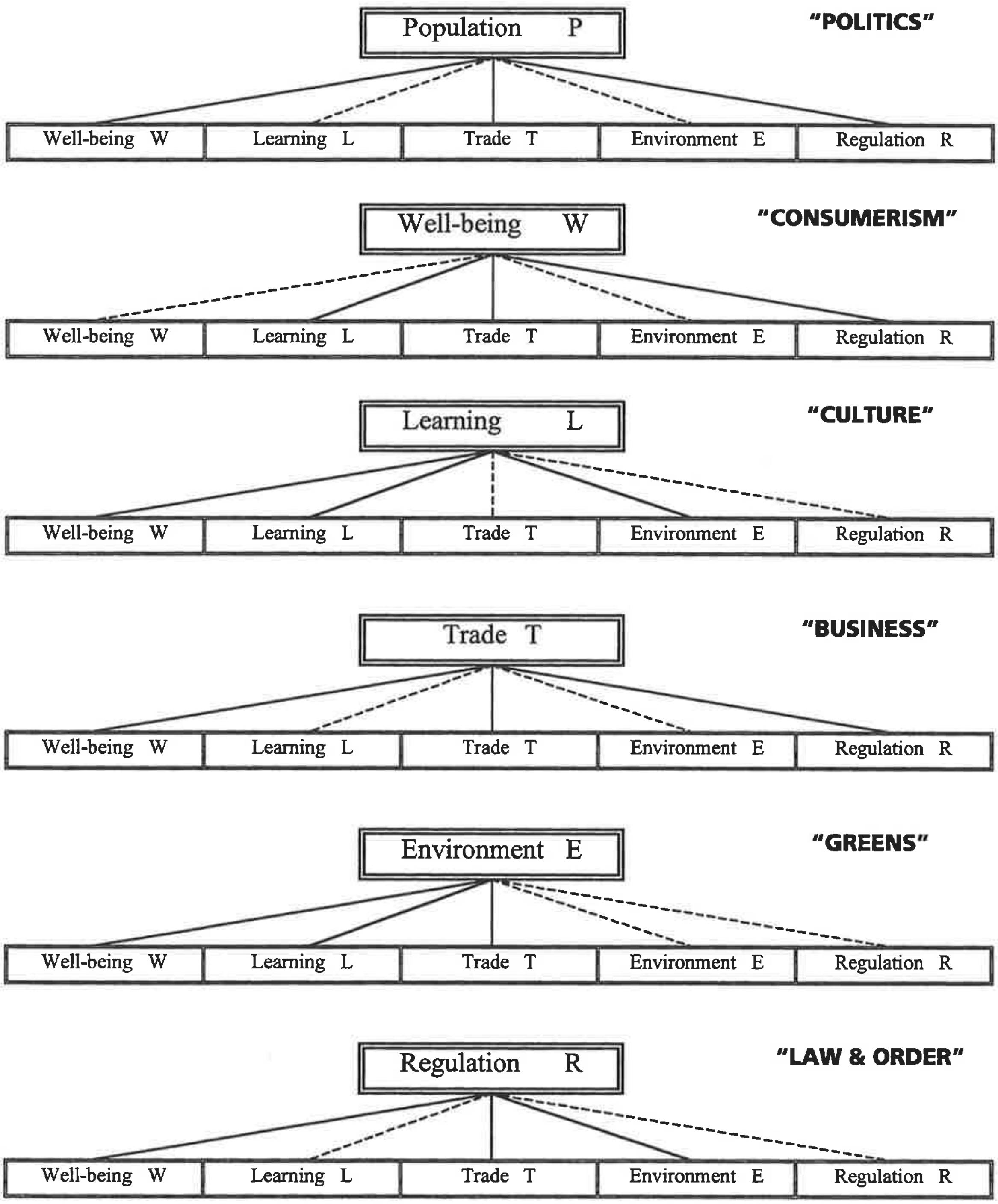
Human Society: Stages	Social Ordering Principle	Conceptual Change
Ancient Times (Greeks, Aristotle) to Middle Ages	Hierarchy Metaphor: Universe as single organism Timeless order All parts have a proper place Hierarchy of increasing perfection Earth-Heaven	By middle ages eternal order integrated into Society: philosophy, laws, ethics, morals, temporal ordering of daily life Location of points in space would be irrelevant
Middle Ages to Recent **Descartes**	Machine/clockwork Metaphor: "new secular order" No special place, ultimately purposeless mechanism Indifferent universe All subject to time flux; motion mechanical with no particular goal Descartes: location of points in space by coordinates	Atomism emphasised role of individual Time (transient, mutable) begins to replace eternity
Newton	Introduction of mechanical order Absolute order of time & space similar to Aristotelian order Attempts to formulate universal laws eternally valid Gradual development of Science & Technology with new values, goals Disappearance of absolutes	Eternal order persists in Space as "external sensorium of God" Absolutes retreating; time still universal & absolute With industrialisation increased individual freedom Loss of ultimate meaning behind morals, ethics, regulation Decrease in hold of Religion, ethical & moral Relativism
Einstein	Loss of absolute time ordering Time relative to observer speed: time ordering questioned Local conditions & contexts replace eternal absolute order	Past-present-future less clear Still mechanistic, linear, Reductionist, Atomistic Newtonian 'eternal' laws found to have limited jurisdiction
Quantum Theory	Energy Metaphors/ abstraction Whole mechanical ordering questioned Objectivity of science questioned Emphasis on time, uncertainty	Universal connectedness, abstract 'Cosmic' concepts, uncertainty: Uncertainty Principle, action at a distance, multiple simultaneous realities, black holes with no laws or structures Everything ultimately subject to dissolution over time
Present	Science & Technology: much improved quality of life Crises in Politics, Economics, Ecology, International Relations Accelerating change Important potential for creativity: "creative transformation without disruption" by open dialogue without rigid attachment to outcomes	Presence of elements of old & new orders Conflict & confusion where competitive (righteous) attitude to ordering principles prevails Blind & often destructive clinging to old structures or equally blind demand for revolutionary change
Emerging	Ecology/Web/Network Metaphor Complexity Theory	Universal interconnectedness Importance of human values Implications of scarcity Information as social currency.

(Bohm & Peat 1987: 104-111;Capra 1985: 270-1;Henderson 1991: 261-73, 268).

Figure 6: BICMES: Competing Models

COMPETING MODELS AND VISIONS OF GLOBAL ORDER VIA FUNCTION DOMINANCE
The 6 hierarchical structures below may be viewed as caricatures of a set of currently competing world views. In each, the dominant function tends to distort or suppress the operations governed by the recessive functions (in much the same way as the gene for brown eyes masks the expression of the 'blue eyes' gene).

The challenge of sustainable development is to interweave the functional contributions so that all are both expressed and constrained under appropriate circumstances ('both/and').



(Transcribed from IFC 1992: Figure 2). *[Minor corrections made].*

Table 15: RRES: Planners Suggest Strategies for Large Scale Public Consultations

"TO IMPROVE PLANNERS' INVOLVEMENT AND INCREASE PUBLIC RESPONSE"

Category	Suggestions
General	Translate theory into practice; use known theory Ask the community how to consult it better
Better Publicity	Extensive use of better publicity ELECTRONIC MEDIA Television discussions: 'The Planning Show'; community service ads.; features Radio: talkback, community, commercial radio Printed Media: Messenger Press – more features Popular press, monthlies
Marketing Techniques	Use media consultants More specific target selection Random phone polls Billboards, buses, taxis Sample surveys: specialist questionnaires to planners
Contact Techniques ***[Email not yet common at time of survey]***	MEDIA Public meetings don't work; avoid '70s methods' Letterdrop Phone discussions Information centres Displays: regional displays & workshops; street stalls Community based discussions using established networks More urban design workshops
Changes for Planning Review to Consider	Community representatives on the team Explain more 'understandably' Written policy Have planners on team *[there were several, but not local government level]*
Present Ideas Differently	Separate technical & non-technical data: don't overwhelm Simplify for lay consumption Focus better Better communication from Bannon *[then SA Premier]* to avoid appearance of a Government stunt Attract interest with more controversial ideas More exciting terms of presentation Gradual process rather than big shakeup; earlier notice; fewer people; more effective consultation
Different Emphasis (Content)	More fun Consciousness raising: more public education about lateral thinking More specificity, better direction Quality rather than quantity More general public rather than special interest groups Include rural, women's issues Get tradeoffs with preference listing *[not just issues, from consultations]*
Different Approaches to Visioning	Creative, meditative, 'right brain' Emphasise fun in participation
Special Local Government Needs	Include the country people! More resources to respond More time for planners: special workshops & small groups to get ideas More notice, time to educate the community better Time to read all the documents.

(Rounsefell 1991: 63).

The Adelaide *2020 Vision Planning Review* (1991-2) was one of the biggest public consultation efforts ever seen in Australia. Despite enormous energy, duration of over a year and broad consultation of interest groups across society, I could only find evidence of approximately 1,200 having been consulted. In particular, people 'stayed away in droves' from the local government consultations, which was the reason for including the above question in the planner survey (Rounsefell 1991: 63b).

Table 16: ESCM: Conversation (vs Debate)

Conversation	Debate
Collaborative: two or more sides work together toward common understanding.	Oppositional: two sides oppose each other and attempt to prove each other wrong.
Goal: find common ground.	Goal: winning.
Entered into in a spirit of respect.	Underpinnings not necessarily respectful.
Ongoing conversation leads to emergence of trust.	Not evident in debate.
One listens to the other side(s) in order to understand, find meaning and find agreement.	One listens to the other side in order to find flaws and to counter its arguments.
Enlarges and possibly changes a participant's point of view.	Affirms a participant's point of view.
Reveals assumptions for re-evaluation.	Defends assumptions as truth.
Causes introspection on one's own position.	Causes critique of the other position.
Opens the possibility of reaching a better solution than any of the original solutions.	Defends ones own positions as the best solution and excludes other solutions.
Creates an open-minded attitude: an openness to being wrong and an openness to change.	Creates a closed-minded attitude, a determination to be right.
There is an acknowledgment of diverse viewpoints all being 'right'.	Based on the premise that only one position is right.
One submits one's best thinking, knowing that other people's reflections will help improve it rather than destroy it.	One submits one's best thinking and defends it against challenge, to show that it is right.
Calls for temporarily suspending one's beliefs.	Calls for investing wholeheartedly in one's beliefs.
One searches for basic agreements.	One searches for glaring differences.
One searches for strengths in the other positions.	One searches for flaws and weaknesses in the other positions.
Involves a real concern for the other person, and seeks not to alienate or offend.	Involves a countering of the other position without focusing on feelings or relationship, and often belittles or deprecates the other person.
Assumes that many people have pieces of the answer, and that together they can put them into a workable solution.	Assumes that there is a right answer, and that someone has it.
Participants are secure in the knowledge that whatever they contribute is of potential value.	Participants are careful about saying anything that may be attacked, knowing that they personally may be vilified.
Participants are not obliged to take sides.	Debate polarises people, sometimes against their will. Being seen to join a camp may set up lasting antagonisms.
Creates the opportunity to speak from the heart.	Draws mainly on intellectual, rational skills.
There is opportunity for movement based on reflection on what is emerging.	Participants maintain the stance they have adopted from the outset.
Opens space for change.	Fixes participants in position.
Remains open-ended.	Implies a conclusion.

(Source: www,co-intelligence.org/P-conversation; transcribed by author to table format, from attachment to Paper *"Conversation and Debate in Public Discourse: Some Fine Distinctions"*; adapted by professional conversationalist Dr Alan Stewart: alan.stewart@flinders.edu.au/).

2.2.6 THE SUBATOMIC SCALE

CONTENTS

2.2.7 ORDERING PRINCIPLES

CONTENTS

Table 17: CM: Bohr's Complementarism: "A New Kind of Relativity"

Note: Complementarity in Quantum Theory gains quantitative support from Heisenberg's Uncertainty Principle. Since conceptual extension into other areas lacks this support, Pais named this Epistemology 'Complementarism'.

Discipline	Area of Discourse	Specific Conundrum	Bohr's Complementarist Contribution
Physics, Light	• Objectivity • Nature of light	• Problem of observation • Maxwell's wavelike continuity vs Einstein's incompatible discreteness, discontinuity descriptions of light	• Distinction between object and tool for observation in Physics: new definition of phenomenon; no clear distinction between object being observed and conditions and instruments of observation; facts are theory laden (Clark 1994: 1034-5). • Essential non-analysability of atomic stability in mechanical terms. • Reconciliation of light conundrum through Complementarity concept replaced 'either/or' approach with 'both/and' (Holton 1988: 1026).
Psychology	• Consciousness • Freedom of will • Objectivity • Mind/matter	• Distinction between life and death: consciousness inseparable from life; we are spectators as well as actors; stream of consciousness • Is actor free to choose what act he wills to perform? • Subject-object split • Thoughts/feelings split	• Subjectivity and objectivity are Complementary; spectator mode alternates with & excludes actor modes; meta-contemplation of self as spectator causes confusion (and recursion-driven dizzy headache!!: Bohr quotes Møller: 440). (Concept of Complementary primary & secondary processes[1] of consciousness probably based on William James "The Principles of Psychology" 1890 chapter on the "Stream of Thought") (Holton 1988": 1035). • Arbitrariness between subject & object similar to problem in physics. • Postulates Complementarity between feeling/sentiment ('I will': feeling of freedom) and reason/thought (analysis of motives for action)[*note linkage to Transactional Analysis: Child/Adult in context (Parent) of constraints learned from past experience]*. Also Holton quotes Bohr (1929) re analogy of particle-like unity of personality/wave-like continuous flow of associative thinking (Holton 1988:1043).

[1] Holton, 1988 quotes James: '"Consciousness does not appear to itself chopped up into bits; it flows. Let us call it the stream of thought of consciousness, or of subjective life". Yet there does exist a discontinuous aspect: the "changes, from one moment to another, in the quality of the consciousness ..." Like a bird's life, *[thought]* seems to be made of an alternation of flights and perchings. The rhythm of language expresses this..."' (:1036).

[James concludes] '"It must be admitted, therefore, that in *certain persons,* at least, *the total possible consciousness may be split into parts which coexist but mutually ignore each other,* and share the objects of knowledge between them. More remarkable still, they are *Complementary'*....'what the upper self knows the under self is ignorant of and *vice versa."'* (:1038). Modern Process Oriented Psychotherapy recognises and works with this distinction.[§]

Discipline	Area of Discourse	Specific Conundrum	Bohr's Complementarist Contribution
Biology	• Living processes	• Will analysis of living processes ever be possible in terms of pure chemistry & physics? • Scientific (proximate) causality vs finalistic (teleological, ultimate) causality	• "Mechanistic and vitalistic arguments are used in a typically Complementary manner" (:442). Self-preservation/generation excludes ultimate physical analysis (animal dies before full certainty achieved); shift by Bohr from mechanistic : vitalistic to mechanistic : teleological/purposeful by 1958 after DNA discovery in 1953. • Structure and function of organs <u>both</u> key to understanding. • Psyche vs physis; instinct vs reason.
Human Cultures	• Anthropology & Ethnology • Sociology	• Nature vs nurture	(Context of Bohr's personal aversion to racism) • Opinions favouring nurture (traditional cultural prejudices *[Pais' description appears to contradict Complementarity by emphasising one description over the Complementary one]*. • 'Contamination' of studied cultures in process of studying them. • Relation between individuals and society seen as Complementary (tension between self and society); also self/other distinctions (nationalism/appreciation of diversity). *[Both/and]* • Justice/love.
Language	• Communication	• Avoidance of ambiguity in expressing ideas and experience	• "The practical use of every word stands in a Complementary relation to its strict definition". • "The conscious analysis of a concept stands in an exclusive relation to its immediate application" (:446).
Philosophy	• Dialectics	• Role of discontinuity	• Bohr's dialectical style of thinking & working (seize on contradictions for educational value; appoint colleagues as sounding boards for vigorous argument to develop theory) possibly influenced by Kierkegaard via Høffding (Kierkegaard's 'qualitative dialectic' which accepted the tension between thesis & antithesis without proceeding to synthesis (Holton 1988: 1040-44). • Dialectical Philosophy of Truth: 2 sorts of truth: trivialities - opposites are absurd; profound - opposite is also a profound truth (Holton, 1988 quoting Hans Bohr :1044).
Epistemology	• Meta-themata eg Complementarity Atomism/ discontinuity continuity	• Generic statement of themas (here Complementarity = continuity + discontinuity)	• Universal transdisciplinary statements example (based on Holton, 1988: 1045): General Thema eg discontinuity) is the sum of specific sub-forms eg Physics form (Atomism), Psychology form (individualized identity), Folklore form (discrete folk tale), Architecture form (single building), Planning form (statute), Economics form (money) etc. • "<u>Fundamental thematic attitude</u> ... of accepting basic dualities without straining for their mutual dissolution or reduction" (Holton 1988: 1049). *[emph.added]*

(Based on Pais 1991: 438-51); other sources as indicated.

Table 18: CM: Complementarity Principle (After Pattee)

Rate Dependent	Rate Independent
Particle-like	Wave-like
Laws: universal laws of Nature, Physics; inexorable, incorporeal, inevitable, hold at all times & places, mechanistic	Rules: locally derived, history dependent, arbitrary, 'hereditary' constraints, regulations, structure dependent, changeable, hold only where physical structures available to execute them, linguistic, teleological
Transmitter of observed information	Role of observer in making the observation
Objective	Subjective: self-reference, teleology, self-organisation
Rate dependence	Order (topology, ordination) dependence
The known	The knower
Structure, pattern	Function (biology), process
Causal description: 'requires'	Prescriptive: "allows, forbids, does not require" (Gould 1986)
Hardware	Programme/software
The event	The image
Cognition	Volition
Darwinian evolution, natural selection, mechanistic evolution, 'abaptation', (feedback)	Anticipatory evolution, pre-adaptation, (feedforward)
Phenotype (matter)	Genotype (symbol)
Laws & codes (DNA)	Meaning (DNA)
Social dynamics	Social policy
Behaviour: forces, dynamics	Policy (society, organism)
Laws, statutes, implementation	Policies, plans, goals, strategies (intent)
Convergent issues	Divergent issues (Schumacher)
Indicator Criteria ('Traffic')	'Backcloth' Criteria (Link: q-analysis)

Based on Pattee (1978:191-200); Allen & Starr (1982: 57-66); Gould, (1986); Schumacher, 1987: 145).

Table 19: BI: Theories of Justice & Virtue

Theory	Characteristics	Extension & Comment	Implications for Ecosocial Justice
Theories of Justice	• Justice issues "arise when people want more than they can have" ie at least some must relinquish wants • Insecurity & violence follow lack of agreement as to just distribution of scarce goods • Voluntary cooperation avoids the disruption of dissidence in a forced régime • A perception of justice supports voluntary restraint • Perception is manipulated through education and propaganda (:5) • In practice there is ambivalence, disagreement and fuzzy membership of competing Theories of Justice • The tolerance of injustice is greater when people do not perceive themselves to be under threat or can be convinced the injustice is justified (:17-18) • "The state is defined as the organisation that claims the exclusive right to determine the legitimate use of force in society." (:57)	• These principles apply to justice in general • Environmental justice is a subset to which the same principles apply • Questions of justice are context-dependent and tend to arise in conditions of actual or perceived shortage of supply • Justice will not be demanded where people do not care about the good in question • Some items (eg fresh air, environmental services) are not distributable (:6) • Justice is necessary in the long run in any form of relationship (personal, organisational, civic) • The state can run things by force or its threat, and does so (:13) • The specialisation of modern societies and reliance on technology makes them vulnerable to disruption, thus appeasement of the majority is important to governments (:14-15) • Social stability requires a sense of investment in society, thus a perception of justice by most people (:17)	• The "tragedy of the commons" (Hardin 1993) results from a system which allows a free-for-all-barring-direct-attacks approach to acquiring environmental resources and managing wastes, necessitating a shared vision of environmental justice (:9-10) • For environmental justice, state or organisational force is necessary but not sufficient (a sense of justice is also essential since authoritarianism incurs rebellion) (:12) • Environmental justice and supporting policies are necessary because of the transnational side-effects of resource use (eg acid rain) (:19-21).
Virtue Theory	• A rationale for the assignment of priority to the wants & needs of the wealthy (:44)	• 'Secular Puritanism' decrees that material success is aligned with high moral character (a mis-interpretation of Puritanism) (:44-52) • Application used to be compulsory in the USA, and is usually subliminally used (the 'goodies' in movies had to win <u>by law</u>) (:53)	• Property rights may often be used to avert commons tragedy (:40).

(Based on Wenz 1988: 1-53).

Table 20: BICM: Reality - The Puzzle of Fundamentals

Entity/Field	Explanation	Scale
Strings	Where fields are the fundamental entity, points in fields become the objects of analysis. Superstring Theory (limited to theory and by Mathematics). Superstring Theories (Green, Schwarz, Witten); Supersymmetry (concerns fermions:bosons – equivalent to matter:radiation symmetry); elementary particles regarded as lines, not points; this removes 'the infinity problem'; lines in spacetime form tube structures, smooth, no infinity values, all computable, → finite & self-consistent natural laws. Hoped to point to a Theory of Everything (TOE). Strings have tension inversely proportional to local environmental energy; they loop into points at high tension/low energy producing the *points* of Field Theory (today's universe); most stringy at high energy/low tension, needing different concepts (original universe: initial conditions); have infinite vibratory potential, each harmonic corresponding to a different elementary particle mass. Many elementary particles known (see below), for example at low energy: 3 types of neutrino; high energy: unobservable; thought to be constrained to a small number of overarching symmetries (Barrow: 22, 77, 78).	
Fundamental Fields & Forces	Four 'fundamental' (actually humanly conceptualised) forces (from force-carrying particles), are believed to underlie all reality phenomena: Gravitation, ElectroMagnetic force, Weak Nuclear Force, Strong Nuclear Force; a possible fifth is currently suspected (Quantum Gravity), plus the existence of others is speculated upon (Barrow). Fundamental particles have associated fields or may be regarded as emerging as condensations of corresponding underlying fields (Weinberg). Descriptions below of recognised 'fundamental' particles appear below forcefield descriptions, which are arranged by descending strength.	Strength relativities: Gravitation 10^{-39}cm Weak 10^{-5}cm Electromagnetic 10^{-2}cm Strong nuclear 1 cm (Barrow)
Intra-Nuclear Interactions	Arena of interactions of Quarks known as 'QCD' (Quantum ChromoDynamics, a Local Field Theory that imperfectly applies Gauge Theory† to strong interactions); some issues not explained by QCD are explained by Topological Bootstrap Theory (TBT) (eg origins of quarks, confinement in strong interactions, three colours, Quantum Numbers) Colour degrees of freedom provide basis for Algebra of Currents (movement of quark charges; Quantum Theory formalism satisfies algebraic currents formulae), Gluon Fields, Non-Abelian Gauge Theory† ('Standard Model')	
Spin	All particles in universe have either 1/2 spin (matter) or spin 0, 1 or 2 (generate inter-paticular forces). Spin is a special quantum property.	
Matter: Spin 1/2	Matter (spin 1/2) obeys Pauli's Exclusion Principle: 2 particles can't be in same state & place simultaneously (P&V), eg electron, quark. NB Pauli Principle is key organising principle that enables formation of discrete entities such as protons, neutrons & atoms (ORR amorphous 'soup'; ie the keystone for structure). Electron's spin-1/2 explained by Dirac (1928), and anti-electron (positron) proposed & later confirmed. New concept: anti-matter, anti-particles, anti-universes; laws of Physics are different for particles & anti-particles (Lee, Yang, Wu, Cronin, Fitch).	
Spin 0,1,2 Forces	Spin 0, 1 & 2 (force-carrying) particles don't obey Pauli Principle, so unlimited no of exchanges, so produce strong force but at very short distance if big mass. If no mass, ('virtual') force-carrying particles operate over long range; detect indirectly as force since can't detect as particle. Forces usually carried by virtual particles; sometimes real particles also (detect indirectly by light or G wave emissions released by state/orbit changes); see exchange particles. Forces carried by matter particles (eg electron, quark): matter particle emits a force particle & changes velocity by recoil; force carrying particle	GeV = Giga electron Volts Massive vector bosons (weak force) have mass 100 GeV; all look the same at high energy,

Entity/Field	Explanation	Scale
	collides with another matter particle which absorbs the particle & changes velocity: overall appearance of a force between 2 particles. Spin-1 particles include photon, massive vector bosons (W^+ W^- & Z^0) which carry the weak force.	separate out at low particle energy by 'spontaneous breaking of symmetry'.
4 Fundamental Forces	(Hawking 1988/1991: 74-9, 85)	
Gravity	Classical (ie not Quantum, does not take account of Heisenberg Uncertainty); described by General Relativity Theory (Einstein). Universal, the weakest force by far, operating over very long distances; affects all particles in proportion to their mass/energy; gravity dictates overall universal evolution due to attractor qualities, action over long distances and aggregate effects (despite unitary weakness). Virtual particle is 0 mass graviton; particle exchange results in detectable Gravity Force; real graviton produces Gravity Waves - extremely weak.	
Electro-Magnetic Force (EMF)	Electricity & magnetism unified by Maxwell (mid 1800s). EMF acts on charged particles (quarks & electrons) not on gravitons (not charged); EM attraction between nuclear protons (positive charge) and electrons (negative charge) causes electron orbiting similar to planets in solar system (Hawking 1988: 75). Involves: exchange of virtual photons (mass 0, spin-1) → EM attraction in atoms → re-emission of real photons (visible as light as orbits change).	EMF (between 2 electrons) ≡ Gravity 10^{41} cm, but net after cancellation of pos + neg is small
Electro-Weak (WNF)	Acts on all 1/2-spin particles (matter), not on spin-0, -1, -2 particles (ie affects matter but not forces). Carried by massive vector bosons of spin-1 (W^+ W^- & Z^0): large mass, very short range effects, 37 states at low particle energy; undifferentiated at high ('spontaneous symmetry breaking'). Theory overlaps with electromagnetism; includes radioactive process of b-decay. Do not admit contractions, thus suggests local origin. Non-arbitrary (deterministic) ?due to locality at a Spacetime point resulting from interference pattern from three fields; other explanations of determinism include surface boundary effects and Cylinder Theory. Electroweak (gauge field) Theory of Weinberg & Salam - unified with EMF 1967; supported by TBT[¶].	100GeV Gx10^{42} cm
Electro-Strong (SNF)	Interactions that hold nucleus together; carried by spin-1 gluon; holds quarks together in proton & neutron, & holds proton & neutron in nucleus. At normal energies very strong binding, free up at high (eg particle accelerator); diminishes at extremely short distances as log of energy ie exponential diminution/increase with distance in direction opposite to inverse squares behaviour of Classical force fields ($1/d^2$), which fall off with distance ('asymptotic freedom').	Energy to disrupt = 10^6x energy of inter-atomic/ molecular chemical reactions.
Quantum Gravity/ Supergravity	Current search for evidence (Penrose); different from Classical Gravity. Postulated to subsume General Theory of Relativity + Heisenberg Uncertainty Principle (HUP from Quantum Theory) Approached mathematically by 'renormalisation' to remove infinity values (Hawking). See next row.	
Ultra-High Energy	Ultra-high energy/very short distance realm beyond present experimental capacity. Most research done at relatively low energy (but recent development of computer simulation may change this). Energy relativities: SNF decreases at high energy; WNF & EMF increase; effects cross: energy of EMF and weak nuclear force merge at 10^{15} degrees; energy of strong & weak (EMF) interactions would become equivalent at 10^{-15} proton masses (10^{27} degrees); gravitation merges at 10^{32} degrees at which point new theory is required of a unified superforce. Search for Theory of Everything (TOE) or Grand Unified Theory (GUT) (eg Superstring Theory, Quantum Gravity, Conformal Field Theory). Possibilities for new theory suggested: (Weinberg): a type of S-matrix theory; (Penrose): Twistor Space, high energy space, energy defines	'Asymptopia' from 10^{-16} cm to 10^{-29} cm where TOEs operate & strong, weak & EMFs develop equivalence at ultra-high energy GUT: present particle accelerators work at 100GeV, newest plans for

Entity/Field	Explanation	Scale
	transition, not mass; (Bohm): Quantum Field Theory, hidden variables indicate further levels of reality; (Barrow): Superstring Theory - predicts many unconfirmed phenomena, particles, instability of proton; (Hodges, Singer, Penrose): Conformal Field Theory.	several thousand GeV, required for GUT: 10^{15}GeV (Hawking 1988).
Spacetime Threshold (Planck Scale)	Cartesian reality is an approximation which emerges from complexification of quantum behaviour; all objects & Newtonian Physics are approximations (Capra:279) which are complexity-dependent (implicate order becomes explicate). According to TBT (also Causal interpretation of Bohm), Spacetime emerges in parallel with the Classical domain, is not fundamental; Uncertainty Principle, theory of objective reality, Spacetime, a theory of measurement, notions of continuity of gentle events which approximately localise finite, discrete events (needed for Classical interpretation), and probably gravity, all emerge/unfold together.	10^{-33} cm (Hawking & Penrose) Realm of Quantum Gravity
Fundamental Particles	All particles have anti-particles.	
Atom	Two fundamental particles compose matter: hadrons & leptons.	10^{-8} cm
Nucleus (Hadrons/ Nucleons)	Hadrons (a general term) = composite entites composed of Quarks. Realm of strong interactions. Strong interactions: qualitatively - contraction, associated with 0 entropy & inaccessible degrees of freedom (hidden variables); order in strong interactions is described by using Quark concept.	10^{-12} cm
Proton (a Hadron)	Composed of Quarks: 2 up + 1 down (=3, R+G+B). Search for Grand Unification (explaining hypothesised instability of Proton, with Quark ← → Lepton interconvertability); Topological Bootstrap Theory (TBT) predicts absolute proton stability.	10^{-13} cm (Redhead; 10^{-15} cm according to Hawking & Penrose) Energy of level 10^{-19} proton masses = limit to theory (Weinberg)
Neutron (a Hadron)	Composed of Quarks: 2 down + 1 up (=3, R+G+B).	
Quarks	6 types: up, down, strange, charm, bottom, top (imaginative names); each coloured R,G or B but can't exist as such (see strong nuclear force); strange, charm(ed), bottom & top all very large & unstable. "If particles are relationships then quarks are patterns in these relationships" (Capra: 273); these relationships are constrained by contraction, thus non-arbitrary. Quarks have no momentum, thus non-particulate, despite particle-like description as current fundamental building blocks of Nature. The Quark level marks the threshold for atomist approach: while Classical force fields decrease with distance (the "Inverse Squares Rule), those between Quarks increases with distance.	10^{-15} cm (Hawking & Penrose?) 10^{-16} cm = limit of reach of high-energy particle accelerators (10^{15} degrees)
Leptons	6 types. Realm of weak interactions.	
Electron	Best known example of a Lepton. Each related to a positron (anti-electron - Dirac 1932). Part of a family which also includes muon, tauon & others; each type related to a neutrino (very light particle, affected only by weak force).	
Exchange Particles	Emission, with resorption by other or emitting particles ('exchange' or 'self-interaction'). Self-interaction creates mathematical problems: infinite contributions to particle masses & coupling constants ('renormalisations'): constant	

Entity/Field	Explanation	Scale
	process of creation & destruction of matter. Relativity limits information transmission speed, thus exchange particles postulated to mediate faster (instantaneous) transmission speeds: gravitons exchange in gravity, photons for EMF, massive W or Z particles for weak nuclear interaction, gluons for quarks.	
Photons	Electromagnetic (EM) interactions (Abelian Grouping). Zero mass of Photon allows EMField description as a Classical observable, disallows description by ordinary use of S-matrix; a 'funny complementarity' applies (Chew in Capra: 181). 'Asymptotic freedom' = (quarks & gluons) free at high energy states. S-matrix usually defines asymptotic states by counting individual numbers of particles; for EMFs, asymptotic states reached by superposition of different (indefinite) numbers of particles which are then used to measure the states; Superposition of states with indefinite nos. of particles is equivalent to Classical measurement, eg of soft photons of indefinite number. To comprehend EM, must relinquish standard scientific framework. Definitions of Spacetime, measurement, observer & EM all linked; best language is of Topology, graphs (Feynman) & 'gentle events'. Photons have mass zero, spin-1 (flips chirality, attracts unlike charges, repels like charges, produces electrically neutral clumps of matter, Classical entities recognised by low electric charge.	
W & Z Particles	Heavy particles (massive bosons) in realm of weak interactions (W^+ W^- & Z^0).	
Gluons	Involved in strong interactions (binding quarks); see binding under Electro-Strong Nuclear Force. 'Confinement': gluons bind R+G+B quarks (RGB quark + string of gluons = proton or neutron) or quark + anti-quark → colourless 'mesons' (R+anti-R, G+anti-G, B+anti-B); unstable (quark + anti-quark annihilate, releasing particles including electrons). Gluons also coloured & can't exist separately, but as colourless clumps ('glueballs').	
Gravitons	Gravitational interactions: real -→G waves, virtual (mass 0) → G force. Gravitons may not exist if gravitation only has meaning at Classical level. Quantum Gravity is a different concept from Classical gravity.	

(Baggott 1992: 87;Barrow 1991: 22-3, 77, 78, 72-4, 67, 76-85;Capra 1985: 272-9, 279-84;Davies 1989: 122-5;Hawking 1988: 67-84, 165;Hawking & Penrose 1996: 48;Penrose 1996: 115;Redhead 1995: 2-9, 64-55, 80-86;Weinberg 1985: 116-124). Note: last updated 1996.
[Note that even at these scales there are apparent structures and fields of relationship: rate dependence and independence, and both linkage and glue elements (connectance: exchange particles and force fields)].

¶ *Topological Bootstrap Theory* (TBT) predicts a large, finite number of elementary particles (18,000 Hadrons, mostly hexons with 6 topological constituents, 2-300 elementary mesons, and 1000 elementary baryons). All particles are shown by TBT to be composed of two topological elements.
† Gauge Theory expresses linkage between Laws of Nature, forces and fundamental particles; theory of mathematical transformations from point to point in Spacetime, which may be symmetrical, or if not so (ie arbitrarily varying), must be explained by adding 'gauge fields'. An Abelian Group refers (for example) to electromagnetism, where the theory commutes and symmetry prevails. A 'non-Abelian' example is Gluons, which do not all commute, thus a 'Gluon Field' is postulated. Many gauge theories exist (eg gravity, electromagnetism, weak & strong nuclear forces) and need an over-arching theory, the 'Theory of Everything'.

Local gauge Theories include General Relativity (theory of gravity), Quantum Chromodynamics (theory of strong subnuclear forces between quarks & gluons).
R=red, G=green, B=blue

Table 21: CM: Bohm's Causal Interpretation of QT - Selected Features

Aspect	Summary Description
Cartesian Fragmentation & the Pursuit of Wholeness	• Emphasis on verbs rather than nouns in sentence construction ('rheomode' linguistic experiments); new phrases representing undivided wholes together with all their implications, aspects & meanings. • *Soma-significance* replaces fragmented concept of *psycho-somatic;* represents unity of physical with mental, extending to meaning.
Ontology vs Epistemology and Quantum Theory	• Bohm's *Causal Interpretation* is ontological, proposing the existence, side by side, of Classical and Quantum features at large and subatomic scales. • Most other interpretations are epistemological, assuming a change of some kind in the fundamental conditions which enables a Classical level above the quantum.
Reality, Structure, Knowledge & Consciousness	• Unbroken wholeness underlies all reality at fundamental level. • Quantum reality exists independent of observation; the particle and wave aspects of entities are regarded as objectively real, not just mathematical phenomena. • At quantum level the particle is affected by the wave function through the *Quantum Potential* & the *Guidance Condition*. • Because wave <u>form</u>, not magnitude, determines effect, weak intensity waves may have high quantum potentials, with strong nonlocal connection with distant particles & strong sensitivity to local environmental context; indivisible wholeness is derived from influence of whole system function on inter-particular forces. • Different wave forms produce an array of different functional connections; part-whole dependencies similar to organic wholeness of living beings; character very different from Classical. • Reality displays/unfolds in human perception/thinking; soma (physical) & significance (mental) each implies & reflects the other. • All laws are mental abstractions and approximations.
Role of Observer & Measurement	• Quantum reality can contain observing instruments and also has independent existence.

Aspect	Summary Description
Relationship Between Explicate Order & Classical Mechanics, Interscale Transitions	• The Classical level arises naturally and is detected by us through 'common sense' and ultimately, Classical description; it is a 'manifest' world (can be held in hand, eye or measuring apparatus) consisting of stable, locally interacting structures. • The classical level is necessary: it is observable, quantum processes can exist within it and manifest as independent observables which form the basis of a consensual objective reality, despite fundamental nonlocality. • A Classical level exists below quantum level which is largely independent of measuring instruments. • Classical Physics depends on nature of potentials as well as Newton's laws of motion for particles. • Conversely, behaviour at large scale is not necessarily Classical (when quantum potentials are large, which can still occur at very high quantum numbers); at large scale with high & rapidly varying quantum potential, Classical behaviour pertains unless wave forms intersect (such as in inhomogeneous gravitational fields) causing non-Classical deflection of trajectories of stars & planets. • Generally objects behave approximately Classically when a 'sufficient' number of particles is present (essentially independent of measuring instruments). • Where quantum potential is negligible the wave function is insignificant, the Classical limit then holds, the motion of particles then approximately obeys Newtonian laws.
Other Important Aspects Covered by Bohm's Interpretation	• Soma-significance; active information; superfluidity & superconductivity. • Hidden variables, determinism & ambiguity; nonlocality. • Complexity Theory at subquantum level. • Action at a distance. • Interscale transition (Correspondence zone between quantum & Classical levels). • Order, measure & structure. • Generative order & creativity. • Implicate Order, Explicate Order. • Relationship between Quantum & Relativity Theories.

(Based on Bohm 1965;1980;1985: 72-99;Bohm & Hiley 1993: 160-80, 160, 161;Bohm & Peat 1987).

2.2.8 *HYPERCYCLIC SYSTEMS THEORY*

2.2.8.1 ENERGY & THERMODYNAMICS

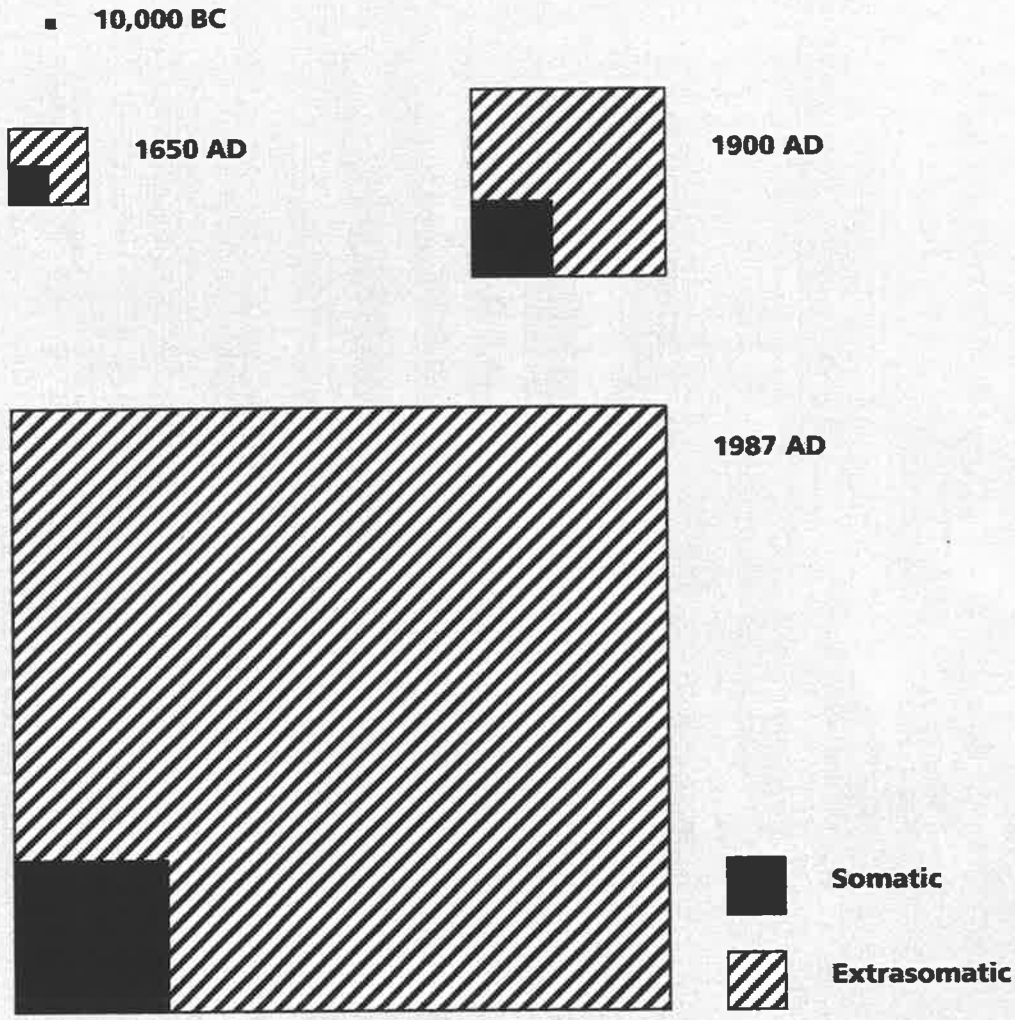
CONTENTS

Table 22: CEES: E = MC²

	Theory	Application
E: ENERGY	Entropy & FFE systems	Environmental management models (for example McHarg 1992), PM Allen (Allen 1982;Allen & Phang 1993)
	Energy life cycle	Energy cycle audits & budgets BREEAM (Building Research Establishment Environmental Assessment Method) UK, R2000 Canada, standards Cradle to grave energy studies (University of British Columbia) EcoCost (Sainsbury, University of Tasmania, Launceston) Optimize™ (Canada Housing & Mortgage Corporation) NatHERS (Australian National House Energy Rating System) Eco-modelling (dynamic equilibrium studies) Ecological Economics modelling (eg Costanza) Ecological Urban Studies (Boyden, Man and Biosphere Program) (Boyden 1979;1984).
	Energy flow studies	Standard consumption aggregates for energy provision & demand management (Sheltair Scientific Ltd 1995).
	Energy forms (Adams)	Proposes conflation 'extramural' energy + matter + 'intramural' energy + information as 'Energy Forms' (Adams 1988: 14-16).
M: MATTER	Resource location Resource management	Refuse-resource coupling The Natural Step programme Urban footprint (especially Rees & Wackernagel, Centre for Human Settlements, UBC) Ecological rucksacks (Industrial Ecology) (Durney 1997;Hinterberger,Luks & Schmidt-Bleek 1997;Powers & Chertow 1997;Simonis 1990).
	Eco-chemistry (Clark et al)	Cradle-to-grave chemistry eg C, N, S cycles UBC CO2 studies (Cole 1993).
RESOURCES	Radical efficiency of use, energy & matter	4-132: 50 examples of quadrupling resource productivity 4-67: 20 examples of revolutionising energy productivity 68-111: 20 examples of revolutionising material productivity 112-142: 10 examples of revolutionising transport productivity (Von Weizsäcker,Lovins & Lovins 1997).

	Theory	Application
C: CHANGE (relative to speed of light)	Self-organisation (SOS), Edge of Chaos	Economies, business cycles, urban growth & form, emergence phenomena (Santa Fe Institute), self-organised criticality (Bak)
	Evolution, emergence, coevolution devolution	'Grow"' housing (Montreal example from IHC), Permaculture, Alexandrian architectural patterns (allowance for future evolution) (Santa Fe Institute, Lewin, Kauffman, Adams, Allen) Evolutionary approaches across disciplines; Industrial Ecology (Adams 1988;Allen 1982;Anderson,Arrow & Pines 1988;Burns 1998;Context Institute 1993;Costanza et al. 1993;Day & Chen 1993;Einstein & Infeld 1938;Friedman & Rowlands 1977;Goldsmith 1988;Kauffman 1993;Slocombe 1993a;Stenseth 1986) Aligning with Nature; Rheotics (change-oriented development) Rheomode (Bohm).
	Autopoietic systems	Bioevolutionary explanation (Maturana & Bunnell 1998;Maturana & Varela 1980;Maturana & Varela 1988;Zeeman 1977).
	Synergetics	Phase transitions; critical thresholds Sustainability Spaces & ranges Self-organising systems across disciplines (Haken) (Haken 1977;Haken 1983;1993;Haken & Mikhailov 1993a;1993b).
	Surprise, Catastrophe	Morphology, Embryology, Urban Studies, Biosphere Program, ecology especially Population Studies (Thom, Wilson, Zeeman, Casti, Holling, Thomson, Timmerman, May) Creativity & creative processes.
	Collapse & transition	Civilisations (Allen, Tainter, Lewin, White); relative disconnection (Hierarchy Theory) Sustainability Principles.
	Systems thinking	MIT, Senge, Maruyama, Meadows & Meadows , Capra The Natural Step programme (see indicators).
	Hierarchy Theory	Rate-based (frequency) hierarchies (O'Neill, Allen, Starr, Hoekstra, De Angelis) Ecological approach to human settlements.
	Sociobiology	Social Darwinism (Buckley 1977) Evolution, Co-evolution; social change; adaptation, responsiveness.

Figure 7: BICM: Human Energy Use: Global Totals



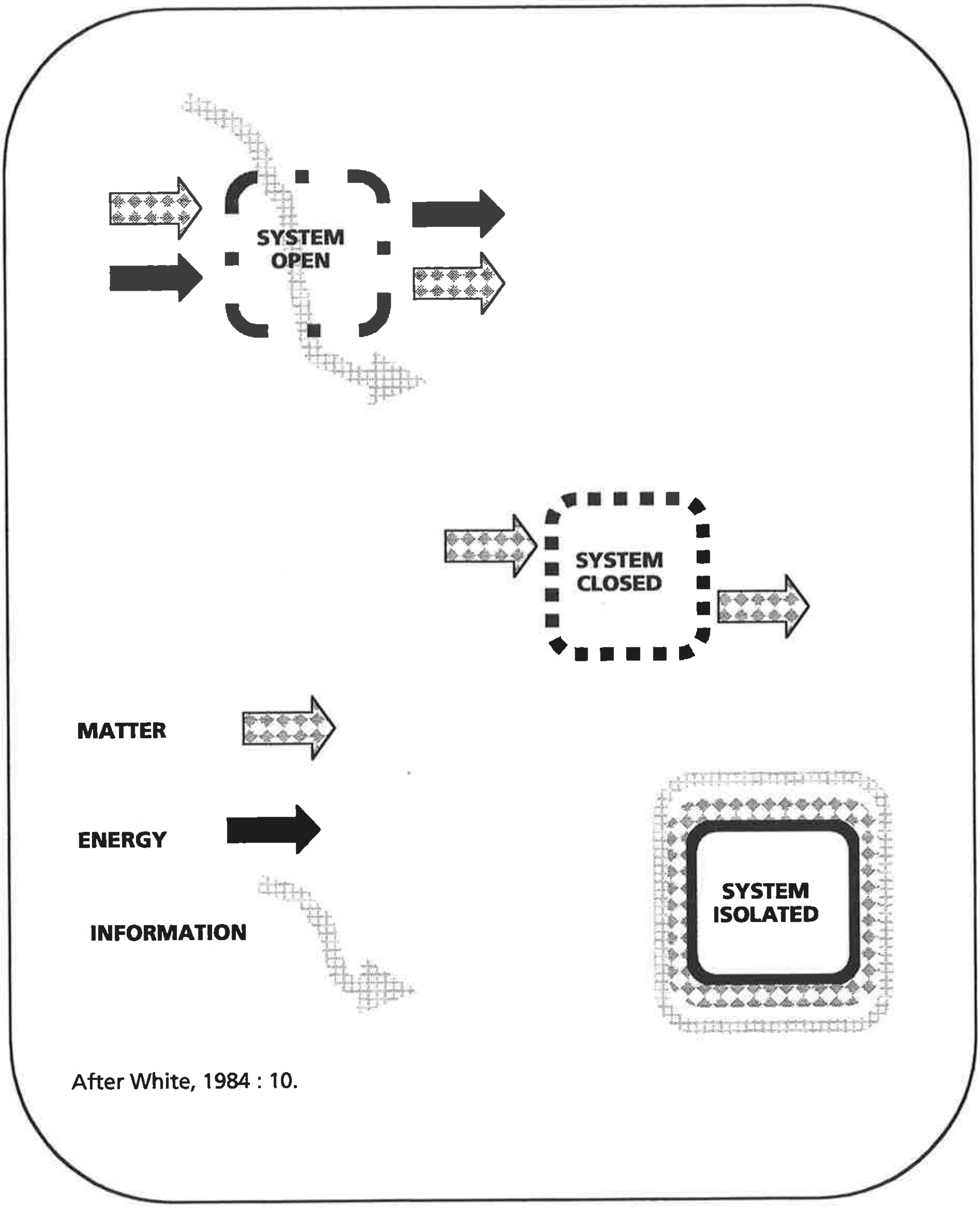
TOTAL GLOBAL HUMAN ENERGY USE

Adapted from Boyden. Dovers & Shirlow 1990, _Our Biosphere Under Threat: Ecological Realities and Australia's Opportunities_: 70.

Somatic energy is that required to fuel a human being, derived from metabolising food, and sourced ultimately from the sun (Boyden *et a*, 1990: 54).

Boyden *et al's* diagram starkly demonstrates the human 'energy addiction' plaguing the Biosphere, which is largely a fossil fuel addiction (Boyden *et al* 1990: 159), contributing to rising CO_2 levels. If we added plastics to these charts, the picture would look even worse. The massive use of plastics and other fossil fuel derivatives puts substantial burdens on biota, but also contributes to gross and molecular pollution (CO_2, plasticisers, PCBs, thousands of others, many feminising).

Figure 8: BICM: System Types



1). Open Systems: ecological and social systems are good examples. They trap, transmit and transform matter, energy and information (dissipative systems), delaying entropy.

2). Closed Systems: Planet Earth is viewed as a relatively closed system for most purposes. We now know it is far from closed, especially chemically, microscopically and geologically, and maybe biologically.

3). Isolated Systems: Reductionist Science tries to isolate parts of systems for objective, detailed study, eliminating context as far as possible. To the extent that this succeeds, the knowledge derived is paradoxically disconnected from the systems to which it is to be applied.

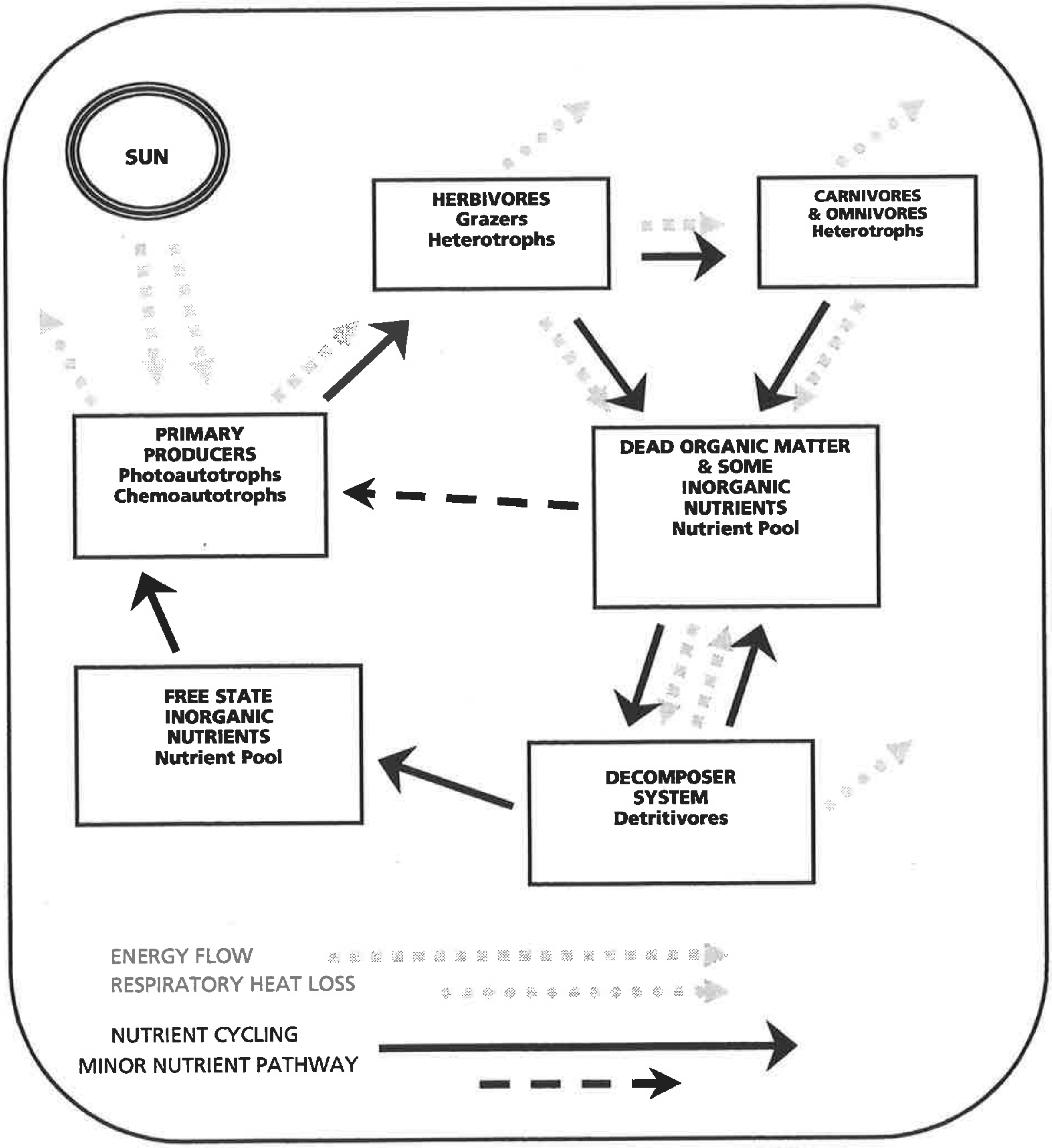
Table 23: BICM: Biogeochemical Services & Biodiversity

TAKEN FOR GRANTED Photosynthesis Atmospheric composition Climate moderation Hydrological cycle operation Soil generation, aeration Nutrient recycling Crop pollination Genetic library Pest control Seed dispersal	**LOST WITH CHANGED LAND USE** Flood control Pollutant filtering Waste assimilation Air cleaning Soil preservation & building Insect & predator balance Resilience to perturbation Genetic library
DIRECT ECONOMIC BENEFITS Renewable resources: food & fibre, energy Aesthetic (tourism, real estate) & recreational values Genetic library (Biotechnology) Pharmaceuticals	**SURVIVAL NEEDS** Water supply (clean) Air (clean) Food production Shelter Climate & temperature range Bio-Energy Genetic library (diversity, resilience) Psychological wellbeing (contact with Nature) Spirituality (Cosmology/belief system)

(Daily,Alexander,Ehrlich,Goulder,Lubchenco,Matson,Mooney,Postel,H.,Tilman & Woodwell 1997: 1-17;after Folke,Holling & Perrings 1996: 1019; also Hartig & Evans 1993;Kaplan 1984;Kaplan & Kaplan 1989;Norton 1995;Pigram 1993;Spretnak 1986).

Links: Criteria Biotics, Ecocycles.

Figure 9: BICM: Ecological System: Energy & Nutrient Flows



Based on Boyden, Dovers & Shirlow 1990: 20; Begon et al, 1990: 682; Lincoln 1982.

RECYCLING IS A CRITICAL CHARACTERISTIC OF ECOLOGICAL SYSTEMS

Autotrophs (usually plants & microorganisms) feed on inorganic substrates, which they cannot synthesise themselves from organics. Chemoautotrophs produce energy from oxidising elements like sulphur, iron & nitrogen; Photoautotrophs use photosynthesis to trap solar energy and build organic structures, which are then consumed in the grazer-carnivore system (Heterotrophs), which take (eat) solar energy second-hand.

Dead organic matter is broken down by decomposers (Detritivores), which release nutrients in a simple organic form. These then join the Nutrient Pool, and are readily assimilated by Primary Producers (Autotrophs).

Nutrients and energy are locked up in biomass. The system depends on eventual decomposition of these structures. It also depends on WHERE the decomposition happens. Thus landfill locks up nutrients and makes them unavailable for recycling at the original source. Unsustainable forestry removes and allows leaching of essential nutrients, which are unsatisfactorily and incompletely restored by adding fertiliser.

Sustainable Agriculture and Ecocity Development both organise their strategies around reconnecting these cycles. Industrial Ecology imitates this pattern. **Link: Criteria Ecocycles: Loop work; Indicators: Ecological Footprint.**

Table 24: BICM: Odum's Energy Analysis of Civilisation

STAGE	CHARACTERISTICS	COMPONENTS
Excess power	Central control of power budgets. Excess power available for organisation. Innovation gives power control monopoly. Energy for choice & selection (high priority in industrialised societies).	Large investment in organised innovation (science & technology research). Potentially competing peripherals also develop fast with fuel subsidy & new information.
Constant power	Fully developed civilisation. Build-up of additional structure. Maintenance requirements increased to equal available power budget. Vulnerable to relative or absolute resource scarcity.	Power costs of maintenance reduce flexibility margins. Power erosion initiated by fossil fuel diminution, diversion of supply to periphery, or over-development (exceeding power supply). Must reduce structure and/or increase power flows or may disintegrate.
Eroded power	Disintegration of central control. Fossil fuel input reduction/ dissassembly: positive feedback loop.	Catch-up of former subordinate or less developed components. Energy drain from relative rise in control requirements. Energy diverted from organisation & specialisation to control. Components reusable in new system if power control mechanism found.
Ecological system parallels	Resource dependence of superorganisation: structure build-up constrained by power budgets. Disintegration when power sources fail. Loss of specialists in disintegration means restart succession from generalised species.	Examples: forests, coral reefs, river rapids, ocean up-welling. System stress (pollution & other) diverts energy: power for central organisation & specialisation diverted to survival.

(Based on Odum 1970: 229-35).
For 'power' read 'energy'. **Link: HST: Holling's Infinity Loop.**

2.2.8.2 COMPLEXITY & CHAOS

CONTENTS

Table 25: CM: Characteristics of Systems Approach (after Capra)

Concept Area	Notable Characteristics	Further Comments
Salient Features	Universal interconnectedness. Dynamism. Inter-relationship of phenomena in many fields; network of inter-locking concepts & models + corresponding social organisations.	Physics, Chemistry, Biology, Psychology, Sociology, Anthropology, Ecology: same patterns, different mechanisms & terms.
Relationship to Mechanism	Mechanistic approach still important. Mechanism is about building blocks; can't derive characteristics of integration from nature of units; system destroyed if dissected. Some secondary processes do build up from atoms (units): mechanistic intervention then appropriate.	Relationships & integration also important. Integration is an emergent property; systems approach is about organising principles. **[Link: Subatomic Theory: Organising Principles]** Mechanism is an incomplete explanation **[Link: Subatomic Theory: Complementarity].**
Wholeness	Whole greater than sum of parts. Multi-level reality: complex systems within systems. Elements of systems are living wholes; organism-like quality. Possible holonomy: whole in all the parts; dynamic order enfolded by subatomic holomovement (Bohm, Pribram, Chew).	Each level has <u>structure</u> (organism in space), <u>function</u> (organism in time) & <u>mentation</u> (the dynamics of self-organisation: a metafunction; all organisms including eco- & social systems) (after Coghill). Includes cells, organs, social systems, eco-systems.
Structure	Derived from interactions & inter-dependencies. Rhythmic interlocking engagement: patterns.	Termed 'transactions' (concept pre-dated systems theory) *[note link to Transactional Analysis & Transactional Psychology].* Extend by growth (as distinct from construction).
	Stratified order bestows resilience; strata defined by observer. Each level integrated internally, connected to others; bidirectional flows.	Hierarchical structure of un-nested holons (diagrammed as tree to avoid power/control hierarchy concept).
Connectedness	Emergence not causation. Modulated by feedback loops; non-linear inter-connectedness. Integrated & cooperative relationships between components benefit whole system.	Fallacies of biomedical causation & genetic determinism (simplistic, problematic to cite 'cause & effect'). Even predator-prey benefits system as a whole.

Concept Area	Notable Characteristics	Further Comments
Processes	Underlying processes define living form: organic patterns that emerge are inherently complex, dynamic:, flexible but ordered. Cyclic build-up & breakdown. Frequencies (rhythms, pulsations) of high importance, ubiquitous.	Inter-related by interaction. Unification of opposites by oscillation. High internal plasticity; adaptable; shape & parts patterned but non-rigid, flexible. Order by fluctuation. Individuality expressed by distinctive rhythms *[patterns]*.
Mentation	Is the essence of being alive (Bateson): 'mind' in higher beings, 'mentation' in lower entities. Immanent at all scales (thus mind is stratified). Is the <u>pattern of organisation</u> of complexity in dynamic system relationships: an emergent quality. **Link: Subatomic Theory: Mathews.**	*Metabolic mentation* (several levels: eg cells, tissues, organs); *neural mentation* (layering reflects evolutionary history: brain stem, limbic, neo-cortex); *social mentation; eco-system mentation, Gaian mentation, cosmological mentation* - all embedded.
Self-Organisation	Internally determined. Relative autonomy, increasing with complexity. Basic unit is organism-in-environment (that is, is a system in itself).	Constant interchanges with & adaptations to environment but does not determine organisation itself. Autonomy but always embedded in cosmos.
	Self-renewal.	Re-cycling components, repair, healing, renewal.
	Self-transcendence.	Learning, development, evolution; positive feedback important in this *[creative process]*.
	Self-regulation; by balance of self-integration vs self-assertion.	Positive & negative feedback loops; homeostasis. Self-maintenance by fluctuation; rhythms generate order (after Prigogine). *[Perception is also tuned into change]*.
	Far-From-Equilibrium state; dissipative structure.	Dynamic stability maintained by metabolism.
	Adaptation to change; 3 types; flexibility increases as reversibiity decreases. For populations, flexibility comes from variability (diversity).	Physiological temporary adaptation (reversible); long-standing somatic change (reversible); genotypic by mutation (irreversible).
	Self-reproduction	By cell division or life cycle including organismic death & replacement.
Evolution	Complementary approaches based on chance & necessity. Chance originates internally, emergent; represents creativity, self-transcendence *[future-related]*.	Necessity evolution (Darwinian model) responds to environment (external); involves heredity, reproduction, DNA, mutation *[historic - past oriented; also see Allen & Starr re past & future-oriented evolutions – anticipatory evolution (Allen & Starr 1982)]*.
Complementarity	Unifies scientific & mystical views	Inclusive of consciousness, mind, evolution

(Based on Capra 1982: 285-332; *Author*).

Figure 10: CM: Principles of Systems Thinking

PRINCIPLES OF SYSTEMS THINKING

1. Everything can be connected to everything else. Nothing is isolated. We draw the boundaries to define the systems and subsystems we study. The boundary we draw may or may not include ourselves.

2. All actions have feedback. The feedback returns to influence our next actions. We live in systemic circles of feedback loops and not static (cause – effect – stop) lines. Therefore when we have influence we also have responsibility. Feedback may appear far away in both time and space to *[sic]* the original action.

3. The structure of the system determines the results.

4. Results are not proportional to effort.

5. A system works as well as its weakest link. (Not its strongest one).

6. Good enough for each part is usually best for the whole system. When one part is maximised then there are inevitable losses for other parts.

7. You can never do only one thing.

8. The emergent properties of a system are not reducible to its components.

(From www.lambent.com/systems/sysprin.htm; last updated 1/4/98).
This paper was intended to seed a discussion on systems thinking.

Figure 11: CM: What is it? Explanations of Complexity

(Allen & Hoekstra 1992: 63):

Nonlinearity and asymmetry inherent in the 'part-whole' relationship of entity: environment.

The interplay in nested hierarchies between the higher constraining level *[rate-independent]* and the constrained *[rate-dependent dynamic interaction within a level]*.

(Allen & Starr 1982: xiv):

Spontaneous unpredictable behaviour from higher and lower levels in un-nested hierarchies.

Switches in fractal dimension as scale change invokes different system controls.

Sensitivity of complex systems to "surprise generators". **Link: Catastrophe Theory**.

[Producing unpredictable discontinuity]: "logical tangles and self-reference, chaotic motion, static instability, uncomputability, irreducibility, emergence".

(O'Neill,De Angelis,Waide & Allen 1986: 115-6):

Complexity involves subjective criteria that depend on the scale of observation....always appears when several levels of organization are called into play to describe behaviour...can be a helpful organizing principle but one that is strongly influenced by the way we choose to observe the system ... [a] hierarchical perspective ... simplifies the problem of increasing complexity in evolution ... as the investigator deals with successively higher levels ... the distance between the level of observation and the level of explanation increases.

(Casti 1994: 268):

Decentralised nature of controls.

(Kay 1991: 483-8):

Interface between external environmental changes and far from equilibrium nature of dissipative systems with nonlinear options for response to perturbation and optimum operating points.

(Gleick 1987: 8, 20-21):

Sensitive dependence on initial conditions ('butterfly effect'). **Link: Chaos Theory**.

(Lewin 1993: 51):

Special sensitivity to information as a system component *[above energy]* in deterministic chaos region *["universal computation"]*.

(Adams 1988: 72-3):

Functional organization of a system so as to have high informational content, non-random by design or selection: functional linkage of assembled parts *[as distinct from an ordered system, describable by simple algorithms]*.

(Kosko 1993: 108, 60, 59):

Nonlinearity: parts do not add up to the whole; system complexity (nonlinearity) exceeds subsystem complexity due to "conditional probability" of the real world.

Variable (fuzzy) containment of whole in the part *["The part contains the whole in direct proportion to its size or mass or overlap with the whole." Probability is a limiting case where the part contains the whole 100% or none at all]*.

(Brindle 1992: 46):

Scale-linking systems... imply a Wholism in which everything is in some sense constantly interacting with everything else.

(Van der Ryn & Cohen 1996: 34):

... Nature is infused with the dynamic interpenetration of the vast and the minute ... Matter and energy continually flow across scales, the small informing the large and the large informing the small.

(Senge 1990: 71, 71, 72) *[distinguishing detail complexity from dynamic complexity]*:

... *dynamic complexity* ... where cause and effect are subtle, and where the effects over time of interventions are not obvious ... where the same action has dramatically different effects in the short run and the long ... one set of consequences locally and a very different set ... *[elsewhere in]* the system ... obvious interventions producenon- obvious consequences ... Conventional forecasting, planning, and analysis methods are not equipped to deal with dynamic complexity. Mixing many ingredients in a stew involves detail complexity, as does following a complex set of instructions to assemble a machine, or taking an inventory ... *The real leverage in most management situations lies in understanding dynamic complexity, not detail complexity.*

Table 26: BICM: Mathematical Approaches to Different Number Systems

SYSTEM SIZE (Number of Significant Entities) (Weinberg 1975)	**SMALL NUMBER SIMPLE SYSTEMS** Small number of components with simple interactions: Weinberg's "organised simplicity" (O'Neill *et al.* 1986: 41-44).	**MEDIUM NUMBER SYSTEMS** Simple, non-linear	**MEDIUM NUMBER SYSTEMS** Increasing complexity, non-linear	**LARGE NUMBER SIMPLE SYSTEMS** Very large number of components; independent, identical.
Helpful Maths. Approaches	Newtonian approaches; differential equations; General Systems Theory (GST) also applies.	Inter-relationships between parts (connectance); needs GSMs (General Systems Models); complex adaptive system (CAS) maths: grammar of point, line & periodic attractors (Abraham & Shaw 1992;Lewin 1993: 48-9).	Modified GSMs; CAS maths: grammar of chaotic (fractal) attractors (Abraham & Shaw 1992); needs acceptance of complexity as entity & hierarchical models.	Statistical mechanics approaches; actual values replaced with averages; GST also applies.
Limitations of Approaches for Complex Systems	Large scale reductionist simulation modelling: problems interfacing with complex systems (eg ecosystems).	Calculus & Statistics do not satisfy, even when simple relations; too few parts to average, too many to use individual equations; simulation limited by finance & computer power.	Standard GST; artificial isolation of simple entities (Classical Newtonian maths: 'theoretical' or 'mathematical' Ecology) limited by simplifying assumptions; statistical methods give fuzzy results.	Statistical averaging "less and less justified."
Other Maths. Approaches	Simple difference equations link to large numbers (May 1976); Relativity Theory.	Small scale simulation modelling, general constraints, high stochastic: highly realistic yield.	Set theory: fuzzy logic, q-Analysis Catastrophe Theory.	Simple difference equations link to small numbers.
Examples	Planetary movements; population & community dynamics: growth or competition only (single component or pairwise dynamics).	Monomolecular metal sheets (self-assertive atoms exhibit unique behaviours).	Exact human behaviour, thought process, exact whole cell behaviour, ecological community behaviour.	Gas laws; GIS (spatial & hybrid systems).

(Based on Allen & Starr 1982: xii-xiv; other sources as indicated).

Table 27: CM: Wolfram's Behavioural Classes

Classes	Characteristics	Summary Behaviours	Attractor Types, Field Entities
Class I	Pattern disappears over time or fixed, homogeneous	Fixed point	Point attractor, attractor basin
Class II	Pattern evolves to fixed size, finite, cyclic structures repeating indefinitely Wave-like pulses , oscillations (curved line) or cyclic (periodic)	Periodic	Line/oscillatory attractor, limit cycle/ periodic attractor
Class III	Chaotic states, no structure, no regularity Random	Chaotic (stochastic)	Stochastic 'noise' (actually Backcloth entites excluded from current system definition)
Class IV	Complex patterns grow and contract repeatedly; thought to uniquely support the emergence of life Complicated aperiodic patterning, intricate, fractal structure, universal computation, maximum complexity, phase change transits, 'self-organising criticality', exquisite sensitivity to initial and local conditions, creative bursts & extinctions	Chaotic (deterministic) 'Edge of Chaos'	Chaotic/ fractal/ strange attractor, repellor (single or multiple attractors/repellors), saddle, separatrix .

Based on Coveney & Highfield 1995: 98-101; Lewin, 1993: 48-9; Abraham & Shaw, 1992; text this work.

Table 28: BICM: Beer's 'Everyday' Classification System

	Determinisitc	**Probabilistic**
Simple	simple deterministic	simple probabilistic (toss a coin)
Complex	complex deterministic (computer)	complex probabilistic

(After Beer 1959. Cybernetics and Management, English Universities Press).[2]

Link: Background - Paper: What Mathematics for the Divergent Sciences?

[2] Unable to find original.

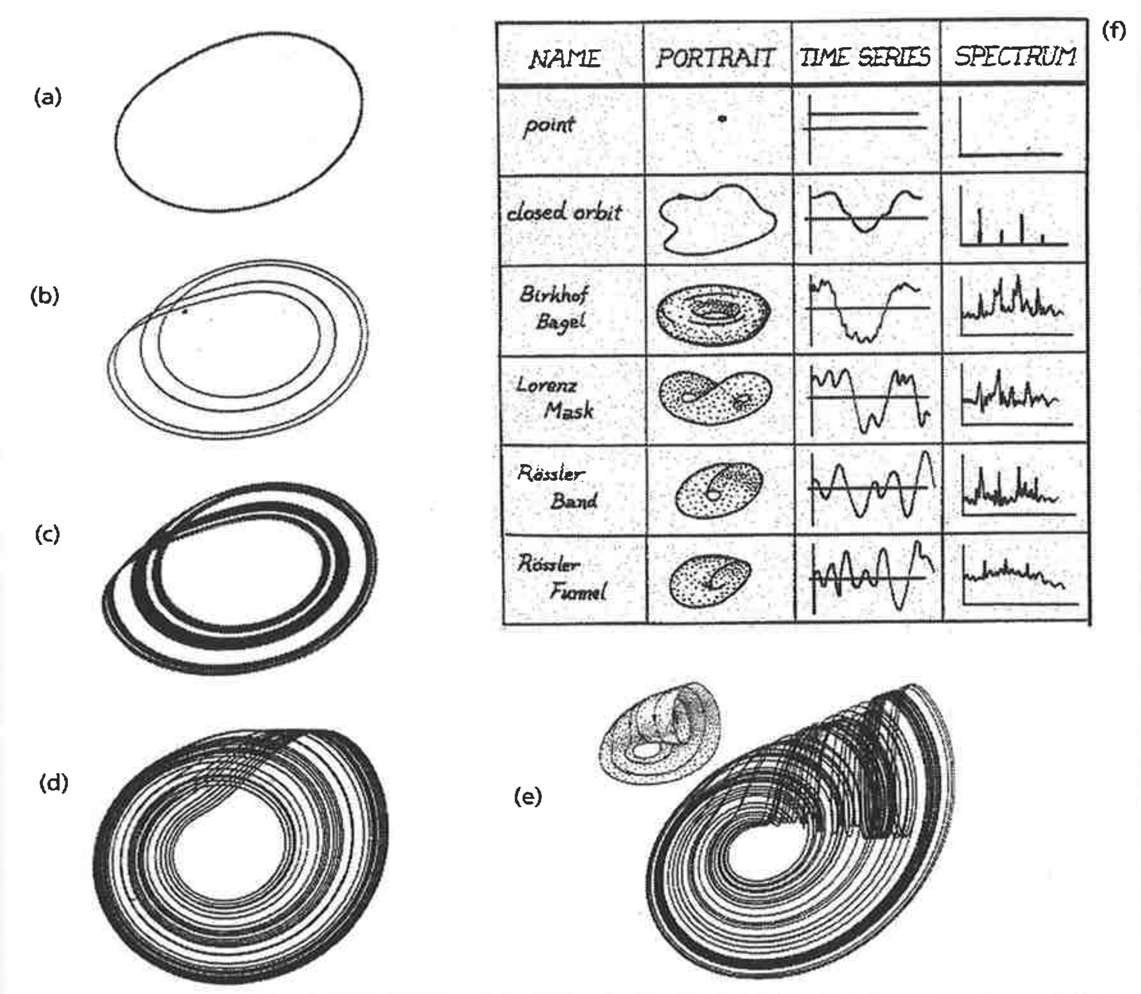
Table 29: BICM: Boulding's Typology of Systems Complexity Frameworks (1956)

Human society	Social organisation
Human being	Self-aware, individual system; self-aware, self-image, symbol producing/absorbing/interpreting.
Animal	Increased mobility, self-awareness, behaviour teleological.
Genetic-societal	Plant
Open	Self-maintaining, cell level.
Cybernetic	Homeostatic, physiological; information an essential system element.
Simple dynamic	Clockworks, equilibrium models: predetermined, necessary motions, including stochastic dynamic systems if lead to equilibrium.
Static structure	Structural relationships. eg Copernican description of solar system.

(After Boulding 1956: 14).

Note the influence of the concept of the 'Great Chain of Being', which is in fact congruent with the concept of *Constitutive Hierarchy* (**Link: Theory of Scale**).

Figure 12: CM: Becoming Chaotic



Development of Complexity (a) – (d)

Experimentally increasing the forcing frequency, the trajectory becomes more complex (Abraham & Shaw (1992): 298, 299): **(a) Simple Periodic Attractor**: has a stable, predictable trajectory in all its states. **(b) Periodic Attractor** with four cycles per iteration: higher harmonics emerging, but still predictable. **(c) Extended Attractor:** is mathematically deterministic but now unpredictable in experimental terms. **(d) & (e) Rössler's 'band'** and **Rössler's 'funnel'**, (Abraham & Shaw, 1992: 293, 294). In three dimensions these trajectories do not cross.

These are experimental 'chaotic attractors'. The arrows on the small funnel show the general path of the system as it moves around this complex surface over time. It will predictably visit all points on the surface, never repeating a particular path; the exact position at any one time is inherently uncertain. The system will stay within this surface under constant external conditions. The attractor determines the dynamic behaviour of the system elements attracted, but is not static itself.

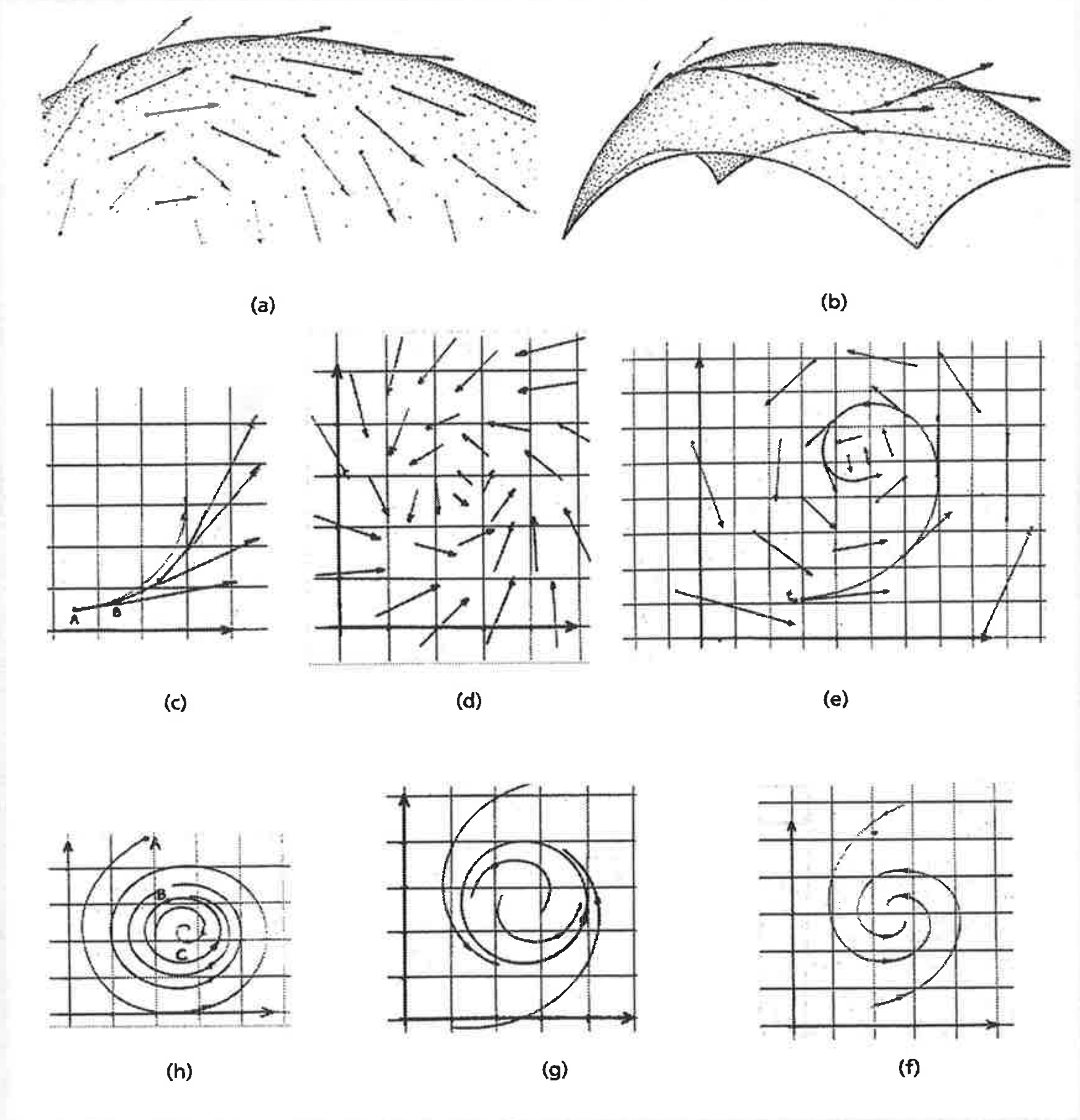
Manifolds (f)

Time series of research data can be distinguished by pattern recognition from the background of 'noise', which represents other elements or systems not under research focus. Where dimensions (*'degrees of freedom'*) are fractal or beyond three, representation becomes increasingly difficult. Such systems are represented on paper and in three-dimensional models using strangely-shaped images called 'manifolds'. This table from Abraham & Shaw (1992: 327) summarises some of the attractor portraits of systems they describe in their text.

Table 30: CM: Aspects of Chaos

\Characteristics Geometry\	Field Entities	Dimensions (Degrees of Freedom)	Examples	Behaviour
Point	Point	0	Fixed, static structures, orthodox mapping (scale relative), point source pollution.	Static
Line	Line	1 (2)	Arbitrary boundaries, fences, land divisions, borders, faultlines, cutoffs, thresholds, financial bottom line (excludes other dimensions).	Static
Cycle (Oscillator)	Periodic	2	Clockwork, pendula, electronics, fixed political & economic events (temrs of tenure, taxation schedules).	Dynamic
Volume	Attractor basin	3	Predator-prey systems (arbitrary definition, reductionist), simple (Classical) relationships, fixed social & structural relationships while extant (legal), mechanical feedback control systems.	Dynamic
Spacetime	Volume	3 + Time	Fixed social & structural relationships: trajectory through time (moving but relations not changing).	3D space + time, dynamic, relative.
Spiral	Spiral	4 fractal	Development process (system moving, internal relations change in clearly fractal manner (regular): shells, music, tree structure, natural forms. **Link: Fractals**. Distortions in 'perfect' structure record history of environmental interface (defects in regularity of spiral shells, tree rings); see Strange, next row.	Dynamic, fractals in Spacetime. (Coveney & Highfield 1995: 160, after Mandelbrot).
Torus (Deterministic Chaos)	Strange	N > 4 fractal	Development process (internal relations unclear or multidimensional, or varying external relations taken into account). 'Impecfect' internal fractal of 'power law' relations often demonstrable. Systems characteristically include living elements. Hierarchical structure 'simplifies' structure into functional subunits. **Link: subsections on CDS elements**.	Dynamic, reciprocity with variable environment, power law/fractal structures, self-organising.
Stochastic Chaos		N = ∞	Subatomic fields, Brownian movement. Undifferentiated crowd behaviour (scale-relative) **Link: Subatomic Scale: David Bohm: random = infinite degrees of freedom**.	Dynamic, 'unstructured'.

Figure 13: BICM: Vector Fields



Representation of dynamic systems using Chaos Theory, uses vector fields in curved, folded, multi-dimensional spaces. The Topography of Catastrophe Theory overlaps with these notions: they are just diagrammed differently. Only simple examples given here.

(a) A vectorfield: every point on the curved surface has a tangent vector off the surface (in nearby '3-space') (:28).

(b) A 'trajectory' emerges as a surface curve, integral to the vectorfield (:28)

(c) Euler's Method of constructing a vectorfield, uses a polygon concept to approximate an integral curve (:26).

(d) A planar vector field with an *eddy* (:32).

(e) A *'trajectory'* or *'integral curve'* evolves from *'t'*, the *initial state*, as tangent to every point of the vectorfield (:25).

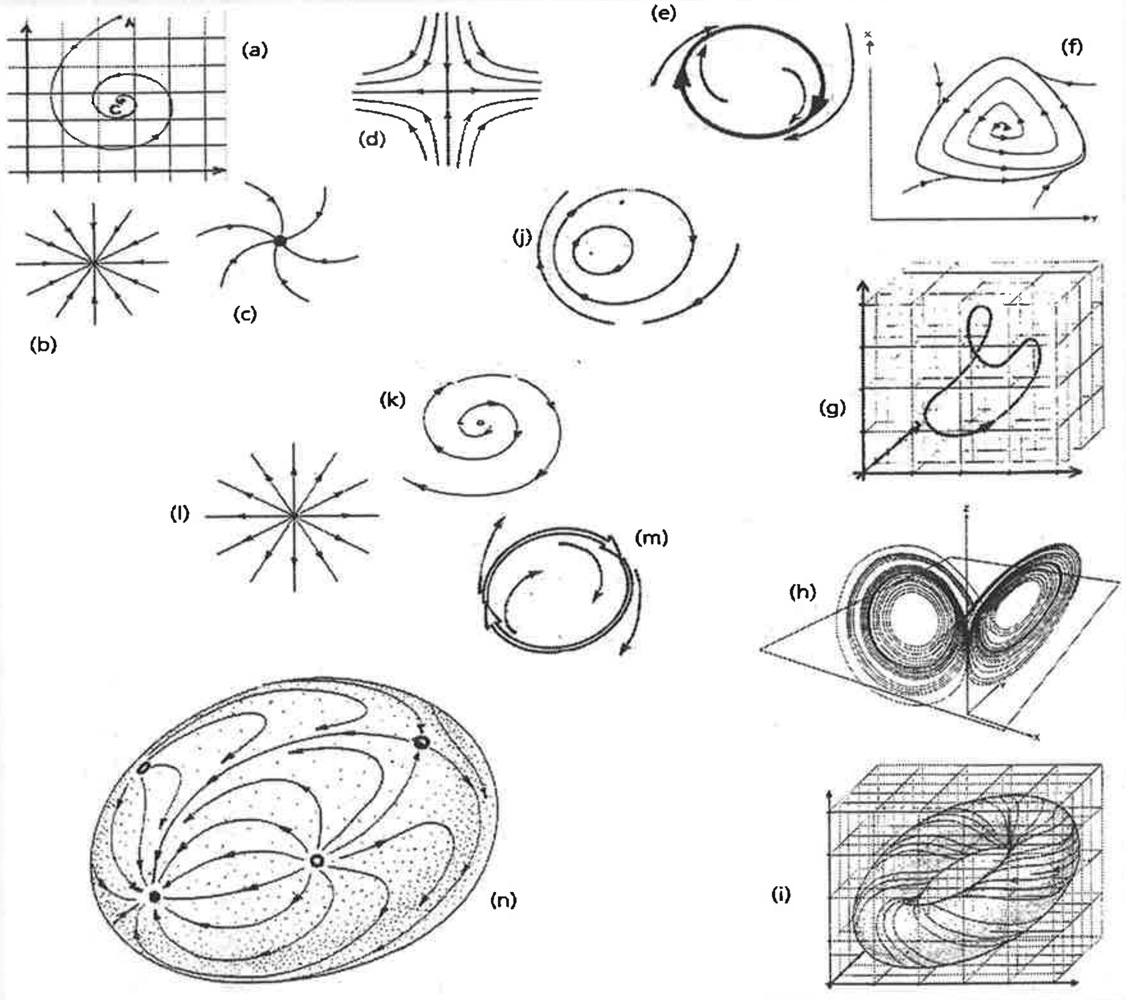
(f) The *'phase portrait'* of the system records the trajectories as determined by the system; internal motion of the space within itself is known as *'flow'* of the system (: 26).

(g) Phase portrait of (g): a closed trajectory emerges *('closed orbit'/ 'cycle'/ 'trajectory'* or *'oscillation'*)(: 32).

(h) Phase portrait of planar vectorfield. C is the *limit cycle* (closed trajectory) of spiral trajectory through A and B (:40).

Source: All elements scanned from Abraham & Shaw (1992) from pages indicated.

Figure 14: CM: Field Entities



These system elements are embedded in larger systems. Much of the low dimension work on this Theory originated in research into the Dynamics of Music. Ecological & social applications in morphogenesis are expected to yield useful explanations (A&S : 110-111).

(a-c) Point attractors, dimension 0: (a) spiral (asymptotic).

(d) Saddle point attractor: unstable attractor, dimension 1; linear.

(e-f) 2-Dimensional limit cycle (periodic, oscillatory) attractors.

(g) 3-Dimensional periodic attractor.

(h) Lorenz' *'Mask'* strange attractor system has three bounded, unstable, saddle-type fixed point attractors; each saddle has stable & unstable manifolds, and system behaviour critically depends on the initial relative positions of these manifolds. Lorenz' equation was historic: the first to be subjected to nonlinear dynamics (Arrowsmith, 1991: 69).

(i) Torus manifold (*'Birkhof Bagel'*): one of the simplest forms: trajectory lines are constrained by the attractor; movement around the torus, different attractor and repellor trajectories and complex folding may add further dimensions.

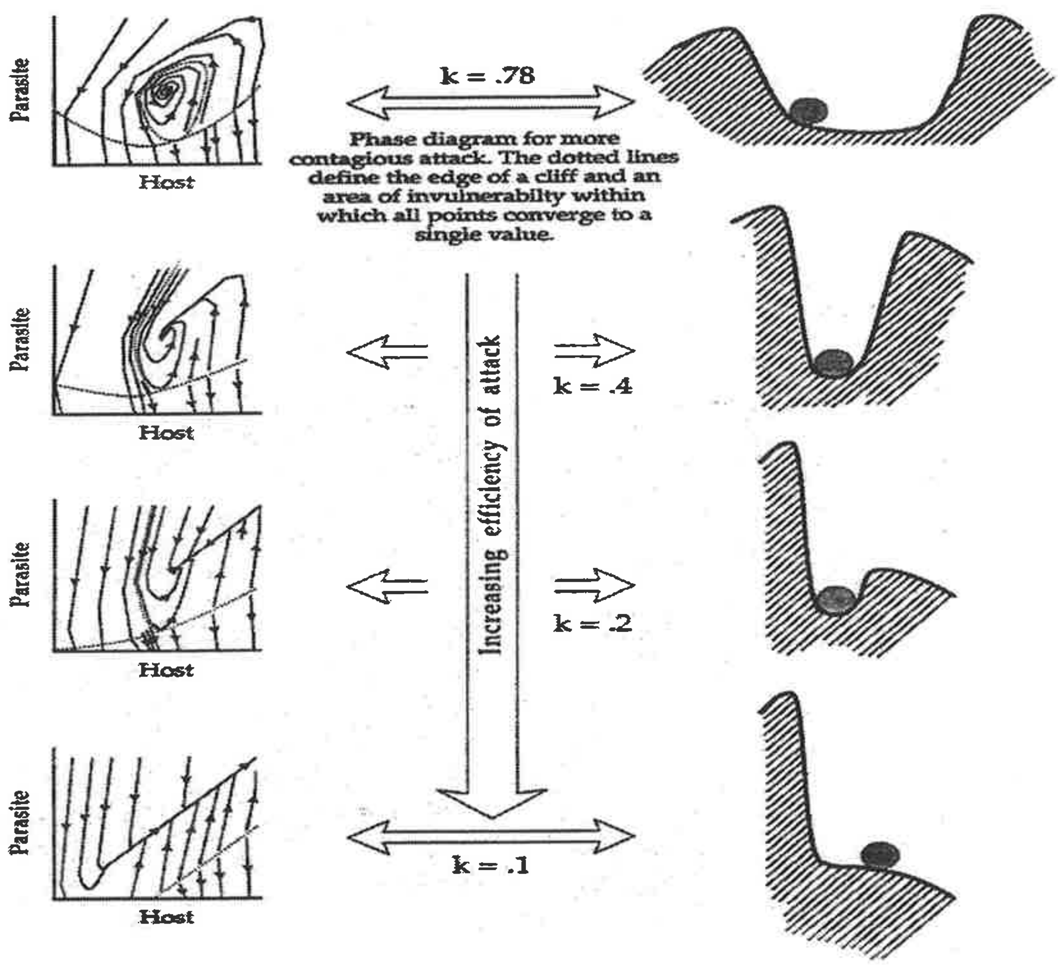
(j) Non-hyperbolic limit cycles: intermediate form between attractor & repellor.

(k) Spiral point repellor (exponential); **(l)** point repellor (dimension 0); **(m)** 2-dimensional limit cycle repellor.

(n) Simple dynamic system showing attractor, repellor, saddle, seperatrix (boundary between similar adjacent entities).

Sources (elements scanned & collated): Arrowsmith (1991): (b), (d) & (l): 50. Coveney & Highfield (1995): (c), (f) & (h): 171. Abraham & Shaw (1992): (a): 58; (g): 34; (i): 35; (k): 226; (e), (j) & (m): 243; (n): 353.

Figure 15: CM: Attractor Basin in Ecology



Allen & Hoekstra (1992: 221) report on the modelling work on parasites and hosts, of Holling & Ewing (1971). Chaos Theory explains similar research findings here and in cases of imbalance between predator and prey, where local stability is lost as a predator population gains efficiency. The system goes into positive feedback until the higher level constraint (prey population crash: the bottom line is resources for survival) brings down the predator population with it. What was a 'comfortable' limit cycle, in dynamic balance, narrows and rigidifies as prey (host) becomes increasingly disadvantaged. The broad, flexible cup narrows and deepens and system parameters become unstable and compromised, prey/host side of the cup breaks down, and the system is eventually uncoupled, with catastrophic consequences for both. 'k' represents the efficiency of assaults on the host.

(Top): a local, stable attractor (limit cycle).

Response surfaces are illustrated by analogous cup structures (a common way to illustrate limit cycle attractors).

(Bottom): loss of all stable equilibria.

This is a visual representation of the concerns about human predators (multinational companies etc) preying on the 'have-nots' through the unconstrained positive feedback of free markets, Economic Fundamentalism and 'Structural Adjustment'. These, and dissolution of natural constraints by technology, are escalating an unacceptable rich-poor economic gap. Raw competition, unbalanced by system constraints is proving tremendously wasteful of all types of resources, as many businesses fail. The impacts must be constrained or we will all crash together.

As an economist once said, "A healthy market needs well-heeled customers".

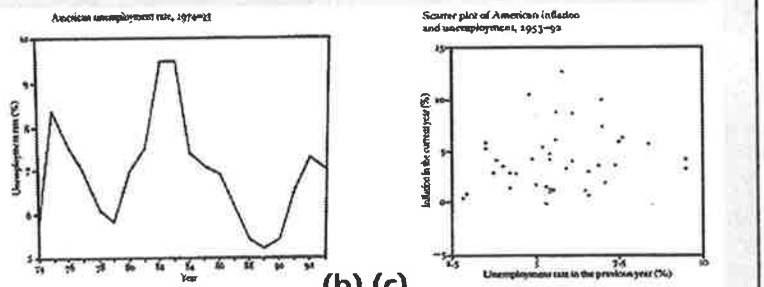
Figure 16: BICM: Analysis of Nonlinearity

Preceding and following figures demonstrate many diagrammatic approaches to nonlinear system behaviours. This figure shows some available ways to chart similar datasets for Analysis. They are scanned from economist Ormerod's *"The Death of Economics"* (1997) and *"Butterfly Economics"* (1998). Most are based on many-national unemployment and inflation figures from 1951-1992.

(a) Familiar data matrix (1997:118).
(b) Simple graph of one variable (US unemployment rate 1974-93)(1997:152).
(c) Scatter Plot linking two variables seeking linear relationship (same years as (c), current year inflation x previous year unemployment, USA). No relationship apparent with first derivatives (1997:128).
(d) Same information, further analysis: data differentiates into three sets of values, each with downward slopes: sudden and marked shifts to new positions. These correlate with oil shocks in 1974 and 1980 (1997:129).
(e) Same data as (c) but plotting rates of change of inflation and unemployment, gives linear graph: a clear negative relationship over the whole period, not necessarily at a particular time within that (1997: 131). The two outliers at top represent oil shocks (maximum rates of change).
(f) Same information as (b), Connected Scatter Plot (CSP) plotting one variable against same for last year. Shows Attractor Point around 6-7%. CSPs detect cyclicity, regularity, average values, magnitude & strength of Attractors (1998: 153).
(g) Appearance of Time Series typical of (noisy) chaotic data. US unemployment 1974-93. Pattern may be 'extracted' mathematically or visually (1998: 194).
(h) 3D Phase Plot (US GDP growth same period). Shows partial system looping (1998: 89).
(i) & (j) 3D Phase Plot (j) of Lorenz System treatment ([level now] x [now-t] x [now - 2t]) of Time Series (i)(1998: 84, 85).
(k) & (l) Lotka-Volterra Limit Cycle Analysis: commonly used in Ecology for predator-prey systems; equations applicable to other socio-economic situations. Shows two 'species' cycling together, shock/chaotic period, then settle to new Attractor (1997: 184-5).

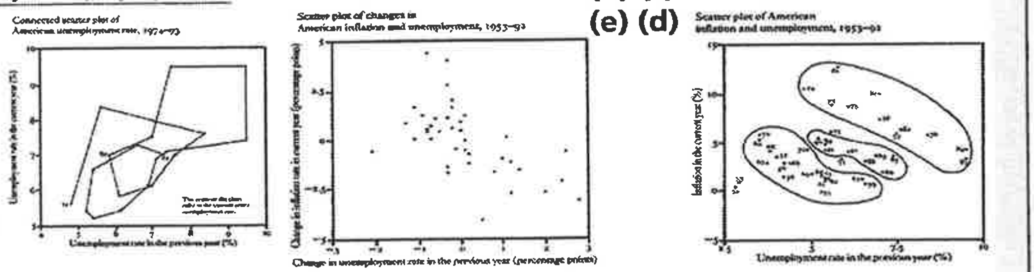
Country		Period							
		1951–60	61–7	68–73	74–9	80–86	87–92	51–73	74–92
Germany	p	1.9	2.7	4.2	5.5	3.5	2.4	2.7	3.8
	u	4.3	0.8	0.9	3.4	6.5	6.7	2.3	5.6
France	p	5.5	3.4	5.7	10.7	8.7	3.0	4.9	7.4
	u	2.1	1.4	2.3	4.5	8.6	9.7	2.0	7.7
Italy	p	3.0	4.2	4.0	15.1	12.7	5.5	3.9	11.2
	u	7.7	4.5	5.8	6.6	8.9	10.6	6.2	8.7
Belgium	p	1.9	2.8	4.4	8.1	5.9	2.5	2.8	5.5
	u	4.8	2.3	2.6	6.3	11.3	8.5	3.5	8.8
Netherlands	p	3.0	3.6	6.1	7.0	4.1	1.8	4.0	4.1
	u	2.4	1.1	2.1	4.9	10.0	8.1	2.0	7.8
UK	p	3.4	3.2	6.4	14.4	7.6	5.5	4.5	9.3
	u	1.4	1.7	2.6	4.4	10.6	9.0	1.8	8.0
Sweden	p	4.8	4.0	5.1	9.3	8.6	6.2	4.8	8.0
	u	1.8	1.6	2.2	1.9	2.8	2.5	1.8	2.4
US	p	2.1	1.7	4.8	7.8	5.9	4.1	2.7	5.9
	u	4.4	4.9	4.7	6.7	7.8	6.0	4.6	6.9
Canada	p	2.1	2.1	4.4	8.7	6.7	3.7	2.7	6.4
	u	4.4	4.7	5.4	7.2	9.8	9.0	4.8	8.7
Australia	p	5.8	2.1	5.0	11.4	8.4	5.3	4.4	8.4
	u	2.1	1.8	2.0	5.0	7.6	8.1	1.9	7.0
Japan	p	3.8	5.6	6.5	9.5	3.1	1.8	5.1	4.7
	u	2.0	1.3	1.2	1.9	2.5	2.3	1.6	2.3

(a)



(b) (c)

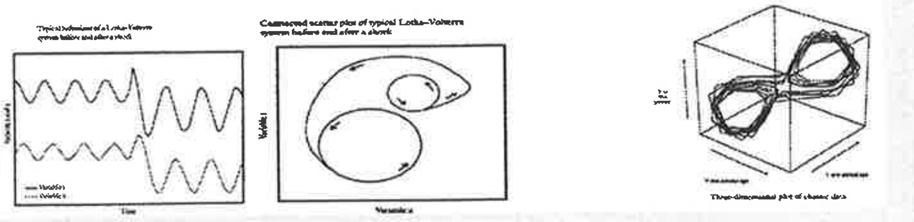
(e) (d)



(f)

(g) (h)

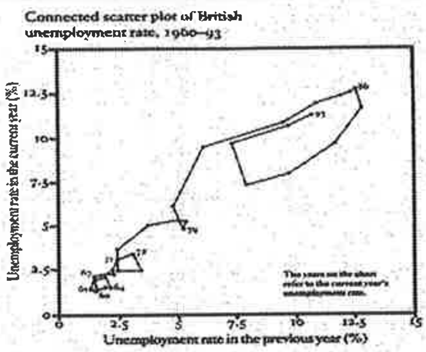
(i) (j)



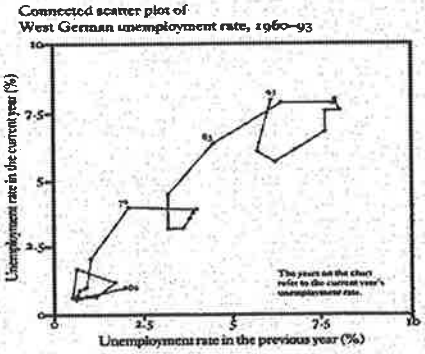
(k) (l)

Figure 17: BICM: Limit Cycles in Economic Systems

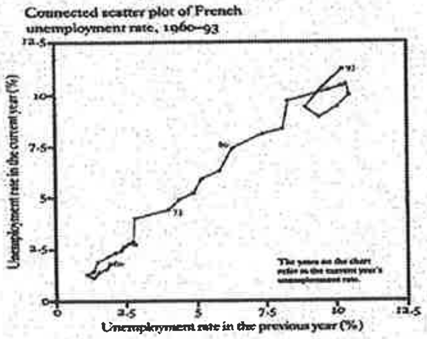
(a)



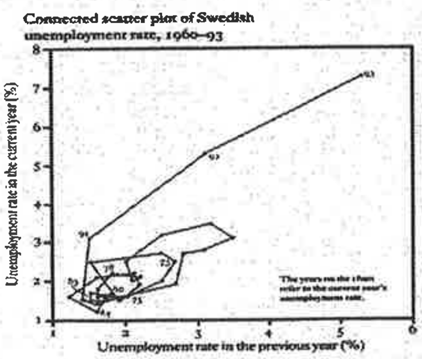
(b)



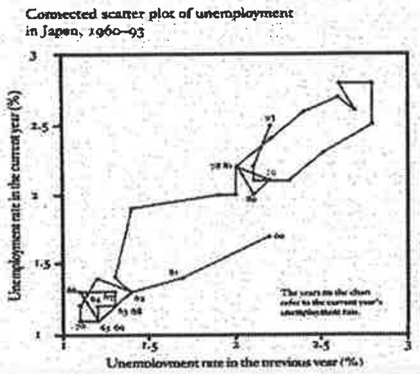
(c)



(d)



(e)



Ormerod uses CSPs (Connected Scatter Plots) to analyse responses to oil shocks in terms of unemployment (graphs below) and inflation conditions, using his '*Butterfly Economics*' Model.

Whereas the USA reached 8-10% briefly, it settled back to its usual 6-7% (see previous figure), while most European countries rose to 10-12%, and some to 20% or more after the second shock, and most remain at about 10% (1997). Ormerod believes the challenge is to shift down to a lower Attractor Point (Ormerod, 1997: 161).

The graphs below (1960-1993), demonstrate multiple equilibria, oil shock impacts (1973-4+m 1980+), and other figures show no relationship between economic growth and unemployment figures, nor between unemployment and inflation. For instance from 1978-1992, all on av. growth 2.3%pa, Austria, Germany and Spain had 3%, 6% and 16% unemployment respectively (Ormerod 1997: 149).

(a) UK: From a low <2.5, shock (i) sent the level to 5%, barely settling when shock (ii) arrived. This shot the level up to 8-12%, a pattern also seen in Belgium, The Netherlands and Australia. In UK there was a period of runaway wages and high inflation, following a union agreement made to peg wages up to an agreed threshold of inflation. The new Attractor cycles on 10-12% (:157).

(b) West Germany also started low, reached 3.5-4% on (i) but settled fast, and with (ii), went to 7%, again settling fast, while others hit 10-12 or even 20%. Workers recognised the need to reduce standard of living temporarily, and traded this for increased influence in decision-making that affected them. This, and fixed exchange rates, kept inflation relatively low, but a further shock from reunification with East Germany has removed the previous economic advantage, cycling at 6.7%, but not shifting Attractors (: 156).

(c) France: Instability, increasing levels until recently; may be settling at 10%. Similar pattern in Italy, also Spain, but latter settling at 20% (:156).

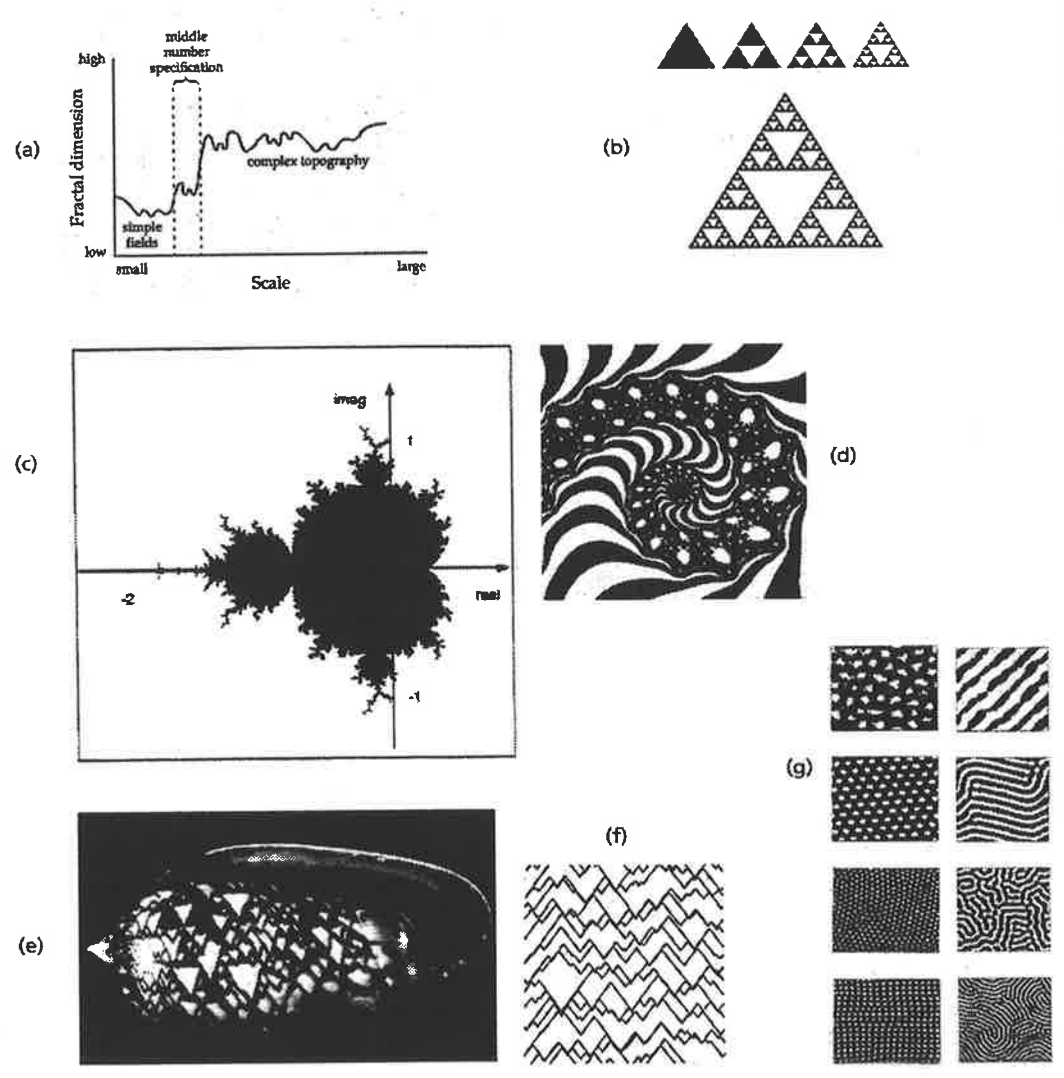
(d) Sweden: Very different pattern: very low levels, not impacted by oil shocks, but unstable escalation from early 1990s, with failure to settle, following deregulation of economy (:157).

(e) Japan: Extremely low start; sent up to new Attractor by oil shocks, but still only 2-3% (:158).

Ormerod ascribes the resilience of Sweden and Japan to 'shock absorbers'. System Constraints happen in these cases to be present for cultural reasons. Both have national traditions of social service through artificially supported, 'inefficient' employment: through public service in Sweden, and through privately funded (service charged in the domestic service sector) 'mini-occupations', such as opening doors or cleaning shoes in hotels, in Japan (Ormerod, 1997: 203-4).

(Graphs scanned from Ormerod, 1997 as indicated).

Figure 18: CM: Fractals



The concept of fractals revolutionised our understanding of dimensionality. 'One-and-a-bit' dimensions are scale-related: they have the same functional characteristics at every scale across a range dependent on the local organising principles (attractor landscape of that system. **Link: Figure: Bifurcation**. Fractals are ubiquitous in Nature (Coveney & Highfield 1995: 172).

(a) Log:log plots display relative complexity. With landscapes, a high fractal index at larger scales reflects the complexity of a system constrained by topography. At lower scales, Complexity is greatly reduced by human influence (fencelines, roads etc), giving a lower fractal index. Between these is a turbulent zone (Edge of Chaos) subject to medium number descriptions (from Allen & Hoekstra, 1992: 61, 58-63). **Link: Criterion: Landscape.**

The most striking visual characteristic of fractal patterning is 'self-similarity'. This is demonstrated artificially in **(b)** by the ***'Sierpinski Gasket'*** pattern (from Casti 1994: 234), and **(c)** & **(d)** by the famous ***'Mandelbrot Set'*** pattern (from Casti 1994: 239). Benoît Mendelbrot coined the term *'fractal'* in 1975 (Coveney & Highfield 1995: 172).

Type IV cellular automata are able to generate patterns that simulate markings commonly seen in Nature. **(e)** A cone shell exhibiting a typical pattern. **(f)** A similar, simulated fractal cellular automaton pattern. (from Coveney & Highfield 1995: 184).

(g) A set of spots and stripes generated from 'stationary Turing patterns' (from Coveney & Highfield 1995: 183).

Table 31: BICM: Applications of Fractal Theory

Application Area	Formulae	Explanatory	Applications
GENERAL SELF-SIMILARITY			
Coastlines	L(r) _ r–	L=apparent length; r=scale unit; _=exponent (negative if L increases as r decreases; smooth asymptotic curve as r approaches 0 - ie _=0)	Rugged coastline measurement eg Norway (S:213)
Logarithmic Spiral		Disregard rotation eliminates scale measure -> scale-free	Spiral shells, 'one-size-fits all' clothing (elastic version eg stockings), certain antennae
Stone Walls		Hierarchical structure of different sized stones (replacing mortar)	Structural strength from self-similar composition (max. connectance)
Stock Market		Self-similarity at different timescales: month, day, hour, minute, 30 seconds	
Electrical Discharges		Explosion pattern, fractal bifurcations	Demonstration of concept
Fractal Geometry (A&H: 56-63)	(various) eg log-log plot of length of estimator segment: length of total perimeter is a straight line	Humans impose simplicity on landscape patterns: land tenure, straight line transport; periodic activity waves of characteristic frequency range 1 year-several decades	Assessment of shape of complex entities; complexity in landscape patterns; realistic landscapes for science fiction movies; low fractal dimension is an indicator of human activity
Geographical Information Systems (GIS)	Logarithmic scaling, usually to base 10	Free range inter-scale translation macro-micro; aggregation error beyond N+2 ascending (S. Buser, QUT, pers. comm.)	Mapping; urban & regional planning; defence; mining etc.
Diameter Exponents General Structure	d_= d 1_+d 2_	Scaling Law; ideal value 3.0 for connectance	Model for design for high connectivity
Trees	$d^2 = d_1^2 + d_2^2$	Da Vinci's Pipe Model; d=cross-sectional area	Internal circulation of tree (xylem & phloem); basis for external branching appearance
Rivers	d_= d 1_+d 2_ dμ	Scaling Law for confluence Q=water quantity; d=width; v=velocity; t=depth Depth means scaling or drawing to scale impossible on maps	Engineering applications
Arteries	d_= d 1_+d 2_	Valid over 20-step range; branching ratio 2.7	Demonstration of underlying design; medical applications
Lungs	d_= d 1_+d 2_	Valid over 15-step range; Branching ratio high (near 3.0) _ least air resistance	Demonstration of underlying design; medical applications
Roads	d_= d 1_+d 2_	2-dimensional; lanes equivalent to Pipe Model (xylem/phloem)	Traffic management & road design

Noises (S:121-137) **General Form**	$f^{-ß}$ Hurst Exponent of persistence H=log(R/S)/log(_t) Also: ß = 2H+1	Homogeneous power functions; ß exponent range 0-4 Hurst exponent H measures divergence: R = range, S = sample standard deviation, R/S = rescaled range, t = time interval	Represent decay functions Slope of R/S: log time demonstrates persistence range - useful in prediction eg of long-term river flows (S: 130)
White Noise (White Light)	f^{0}	ß = 0 Range finite, no persistence, H = -0.5	Innovative processes, frequency-independent (succession of surprises)
Brown Noise	f^{-2}	ß = -2 Range extended, persistent: H = 0.5 Repeated summing of independent random numbers	Integrated processes One-dimensional projection of Brownian motion Gambler's capital (paradoxical consequences) Stock market phenomena
Pink Noise	f^{-1}	ß = -1	Occurrence widespread in nature, approximates many natural noises Power laws at log scales at constant intervals Generated through relaxation processes, often with multiple relaxation times Hyperbolic decay/time eg silk elastic, neuronal recovery, concert halls, technical hearing test research, acoustics, aesthetics, music
Black Noise	$f^{>-2}$ $<x^2>^{1/2} \sim t^{1/2}$	ß > 2 eg $1/f^3$ Diffusion process diverges with root mean square distance proprotional to square root of time Long range persistence in underlying processes	Occurrence widespread, occurs in clusters related to black spectrum Governs catastrophes, floods, droughts, bear markets, electrical power outages Re-interprets calamity frequencies: finite observation times limits the excesses observable; Applications: accelerated global warming needs much extended observation time to confirm, current estimates of minimum viable populations for endangered species very much larger than present estimates (S: 131)
ATTRACTORS			
Attractor	(eg) $x_{n+1} = f(x_n)$	A single point or bounded set of points where starting values from attractor basin (x_0) converge as n -> ∞.	Defines attractor 'basin'
Strange Attractor **"Are Fractal Dusts With a Fractal Dimension Smaller than the Euclidean Dimension of the Embedding Space." (S:206)**	$x_{n+1} = f(x_n)$ (x[t] * x[t-dt]) fractal phase plot (C: 549)	An attractor where x_n depends very sensitively on x_0 ie as n becomes larger, initially minute differences become macroscopically separated	One of the most important multifractal entities; descriptions of nature, entropy and nonlinear dynamic systems.

Based on Schroeder (1991): 117-9, 121-137; Allen & Hoekstra (1992): 56-63; Costanza (1993): 549.

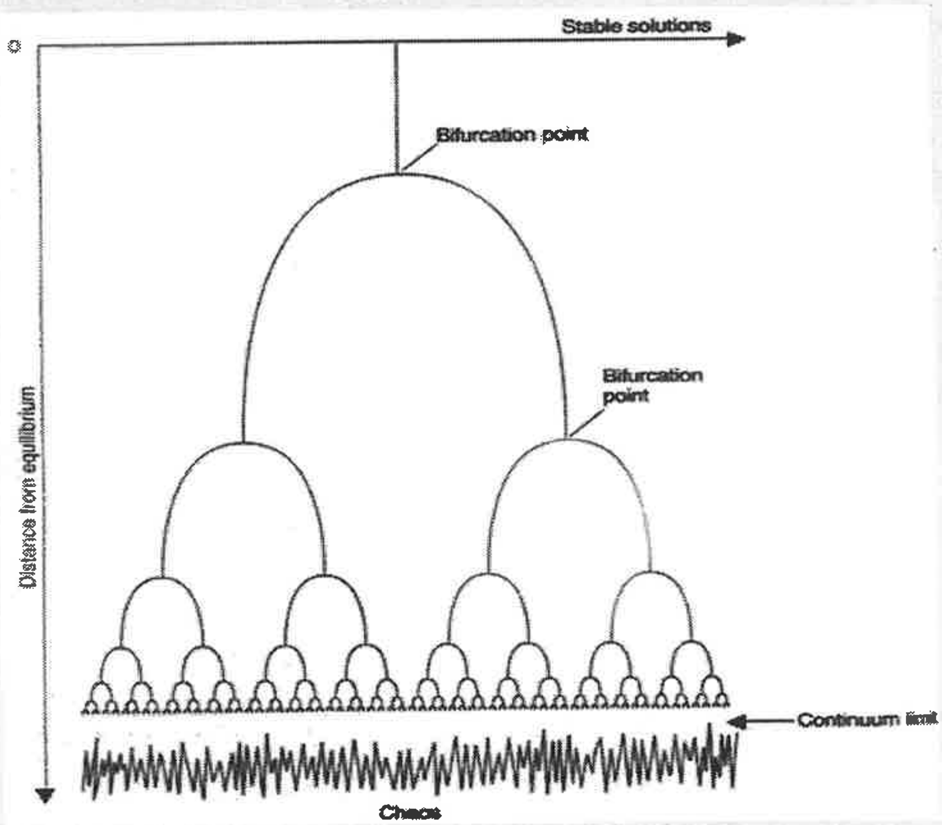
2.2.8.3 BIFURCATION, CATASTROPHE & SURPRISE

CONTENTS

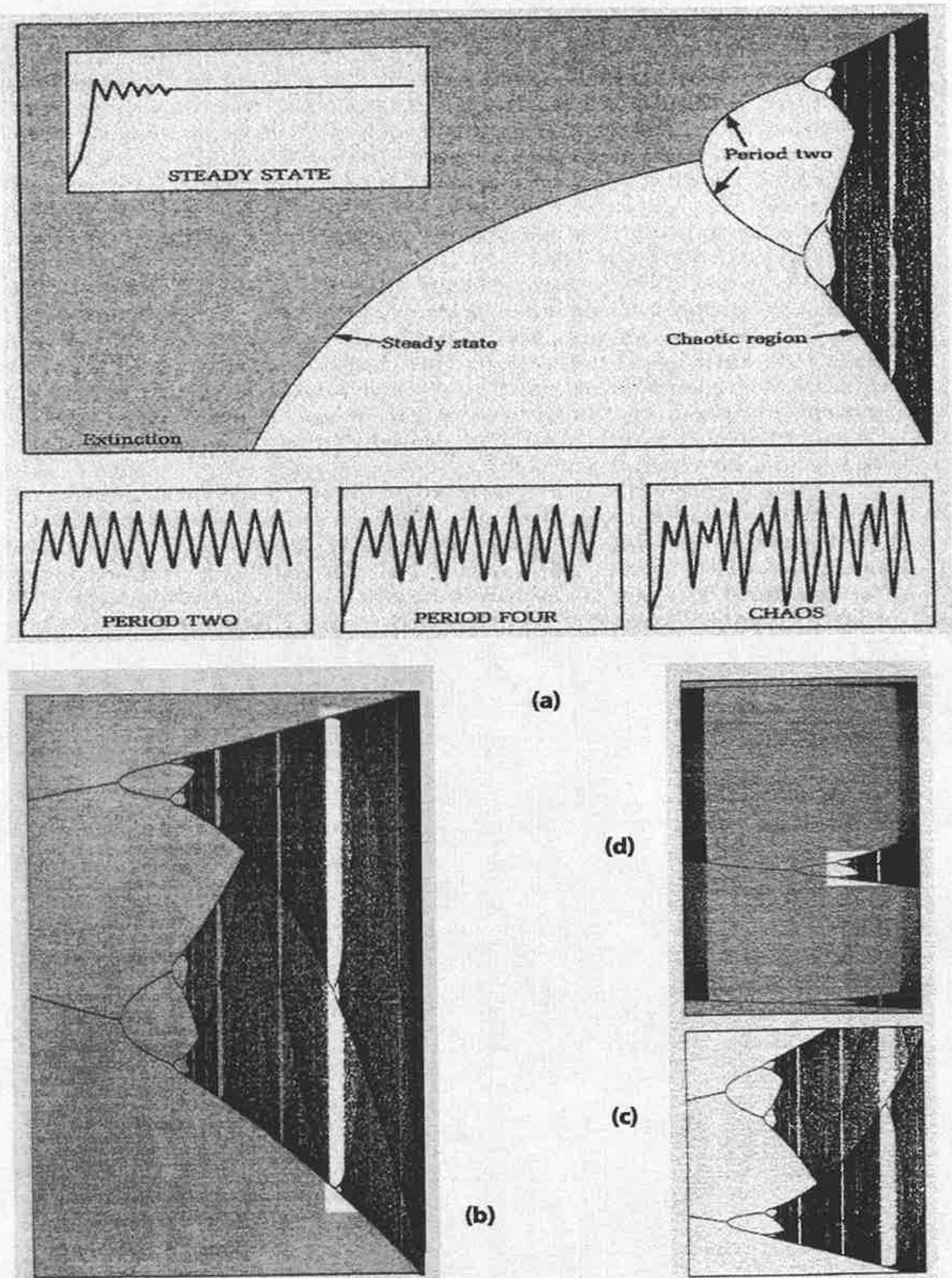
Figure 19: CM: Bifurcation

When the 'soft Sciences' (Population Biology, Ecology, Economics, Demography, Psychology, Planning, Geography etc) tried to legitimise their disciplines in the 1960s, they used simple equations, without the complexity they knew existed in reality. An example is $x_{next} = F(x)$, where x = population that year, and F = a function, derived from studying two consecutive years: a *difference equation* used for *time series*. This maps a linear relation, such as a 'Malthusian' explosion (Gleick 1987: 60-62). Ecologists added another term to reflect the constraint seen when populations became very large, with rapid early growth and later levelling and drop-off (for environment or resource related reasons). Logistic *difference equations* were borrowed from Physics, such as $x_{next} = rx(1-x)$, where r = a growth rate parameter (in Physics representing heat, friction or amount of nonlinearity). The formula was found correct for many different 'r'. This was applied by Picker (Australia) to fisheries. Lower r → lower level steady states, higher → higher ones. But findings of 'misbehaviour' at even higher levels were initially discounted.

It took the work of Lorenz (Meterology), May (Ecology) and the bridging of Physics and Mathematics to recognise the emergence of periodic doubling (evidenced in reality by population fluxes with 2-, 4-, 8- year periodicity), going on to 'chaotic' behaviour from which islands of self-similar structure would spontaneously emerge (Gleick: 62-79. These are illustrated here. Thus Bifurcation is only a stage on the way to Chaos. Casti's conclusion in *"Complexification"* is that Complexity (Science) is only a subset of a *Theory of Models* (Casti 1994: 278).



Bifurcation as explained diagrammatically by Coveney & Highfield. This diagram was referred to under 'Observer Effects', as an explanation of how viewing a system at different scales may result in quite different descriptions, and why therefore, naïve Reductionism can be very misleading in a complex system.
(Source: Coveney & Highfield 1995: 168).



May's fish population model.

(a) The line curving up to the right is the system growth rate parameter. As this increases, the system leaves its 'steady State' behaviour, and starts doubling (period two), then the doubles double (period four), soon after that entering a deterministic chaotic state which looks chaotic but has fine, hidden structure.

(b) Within the Chaos Region islands of doubling emerge (indicated by pale, vertical lines).

(c) (d) Magnification of these islands of order reveals a structure very similar to that of the first bifurcation set. This is typical of a fractal relationship between scales of observation, with power law connectivity between scales. **Link: Fractals.** (Source: Gleick 1987: 74, 75).

Table 32: BICM: Catastrophe Theory (CT) of Complex System Behaviour - Basic Assumptions

BASIC ASSUMPTIONS OF CATASTROPHE THEORY (After Amson)
• A system describable by only a small number of key parameters will have limited potential behaviours.
• CT is based on the concept of families of functions which respond differently to small perturbations (eg stably, unstably, catastrophically). Depending on changing values for the control parameters of the system: a stable, fixed point may become unstable as one 'takes a walk' across the system surface (Casti 1994: 53-5).
• Control vectors on the control manifold (system surface) determine behaviours (régimes) on the behaviour manifold according to the classification below. Each control point c has a characteristic set of potential behaviour points denoted by a function p_C.
• The actual behaviour points b that correspond to c are the ones which make p_C stationary (=0). Only the b's which make p_C a local minimum are observable.
• The model for the p_C function comes from Mechanics.
• The p_C in this case refers to the potential energy of the point. Minimum potential energy states are observable and stable (if at a point) or metastable (if on a surface). Maximum potential energy states are unobservable and unstable whether at a point or an edge.
• The response to small perturbations of systems in stable, unstable and metastable states, is to return from displacement, diverge still further or remain displaced respectively.
• Another example of this system type is the modelling of probabilistic phenomena. The probability is modelled for occurrence of behaviour b for a choice of control c. The local régimes (observable behaviours) locally minimise p_C and so maximise the probability of b. *[Fuzzy Logic opportunity].*
• The above does not indicate which of the many possible local régimes will in fact appear. Three conventions (following table) attempt to remove this arbitrariness.
• A system is observed against a background which includes <u>time</u> *[similar concept to traffic on backcloth].*
• A process is defined as a "system evolving in time"(:180).
• A system is defined as a "collection of states"(:180).

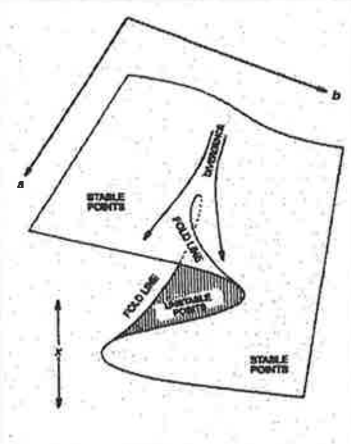
(Source Amson 1975: 178-80, 181-3 except as indicated; *Author*).

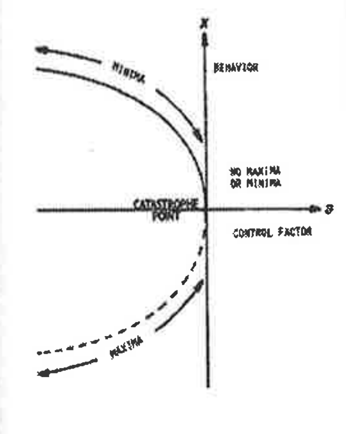
Figure 20: CM: Topology of Catastrophe Theory

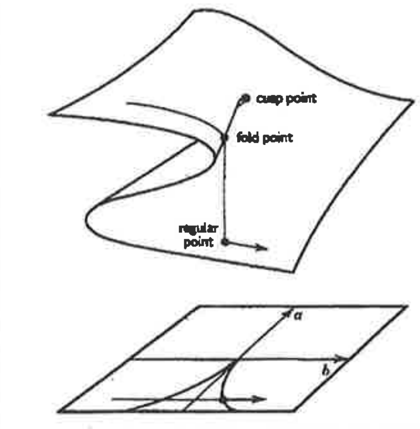
Topology is a method of representing potential system behaviours across surfaces, using 1-2 inputs and up to six outputs. The concept is explained by imagining a folded sheet of paper, with increasing degrees of complexity of folding. The folds are zones of instability, linking to sudden and uncertain state changes. Topology maps the fixed points of families of functions, which may shift suddenly to achieve stability (shift to a new Attractor).

Elementary Catastrophe Theory (ECT) deals with fixed point Attractors, so is good for rate-independent parameters. There are periodic and strange Topologies, as described above, but the catastrophic Mathematics for these is not developed. Since the natural world is replete with such Attractors, this leaves us in Ecology in a position of awe, and hopefully, respect, at such astounding complexity.

Topologies form a 'library' of generic surfaces for analysis of complex situations, and prediction in physical ones, usually selected by number of variables. **Links: Next Figure; Bifurcation (Steady State graph); BP5.3: Fuzzy Logic.**







(a) (:60) **(b)** (:62) **(c)** (:59)

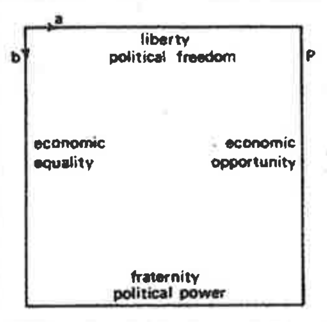
(a) Cusp Geometry with inputs a and b, and output quantity x, showing stable and unstable regions of the folded surface (Cusp Catastrophe). See following Figure.

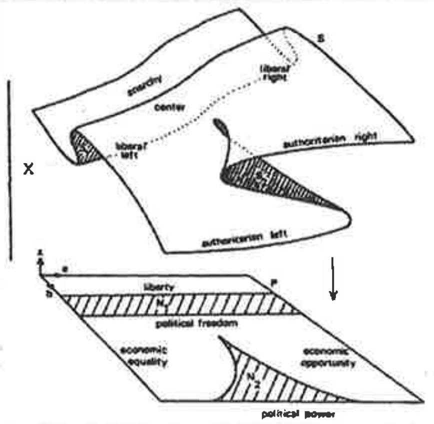
(b) Fold Geometry universalises the concept of families of functions expressed by a single variable. The unstable member 'a' runs through the *Catastrophe Point*, where a = 0. No local maxima or minima exist for positive values of a, but for negative values there exist two critical points, one local maximum, one local minimum.

(c) Three types of points: *regular*: surrounded by flat surface; *fold*: has an edge where a small move in the wrong direction can result in falling off; *cusp*: two lines of fold points come together. These situations are local. The curved surface is projected onto the flat one below. (Source all diagrams: Casti 1994: pages as shown).

(d) Casti demonstrates the use of Topology by analysing an ideological situation, applying ECT principles to explaining the fall of Communism in Eastern Europe (:48-55). With variables scaled between 0 and 1, a and b define a 2-parameter space of parameters P. Each individual is assignable to a space constrained by a (opportunity vs equality), and b (fraternity vs liberty).

(e) Local maxima are stable Ideologies, and there are two instability (conflict) regions. X is an n-dimensional space of personal views; S is the set of ideologically related critical points (forming a curved surface). Conflict regions must be traversed to change Ideologies.





(d)(:49) **(e)**(:51)

Link: HST: CoEvolution (Rugged Fitness Landscapes).

Table 33: BICM: Regulating Conventions for Catastrophe Modelling

Conventions	Descriptions
Maxwell's	Where several minima of p_C compete at a control point c, the local régime is determined by the <u>least</u> minimum value. Where control points move, minima are rearranged as previous and new values interface. Local régimes change as new least minima appear and new régimes 'capture' old through changed relativities ['entrain', 'slave', as in Synergetics]. At the conflict set of control points, local régimes have equal values. Local régimes may disappear (local minimum collides with a local maximum or 'captured' by a $\pm\infty$), jump to a nearby local minimum (new 'captures' old). Control points for obliteration of local régime make up the bifurcation set.
Perfect Delay	System behaviour evolves continuously until & unless forced by passing a bifurcation point to jump to a different path (unidirectional).
Imperfect Delay	A threshold set of points (with fuzzy/probability or OR rules) exists where a local régime jumps to a nearby local minimum if the old minimum is higher and the threshold low enough.

(Source Amson 1975: 180-3).

Table 34: BICM: Amson's Control Manifold Classification

Set type	**Characteristics of Functions p_C**
The Blank Set	No local minimum
The Simplex Set	Exactly one local minimum
The Duplex Set	Exactly two local minima
The Triplex Set	Exactly three local minima
The Quadruplex Set......	Exactly four local minima......
The Multiplex Set	More than minimum two local minima
The Bifurcation Set	A local minimum vanishes
The Conflict Set	Two local minima have equal values
The Threshold Set	Two local minima have values differing in magnitude by < a threshold constant which >0
The Catastrophe Set	Either a local minimum vanishes or p_C has at least two local minima

(Source Amson 1975: 181-3).

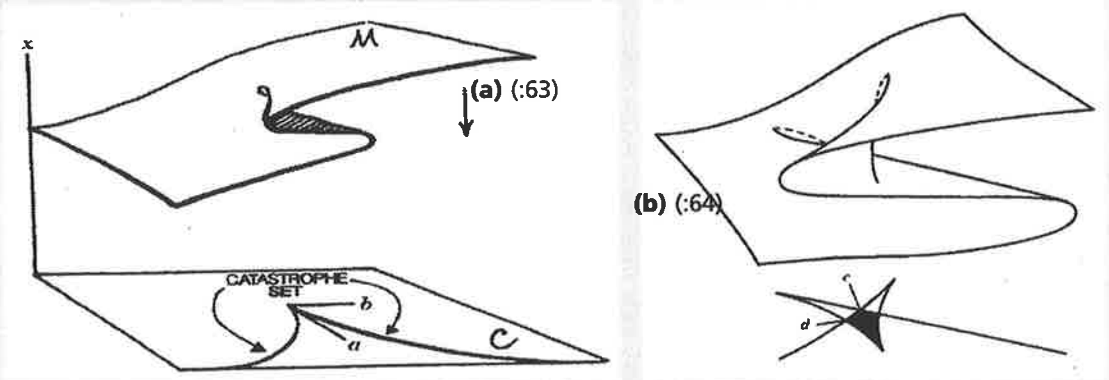
Figure 21: CM: Elementary Catastrophe Portraits

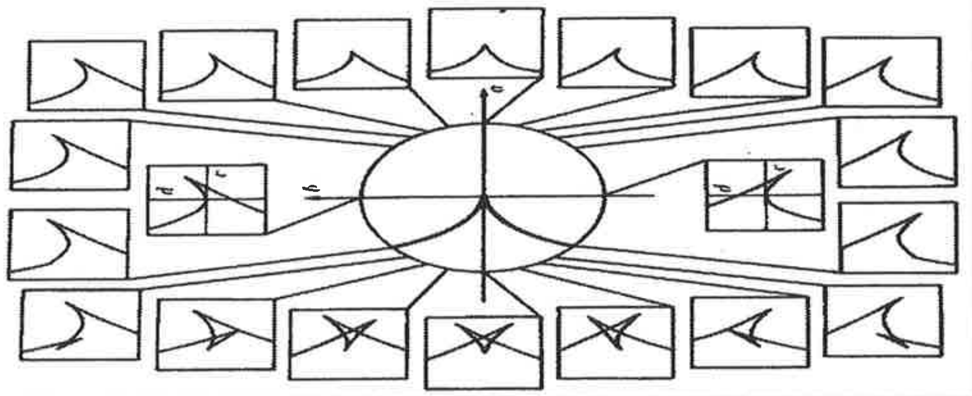
(Source: Casti 1994: all diagrams; discussion : 63-5).

(a) The best known fold is the *'cusp catastrophe'*, which has two parameters. The name *'cusp'* comes from the shape of the projection downwards from the complex surface M onto a flat plane C below. *'Catastrophe'* comes from the sudden transition behaviour the system may go through as it traverses the *'divergence'* or *'instability zone'* represented by the folding.

(b) The *'butterfly'* (4 inputs). The black *'pocket of compromise'* can be manipulated by changing c and d.

(C) Whereas the *cusp* has two possible emergent outcomes, the *butterfly* has three stable surfaces. These are hard to visualise on 2D paper, so (c) shows the possible cross sections.





(c) (:66)

(d) The Table lists the common named *Catastrophies.* Thom described formulae with up to four inputs and two outputs. A *'Magnificent Seven'* are regarded as 'canonical'. Over a dozen have been described since, but are impossibly complex where the goal is simply to gain a general understanding of what ECT is about. The fold, cusp and swallowtail are special cases of the butterfly.

The 'Magnificent Seven' Catastrophes **(d)**

Catastrophe Type	State Variables (x)	Control Variables (c) (Inputs)	Function (f) *[Omitted here]*
		CUSPOIDS	
Fold	1	1	
Cusp	1	2	
Swallowtail	1	3	
Butterfly	1	4	
		UMBILICS	
Hyperbolic	2	3	
Elliptic	2	3	
Parabolic	2	4	

(Transcribed from combined Wilson 1981: 29; Zeeman 1977: 27).

Table 35: BICM: Criticisms of ECT

Criticism	Response
• Inherently local (does not describe system behaviour far from the catastrophe point) and • Association of mathematical jump in attractor space with observable discontinuity in real world process takes faith	• Provides tools for a global theory that justifies a leap of faith beyond conceptual & mathematical reach. • The mathematical jump is extremely small and so macroscopically undetectable.
• Applies only to CDS with fixed point attractors (a very restricted class of CDS) • Only low number of input parameters	• Many natural processes have periodic steady state behaviour (heartbeat, plants flowering) or have strange attractors, so ECT applies only if structurally suited to reducing parameter numbers to fit the model. • Many 'unsuitable' systems may be approximated to fixed point attractors with satisfactory results. • Many interesting processes do yield to ECT analysis. • Non-gradient systems exhibit point, saddle, periodic (closed loop or limit cycle) and chaotic behaviours, and yield to bifurcation theory if not ECT (Wilson 1981: 33-56).
• Not predictive	• Not designed to be predictive, but explanatory. • CT can't be proved or falsified: it is a language; its epistemological (conceptual) value is beyond doubt and its value in prediction is dubious (Thom 1977b: 26, 32).
• Wrong: predictions contradicted by observations	• Acknowledges some cases of bad modelling (Casti labels Zeeman's choice of parameters and acceptance of unreal conclusions as flagrant examples). • The ECT baby should not be 'thrown out with the bathwater'.
• Empty generalities & vague analogies have inflated the catastrophe literature	• The necessary work of careful documentation and rigorous testing of explanatory models has begun (Clark 1986: 32).
• Inappropriate application especially in Social Sciences • Formally untestable	• A literature discusses & counters these assertions (Oliva & Capdevielle, 1980; Woodcock & Davis, 1978; Poston & Stewart, 1978; Stewart & Peregoy, 1983). • GEMCAT Model (see applications section) provides superior formal testing (Oliva,Desarbo,Day & Jedidi 1987: 121).
• A good model for physical process must be stable structurally (after Thom himself, 1977)	• Useful models can be structurally unstable (eg chaotic systems). • A generalised (non-elementary) Theory is required for unstable processes and Catastrophes.

(Based on Casti, 1994: 46-48. 80-84 except as otherwise indicated).

(BP 5.7: Applications of Elementary Catastrophe Theory (ECT)

Table 36: CM: Surprise: Classification by Severity

Surprise Type	Characteristics
Anomaly	Low grade, marginal puzzles, perception not altered.
Shock	Cause freeze or malfunction of system; extensive or intensive.
Epiphany	Revelatory, useful to understanding core dynamics; suddenly illuminates system trajectory & meaning.
Catastrophe	System destroyed before able to adapt.

(Based on Timmerman, 1986: 446, 449).

Table 37: CM: Surprise: Classification by Source

Type	Source
Erupt	Internal to system.
Irrupt	External to system.
Bypass	External (indifferent).
Interactive	Mutual interaction of system and its environment.

(Based on Timmerman 1986: 449).

Table 38: CM: Surprise: Classification by Type

Type	Examples
Unexpected Discrete Event	Rare but disastrous: Oil shocks, nuclear reactor accidents, political coups & revolutions, natural catastrophes.
Discontinuity in Long Term Trend	Accelerated oil imports (USA 1966-'73); OECD stagflation phenomenon 1970s, Decline energy consumption: GNP OECD since 1973; decreased net marginal benefits of technological processes surpass perception threshold.
Sudden Emergence of New Information	Into political consciousness: climate change, acid rain, genetic discoveries, mesothelioma in asbestos workers.

(Based on Brooks, 1986: 326-9).

Table 39: CMRRCE: A Mythology of Surprise

Equilibrium Myth & Social Role	Historic Notes	Description	Idealisation	Remedial Strategy	Religious Version
Historic Equilibrium Pre-Industrial Western **Stability Myth**	Newton, LaPlace (denied intrinsic unpredictability) Parallelled 'exit' of God	Equilibrium from God or Nature Diversity explained by Nature analogies Orderly	Perfect equilibrium Space & time absolute, homogeneous	More information resolves all questions Downplays instability Favours stability, control, idealisation	*[Great Chain of Being]*
Equilibrium **Controlled Equilibrium Myth** Modern Western **Myth of Ideal Historic Equilibrium**	From French & Scottish Enlightenments & Mandeville's satire underlying Adam Smith's Classical Economics Natural Law Theory Classical Economics	Microcosmic competition-macrocosmic order model Private vices (greed, fraud) promote public virtues (wealth, peacefulness, order) Intolerant of externalities and alternatives	Social myth Internal regulation, self-generation, self-sustaining "Invisible hand" System always at or approaching perfect stability Balanced economic order	Laissez faire Supply & demand converge on 'natural' price Concern with production elements: land, labour, resource availability	*[Individualism]*
Contra-Equilibrium Marxism **Crisis Myth**	Malthusian	Tendency towards crisis long term Crash against population limit	Marxist State Materialism	Revolution Power rearrangements Work for equilibrium	*[The 'People']*
Contra-Equilibrium Environmentalism **Crisis Myth**	Malthusian	Qualitative aspects are not externalities Market input resources are not simply & only that Limits to growth	Steady state economy Surprise avoidance Ecocentrism Universal connectedness Eco-social responsibility	Work for equilibrium Work with Nature Ecologically sustaining strategies Respect natural constraints; parsimony, preservation, local action Human scale integrity Equilibrium Economics	*[EcoSpirituality]*
Pseudo-Equilibrium **Progressive Equilibrium Myth**	Adam Smith + Progress Myth Malthus sidelined (irrelevant) Neo-Classical Economics	Unconstrained by God Market without natural prices Utilitarian, competitive Mechanisms irrelevant unless expressable in market	Infinite possibilities Short term pseudoequilibrium Long term prosperity Competition Darwinian evolution	Seek progress, push aside stability All phenomena interpreted as market issues Market determines scarcity/limits Competition	*[Individualism, growth, The Market]*
Stability (Equilibrium) **Myth of Stability** **Myth of Nature Benign** Caste/Bureaucratic	Neoclassical Economics Proponents now "New Classical"	Pebble in bowl (attractor basin); focus on bottom; nil external; displacements temporary; exit = catastrophic Monolithic, Nature thought resilient Survival theme	Keep pebble in (or theory & practice collapse) Nature is benign & reliable All Surprises are "Acts of God" Surprises are threats Time is homogeneous	Keep raising sides of bowl to infinity (more of same for Surprises) Damp oscillations to be predictable Manage Nature rationally Consistent & continuous control essential	Nature a cornucopia Heaven Self-contained, complete, timeless, Perfection Static eternity positive All-knowing, no Surprises Nature Romanticism

Equilibrium Myth & Social Role	Historic Notes	Description	Idealisation	Remedial Strategy	Religious Version
Instability (Anti-Equilibrium) **Myth of Instability** **Myth of Nature Malign** Alienated/lost individual		Round-bottom bowl inverted, pebble atop base, rolls off easily Complex catastrophic cascade from small event Obverse of stability Monolithic, fragile	All vulnerable Everything a threat	Paranoid management if any possible Absolute commitment to status quo	Demonic Hell Catastrophe Imperfection Static eternity negative No Surprises (all bad)
Cyclical Renewal of Equilibrium **Myth of Cyclical Renewal** **Myth of Nature Overall Benign**; regular local malignities	Myth of Stability + Pulsation/rhythm Indigenous Hermit Myth & reality decreasing congruence after cycles & spirals included Multiplication of short term dysequilibria	Broad perspective historical time First intro. of time scales Phase lengths relevant Short time frame may appear unstable Non-simple Seasonality predictable, oscillation size not	Undisturbed indigenous community Cyclic renewal Time is cyclic	Affirm long-term equilibrium only by mapping a complete cycle or viewing from external Distinguish true circle or spiral: noise issue from annual flux > incremental change Develop alternative mythical frameworks	Cyclical renewal in Nature
Multiple Equilibria **Myth of Multiple Stability** Secondary 'Nature is Capricious' after assumption of Stability causes Surprises Myth of Stability underlies	Conservative process seeking alternative myth + Myth of Stability underlying Keynes criticism of Neoclassical: Equilibrium may be too low for trickledown so make a new higher one Post-Keynesian Economics Hierarchy, caste systems Entrepreneur	<u>Landscape</u> metaphor: system moves across multi peaks & valleys Real time in economic theory All externalities are market factors All inputs infinitely substitutable All perturbations temporary Short & long terms indistinguishable	Justifies Government in marketplace Management myths: unlimited resources; interchangeability of species; focus on single species = adequate conservation Mechanisms, events,, commodities, long timescales all unimportant below a certain threshold (distressed ecosystem oscillation rate increases with flip-flops between extremes)	Kick-start economy to new higher equilibrium Persistent 'maximum sustainable yield policy': lock into short term equilibria as if consistent (and system crashes result) Retain Stability Myth in face of data 'Single most important' barrier to sustainable development (failure to shift Mythologies)	Wandering Nature 'natura naturata' Unpredictable Nature, needs controlling, sometimes unstable Expect some unpredictable Surprises of narrow context
Resilience **Myth of Resilience** **Myth of Discontinuity** **Myth of Punctuated Equilibrium** **Myth of Vulnerability of All Things** Heresy to Tenets of Equilibrium	Radical process seeking alternative Myth SJ Gould attack on equilibrium Darwinism _ punctuated equilibrium Catastrophism re massive extinctions _ norm is the anomaly Rational Expectations Theory (relates historic time + Surprises to market adequacy; people learn & anticipate for example inflation)	<u>Landscape metaphor</u>: system moves up & down peaks & valleys and topography also may move: all changing simultaneously Catastrophic evolution Considers uncertainty in market: savings keep decision-making power liquid Anticipatory behaviour, learning Qualitative language linking to quantitative Adaptive theme, courting Surprise	Economic Theory in historical time Time is heterogeneous Long term is important Anticipatory Evolution Catastrophism Systems self-organise Inherent creativity Learning, adapting systems Luck in sequences of events *[synchronicity?]*	Examine Surprises & noise potentially affecting market Focus on market avoidance by producers & consumers Account for internal + external structure plus unpredictable elements Welcome chance & diversity Importance of local	Nature naturing "natura naturans" Nature as a learning experience, pilgrimage Surprise-philic Revelatory Surprise (epiphany).

(Paraphrased from Timmerman 1986: 445-8); *Author*). **Link: Models & Mindscapes: Metaphor; Confluence: Structure: Metaphor.**

Figure 22: CM: Douglas Cultural Bias Analysis (Group/Grid Analysis)

	LOW GROUP		HIGH GROUP
HIGH GRID	***FATALIST*** ***Nature Capricious*** Society & Nature separate, Nature negative Ego-oriented action goals with unelaborated action system Action: routinised symbolic; derision for others' efforts Anti-Hierarchical **DISENFRANCHISED PUBLIC**		***CENTRALIST*** ***Nature Only Robust With Limits*** (but may be better with control) Society part of Nature, harmony valued Elaborated symbolic system Action: routinised symbolic with group-oriented action goals; concern & Responsibility Action type: planning & control (Kratocentric) Censorial & over-routinised Presently the 'rejected Other' **BUREAUCRAT**
		TRANSCENDENT WHOLIST ***Nature Resilient, Nature Epiphanic*** (The 'good society') 'Ideal' hierarchy that constrains without being censorial or over-structuring Find 'gimmicks' to help us appreciate all living beings and contemplate them without rivalry (Biocentric) *Action: love (Maturana); eclectic, ecological systems approach; align with Nature* ***STRUCTURAL COUPLER*** ***(NATURAL WISDOM)***	
LOW GRID	***CORNUCOPIAN EXPANSIONIST*** ***Nature Robust*** (there to be used, can look after itself) Pragmatic opportunist (Anthropocentric) Society & Nature separate and separation valued Personalised symbolic action Ego-oriented action goals and elaborated action system Action type: consume Nature Anti-hierarchical Presently the Dominant Paradigm **ENTREPRENEUR**		***CATASTROPHIST*** ***Nature Fragile*** Sect, activist, eco-centric position Society part of Nature; seen as risky and humans needing security in numbers to deal with dangers Personalised symbolic action Group-oriented goals of symbolic action Unelaborated symbolic system Action: reduce demands on Nature **SECTARIAN**

(Based on Douglas & Wildavsky 1982: 255-69: *"A Credible Biosphere"*;Ostrander 1982: 14: *"Distribution of Beliefs"*);*Author additions to* ***TRANSCENDENT***).

Comment: My experience with EPPs[3] would indicate a tendency to follow one or a mix of Contra-Equilibrium (environmental crisis): *Limits to Growth* group (Trainer, Meadows); Cyclical Renewal (Permaculture group, EcoSpiritual, First Nations romantics, intentional community, organic and biodynamic food producers, some Cohousing); Stability – Nature Benign (resource-focused Urban Ecology groups, some Cohousing groups); Resilience (traditionally Permaculture, some Urban Ecology, Cohousing, intentional community). Wholists: tend to seek 'Transcendent' paradigm .[§]

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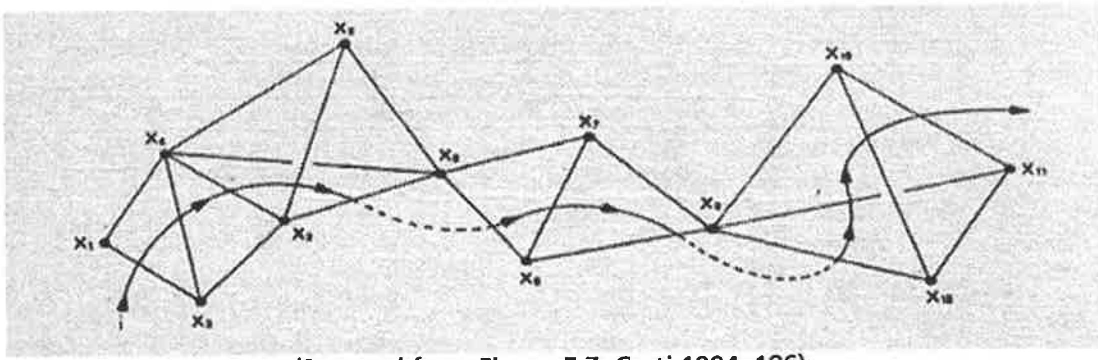
[3] This would make an interesting study in itself.

Figure 23: CM: Connective Structure for p-Surprises



(Scanned from Figure 5.7, Casti 1994: 186).

From Q-Analysis Theory:

- Points, lines and planes (here triangles) are called *'simplices'*; the group of all together is known as a *'simplicial complex'*.
- Four points determine a volume (three-dimensional) ; three points a triangle (two-dimension); two points a line (one dimension); one point zero dimension (vertices labelled $x_{1\text{-}12}$).
- The above diagram illustrates the 'Spider Web principle': chains of connection that link simplices indirectly. Two simplices may have no vertices in common at all, but may be connected by a chain of bridging simplices.
- The dimension of the chain is determined by the link of lowest dimension (dimension q), and is then said to be 'q-connected'.
- The most difficult step in q-Analysis is the initial choice of resolution, ensuring that the sets representing relations and scales are well-defined (Casti 1994: 175-93).

This concept relates to 'the weakest link' (in chains), and 'degrees of separation' (human contacts). While it has been developed for the purpose of <u>disconnecting q-chains</u>, there is no reason why the same approach may not be used for <u>connecting q-chains</u>, with the objective of allowing making things to happen.

2.2.8.4 SYNERGETICS & PHASE TRANSITION

CONTENTS

2.2.8.5 SELF-ORGANISATION

CONTENTS

2.2.8.6 TIME & CHANGE

CONTENTS

Table 40: CM: General Elements of Phase Change

	Event	Dynamics
Old Structure		Stable & unstable modes (collective motions) near instability point in system space.
Instability	Change of external parameters.	Unstable modes slave the stable ones (eliminated in effect).* Interplay between chance & necessity determines outcome.
New Structure	Remnant unstable modes become order parameters for macro system behaviour.	Emergent system characteristics determined by lesser components.

(Source Haken 1983: 351-3).
*Similar concept to 'the squeaky wheel gets the oil' or 'the bad apple'.

Table 41: RRCM: Phase Change Across Disciplines

His research produced the following examples:

- Lasers
- Superconductors } (Graham, Haken, DeGiorgio, Scully)
- Ferromagnets

- 'Flux equilibrium' in open & closed systems (von Bertalanffy)
- Computers
- Tunnel diodes (Landauer)
- Non-equilibrium chemical reactions (numerous authors)
- Chemical reactions producing spatial or temporal structures (Turing, Prigogine)
- Sociology (synergy in business, formation of public opinion, Sociobiology) (Buckley 1977;Welge 1977)
- Economics
- Ecology (Population Dynamics, evolutionary processes, morphogenesis)
- Physiology (Neurosynergetics) (Cowan 1977: 228).

(Haken 1983: 351-3).

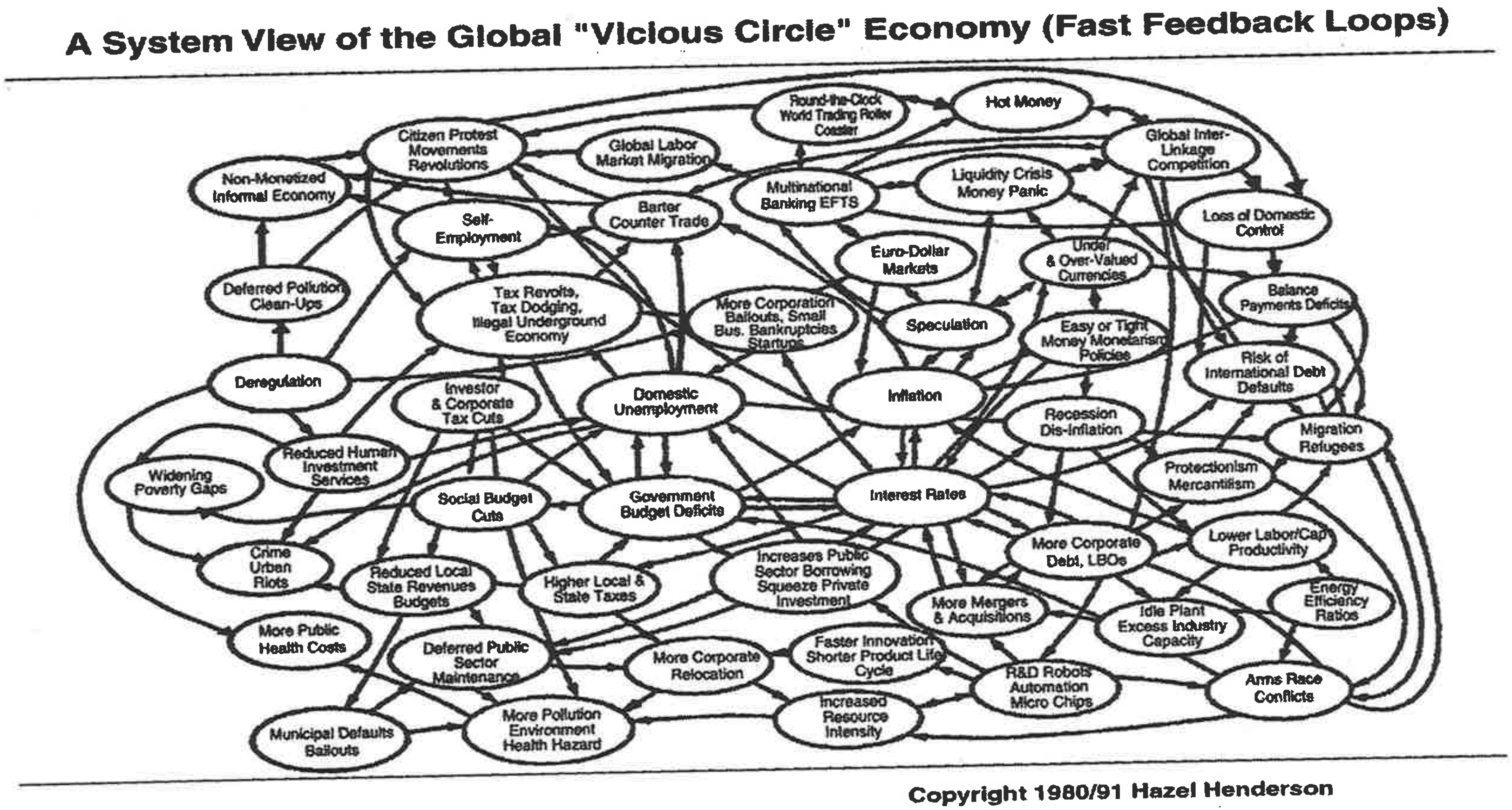
Table 42: RRCM: Self-Organisation in Nonlinear CDS

Discipline	System	Elements	Self- Organisation	Order Parameters
Quantum Physics	Laser	Atom (photon)	Phase transition	Form of light waves
Hydrodynamics	Fluids	Molecules	Phase transition	Form of fluids
Meterology	Weather	Molecules	Phase transition	Form of clouds
Geology	Lava	Molecules	Phase transition	Hexagonal form (Bénard cells)
Economics	Economic system	Consumers, producers	Market mechanisms for example supply & demand	Form of market (interactional form)
Biology	Biomolecules	Molecules	Phase transition	Structural form
	Organisms	Cells	Organic growth	Organic forms (plants, animals)
	Populations	Organisms	Evolution of populations	Form of populations (interactional form)
Sociology	Societies	Humans, institutions etc.	History	Interactional form
Neurology (Psychology)	Brain	Neurones	Recognition (learning)	Forms of neural cell assemblies representing internal & external ('self-referential') states
Artificial Intelligence (AI)	Neural-AI networks	AI neurons	Learning algorithms	Forms of AI, forms of neural cell assemblies.

(Reproduced from Mainzer 1993: 41).

Note: Transition concerns emergence of new system states.

Figure 24: CM: Henderson's 'Vicious Circle' Economy



(Source: Henderson 1991: 96).

Figure 25: BICM: Maruyama's 'Causal Loop' Model

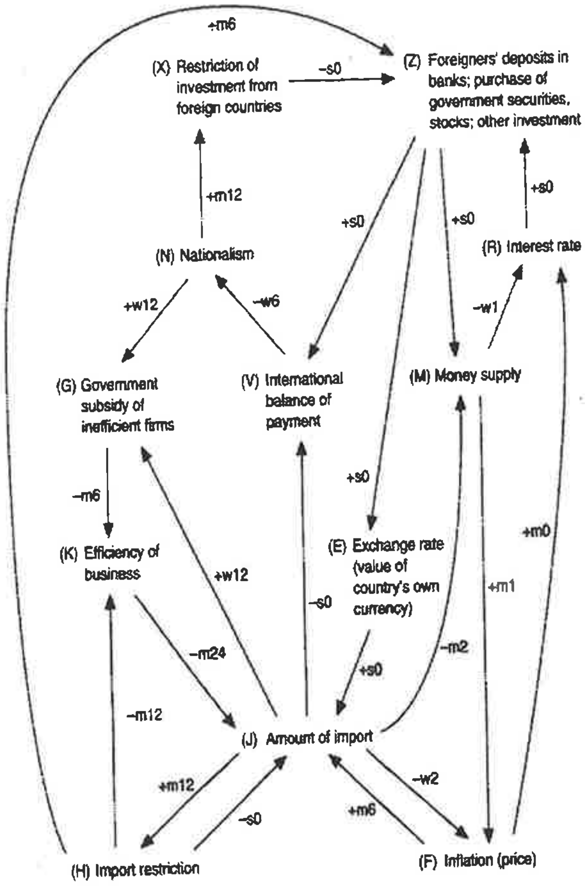
Unlike Henderson's 'Vicious Circle' schema, which seems designed to frighten people, Maruyama's diagrams here are analytical, on two different levels of complexity. Both are similar to Fuzzy Cognitive Maps in appearance. Maruyama also links the different styles of ascription of Cause to his 'Mindscapes', the 'H' type tending to discount Causal Loops and assume direct causation. He is also concerned that computers have taken us back to an old-fashioned input-output mentality, dismissing any Causal Loop thinking we may have been using before we became so dependent (Maruyama 1994: 78, 81). **Link: Criterion Community; Background Paper: Problem of Cause.**

The rules of association in these diagrams are similar to those of algebra. In particular, two negatives make a positive, which can cause both self-amplification (and 'runaway positive feedback'), and counter-intuitive Surprises. Another dangerous situation is the reversal of polarities if the delay in a loop is 180° out of phase with a loop oscillation, so that unexpected potentiation may occur. He gives the example of the four-year time delay in the presidential election cycle, which is potentially change-amplifying. In the economic example, s, m and w refer to strong, medium and weak respectively. The rules here are:

$m \times m = m$
$s \times m = s$
$w \times m = w$
$s \times w = m$.

These models have both quantitative and qualitative capability. Whereas change amplification and change counteraction are the chief quantitative aspects, generation of heterogeneity and interaction are the main qualitative attributes. Heterogeneity is the basis for evolution and the creation of new patterns, while interaction can create information in a way the random, isolated events do not (Maruyama 1994: 79-83). Maruyama then goes on to describe 'Scenario' work using Causal Loop models.

(Source: Maruyama 1994
: 77 [economic model]
:80 [environmental health model]).



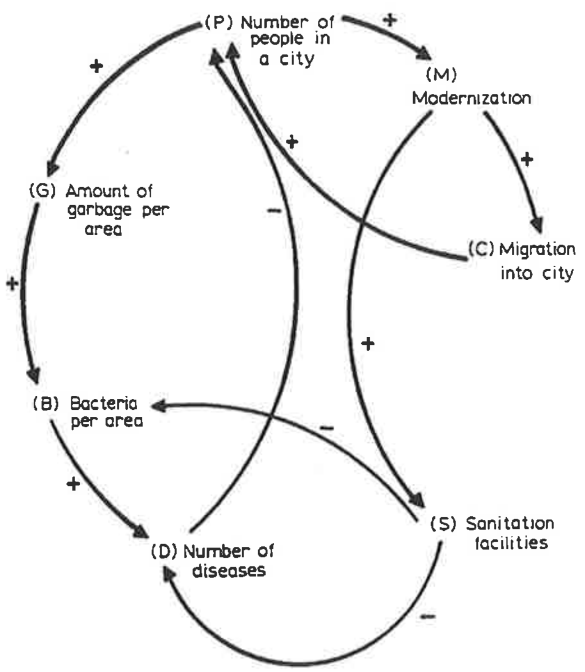
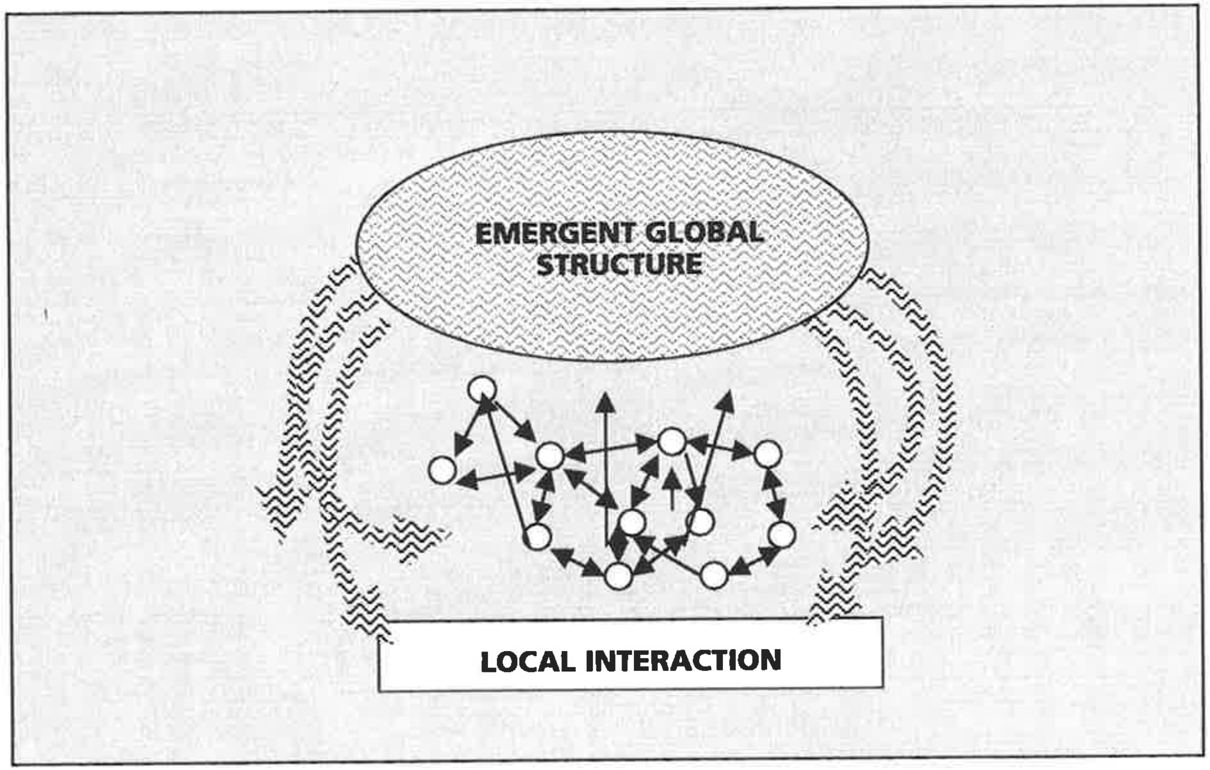


Figure 26: CM: Emergence in Complex Systems



Whole-system function differs from that of the system parts. Local interaction generates something of quite different identity and function at the next level up, which in turn, acts back on the lower level (balancing feedback), a reciprocal arrangement widely seen in self-organising systems. Nature is seen as a set of emergent systems embedded in other systems: a frequency hierarchical arrangement known as a :Constitutive Hierarchy'. Examples of emergence are ubiquitous, for example: rainbows, movement of a car, ecosystem function, software bugs, software function, culture, magic eye graphics, team spirit, health, peace, laughter.

Diagram based on Lewin 1993: 13 after Langton (Santa Fe Institute); O'Connor & McDermott1997: 6-9. **Link: A Theory of Scale: Hierarchy Theory.**

Table 43: CM:Evolution: General Paradigm after Costanza *et al*

	Biological Evolution	Cultural Evolution	Economic Evolution (Subset of Cultural)
Information Storage & Transmission	Genes	Culture: oral tradition, books, modern media (pass on behavioural norms)	Storage of ways to produce things and allocate products (Evolutionary Economics)
Generation of New Alternatives	Sexual recombination or genetic mutation	Innovation by individual members or groups	Generation of alternative ways for example re technical change, development of new institutions, evolution of means of payment (Evolutionary Game Theory).
Selection of Superior Alternatives by Some Performance Criteria	Reproductive success	Reproductive success of the alternatives generated (reproduction is by spread & copying of behaviour)	Functional success
Characteristics	Relatively slow, long term bias; multi-generation changes for significant specific character change in large animals; behaviour (now arguably) not transferred.	Potentially fast; short term bias; technical change the fastest & most important currently; immediate spread to other members of culture → increasing speed of adaptation (also allowing increasing resource appropriation: humans currently appropriate 25-40% total primary production); can employ foresight.	Fastest; can employ foresight.

Research Questions
Question: (Costanza *et al*: 551) what external influences are needed to get optimal economic evolutionary adaptation?
Challenge: apply models to get foresight; respond & manage system feedbacks to avoid unforeseen cliffs (Berker & Folke in press).
Challenge: devise policy instruments to translate this foresight into effective short run Evolutionary Dynamics.
Critical problem: define selection criteria (quantitative measure of fitness) .
Question: applicability of Far-From-Equilibrium Thermodynamic, dissipative structures to modelling Ecological Economics .
Reminder: Holling *Infinity Loop* model characterises stages of evolutionary spiral which partly overlaps the above. Patterns change over time.
(Source Costanza *et al.* 1993).

Link: Holling's Infinity Loop (below).

Table 44: CM: Evolution after Buckley

	Phylogenesis	Ontogenesis	Sociogenesis
Information Storage System	Genetic code	Neurophysiological code (learning) Information reservoir	Normative code (extra-somatic, ideas pool)
Mechanism	'Random' mutation	Plastic neural network probes environment with selective response Trial & error Structural change maps environmental character (morphogenesis) Feedback system codes information reservoir	Sociocultural 'templates' *[Similar concept to Social Parent Ego State elements in Transactional Analysis Script Theory or 'Memes' after Dawkins. 1982: 290].*
Generation of New Types	Mutation, genetic mixing	Trial & error Structural change maps environmental character Encoded feedback	Conscious, reasoned, organised foresight, group decision processes, new ideas
Transmission	Reproduction of individuals	Individual experience base *[déjà vu / jamais vu]*	Sociocultural, political, economic structures Socialisation process
Testing for Success	Darwinian process: phenotype vis à vis environment, natural selection	Indivdual *vis à vis* self and in relationship	Competition between ideas, roles, norms Persuasion Selection processes
Criterion for Success (Fitness)	Species survival Reproductive success	Individual survival	Perpetuation of a particular normative system structure
Advantages, Disadvantages	Wasteful & slow Vulnerable to rapid environmental change	Also wasteful Basis for higher level sociocultural	External storage makes information available to all units, transmission inter-generational Avoids need for personal experience Allows rapid restructuring
General Function	Guiding social & psychological development of young to maturity		Shaping patterned activities & interactions.

(After Buckley 1977: 248-57; *Author*).

Table 45: BICM: Developmental Stages of Human Society

Theorist	Pre 12-6000BP	12.000-5000BP	5000-1000BP	500-200BP	70-90BP	Present	Future
Henderson (some dates quoted from M.King Hubbert)	Hunter-gatherer, nomadic, tribal Material world competence Matri-focal (Great Earth Mother)	Storage technologies Agricultural Age Augment & accumulate naturally-occurring energy Domestication of animals 6000BP Late Stone Age	5000BP Rise of patriarchies & nation states, rise of Egypt, Bronze Age begins 3000BP Iron Age begins 2500 Greek civilisation peak 1700BP Fall Roman Empire 1000BP Solar Age emerging	500BP Renaissance beginning, Fossil Fuel Age dawning 300BP Onset of Enlightenment, Industrialism, Petroleum Age 200BP Industrial Age starts, Enlightenment		Information Age: Overload, extension of Competitive Paradigm & industrial ideals into new Technology Solar Age accelerating	Age of Light: repatterning of Solar Age Wholistic Paradigm Prioritising gentle action, light, surprise, right-brain East-West synthesis Re-membering, re-wholing, Cooperative Paradigm Biomimetics, natural resources, bio-integration, respect for living systems, advanced Optics, Nano-technology,
Boyden	Phase 1 The primeval (pre-domestic, hunter-gatherer) phase. By far the longest.	Phase 2 The early (subsistence) farming phase. Began about 12,000 years ago in some regions of the world.	Phase 3 The early urban phase. Started about 5000 years ago in Mesopotamia, soon after in China & India.	Phase 4 The modern, technological phase. Began with the industrial transition, starting in Europe and North America about 170 years ago. Still taking place in many parts of the world.			
Fuzzy 'Ages' (social psychology, anthropology, communi-tarian)	Bands (circles)		Triangles			→Circles	Circles
Toffler		First Wave (Agriculture)		Second Wave (Industrialism)		Third Wave (globalised Information Technologies)	

Theorist	Pre 12-6000BP	12.000-5000BP	5000-1000BP	500-200BP	70-90BP	Present	Future
Anderson Major 'régime changes'				With 30 years' Napoleonic wars & revolution to 1815 First business cycles Industrialised Capitalism First over-capitalisation possible	Great Depression (1914-44 [1920-35]) Relative democracy: intervention for economic benefit of whole populace Economically fluxless, virulent	1980s. Most dominant economies in severe inflation Response to reduce & create real interest rates Global response to oil shock (resource restriction). Large vote swings for economic security	
White & Whitney	Pre-modern quasi-sustainable: effective hinterland, spare potential, located near resources, natural barriers, local carrying capacity			Colonial-Industrial Revolution – unsustainable Appropriation of carrying capacity from secondary settlements & colonies, unequal trade, net flow capital & resources to MDCs, wastes to LDCs (MDC capture of carrying capacity from LDCs who cannot repeat or escape) Fossil fuel & transport based			Sustainable Cities of the future User pays, heal damage, global planning & management Re-focus on local self-sufficiency
Capra				Descartes, Newton, Mechanistic Paradigm Yang dominating (aggressive, expansive, demanding) Rational knowledge	Circa 1900, 1920: Physics crisis Relativity, subatomic phenomena ←Scientific Age→	Present: ecological crisis, wholistic Systems paradigm, whole planet Decline of patriarchy, fossil fuels, materialism	Cultural rebirth Yin emerging (contractive, conservative, responsive) Wu wei (activity in harmony with Nature) Intuitive wisdom (synthetic)
Lovins			Material scarcity invites trade	Industrial Capitalism, dealing in human, financial & manufactured Capital at expense of Natural Capital		Information Age (passing very rapidly) Natural Capitalism →	Natural Capitalism (dealing in natural resources & ecosystem services) + Financial Capital Constructed Capital, Social Capital. Age of <u>Biology</u>.

(Based on Anderson 1988: 270-3;Boyden 1990: 8-22;Capra 1982: xvii-34;Hawken,Lovins & Lovins 1999: 1-21;Henderson 1979: 5, 54-5;Henderson 1991: 136-45, 261-72;Toffler 1970;1980;White & Whitney 1992: 9-22, Fuzzy of Fuzzies Farm-interviews 1993).

2.2.8.7 FAR-FROM-EQUILIBRIUM SYSTEMS

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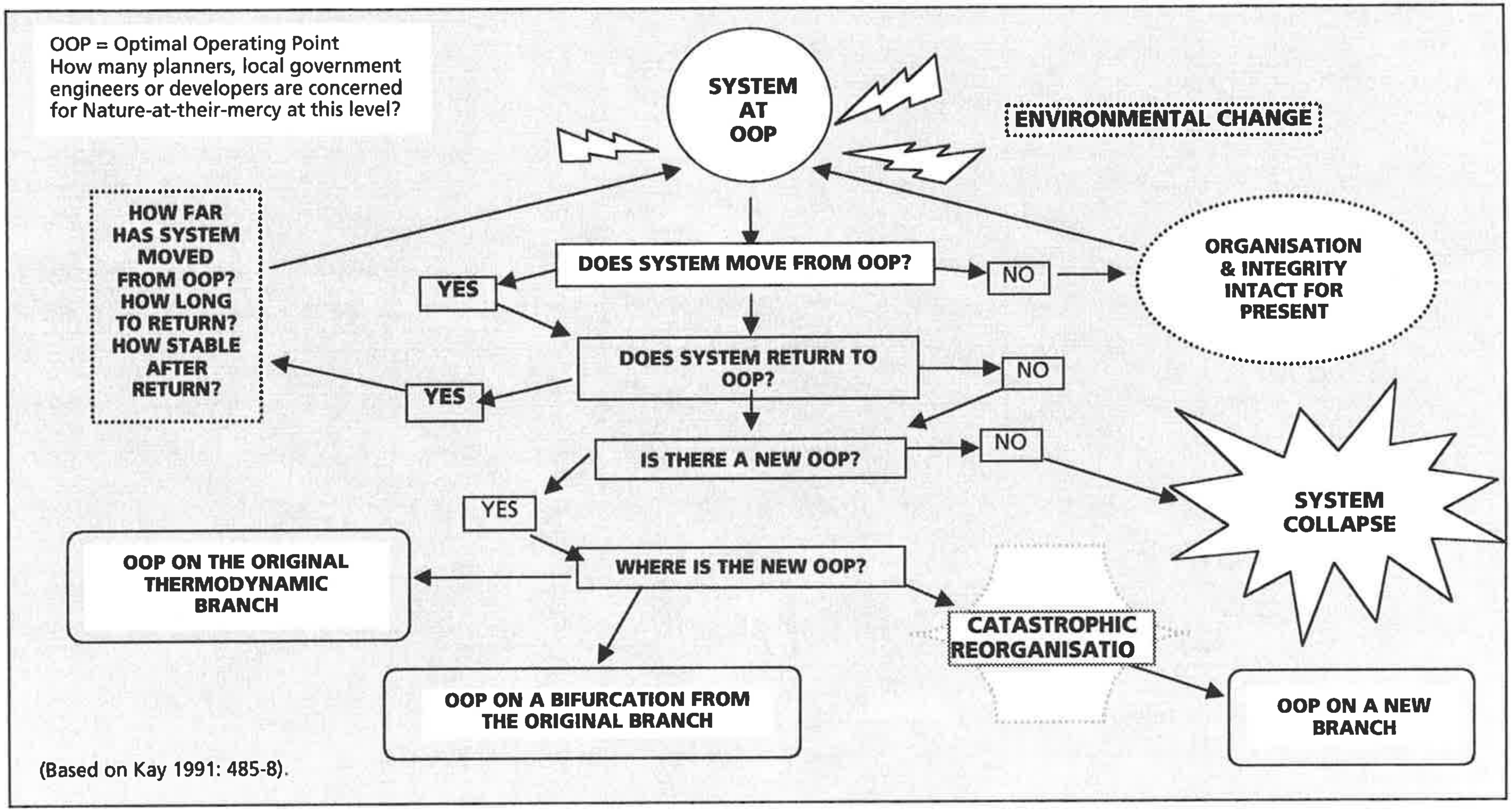
2.2.8.8 HOLLING'S INFINITY LOOP

CONTENTS

Figure 27: CM: System Responses to Environmental Change



(Based on Kay 1991: 485-8).

Table 46: CM: Kay's Cases: Stability & Equilibrium

Cases	Movement from OOP	Change / Time to Regenerate	Future Stability	Examples Cited
No Movement from OOP	Within system's adapted repertoire.	Temporary.	Modest intensity perturbation.	Temporary flood or drought in adapted system.
	No immediate impact.	System not adapted.	Affects ability to regenerate in future.	Fenitrothion for spruce budworm (North America).
Moves from OOP but Returns		Short term. Ten years. 20 years.		• Fire in temperate forest. • Oil spills. • Prairie shortgrass in drought.
Permanent Shift from OOP	Collapse of system.	Permanently uninhabitable. No regeneration. Complex system lost; possibly some life forms.		• Desertification. • Drought in mangroves. • Pollutant precipitation into lake (Sudbury, Canada).
	Remains on original branch but lower dissipative function.	Shift to old field community (pre forest). Shift to lower productivity & biomass. Reversion to earlier stage development.	Not noted. Loss of forest character. Recovery unlikely.	• Secondary effluent sprayed on pine forests. • Acid rain on maple forests. • Frost damage to S. English coastline.
	Bifurcation to new thermodynamic path branch of original.	Mix & match energy path & components or new structures. New level of operation (Variations on original theme).	May never return to original if stressor removed. Unlikely to return to original.	• Warm water stress from power station on marsh gut ecosystem Florida; radical changes in food web & productivity. • Exotics/ferals. *[urban development]*
	System bifurcation to completely new path by catastrophic reorganisation.	New system different from original.	No possibility of return to original (Kay unable to find example).	• Acid rain to Lake. • Clearfelling rainforest with soil erosion. • Spruce forest burn on thin soil. • Savannah to woody vegetation from cattle grazing. *[urban development]*

(Based on Kay 1991: 483-95).

Table 47: BIRR: Ecological Stability: Definitions, Studies & Themes

Characteristic/Definition	Author	Explanation/ Findings
APPROACHES TO DEFINITION		
Well behaved mathematically (Lyapunov stability)	Lewontin (1969) Harte & Levy (1975)	*[Mathematical ideal]*
Stability of species population	Usher & Wiliamson (1974) Granero-Porati et al (1982) & others Authors of contra view	Strength of tendency for population/set of pops. to come to equilibrium point or limit cycle. Ability of population system to counteract disturbance.
Biomass of species (stable)	Hirata & Fukao (1977)	Total biomass if stable , allows for population flux.
Stability of niche		Stability of a species' function.
Function of entire ecosystem	Bormann & Likens (1979)	*[Wholistic view]*
Stability of foodweb	Rutledge et al (1976) Ulanowicz (1979, 1980, 1986)	*[Resource/needs based view]*
Stability of macro-environment (external)		Measure by temperature flux, humidity flux, humidity flux. Unsatisfactory since may be unstable in well-behaved system.
Stability of microenvironment		*[Indicator for context in balance; includes artificial]*
BROADENED DEFINITIONS & CONCEPTS		
Ability to bounce back	Preston (1969)	If no species become extinct/ over a time period (no spare niches). If no plague populations (no destruction of others' niches/ no extinction of other species).
Low sensitivity to perturbation System persistence over time Ability to re-equilibrate after perturbation	Rutledge (1974)	
• Thermodynamics: patterns of energy flow via food webs • Relationship to physical environment constraints • Community structure is moulded through inter- & intra-population biotic interactions	May (1974)	Effects on species distribution & community organisation
Discard the term 'stability': uses too disparate	Margalef (1975)	
Ecosystem health with state variables within a specified range	Wu (1974)	*[Optimal Operating Ranges]*
Keep term & restrict meaning to Lyapunov stability	Kay (1991) this paper	"Well-behaved" systems have stability and other characteristics.

(Based on Kay 1991; 491-4)

Table 48: BIRR: Well-Behaved Systems

Factor	Author	Definition	Comment	Measurement
Resilience	Holling (1973) for budworm outbreaks in forests	Minimum disturbance required to shift system to new attractor.	Resilient systems usually not stable & vice versa. *[Important point supporting Sustainable Agriculture & Forestry, & urban indigenous plantings]*	Disturbance measures.
Resilience *[Becoming]*	Holling (1986): 296-7	Resilience: ability of system to maintain its structure & behaviour patterns in the face of disturbance.	Emphasises domain, boundary, far from equilibrium events, high variability, adaptation to change.	Strength of repulsive forces at boundary; resistance of domain to contraction.
Stability (Classical) *[Being]*	Holling (1986): 296-7	Classical equilibrium-centred definition of stability: Resists departure & returns quickly to equilibrium state Propensity of system to attain or retain an equilibrium condition of steady state or stable oscillation.	Emphasises low variability, absorption of change, resistance to change.	Size of stability domain *[Indicates probable orthogonal relations with resilience]*
Resilience	Pimm (1984) Patten (1975) Webster, Waide & Patten (1975)	Speed of return to equilibrium following perturbation.	Holling (1986): 297}. In Holling's opinion concerns only one facet of stability, unrelated to crucial qualitative distinctions.	Characteristic return time.
No-Oscillation Stability Stability Resilience	Hill 1975	Stabillity of state variables in absence of stress. Stability of state variables under stress & post-stress damping time.	Building on Holling.	
Stress Recovery Characteristics: Ecosystem Vulnerability Elasticity Inertia Resiliency	Cairns & Dickson (1977) in stream ecosystems	Inability to resist irreversible damage. Ability to recover to approx originial steady state after structure/function displacement. Ability to resist displacement of structure/function. Ability to snap back after disturbance.	Irreversible damage : timescale = a human lifetime.	Size of disturbance necessary for irreversible damage. Rate of recovery after perturbation. Size of disturbance needed to displace system. No. of times system will revert after disturbance.

Factor	Author	Definition	Comment	Measurement
Stability Factors (from Species Interactions, Disturbance History & Selection Pressure): Constancy Persistence Inertia Elasticity Amplitude (Includes Cyclical & Trajectory Stabilities)	Orians (1975)	 Of a system parameter. Survival time of system as a whole. Resistance to external perturbations. Rate of system return to former state after disturbed. Area of stability.		
Types of Stability: Local Stability Large Perturbation Stability Resilience Structural Stability Persistence	De Angelis et al (1989) for food webs & nutrients	 Tendency to recover after small disturbance. Possible flip to new equilibrium point on large perturbation. Rate of recovery after disturbed. Whether small incremental disturbance can cause catastrophe. System boundedness over time.	Questions existence of true stability or steady states.	

(Based on Kay, 1991: 493-4, Holling, 1986: 296-7); *Author*).

Table 49: CMES: Positions on Equilibrium & Environmental Management

View	Description	Methodological Strategies	Assumptions, Policy	Consequential Design Approach
Equilibrium Bowl & Gravity Model of Stability	Temporal Constancy Spatial Homogeneity Linear Causation	Equilibrium Theories Empirical Measures of Constancy: Focus on Equilibrium or Near Equilibrium Averaging (Smoothing) of Temporal Variation & Spatial Graininess	*[Equilibrium Myth]* Assumption of benign nature Recovery from mistakes (any scale) & perturbations assured by removal of disturbance Long quiescent period indicates time to adapt without intervention (eg in climate change) Can average out spatial graininess which is relatively small	Large homogeneous economic developments which act on but are not affected by biophysical systems Absence of size penalties Benefits of increasing scale *[Modern monocultures]*
Multiple equilibria Nature resilient (hills & valleys landscape; system flipped by internal or external events)	More than one stable state Instability maintains system resilience Nonlinear causation	Focus on spatial heterogeneity, variability Catastrophe Theory Qualitative ecological determination of stable regions & boundaries	*[Resilience Myth]* Slow changes over long quiescent period predict inevitable sharp discontinuity Small scale events often cascade upwards Nature resilient: • landscape maintained by variability itself • knowledge insufficient to control	Nature resilient: • retain viability and seek economic & social benefits • design in natural & artificial recovery mechanisms • only then allow variables to exceed flexible limits • examples in approach to pollution, env. Hazards, water resources, pest management Nature engineered: • engineering for safety • health standards • nuclear safeguards

View	Description	Methodological Strategies	Assumptions, Policy	Consequential Design Approach
Nature evolving	'allowing' approach	Endothermic animals maintain body temperature near lethal threshold	*[Evolution Myth]* Advantage from internal controls/ homeostasis Organisation into functional subsystems embedded in larger systems (eg food webs, trophic relations) Structural constraint from environmental variability Expect organisational evolution	Internal control increases range of options Self-regulation (homeostasis) Self-organisation Open to organisational change to benefit from embedding in larger ecological or social system *[Both/and 'Quantum' system after Zohar]*
Nature engineered	Constraining approach (engineering)	Constraint of natural variability by monoculture	*[Machine Myth]* Nature engineered: • landscape fixed or • knowledge can fix landscape Keep well away from dangerous thresholds	Monoculture Causes self-simplification through loss of competitive, genetic & behavioural processes; parametric shifts; increases ecosystem fragility & perturbation sensitivity; fitness landscape changes; shrinkage of stability domains; demographic homogeneity Severe surprise risk Ever-increasing vigilance & cost.

(Source Holling 1986: 294-6; *Author's modifications*).

Modern market-driven food production encourages the producer to seek the apparent predictability of an Equilibrium or Engineering mindset. Even EPPs get caught up in this.[§] But the Surprised cries and demands for government compensation after extreme climatic events and discovery of salinity (inter alia) are commonplace. Most EPPs would opt for a combination of Multiple Equilibria and Evolutionary approaches, making concessions to engineering in the form of appropriate technology in the service of human health and ecological restoration.[¥§] **Link: Criterion Ecocycles**.

HOLLING'S INFINITY LOOP

Table 50: CM: Holling's Infinity Loop Model Elements

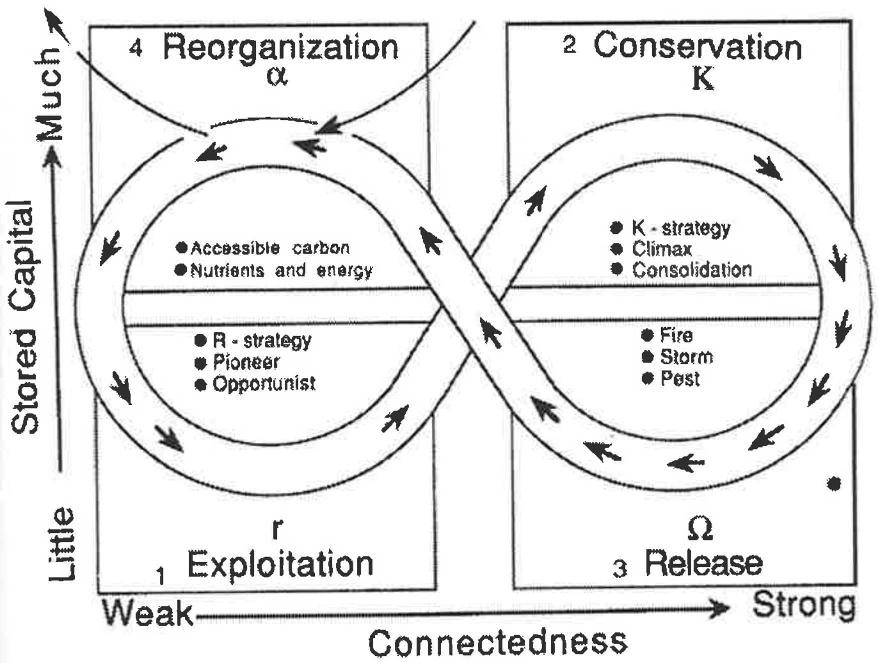
Functions	Ecological	Economic	Organisational	Social	Psychological	Stored Capital/ Connectedness/ Organisation
Exploitation	r-strategists*, early succession in disturbed sites, pioneer species, opportunists.	Entrepreneurs, opportunists, innovation, markets risk takers.	Innovation, market participation.	Pioneers colonising new territories.	Sensation *[Perception]* *[Pastiming, Games[4], social scanning]*	Little/ weak/ low
Conservation	K-strategists*, mature ecosystems, consolidation.	Consolidation, Monopolism, Dominance Hierarchy, saturation, social rigidity.	Large, rigid bureaucracies. *[castes, class systems]*	*[Established colony, community]*	Thinking *[Reflection]* *[Pair bonding, settling down, relationship]*	Much/ strong/ high
Release 'Creative Destruction'	Fire storms, pests, senescence.	*[Market crash, recession]* Structural adjustment, restructuring. *[Economic Rationalist fund-slashing]*	Structural change. Institutional redesign.	Political upheavals.	Intuition *[Catharsis]* *[Divorce]*	Little/ strong/ high
Reorganisation (Renewal)	Accessible carbon, nutrients, energy (new pathways, sources).	Abundant natural resources, invention, (new combinations/ recombination).	(Establishment of new structure).	(New system establishment).	Feeling *[Integration]* *[Grieving process, healing, letting go]*	Much/ weak/ low

Key:
r-strategist: (maximising returns without constraint) high reproductive potential, short life, high dispersal, small size, resistant to extremes.
K-strategist: (efficiency of food harvest in crowded environments) lower reproductive potential, longer life, lower dispersal rates, larger size, effective competitive strategies, occupy stable habitats.

(Sources: Costanza et al, 1993: 552, after Holling, 1987, 1992; Holling, 1986: 298, Holling 1987; *Author*).

[4] Terms from Transactional Analysis. Two of the six Time Structures.

Figure 28: CM: Holling's 'Infinity Loop' Model



HOLLING'S 'INFINITY LOOP

Diagram captures several aspects of Holling's concept of ecosystem function (summarised below and next Figure – Holling's 'Lumpy Landscape').

- Flow speed (small arrows)
- Capital accumulation in key variables (carbon, nutrients)(Y-axis)
- Connectedness among variables (X-axis)
- Likely devolution / evolution point (Reorganisation segment)
- Pattern of discontinuous cycling between order & chaos.
- Relationship between these states, life cycle & reproductive strategy.
- Shows one spacetime-specific level of a nested hierarchy of such cycles.

The Release phase results from chaotic system behaviour triggered by overconnection ('tight organisation') of the system in the previous conservative phase. This makes the system increasingly vulnerable to natural disturbance such as fire, predation, pests, disease, climatic events, human impacts or evolutionary changes

(Reproduced from Holling, 1995: 22).

The value of Hollings' (and a number of others') work in extensive comparative field studies, is, *inter alia*, that it proposes a model that adequately explains observed ecosystem events and provides an alternative to the previous Clementsian orthodoxy, replacing linear succession with successional cycles. These behave as classical multistable FFE systems with a number of potential dynamic stability regions triggered by different sized impacts. The phase outcome can be thought of as a balance between two main drivers (development and disturbance) which changes with phase (Forman, 1986: 275; Holling, 1995: 20-23).

These processes manifest locally in characteristic ways. Human development processes are superimposed, usually as a destructive perturbation, depleting resilience, fragmenting the natural connections.

Table 51: BIRRCM: Key Variables & Speeds in Managed Ecosystems

System	Fast Variable	Intermediate Variable	Slow Variable
Forest insect	Insect, needles	Foliage, crown	Trees
Forest fire	Intensity	Fuel	Trees
Savanna	Annual grasses	Perennial grasses	Shrubs
Aquatic	Phytoplankton	Zooplankton	Fish

(Transcribed from Holling, 1995: 27).

Key references: McNamee et al 1981; Holling 1991; Holling 1980; Walker et al 1969; Steele 1985.

Note: Urban Development is a managed ecosystem also. **Link: Criterion Feedbacks: Table: Constraining Variables.**

Link: Criterion Feedbacks: Constraining Variables.

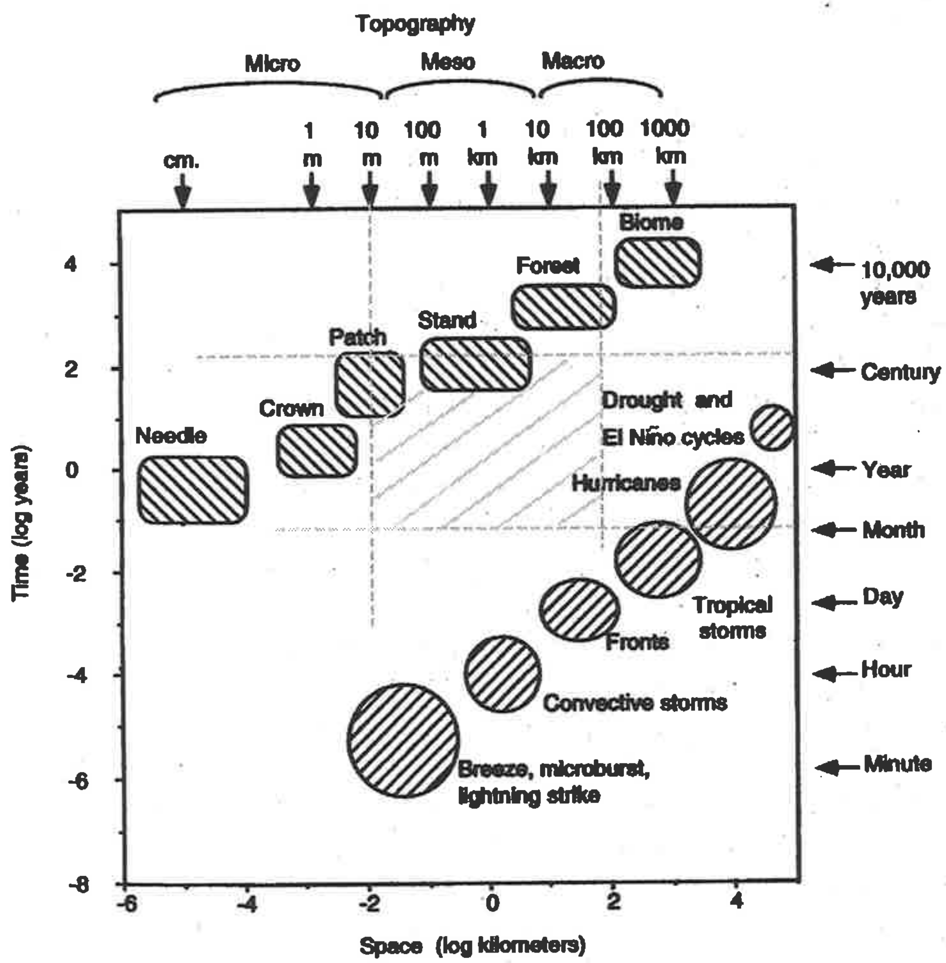
Figure 29: CM: Holling's 'Lumpy' Landscape

LANDSCAPE ORGANISING PRINCIPLES

Holling has found small numbers of recursive 'structuring processes' (major system Attractors) that entrain all the other variables, forming a "lumpy" Backcloth for faster processes ('Traffics'). This forms nested hierarchies of cycling systems and typical spacetime signatures for different levels, according to frequency of turnover, which appear as patches on a spacetime diagram.

So for ecosystems we have in turn, bacteria (thus soil), thus vegetation and so, animal community structure. The model connects Life Cycle & Hierarchy Theories, and also applies to social and economic systems.

System outcome results from the balance between development (matter & energy accumulation, restructuring) & disturbance (natural & human impacts, creative destruction), and a variable-rate cycling, hovering between order and chaos - at each nested level.



Urban development process zone indicated approximately by pale grey stripes.

SPACE/TIME HIERARCHY

Each ecosystem element occupies a characteristic spacetime zone, creating 'lumpy' geometry, landscape and temporality.

In the boreal forest example (left), the nested hierarchy runs: pine needle - crown - patch - stand - forest - biome; time runs from minutes to thousands of years.

The disturbing climatic influences run from breeze to El Niño, while the slower Backcloth moulder, geomorphology is relatively unmoving, so is only present indirectly, and is not mapped at this scale range (minutes to 10,000 years; cm -1000km).

Figure reproduced from Holling, 1995: 23.

This type of diagram is useful in visualising some of the very long timeframes we need to come to terms with if we are to walk the talk of sustainability.

Table 52: CM: Infinity Loop Collaborations

Collaboration Type	Planning-Led Collaborations	Vision-Led Networks	Learning-Led Networks
Examples	Task-forces Roundtables Committees	Single visionaries & their supporters	Social movements Scientific consortia Community forums
Tendency to Crystallise Over Time into Formal Organisations	✓	✓	✓
Vulnerability	Issue definition Avoid premature closure Avoid alienation of important stakeholders	Exhaustion from demands for time & money resources Burnout common Uninterested in institutional structures (even those required to resource vision)	Crucial to secure enough resources to survive Avoid compromise of principles through need to piggy-back on other entities
Best Management Strategies by Loop Phase	Consolidation	Renewal/Exploitation	Reorganisation

(Based on Westley 1995: 420-7).

2.2.9 *HIERARCHY & SCALE*

CONTENTS

Table 53: CM: Inter-Level Principles: Relative Frequency

Characteristics	Whole turns over slower than parts. Whole is larger than parts. Apparently directional behaviours may be cyclic over time; apparently non-dynamic behaviours may be very large scale (eg geological time). Concept of 'biological inventory' for organisms: evidence of conditions during evolution & selective pressures, from time to exhaust, eg humans need vitamins *B* & C daily, suggests they had daily access to vitamins *B* & C during evolutionary development. Levels of organisation related to frequency of return time (higher level = lower frequency). Big, slow events termed 'large scale' (cf Cartography, which reverses terms large & small scale).
Ecology Literature Examples	Breathing, water ingestion, eating; short inventory of readily available resources (eg air, fast cycle ± 16/min, 3 minute inventory; water cycle in hours, inventory several days; food cycle 4-6 hours, inventory several weeks). Many nutrients cycle annually; upper level biosphere nutrient accumulation cycles over centuries & millennia. Dissipation rates for ozone depleting substances up to 500 years; radioactive isotopes: ±500,000. Definition of return time critical when working with ecosystems.
Social & Human Examples	Human evolution in context of high vitamin C availability thus body lost ability to manufacture when stressed, no body stores, inventory one day. *Similarly with Vitamin B (1 day) and essential amino acids (1 protein meal: there being no storage system for essential amino acids, vegetarians must combine protein foods at each meal or protein elements will go to energy production not structure building/repair).* *Hydrocarbon plastic bags designed for short social cycle time (single use) have persistent qualities for strength, thus long cycle time menace at higher level; new technology potato starch bags (MFP-Australia project) have strength but much lower scale persistence: shorter life cycle.* Problems balancing pesticide effectiveness (lower level) with persistence (higher level: wide scale, causing long lasting pollution).

(Based on Allen & Hoekstra 1992: 30-31; *Author*).

(BP 5.8: Representation of Space & Time Using Geographical Information Systems (GIS))

Table 54: CM: Inter-Level Principles: Context

Characteristics	Whole is context of parts; context either occupies larger space or longer time constant, usually both. May be change based and critical constancy related. 'Always happens' quality. Relative stability allows anticipatory behaviour in biota. Survival of entities which fit the context.
Ecology Literature Examples	Plants anticipate new unmanifested season by germinating. Weeds rely on constant habitat disturbance. Many animals & birds anticipate warmer conditions & food availability by preparing nests for breeding in spring. Many plants anticipate fire by woody seeds & fire release.
Social & Human Examples	*Synchronicity is multi-focal lower level response to change in upper level constraint conditions.* *Long and short economic cycles influence wide range of human behaviours & decisions at local levels.* *National economic difficulties must be seen in global economic context: need to work with upper level: Policy & Constraints: global scale in a global system for collective National protection; otherwise dangerous to participate in larger scale system.* *Personal frame of reference - Script - (slow to change) governs/filters/constrains moment-to-moment behaviours.*

(Based on Allen & Hoekstra 1992: 31; *Author*).

Table 55: RRCM: Management of Systems Far From Equilibrium (The Context Replacement Issue)

	System Conditions	Management Issues	Economic Issues
Key principles	(1) FFE SYSTEMS NEED A HIERARCHICAL MANAGEMENT SYSTEM, WITH THE MANAGER OPERATING AS CONTEXT	(2) AN EFFECTIVE MANAGEMENT RÉGIME ATTRACTS MAXIMUM SUBSIDY FOR MANAGEMENT EFFORT FROM THE MANAGED UNIT (MU) (Hypothesis in progress)	Maximum natural energy contribution; minimum artificial subsidy.
'Home Truths'	FFE system arrangements enable 'deferral' of entropy. This is enabled by hierarchical structuring of systems: lower levels are held FFE by upper. Humans fragment & displace primæval equilibria. Fragmented ecosystems degrade because they have lost their context. Local extinction is normal; having no sources for repopulation (forests, bushland etc.) is not.	Management must be for FFE, and understand itself as context (upper level). Context *[Backcloth]* for the system must be viable. You must work with underlying processes, ie external management, not forcing abnormal behaviour on internal systems. A damaged system can not be successfully managed as if pristine. All managed systems involve humans. You can't have pristine goals for managed ecosystems (other OOPs are available). Sustainable goals will do. Seek gentle, subtle processes, eg repopulate edges & allow natural spread rather than shifting large populations about.	It is a bad idea to start with a prescribed output goal. Fighting natural processes costs a lot and diverts resources. Fighting epidemics & plagues [eg grasshoppers] holds a system in its destructive phase, costs a lot and destroys the environment.
Implications	(a) **Recognise manner in which context is missing.** (b) Identify the services the context would have provided. (c) Subsidise the MU as best possible.		Subsidies may include infusions of genetic diversity (breeding programmes); provision of adequate territory; bringing in resources that would have been sought in larger ranges; *[microclimate or climate: water, soil characteristics]*[5].

Signs of Good Management:	Signs of Bad Management
Free function without resource deprivation. **MU behaves as if context there (eg breeding, producing max biomass, *healthy*).** **Homeostasis: maintains system health in presence of constant inputs and constant leakage *[sustainable Ecocycling would maximise input-output linkages]*.**	MU needs increasing inputs for dysfunctional internal workings. Need for zoos and seed banks. Native vegetation stripped/ over-consumed. Poor population numbers or health.

(Source: Allen & Hoekstra 1992: 274-81). MU = Management Unit; OOP = Optimal Operating Point.

[5] Note conflict between parsimony of energy input and taking on climatic context. The principles are the same, but climate is a very expensive context to replace, hence the wisdom of using indigenous plants, animals and associations. This is becoming increasingly important in Australian cities as the cost mounts of water and other context replacements for exotics.

Figure 30: CMCE: Scaling in Ecological Research

HIERARCHICAL SYSTEM DESCRIPTION IN ECOLOGICAL RESEARCH

In order to scientifically describe a complex hierarchical system, the first task is to differentiate scales on a basis of relative frequencies, and arrange it with the slower entities above, grading to the fastest below. This defines the fundamental relative disconnection, the asymmetry, the inherent *systemic rate structure*. N+x affects N, but in normal circumstances, N does not affect N+x, except by being there. If there is functionally no slower upper level, as, for example, with technological assemblies, or random assortments, then while aggregated into a hierarchy, further analysis would be meaningless (O'Neill *et al.* 1986: 93-100, 87). *[I would disagree with this on Complementarity grounds]*.

In complex activities that involve a number of different Criteria, and especially where these are represented by different disciplines, the scales of resolution of the system of interest should be agreed on, and information should be collected <u>at those scales</u> (including N+1 and N-1). O'Neill provides a succinct summary of a workshop on his approach to inter-disciplinary (ecological-geophysical) collaboration, using Hierarchy Theory for research into global change (O'Neill 1988).

Table 57: Scales & Global Change: Practical Considerations in Cross-disciplinary Research (below) demonstrates how frequency thinking works in practice, and links back to previously presented theory. If the Scale, the Criteria and the diagonal connections are checked in turn against each other, variations will be found between Criteria, in Scale ranges, in Connectivity and in robustness to transformation in relationship to a particular problem. *[With experience, patterns of relatedness will be noticed. Such patterns once noticed, can be exploited in design]*. **Link: Figure 60: JVNIC Theme Report.**

Frequency is best identified through the frequency of patterns of perturbation, constraints or limiting factors. For instance seasonality is obvious, but longer cycles are recognised, such as 100-year or 50-year floods, fire régimes or whole-of-life considerations (note also Holling Infinity Loop). The point is to develop an appreciation for such variations, not to seek control, but to see them as *limiting factors. [And an inspiration for appropriate design for resilience in human settlement applications]*.

Many low level limiting factors influence a system in their homeostatic roles, but only become high level constraints in critical ranges. If too many limiting factors are defined, prediction is impossible because there is rapid switching from one limit to another as resource levels vary relative to one another (a deterministic chaotic situation). A higher level ('deeper'), slower constraint system with a smaller number of limiting factors should then be sought, which is reliable and relatively stable (a limit cycle situation). <u>If</u> such reliable constraints can be found, the system behaviour will be predictable <u>so long as those constraints hold</u> (Allen & Hoekstra 1992: 63-4). Some clues may be found from identifying local patterns of Competition and Mutualism.

In ecosystems, Community represents the relationships of accommodation between different species. Community Ecology may offer insights into human community issues such as differences between inter- and intra-specific competition. This web of relationships forms a constraining context for species related by Mutualism, which is only partly expressed by the competitive inter-species predator-prey systems (studied by Population Ecology methods). These rely on stably alternating internal Constraints (operating as a limit cycle) as well as a degree of Community Constraint. This appears to be analogous to the difference between the 'market' of all behaviours and relationships and the specific 'predator-prey' or symbiont mutuality between vendor and customer in human society, where money is a surrogate for survival for both parties. In Nature and society, the Community Constraints modulate the more extreme possibilities potentially present under Competition: the winner is prevented from taking all and the loser is able to survive. In Nature (where losers die, as in war) the loser's occupation of the landscape at a larger scale is thought to explain its persistence in the face of domination by the winner (Allen & Hoekstra 1992: 232-7).

Within a given level, where rates are more or less the same, the symmetric holonic relationships are sought; Allen & Hoekstra use the concepts of *'fields of influence'* and *'interference field'* (**Links: HST, Criterion Biotics**) to illustrate this (Allen & Hoekstra 1992: 290-2, 62). In this case, N^a has reciprocal effect on N^b, and structure may be sought in the relative strength of interaction or connectedness. Holons have higher internal rates of exchange, with a rate change at the surface (a tangible surface if robust to observation), so that inter-holon exchange is minimal. **Link: Table: Nested vs Non-Nested Hierarchies**.

If one needed Mathematics, that of q-Analysis is designed to describe the structure and valence (number of aspects shared by whom) of such relations. The 'tightness' of these connections (as in co-evolution) and the functional redundancy in the system are the subject of an extensive literature in Ecology (including food web stability from hierarchically organised subsystems), and similar literatures without this theoretical basis in the Social Sciences (multivariate approaches).

(Based on Kirk 1990: 201-232;O'Neill *et al.* 1986: 125-58; *Author*).

Table 56: BICM: Inter-Disciplinary Research Integration

Appropriate Choice of Scale	Do not force data inappropriately: choose the scale(s) that give best resolution for the specific problem. Do not expect fine data to explain coarser scale phenomena.
Cross-disciplinary Integration	For coherence, match scale of state variables across disciplines.
Global-Local Relationship	Higher levels normally constrain lower or define boundary conditions. Constraints change or disappear when system perturbed (replaced by other constraints).
Local-Global Relationship	Level –1 determines system dynamics (mechanism). Levels <-1 is usually too fine scale to be influential. When system is unstable, constraints at L+1 disappear or change, levels <-1 become dramatically and unpredictably relevant. Influence of lower levels on higher is termed *'the aggregation problem'*.
Research Challenge	Need a research plan. Approaches need to be innovative, fresh from old assumptions and synthetic methods. Likely to involve large scale equipment such as Geographical Information Systems, remote sensing. Catastrophes may be predicted by using recovery rates as indicators of instability leading to bifurcation points.

(Based on O'Neill 1988: 37, 42-4: key points).

ALTERNATING FUNCTIONAL HIERARCHIES

O'Neill *et al* suggest an alternating hierarchy of Constraints to which they refer as 'functional' (such as limits to water or nutrients) and 'biotic' (relationships between component organisms such as Competition) (O'Neill *et al.* 1986: 197-200). Thus when (say) an extra nutrient source is added to the system, a (rate-dependent) resource Constraint is removed, a positive feedback system pertains until the next higher level Constraint is encountered, which can be predicted to be rate-independent, relationship or purpose-based. This can be expected to be a biotic competitive constraint. Such a pattern would need to be confirmed in urban research. As Allen & Hoekstra say, prediction in ecological systems is most reliable when an entity is 'up against its Constraints'. Conversely, in design, not just the designed entity but also a Constraint (positive or negative feedback) system, should be designed or at least understood in terms of Constraints extant. Human global population issues may be interpreted through this framework.

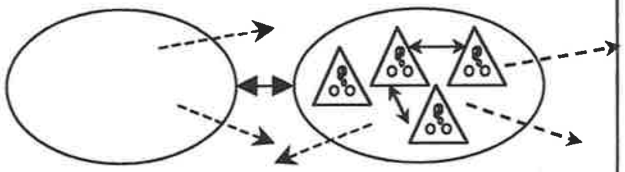
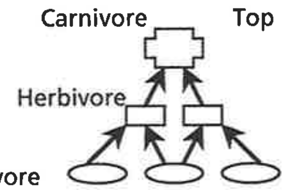
Table 57: BICM: Scales & Global Change in Cross-Disciplinary Research

Effect of a Higher Level on a Lower	• Constraint of lower by higher scales • Upper level appears constant (relativity); L_0 constrained by L+1 • Prediction about lower level without L_0 data is possible if constraints are known (eg phosphorus loading indicates productivity in nutrient-limited lake system) • Some situations benefit from analysis of levels >+1.
Predicting the Higher Level from the Lower	• Tendency to ascending error ('the aggregation problem')*[Divergent]* • Sometimes summation of lower levels gives upper values (eg biomass quantities)*[Convergent}* • Most available information is small scale • L_0 components provide dynamics of L+1 (easy to see relationship) • Some situations benefit from more extensive analysis of levels <L-1 (eg biochemistry of micro-organism activity or when catastrophic global change is the issue) • 3 reasons for addressing problem of aggregation: *need to use fine scale data *want insights from fine scales *fine scales can impact during system perturbation by disrupting constraint system to trigger catastrophic change: may be able to predict unstable conditions by looking at fine behaviour.
Interactive State Variables	• Having selected scales, focus on Criteria for different disciplines • Scale is useful only if <u>state variables shared</u> across disciplinary models **Link: Criterion Landscape: cross-disciplinary Landscape mapping**.
Seek Coherent Levels	• Level of resolution is not arbitrary • Coherent levels have more clarity than other levels and have greater predictive power • Take advantage of inherent system structure • Often correspond to scope of existing disciplines (can take advantage of knowledge) • Interactive state variables (the region where space and time scales interface interactively) define the coherent level; where spatial distributions mismatch, the smaller model may need frequency distribution calculations across a region taking heterogeneity (such as seasonal biotic & temperature fluxes) and any other spatial correlations into account; ie need to match spatials in a coherent way also.
Critical Points in Parameter Space	• Delays inherent in measuring very large scale may be significant (eg 20 years), thus normal states difficult to measure • Key interest (for global change) is in bifurcation points ('critical points'[6] causing instability to perturbation) • Bifurcation activity may arise from upper level climate change or perturbations (environment change) or normal Complex Dynamic System processes from lower levels (through overcoming constraints in a constant environment)*[The technology problem]* • Approaching bifurcation is indicated when fast variables become unstable to minor perturbation (recovery rates slower indicates diminished response to slower, higher level constraints) • Example could be slowed succession rate as cleared forest % increases (indicated by rainfall or moisture changes, onset of erosion cycles) *[Note parallels in mental illness]* • The aggregation problem still applies.

(Source: O'Neill 1988 : 32-42; *Author*).

[6] <u>Holdridge classification</u> system identifies *critical points* in temperature & moisture conditions where vegetation types suddenly change dramatically (similar concept to *Goyder's Line* in SA which defines extent of potential wheat growing area) (O'Neill 1988: 40-41). Examples (climate interactive over very long timescales): annual temp. for permafrost, moisture levels for forest/grassland/desert differentiations.

Table 58: CM: Nested vs Non-Nested Hierarchies

	Nested	Non-nested
Definition	Apical holon <u>contains & physically made up of</u> lower holons. A <u>fuzzy definition (not necessarily sharply defined).</u>	Higher holons <u>do not physically contain</u> lower. Higher holons <u>not composed of aggregate</u> lower.
Characteristics	Whole = sum of parts except in sense of Complementarity (difference between dynamic & linguistic).	Whole clearly more than sum of parts. Whole unpredictable from parts.
General Criteria of Hierarchy Met by Both Types	Higher holons have slower behaviour. Higher holons larger (if they occupy space). Higher holons constrain behaviour of lower. Connections intra-holon stronger than inter-holon.	
Emergence (Very Resolution Sensitive)	Applies. Difficulty of detection may be related to inability to make complete observations: related to linguistic aspects.	More easily detected. *[Emergence: Constitutive Hierarchy]*
Relation to Scientific Investigation	<u>Same structural principles</u> across all levels; <u>organising principles differ with level.</u> Supports Reductionism which may suppress subtle self-organisation characteristics (eg energy approach of Odum, or conservation principles in modelling).	<u>Same organising principles</u> across levels; <u>structures vary</u> Scientific studies see Holons as quasi-dependent units. Choice of measurement made, context inescapably <u>linguistic</u>, & defines form of the hierarchy (creates an initial condition).
Conceptual Differences	Models explain 'how'.	Models explain 'why'.
Complementarity	Laws of Nature pertain inexorably, universally, intangible, not structure-dependent. Rules are scale-specific, local, arbitrary, depend on physical structure or constraint *(institutions in human case)* for implementation. *Both lenses apply at all levels, including 'Community Cascade' spectrum.* ***Link: Criterion Community.***	
Theoretical Distinctions	Special case rather than the quintessential hierarchy. Physical boundaries robust to transformation.	Includes command structures (military, church). Most common type.
Examples	Taxonomic units. Structural relationships (spatial). Landscapes. Individuals in Populations. Organism-organ-tissue-cell (physical structure). Military structural diagram. Bond strength maximum <u>within</u> holon boundary relative to external relations. 	Ecosystems (Rate-based). Dominance Hierarchies. Food Webs (eat & be eaten) (Frequency Hierarchy web). Constitutive Hierarchy: Food 'Chain'. 

(Based on: Allen & Hoekstra 1992: 31-4;Allen & Starr 1982: 38-45).

Table 59: CM: Inter-Level Principles: Bond Strength

Characteristics	Connections within entity stronger than across surface. Separating surfaces at lower level are part of bonding at upper level. The higher the level the weaker the bond strength.
Ecology Literature Examples	Break chemical bonds in fire or explosion releases much less energy than breaking atomic bonds. Holonic integrity appears to rely on maintenance of variables within an optimal range of connectedness (See Connectivity). Population/resource pressure from diminishing food supply creates over-connected condition → food resource variable speeds up (drops down the hierarchy) → value nearer to that of population holon; connectivity tighter, bond strength increases → major system shifts to adjust connectedness and thus stability of the holon. This may involve temporary flocking, equivalent to setting up a collective task force holon for mutual benefit, with the task of efficiency in resource-finding. Further scarcity may result in a more extreme version: every individual for itself, pecking order, alienation & death of weakest. See section on Connectivity (Allen & Starr 1988: 206-7. *[This is a highly simplified presentation of an exposition of much more complex theory.]*
Social & Human Examples	*Breaking acquaintanceship bonds releases much less emotional energy then breaking family or couple bonds.* *Cohesion as a group can happen at many scales; marriage, family, neighbourhood, city, nation etc. Such groups have the potential to behave holonically, and would be described by Adams as 'Survival Vehicles'.* *Disturbances at self concept level (challenge to integrity) create more active response than perturbations in areas of non-interest (lower interaction frequency).* *Overcrowding & unemployment in cities (overconnection to resource base) results in people switching off from each other (adjustment to overconnection) eg competitive, meanness to minorities, indifference to victims of violence, shoving behaviour in transit.*

(Based on Allen & Hoekstra 1992: 29; *Author*).

Table 60: CM: Inter-Level Principles: Constraint

Characteristics	Upper level constrains are at lower frequency; filter passively by frequency difference. Contexts are relatively unresponsive. Scale of constraint = time frame of the constrained. Predictability relies on finding a description of reliable constraint patterns. Unpredictable systems have been described without identifying reliable constraints. Science is about adept description & finding helpful constraints. 'Limiting factors' = the static, reductionist equivalent of wholistic 'constraint'. Limiting factors supersede each other & are context for each other. Breaking constraint allows system change. Where there is system change, look for changes in constraint.
Ecology Literature Examples	Regular, 'always' return pattern of river constrains sand dune build-up. Population size prediction is only possible if a constraining critical factor appears eg silicon availability to lake diatoms. Constraint switches in spruce budworm outbreaks, from bird constraint to epidemic uncontrolled worm population growth rate (positive feedback system), to food limitation as trees die. Neolithic revolution due to global (upper level) structural change (rate & population density- related constraint changes); city & agriculture emerged due to overconnected condition of humans + new rule system; varied local histories re order of appearance of husbandry, cultivation, permanence, seed bins, modern cultivars (Allen 1977;Allen & Ilitis 1980;Allen & Starr 1982: 227-236).
Social & Human Examples	*Individual scale: 'Do nothing' strategy for avoiding responsibility (Life Script constrains free behaviour).* *Individual scale (psychotherapy = therapeutic replacement of pathological constraints): Transformative learning (education through working with change in personal frame of reference); reframing (Neuro-Linguistic Programming psychotherapy for personal problem solving); redefining: Transactional Analysis therapeutic strategy for neurosis or psychosis: personal 'hangups' = personal constraints.* *Social scale: 'NIMBY' community constraint.* *Reliance on a 'reasonable public' for balance against Police excesses in democracies.* *'Economies of scale' (diminish constraint by going upscale) & 'diminishing returns' (explanation of upper level contextual limitation).* *Long & short economic cycles, constrain individual behaviour.* Technology 'solves' natural constraints resulting in perturbations at higher scales through dissemination of by-products (eg pollution, climate change: spatial) or persistence (time).

(Based on Allen & Hoekstra 1992: 33-9; *Author*; others as noted).

Table 61: ESCM: Social Implications of Six Emerging (Post-Cartesian) Principles

Interconnectedness	Planetary cooperation of human societies, living systems policy models
Redistribution	Justice, equity, balance, reciprocity, sharing
Change	Redesign of institutions, perfecting means of production, changing paradigms and values
Complementarity	Unity and diversity, from 'either/or' to 'both/and' logics
Heterarchy	Distributed networks and intelligence, no rigid organizations or hierarchies
Indeterminacy	Many models, viewpoints, compromise, humility, openness, evolution, 'learning societies'.

(Transcribed from Henderson, 1991: 66: Copyright 1991).

Henderson, now a 'public intellectual', has been a broadly integrative elder EPP since the 1970s, from her disciplinary base in what is now called 'Ecological Economics', although she despises all brands of Economics, arguing in her *"Politics of the Solar Age: Alternatives to Economics"* and *"Paradigms in Progress: Life Beyond Economics"* for a 'Cosmic Economics' based in the Age of Light: a shift from 'Economism' to Systems Theory (Henderson 1979;Henderson 1991: 90-1). Similarly, Ormerod argues for the end of Economics in *"The Death of Economics"*, reinterpreting the Science of Economies and Society through Complexity Theory (Ormerod 1994). **Links: Figures: 16 Analysis of Nonlinearity, 17 Limit Cycles in Economic Systems; 24 Vicious Circle Economy & text references.**

(BP 5.9: The NLP Meta-Model)

Table 62: BIRRCM: Scale Definitions of Prominent Sociologists

Author	Scale: Macro	Scale: Micro	Criterion: Macro	Criterion: Micro
(Blau 1987;Haferkamp 1987: 177-192)	Populations (numerical)	Individuals (numerical)	Population	Organism
(Alexander,Giesen,Munch & Smelser 1987: 289-318)	Large social units (continuum)	Small social units (continuum)	Community (defined scale)	Community (defined scale)
(Wippler & Lindenberg 1987: 135-152, 237-9)	Individual actions with societal scope (eg value systems)	Individual Actions with limited scope (banal)	Community: institution	Organism
(Collins 1987: 193-206;Luhmann 1987: 112-131)	Repeated experiences of large numbers of persons in time and space (event patterns)	Interaction (specific encounters & exchanges)	Population (aggregate or emergent)	Community: individual scale relationship
(Wippler & Lindenberg 1987: 135-152)	Constructed from behaviour and statements of individuals (whole = sum of parts)	Empirical indicators of observable units (individuals)	Organism x Community: culture	Organism
(Wippler & Lindenberg 1987: 135-152, 358)	Statements & laws about larger-scale social processes	Psychological propositions (generating macro)	Community: (laws change by scale)	Organism
(Schegloff 1987: 207-229)	Social structures at a range of scales; personal attributes relevant to higher, including "medium" level (gender, race, organisation etc. - deterministic)	Individual interpersonal transactions	Community: culture or Community: ideology or Community: institutions (structure similar to Transactional Analysis Parent Hierarchy)	Organism x Community: relationship
(Schegloff 1987: 218-220)	Modes of interactional organisation: context	Interpersonal transactions	Community: relationship	Organism x Community: relationship
(Blau 1987: 71-85)	Structure of different positions in a population & their constraints on interaction	Social processes that engender relations among individuals	Community: institutions (role-driven determinism)	Community: relationship (programmed individual) – Determinism.

(Based on Alexander *et al* 1987).

2.2.10 UNIFIED ECOLOGY

2.2.10.1 INTRODUCTION

CONTENTS

(Tool 3.1: Use of Matrices)

Table 63: CE: Vocations x Scale

\ Criteria Scale \	Laws (Natural) Elucidation Invariant Patterns & Law-Seeking Science	Rules Application Scale-Related Conditioning Constraints	Technical Applications & Vocations: Applications in the Area of Health
Energy	Particle Physics; Quantum Mechanics Thermodynamics	Health & Safety Law (Radioactive Substances) Local Energy Budgets	Ultrasonics, Infrared, Xray, Laser Investigations & Therapies; Electron Microscopy; Nuclear Medicine; Acupuncture, Homeopathy
Atomic/ Molecular	Atomic Physics; Molecular Physics; Chemistry	Therapeutic Goods Law; Pollution Laws & Regulations Possibility Theory	Orthomolecular Medicine; Endocrinology; Nutrition; Pharmaceutics, Toxicology
Cell	Cellular Physiology; Evolution	Patent Law (Genetic Material); Genetic & Cellular Law Rights of the Unborn Child Physiological Training Effects & Adaptations	Fertility Regulation (Barrier Methods, Artificial Insemination); Genetics; Genetic Engineering Cell Therapies, Blood Transfusion; Toxicology, Pathology
Organ	Organ Physiology; Individual Psychology, Psychiatry Neurology	Transplant Law Medical Consent Laws Functional Conditions, Substrates & Adaptations	Nutrition; Internal & Specialist Medicine, Orthodox General Practice Medicine, Orthodox Psychiatry, Pathology; Anatomy, Embryology; Ego Psychology, Psychotherapy; Tissue Transplants;
Individual	Psychotherapy Schools; Preventive Health Sciences	Criminal Law, Abortion Law, Inheritance Law; Individual Rights; Euthanasia Law; Medical, Psychological, Legal Ethics Life Scripts Indoor Life Conditions Nutrition, Lifestyle	Individual Psycho-Therapy, Personal Growth Movement; Therapeutic Massage; Orthodox, Traditional, Wholistic,Nutritional, Third Line & Naturopathic Medicine Voluntary Euthanasia Surgery Clinical Ecology

\ Criteria Scale \	Laws (Natural) Elucidation Invariant Patterns & Law-Seeking Science	Rules Application Scale-Related Conditioning Constraints	Technical Applications & Vocations: Applications in the Area of Health
Family/ Social Group	Anthropology, Sociology	Family Law; Counselling Requirements Rights Of The Child Local Mores, Organisational Scripting	Family Medicine; Group Therapy; Family Therapy; Social Services, Public Housing (Eugenics)
Community	Anthropology, Ethnology, Sociology;	Local Government Regulations; Occupational Health & Safety Law Toxic Sites Law; Community Rights Community Mores Microclimate Nutrition, Work Ethic, Lifestyle	Social Psychiatry, Transpersonal Psychology; Epidemiology; Community, Workplace & Public Health; Healthy Cities Programme Implementation Community Consultation Local Agenda 21 Non Government Organisations & CBOs
Nation	Politics; Economics; Metaphysics Health Research	National Policy; Federal Law Party Political System; Economic Policy National/Cultural Mores, Cosmology, Scripting Health Regulations	National Health System Agenda 21 EPA
Planet	Planetary Ecology Complexity Sciences Macro Economics International Health & Environmental Sciences	International Law; Human Rights; WHO Standards; UN Treaties Military Constraints Climate Food Supply Global Governance System	Who Healthy Cities Programme; OECD Ecological Cities Project Diplomatic Services

Figure 31: BI: Ekistics Grid

Ekistic grid index

The articles in this issue are coded by the scale of settlements and an aspect of an element indicated in the ekistic grid.

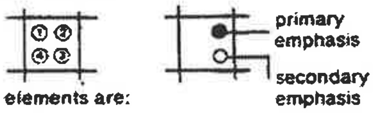
The content of each article is classified within an ekistic grid as follows:

- The scale of the settlement(s) with which the article deals is selected from among the 15 ekistic units:

Anthropos	1
Room	2
House	5
Housegroup	40
Small neighborhood	250
Neighborhood	1,500
Small polis	10,000
Polis	75,000
Small metropolis	500,000
Metropolis	4 million
Small megalopolis	25 million
Megalopolis	150 million
Small eperopolis	1,000 million
Eperopolis	7,500 million
Ecumenopolis	50,000 million

- The subjects dealt with in this article are selected from among the subheads of the five ekistic elements. The position of a dot in any square of the grid indicates which of the four subheads is being referred to. If the article arrives at a synthesis of these elements, either in a physical plan or in ekistic theory, the dot is at the top or bottom of the square.

key to placement of subheads



The subheads of the elements are:

NATURE
1. Environmental analysis
2. Resource utilization
3. Land use, landscape
4. Recreation areas

ANTHROPOS
1. Physiological needs
2. Safety, security
3. Affection, belonging, esteem
4. Self-realization, knowledge, esthetics

SOCIETY
1. Public administration, participation and law
2. Social relations, population trends, cultural patterns
3. Urban systems and urban change
4. Economics

SHELLS
1. Housing
2. Service facilities: hospitals, fire stations, etc.
3. Shops, offices, factories
4. Cultural and educational units

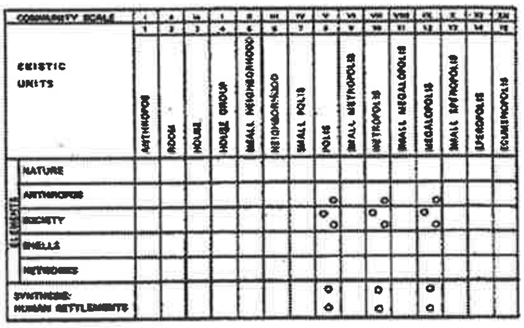
NETWORKS
1. Public utility systems: water, power, sewerage
2. Transportation systems: road, rail, air
3. Personal and mass communication systems
4. Computer and information technology

SYNTHESIS HUMAN SETTLEMENTS
1. Physical planning
2. Ekistic theory

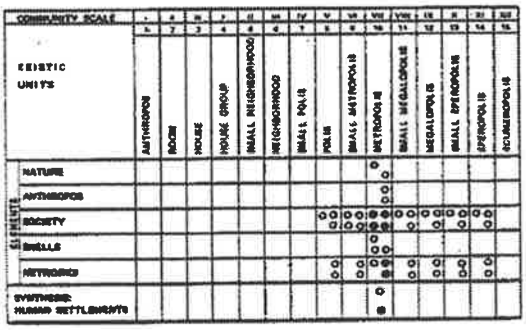
Each article is described by key words, which are also used in the Ekistic Index, and by abbreviations referring to their illustrative content.

Key word letter code

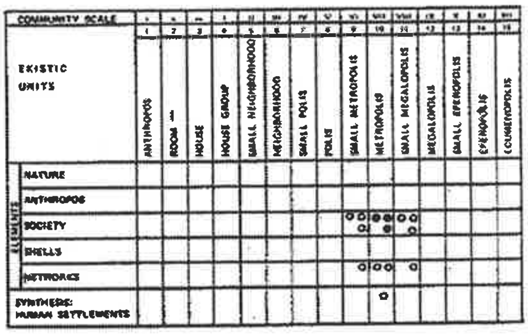
D = diagrams
I = illustrations
M = maps
R = references
S = statistical tables and or graphs
X = simulation and mathematical models, etc.



The editor's page p. 3
Politics, Urban and Regional Planning, Ekistics General; Past, present, future.



Political problems of urban growth p. 4
Urbanization, Politics, Urban Networks, Research America, Asia, Europe; Past, present and future

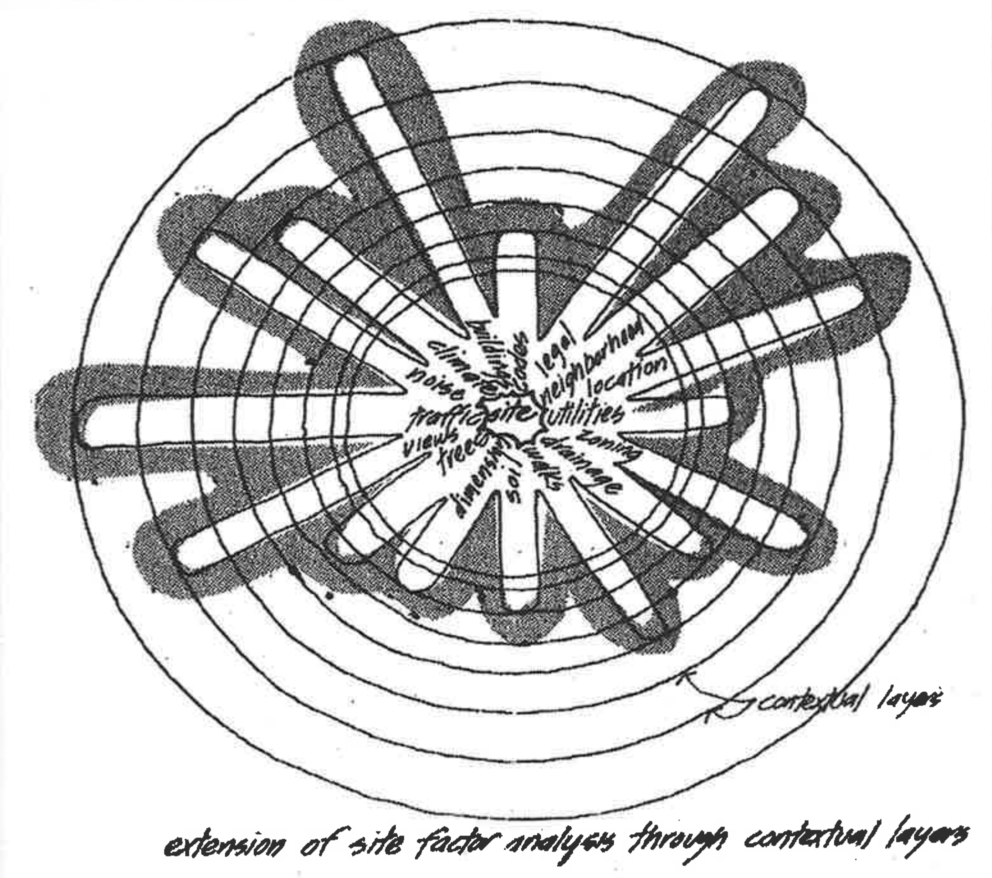


Administrative and political issues p. 11
Politics, Administration, History, Urban and Regional Planning
Paris, Ile de France; 1789 to present M,R

(Source: <u>*Ekistics*</u> 1990, v57: 116).

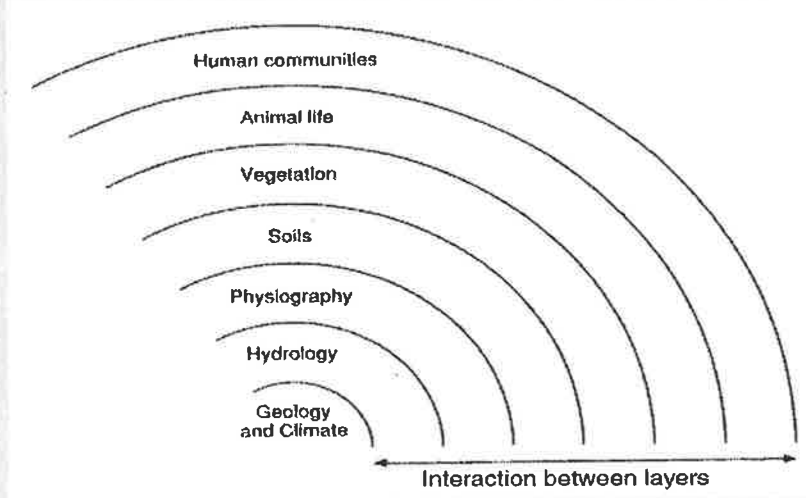
Figure 32: BI: Contextual Models

CONTEXTUAL ANALYSIS (WHITE)



((Source: Scanned from White 1983: 14).

YEANG'S *'HORIZONTAL LAYERCAKE'* (AFTER McHARG)



White's analysis emphasises the spatial (but not exclusively). Yeang's 'ecological' analysis uses the standard 'levels of organisation' from Ecology, which are treated as if they were layered spatially. **Link: Hierarchy Theory: Rate Based Hierarchies.**
Yeang particularly emphasises the connectivity between elements.

(Source: scanned from Yeang 1995: 92).

Table 64: BI: Rowe's Criteria

Point of View	What?	How?	Where?	When?	Who?	Why?	Scope
Form: External	Morph-ology						
Form: Internal	Ana-tomy						
Function: Internal		Physiology "skin-in": in-quire, in-vestigate					Reductionist question: how does it work?
Function: External		Ecology "skin-out": find out, ex-plore, ex-plain, ex-amine				Wholistic Ecology affirms; Complementary "supportive though nebulous ideas"; Subjective concepts of "community", "ecosystem", "biosphere"	Biological Ecology (orthodox Ecology): organisms in resource habitats ("Resourcism", anthropocentric; "community + environment") Wholistic Ecology (more recent but still academically unpopular): hierarchical, embedded element, wholistic question: what is its function? (In larger system)
Interactions: Space			Chorology				
Interactions: Time				Chronology			
Systematics (Relatedness)					Taxonomy		
Purpose						Not asked by Ecology but implied in the outlook	

(Based on Rowe, 1961: 147).
Link: Criterion Population.

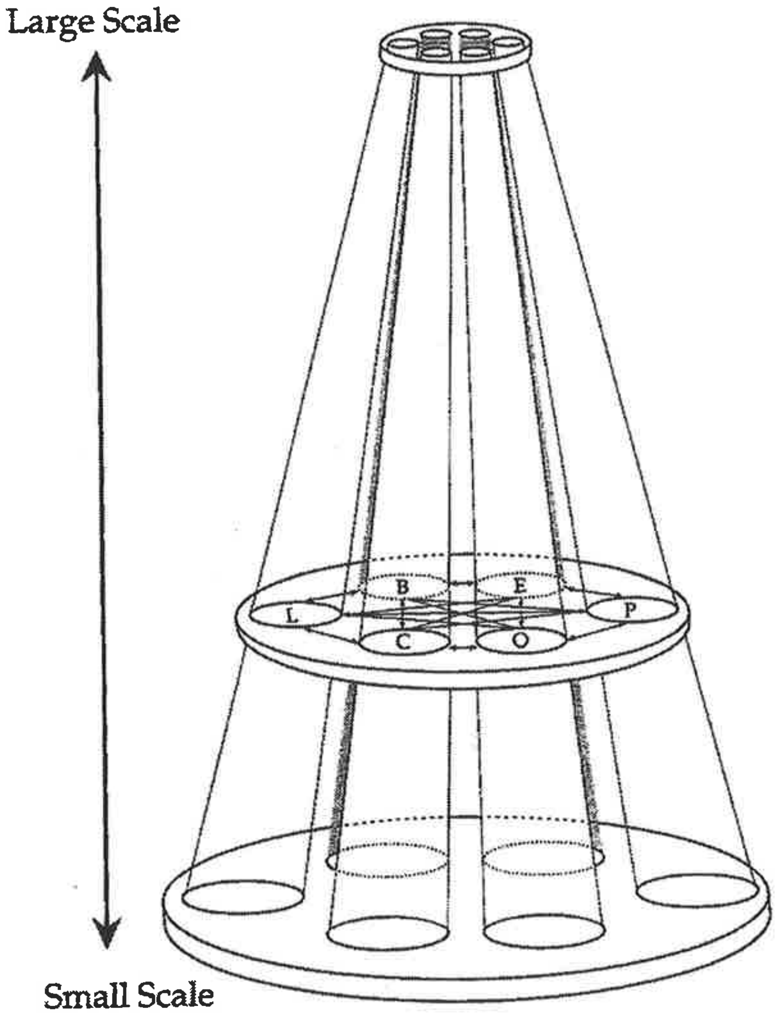
With Unified Ecology, while the 'in' and 'out' may be expressed in terms of holons and bond strength (see small diagram in table , they may also be described as occurring at different scales, where the lower (faster) scale is mechanism to the upper, slower scale: an expression of frequency of return time (cycling time). See small diagram (left) in Table 58 (Nested vs Non-Nested Hierarchies).

Table 65: CE: Criteria of Observation by Disciplines: Theoretical & Applied

Landscape	**Organism**	**Ecosystem**	**Biome/Biota**	**Community**	**Population**
Landscape Ecology	Biology Plant Biology/ Pathology Geophysiology	Ecosystem Science 'Ecology' Ecosystematics Process-functional ecology	Zoology/ Botany/ Entomology/ Bacteriology/ Microbiology Forest Ecology Systematics/ Evolutionary Biology Conservation Ecology	Community Ecology/ Plant Ecology Conservation Ecology Plant Community Modelling	Population Ecology/ Biology Fisheries & Wildlife Resource Management Agronomy/ Horticulture/ Silviculture
Physical Geography **&** **Landscape Architecture**	Physiology Pathology Medicine Psychology	Systems Analysis Human Ecology Engineering Resource Management	Human/ Urban Settlement Ecology Permaculture Resource Management Environmental Conservation & Restoration	Human/ Urban/ Social Ecology Applied Human Geography Social/ Urban Geography Sociology	Population Geography Demography (Eugenics)

(Partly based on Allen & Hoekstra 1992: 256-62).

Figure 33: CMES: Allen & Hoekstra's 'Layercake' Model



The layer cake metaphor for ecological criteria and ecological scale.
The wide base indicates a large number of small entities; the narrow top indicates a small number of large entities. The cross-section across the entire cone represents one middle-level scale. Although there is only one here, any number of cross-sections could have been inserted, each at its own scaled level. Each letter indicates a different ecological criterion: O = organism; P = population; E = ecosystem; L = landscape; B = biome. The six lettered discs correspond to where the abstract, scale-independent criteria intersect with the scale to produce a given way of identifying an ecological entity at a given scale. Individually, the columns represent a criterion for looking at the material system, e.g., the abstract notion of community. The disc labelled C is an actual community with a particular scale. In the C column, larger-scale contextual communities occur above that community, while smaller-scaled community subsystems occur below. A community context to an organism would be a C disc diagonally above a given O disc; the ecosystem that is a cow's rumen would be an E disc diagonally below an O disc representing the cow.

(Source: scanned & text transcribed from Allen & Hoekstra 1992: 53).

Table 66: BICM: Unified Ecology Criteria: Comparative Definitions & Descriptions

DESCRIPTORS	LANDSCAPE	ORGANISM	ECOSYSTEM/ ECOCYCLES	BIOME/ BIOSPHERE/ BIOTICS	COMMUNITY	POPULATION
Allen & Hoekstra References	**: 54-88**	**: 159-200**	**: 89-125**	**: 238-255**	**: 126-158**	**: 201-237**
GENERAL CHARACTER	Patterned aspect of land surface Ordered by spatial contiguity Fluxes of materials in spatial contexts Readily mapped Remote sensing pattern recognition, distinguishes fossil from biological pattern by *Brightness Analysis* characteristics *Fractal Dimension* defines complexity character (self-similarity across scales)	Functioning individual entity Anthropocentric concept Arbitrary Physically discrete Single gene stock	Biota systemically linked to physical environment Boundaries include physical environment: functioning subunits are mixes of plants, animals, soil, atmosphere Energy & matter: aggregate cycles, paths, conversions/ transformations, nutrient cycles No sense in dividing into living & non-living compartments Many variables, high complexity: nutrients in & out of biotic compartment minimum 4 times/cycle	By definition large Biotic components characterise Often named for dominant vegetation type Climate, soils critical Atmosphere critical at large scale	Individual Organisms of different species in relationship Especially used for plant community research Separate from environment (soil etc) Biotic integration as CDS: emergent concept Modulates Population competition Self-assertive, self-organising, reciprocal relationship with environment Cohesive whole, multi-facetted Untidy tangle, dynamic, far from equilibrium: finds relative equilibria Aggregate relationships between species: *competition, accommodation, interference, mutualism*	Collection of individuals, usually of one species (not usually >2 spp.) Relative genetic similarity Usually defined by species reproductive integrity Spatially discontinuous Mostly used to describe animals but also plants Includes intraspecific relationships: *dominance, accommodation, breeding behaviours, collective activities* Emergent outcome of needs & environmental influences (attraction/ repulsion)
DRIVERS & ORGANISING PRINCIPLES	Spatial relationship	Functional	Transformations (matter, energy, information) Processes & cycles	Life & life support modified spatially	Inter-specific accommodation	Intraspecific collective accommodation Resources for needs
THEMATIC	Horizontal/ vertical variation	Health, high level wellness (unitary)	Function	Vitality, life	Networks/webs	Traffic on backcloth
KEY QUESTIONS	What patterns at what spatial scale?	Is this a good animal? Does it work? What does it need to work well?	What goes round at what spacetime scale? Are the loops closed?	What can live where & how?	Who's participating? What's the glue?	Who's where and why? What's the mob up to?

DESCRIPTORS	LANDSCAPE	ORGANISM	ECOSYSTEM/ ECOCYCLES	BIOME/ BIOSPHERE/ BIOTICS	COMMUNITY	POPULATION
EXCEPTIONS, VARIANTS	Extended concept: Social, cultural, other landscape Fitness landscape	Definition issues: Same plants, competing parts eg grass shoots Sponge, coral (at once Organism & Population) Superorganism concept (Gaia)	Technology (augmented ability to process energy, materials) Bowel flora	Biosphere = the largest biome Similar to macro ecosystem Atmosphere defined reciprocally at this scale (emergent character, ultimate habitat for all life) Smallest Biome = Biotope	Human community: special extra characteristics augment relationships (eg politics, technology, economics extends impacts, skews natural process Human community in many respects behaves as if composed of different species Human-biotic interface = new communities of concern	Populations may organise collectively into individual (Organism) eg slime moulds, sponges, anemone relatives Interspecific hybrids occur: new blurring with genetic engineering
ESSENCE	Pattern	Functional whole with needs, wants, proclivities, inputs, internal functions, wastes, potentials dysfunction Entity, being, Animal	Pulsation: loops, cycles, transformations of matter, nutrients, energy, life cycles, seasons	Life & life support	Relationships, participation	Traffic: who? why? where? how? when? with whom?
ARCHETYPE	Map	Human being	Circle	Bioregion	Forest (web or network)	Herd, crowd
SCALE ISSUES	Fractal Dimension varies with scale due to variations in complexity of self-similarity: characteristic patterns for human impacted Landscapes (low dimension) Similar range to Ecosystem & Community	Range: microorganism to Superorganism Gaia (Geophysiology)	Complex multi-scale interlinkage enhanced through water, air, contiguity, corridors retarded by topography, boundaries	Biosphere similar to 'superorganism'	Range: small (eg skin pore) to Biome	Range: a few individuals in small area to millions over large area
CONTAINMENT & HIERARCHY TYPES	*Nested, Spatial, Temporal, Constitutive*	*Nested, Spatial, Temporal, Constitutive (by Evolution)*	*Non-nested, Temporal, Constitutive*	*Nested, Spatial, Constitutive*	*Non-nested, Constitutive, Dominance (including cooperation)*	*May be Nested, Dominance , Constitutive*

DESCRIPTORS	LANDSCAPE	ORGANISM	ECOSYSTEM/ ECOCYCLES	BIOME/ BIOSPHERE/ BIOTICS	COMMUNITY	POPULATION
CONNECTIVITY	Patch dynamics: max patching at 30% habitat cover Corridors, connectance, boundaries, barriers Water, air, forest High biodiversity at corridor intersections & ecotones	*Internal circulatory* *Homeostatic* *Holonic*	Connection between biota & soil via water Major & minor circulation systems Relative disconnection a key concept Boundaries leaky Feedback loops (positive & negative), functional connection	Patch dynamics Corridors critical thresholds, edge effects, territory/range sizes	Webby pattern with leaky boundaries Via corridors (eg roads, tracks) or dispersed (eg aquatic) Holonic, hierarchical structure (non-random, relative disconnection, eg food chains) Internal structure time hierarchical	Flocking/herding *Glue concept*
CONSTRAINTS	Topography Scalar description arbitrary, depending on point of view of which Organism Climate Human impacts	Availability of basic resource needs for survival Needs for high level wellness/function Homeostasis Disease, predators, pathogens	Availability of materials, substrates, life forms Disconnection Scaling (relative disconnection) *Transmission media (water, wind, animals, humans, disturbance)*	Landscape, climate, nutrients, (Elements) Toxics Disconnection/ alienation of patch structure, edge effects, fences (exclusion zones), shared use, territory/range size	Predators Disease (biological) Resources// needs Nutrients// location Balance cooperation/ competition	Similar to Organism (needs, wants) Predator population ratios Higher level predator or substrate constraints
MECHANISMS	Moulded by humans at small scale (human: 12/12 to decades cycles follows from enclosure, straight edges roads etc.) scales, geomorphology, topography: processes at large scale 4 functional pattern types (spiral, meander, explosion, branching)	Physiology: nutrient acquisition, waste generation, circulation, nested internal subsystems & their function Basic survival needs Needs for high level wellness, normal functional ranges	Essential macro & micro elements Planetary Geochemistry, Geophysiology, Geomorphology (ultra-slow cycles) intimately connected	Biodiversity with functional redundancy to enable opportunism in niche exploitation Biotic ability to exploit environmental situation Animal grooming Social ownership, territory	Survival of the first (competition for niches) Relative exploitation abilities *Initial conditions sensitivity* *Policy (applies to all living beings)* *Dominance, competition, cooperation, mutualism, co-evolution, predation, deception, restraint, ritual* *Evolution*	Emergent from attractor/repellor backcloth Attraction & thus movements & location relative to needs, wants proclivities, ability to utilise resources present Integrity from intra-specific cooperation Flocking/herding for protection: critical mass against competition Reproductive success

DESCRIPTORS	LANDSCAPE	ORGANISM	ECOSYSTEM/ ECOCYCLES	BIOME/ BIOSPHERE/ BIOTICS	COMMUNITY	POPULATION
RELATIONSHIPS TO OTHER CRITERIA	*Locational Backcloth for other Criteria*	Survival & Reproduction *Component of Population (N-1)* *Overall function (N+1)*	Ecological/biospheric "services" *Engine for other Criteria*	Differs from Landscape & Community: emergent from (interference field) of Community & Ecosystem in Landscape context Related to Genius Loci which describes the human sensory response to location which has interpretive elements related to Time (especially history) and Aesthetics	Community is usual way to study plants (often for scale & convenience reasons) Contains both animals & plants in relationship individually,	Outcome of grouping of individual Organisms Usual approach to studying animals bacteria or small plants Animal population studies many include plants secondarily (as food or re impacts like trampling)

DESCRIPTORS	LANDSCAPE	ORGANISM	ECOSYSTEM/ ECOCYCLES	BIOME/ BIOSPHERE/ BIOTICS	COMMUNITY	POPULATION
HUMAN SETTLEMENTS	*Built environment and environment-human settlement interface patterns location of settlement features on maps GIS information scale crucial* *Corridors & patterns of natural landscape & green space* *Connectivity a key aspect of human settlements so deserves a separate Criterion.*	*Can take account of human organism as physiological-anatomical-psychological being in Design, Planning & Consultation* *Can be used as a concept to approach functional integrity of elements at any scale* *Useful to look at Gaia as superorganism, city as an organism, site as organism, site element as organism: ask questions 'does this work?' 'how will it survive long term?'* *Individual Psychology: psychological relationship with self as a subsystem of whole human individual: including basic psycho-social needs through 'psychic organs' (Ego States)* *Defines needs for high level wellness & subsistence.*	*See definitions of "ecosystem": best termed "ecocycling" for human settlements: includes industry, technology, goods transport, ecological footprints & rucksacks, interface of human activity with ecological services.*	*Human scale: best approximation is Bioregion* *Provides a functional concept for political and management boundaries* *Exact boundary depends on what function is being considered, therefore problematic for orthodox political arrangements* *Includes literature on sense of place and human territorial functioning (humans as animals)* *Any management unit can be considered an artificial bioregion/ subregion dependent on ability to substitute for needs normally derived from larger scale (eg cities, constructed habitats, gardens, monocultures)* *This is a technical over-riding of natural constraints, an appropriation of external carrying capacity (Wackernagel et al: 'ecological footprint') (also 'end-of-pipe solutions', ecological rucksacks and the core of human unsustainability.*	*Human power structures & institutions include the legal and planning framework, and superimpose on Nature's wider community.* *Constraint: a power-based structural skeleton which may be cooperative or competitive, with a hierarchical form of circle or triangle* *Constraint and Enablement (Catalysis) push & pull system as a whole with emergent outcomes* *Community used to specifically look at human and human-eco or human-other biota relationships and cohesion of human clusters defined by the relationships between individuals & groups* *Formal & formal human institutional structures plus all the relationships described for Ecology* *Concept of 'ecological participation' (Hu Dan).*	*Clear extension to human Population Geography, Demography, Epidemiology* *Further extension through essential meaning to* Marketing, Stroke Economy & Satisfier Theory *This comments directly on gender, status & minority groups as collectives (considered as 'sub-species').*

(After Allen & Hoekstra 1992: 42-255; *Author*).

Table 67: CMES: Advantages of Layercake

Quality	Advantages & Assumptions
GENERIC	General, generic model, embraces best & worst practice. Values neutral but structural assumptions at least demand consideration of 'externalities' (scale-related features).
COMPLEX **ADAPTIVE**	Human settlements now recognised as Complex Adaptive Systems. Flexibility allows for change of knowledge & evolution of model.
COMPLEMENTARY	Invites distinction between structure & function/meaning.
CONTEXTUAL	'Transactional' perspective sees humans/entities in context as units: holons/socions/environs. Assumes humans & human settlements part of biosphere/natural world.
LINKAGE	Accommodates basic Sciences ←→ everyday practice. Ecology ←→ Settlement Ecology. Indicates connections between parts. Horizontal & vertical. Potentially connects disciplines, sectors, data, scales; educators, researchers, policy makers, practitioners.
ACCESS	Simplicity of basic concept. Elaborates as required.
INTEGRATION	Many criteria & unspecified focus (Empty Criterion). Connector concepts: glue, wiring, patterns, MF strategies. Assists policy integration.
INCLUSION	Respectful, egalitarian towards ecology, society, economy, tangible, intangible, technology, gender, time, eco-social needs. Community in ecological perspective. 'Both/and' approach, less vulnerable to inappropriate 'either/or' or fashionable exclusive approaches.
SCALE	Global-local-personal, specified other: accommodates "think globally, act locally, respond personally" and beyond. Clarifies path to policy integration. Points to inter-scale phenomena: transitions, positive & negative feedbacks, constraints, thresholds, conversion paths, aggregates.

Quality	Advantages & Assumptions
EXPLANATION	Enables re-examination of definitions of sustainable society/community elements. Clarifies functional relationships.
RESEARCH **EVALUATION**	Framework to hang new approaches to research, interpretation, prediction. Suggests new disciplines and research topics. Evaluation: suggests protocols to build into design.
PREDICTION	Indicates need to define system constraints, which leads to best hope of predictability in complex unpredictable systems. Complexity Theory suggests ways to approach pattern prediction where patterns may be predictable but details may not be.
EDUCATION	Framework for students, designers, educators, policymakers, planners, developers, community: internal consistency.
COMPUTATION	Pattern recognition, Complex System and Manifold Theory Mathematics, & Fuzzy Set Theory assist translation to computer extensions. Fuzzy & other concepts suggest uses for new hybrid computer systems.
DESIGN	Framework for generation of issues, linkages & concepts for wholistic design. Ensures important issues not missed (similar to Medical Diagnostics). Suggests starting place for Design of supportive backcloth for desired artefacts.
IMPLEMENTATION	Assists integration & implementation of eco-social in human settlements by pointing to resources required: policy integration & leverage, regulation, community development. Dauntingness of complexity relieved by having a structured approach.
DOCUMENTATION	Assists comprehensive analysis & documentation of projects of any scale.

The above are theoretical advantages of a UHSE Model. Disadvantages could include the perception that anything complex is too hard. See comments following Tool 3.15 Self-Referential Matrix. I have experienced reluctance in busy people who already feel they know everything about large scale project development, to even be prepared to listen at all to what I might be proposing. The theoretical (scientific) justification for the model does not in fact need to be presented (as demonstrated in the OCW case). The Criteria could just be called 'perspectives'. If the Model were accepted as a general framework, then more *child-friendly* ways of presenting it could be developed. I see its main role as the ordering framework in a tertiary training situation: lectures would be presented one Criterion (including Scale as a topic) at a time, and the whole brought together through practical design exercises after that.

(Tool 3.16: Questions for Human Habitat Designers)

2.2.11 UNIFIED HUMAN SETTLEMENT ECOLOGY

2.2.11.1 DEFINITIONS

CONTENTS

2.2.11.2 SCALE & SCOPING

CONTENTS

2.2.11.3 CRITERION COMMUNITY

CONTENTS

(Tool 3.4: UHSE Criteria: Essences & Themes)

SCALE & SCOPING

(Tool 3.5: Hierarchies Implicated by Different Criteria)

CRITERION COMMUNITY

(Tool 3.6: Community 'Cascade')

Table 68: ESCM: Spiritual Dimensions of Green Politics: 10 Key Values of the US Green Movement

Values	Explanations & Examples
Ecological Wisdom	Human society within Nature. Respect for ecological & resource limits. Energy-efficient economy. Urban-rural integration. Non-human species' rights. Sustainable Agriculture. Respect for self-organising natural systems. Multi-sphere promotion of biocentric wisdom.
Grassroots Democracy	Participatory Democracy. Accountability of elected representatives. Citizen-initiated planning policies & budgeting. Retrieval of family, neighbourhood and special interest groups from government control. Reinstatement of Civics, Voluntarism, community responsibility (*'Social Capital'*).
Personal & Social Responsibility	Healthy, dignified lifestyle. Wholistic, community-controlled education, encompassing "academic skills, ecological wisdom, social responsibility and personal growth". Non-adversarial conflict resolution. Local surveillance. Simplicity & moderation.
Nonviolence	Non-violence at all scales. Nuclear elimination while accounting for hostile others. Constructive non-violent opposition of inappropriate policies & practices, selfishness and polarisation.
Decentralisation	Efficient & practical decentralisation of democratic power, political, social & economic institutions. Regional cultural basis. Central-local balance in finance, regulation, self-determination.
Community-Based Economics	Employee ownership. Workplace democracy. Appropriate, accountable, eco-community-oriented economic activity, institutions & technologies. Basic economic security for all. Transcendence of old *'job ethic', 'work', 'jobs', 'income'* definitions. Income recognition for presently unpaid work. Constraint of corporate size & power while preserving efficiency & innovation.
Postpatriarchal Values	Cooperative Paradigm. Caring beyond personal group. I-thou relationships across genders and subgroups. Appreciation of political/cultural diversity; valuing of the rational and feelings. Respect for product and process. Respect for outer activity and inner.
Respect for Diversity	Reclamation of previously shared ideals: dignity of individual, participation in Democracy, Liberty & Justice for all. Honouring of diversity: cultural, racial, ethnic, sexual, spiritual, religious.
Global Responsibility	Interchange, learning from, support, genuine help for LDC grassroots groups. New world order reflecting these principles & retaining diversity. Reduction of defence while retaining self-protection.
Future Focus	Long-term thinking. Future visions and steps to implement: encourage people. Social appraisal of new technologies. Fiscal responsibility in governments & institutions. Quality of life goals, not economic growth.

(Spretnak 1986: 78-82;1994: reiterated).

Note: while this list was written nearly 15 years ago, later works largely reiterate it:

> ... the intellectual centre of gravity in their *[European religious parties']* programme is located elsewhere than in the debate between 'mainstream' parties. The position of green parties is rather like that. They take stands on a whole panoply of political issues ... They can credibly claim, by virtue of that, to be full-service political parties rather than single-issue movements. But while they take a stand on distributional issues, that is not what lies at the core of their programme. Rather, it is ecological values that form the focus of the green programme. Their stands on other issues are either derived from of peripheral to their stands on the questions of ecology, which they see as central (Goodin 1992: 183).

Figure 34: BICM: Ernst's 'OK Corral' & 'Social Corral'

I'm OK, You're OK (position of psychological health) 'Get on with' **I+/U+**	**I'm OK, You're Not OK** (sociopathic or paranoid position) 'Get rid of' **I+/U-**
I'm Not OK, You're OK (neurotic position) 'Get away from' **I-/U+**	**I'm Not OK, You're Not OK** (despair position) 'Get nowhere' **I-/U-**

OK CORRAL

(Based on Haimowitz & Haimowitz 1976: 47 after Dr.Franklin Ernst Jr.).

We're OK, They're OK **W+/T+** (position of social health) Link to Douglas Transcendent position	**We're OK, They're Not OK** **W+/T-** (chauvinist position oppressor: genderist, classist, racist nationalist, terrorist) Links to Douglas Low Group, Low Grid, High Group Low Grid and High Group High Grid
We're Not OK, They're OK **W-/T+** (chauvinist position oppressed-servant: proletarian frog view) Link to Douglas Low Group/High Grid	**We're Not OK, They're Not OK** **W-/T-** (terrorist position, oppressed minority) Link to Douglas Low Group High Grid

SOCIAL CORRAL
[Author].

The standard Transactional Analysis Basic Position generics provide a general way to map personal bias and thus values, (this or that is OK or not): behaviours emergent from a personal system based on one will differ from those based on another. TA recognises situational differences (for instance 'I feel OK in all circumstances except where someone authoritarian is around'), and also describes a Basic Position as a type of 'home base' - when the 'chips are down'. Stressed people tend to regress to the Basic Position with which they grew up. Everybody carries such Scripts, and everybody not treated with respect is challenged in this way, with very diverse and collectively unpredictable (emergent) results. The cumulative impacts equivalent in people, in TA is called 'Stamp Collecting' or 'Racketeering'. People not functioning well will eventually 'cash in' their 'stamp collections' in ways that fit in with their own Scripts.

Figure 35: BICM: Systemisation of Social Constraints: Douglas Group/Grid (Cultural Bias Analysis)

	Low Group		High Group
High Grid	**DISENFRANCHISED PUBLIC** Ego-oriented action goals with unelaborated action system Routinised symbolic action Society & Nature separate, Nature seen negatively		**BUREAUCRAT** Routinised symbolic action with group-oriented action goals Elaborated symbolic system Society part of Nature, harmonious relationship valued Tends to deal with Entrepreneurs: ++/-- stable Axis
			← TRANSCENDENT
Low Grid	**ENTREPRENEUR** Pragmatic opportunist Personalised symbolic action Ego-oriented action goals and elaborated action system Society & Nature separate Nature there to be used Nature can look after itself		**SECTARIAN** Activist, ecocentric position Personalised symbolic action Group-oriented goals of symbolic action Unelaborated symbolic system Society part of Nature; seen as risky and humans needing security in numbers to deal with dangers

CULTURAL BIAS ANALYSIS

(Based on Ostrander 1982: 14).

	Low Group		High Group
High Grid	**I'm NOT OK, You're OK or I'm Not OK You're Not OK; It's OK but NOT OK IFF...** Pragmatic Survivor, slave or Adapting/Adapted/Free Child Positions of unsupported masses expected to behave well (70% do) Nature negative if interfered with (and 'they' are) 'Frog' positions: low self-expectation, relatively high drive to conformity; conditional, insecure OKness: susceptible to material & stimulating Satisfier Attractors Market-trained Stimulocentric (Stimulus Hunger/Addiction) to extent not 'I+' Idiocentric (survival level)		**We're OK IFF, You're Not OK unless... it's OK IFF...** (but may be with better control) Bureaucratic: Kratocentric High level conditionality of OKness; high expectations self & others; values: control & conformity
			← INTEGRATED ADULT **I'm OK, You're OK, it's OK, they're OK, unconditionally**
Low Grid	**I'm OK, you're Not OK, it's OK-so there!** Pragmatic, entrepreneur, opportunist Society & Nature separate and seen competitively: both there to be used, Utilitarian Egocentric, Kratocentric, Anthropocentric		**We're OK, it's OK, they're NOT OK (those who disagree with us)** Ecocentric

TA INTERPRETATION OF CBA

Source: (Douglas1982: 1-13; *Author*).

IFF - 'If and only if': an expression of conditionality.

This figure takes Ostrander's description of Cultural Bias Analysis and lines this up against the parts of Transactional Analysis that serve a similar function. See description following.

CULTURAL BIAS ANALYSIS VIS à VIS TRANSACTIONAL ANALYSIS

The first diagram follows the usual CBA descriptions, with the four Attractors of Bias and their patterns of outcome, plus Ostrander's 'Transcendent' category, which he does not fully systematise in the works I have been able to discover, but which I take to have a degree of equivalence to a flexible, appropriately adapting and inclusive position, akin to the 'Integrated Adult' (TA), the 'Self-Actuating Individual' (Maslow) or the 'healthy EcoCommunity' at a higher scale.

In inter- and intra- personal work with clients, TA explores 'OK' and 'Not-OK' aspects of any given structure, recognising that in most things, the world is grey (or a rainbow, but not black-&-white), that balance between extremes in usually best (an Optimal Operating Range - OOR), and that for psycho-social health, one should be aware of the negative aspects of functions and avoid them (Nurturing is a core need, but overnurturing can be lethal; having a control structure is an important Constraint, but abuse of Power can be very destructive).

I would argue that if a person or a society can keep with the positive aspects of all Ego States, can act consistently on a Basic Position of I'm/You're/We're/They're/It are all 'OK' (mutually valid, respectful, self-respectful, graceful), and can be open and flow freely enough to be able to access all available resources appropriately to a changing environment, then that would place him/her/us/it in a Transcendent position. I have seen many transitions of this type in certain people coming to terms with approaching death from cancer, achieving great personal power in a way that can really be described as 'saintly'. I have often commented that it was a pity that it took a threat to life to give the person Permission to transcend the Life Script, by which time it was often too late. Some, like Ian Gawler, Michael Sowerby and Petrea King are well-known Australian 'saints' who did make the transition in time.[§]

It may not be too far-fetched to contemplate that humans collectively are undertaking a similar process (ie they may have to experience a collective near-death experience to take 'Permission' to challenge the status quo.[¥]

'it' = Nature
'they' = others outside our small group.

Table 69: BICM: Maruyama's Mindscapes

H-type	I-type	S-type	G-type
homogenist	heterogenist	heterogenist	heterogenist
hierarchical	independent	interactive	interactive
classifying	randomising	pattern-maintaining	pattern-creating
competitive	making unique	cooperative	cogenerative
zero-sum	negative-sum	Positive-sum	positive-sum
sequential	no order	simultaneous	simultaneous
Similar conditions → similar results Dissimilar conditions must ← dissimilar causes Linear explanations	Any cause may → any result (random explanations)	Dissimilar conditions may → similar results Causal loop explanations	Similar conditions may → dissimilar results Chaotic* causal loop explanations
Linear & volumetric Mathematics	Point Mathematics	Cyclic, periodic, dynamic Mathematics	Deterministic chaotic Mathematics
Preferred macro-geometrics for human settlements reflecting cultural goals & social philosophies in design for space stations (brackets indicate medium acceptability)			
Concentric spheres (cylinder, sphere)	Necklace (concentric spheres, parallel rings)	Cylinder, sphere (ring)	Cylinder, sphere (ring)

(Maruyama, 1994: 4, 81, 99). From Maruyama'sTables 1.1, 7.1 & 8.2; author: explanatory additions.
Characteristics (first 6 rows), ascription of cause, mathematical representation, geometric representation (manifested in design for space station – theoretical exercise).

(D&C 6.5: Istanbul Declaration of Cities & Local Authorities)

2.2.11.4 CRITERION LANDSCAPE

CONTENTS

Table 70: CMES: Patterns in Nature

Pattern	Functional Emphasis					
	Special Features	**Uniformity**	**Space Packing**	**Total Path Length**	**Connectance**	**Examples**
Spiral	Strong Self-Similarity	Beautiful (Fractal)	Very Good	Relatively short	Low, indirect	Shells, art, staircases, asymptotic behaviours
Meander	Low energy, high surface area: volume	Less uniform, appears messy, random	Very good	Relatively short	Indirect, low	Recreation areas, rivers in flat terrain, self-seeding
Explosion	Rapid dispersal of materials, high energy, frequency higher than background rate, uses/wastes materials	Even spacing related to faster erosion, positive feedback	Centre angles very uniform but overcrowded centre, sparse periphery	Very long, much duplication	Very direct, especially Centre-edge, fast traffic in/out	Volcano, sheep tracks to trough, city arterials (eg L'Étoile, Paris), erosion
Branching	Economy of materials	Less than spiral, also fractal	Good	Exceptionally short	Relatively direct	Trees, road systems, lungs, blood vessels, rural roads
120° Angles (Hexagon Elements)	Related to stresses in relatively homogeneous media: high structural strength	Sometimes extreme	Feature of	Low	Indirect	Cracks In Clay, Frost Patterns, Pangæa Split To Laurasia, Gondwana
RACEME	*Clusters of acinae on short stalks* *Maximum delivery density for minimum connector length*	*High*	*Maximum (excellent return for developers)*	*Low for direct path from centre* *High for indirect paths between acinae*	*Excellent in Nature* *Highly inefficient for diverse destinations*	*Compound fruits & flowers, cluster development, racemose glands.* *Legibility poor & maximises trip length for non-standard trips in suburban developments*
NETWORK	*Outstanding distribution/ communication or economy of materials* *Rapid distribution*	*High to low*	*Varies, usually high linear but low spatial*	*Local: short, flexible: allows shortest path or minimal materials, maximum strength for space enclosure* *Total: extremely high*	*Extremely high* *Direct and indirect*	*Capilliary circulation, Internet, Information, nutrients, innovations, thoughts, marketing, social movements.* *Grid road systems (free, efficient traffic flow, cf culs de sac).*

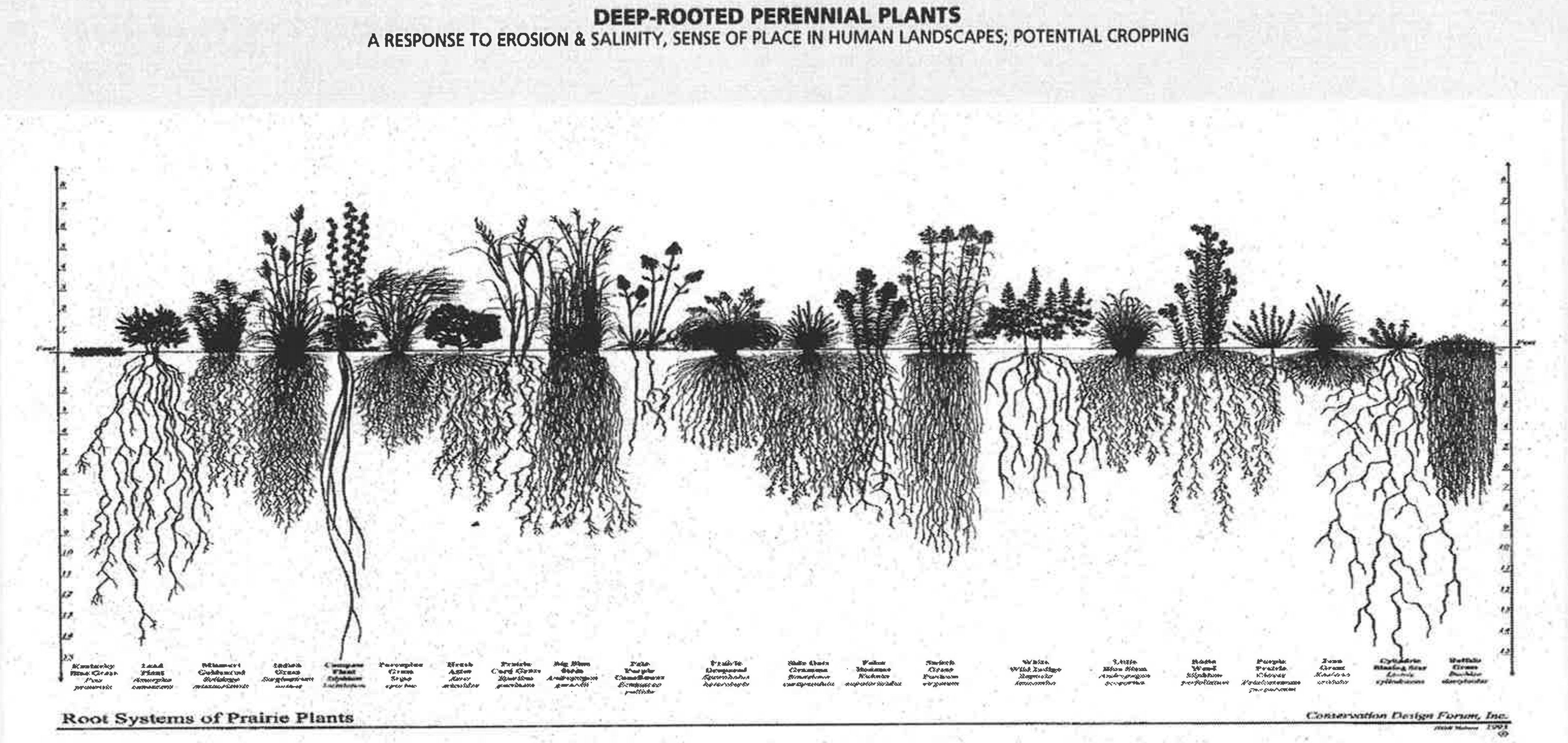
(Based on Allen & Hoekstra:66-73 after Stevens, P. 1974 *"Patterns in Nature"*, Little & Brown, Boston; *Author*).

Table 71: CMES: General Principles of Landscape Ecology

Principle		Description	Comments & Explanations
Landscape Structure & Function	Structure	Landscapes are heterogeneous and differ structurally in the distribution of species, energy, and materials among the patches, corridors and matrix present. Consequently landscapes differ functionally in the flows of species, energy, and materials among these structural landscape elements.	Framework for multi-disciplinary understanding of landscapes.
Biotic Diversity	Structure	Landscape heterogeneity decreases the abundance of rare interior species, increases the abundance of edge species and animals requiring two or more landscape elements, and enhances potential for total species coexistence.	Heterogeneity can be environmental or human impact. Perimeter-to-area ratios relevant to biodiversity.
Species Flow	Function	The expansion and contraction of species amongst landscape elements has both a major effect on, and is controlled by, landscape heterogeneity.	Landscape structure & species distribution are in a feedback loop: *heterogeneity is a Constraint*.
Nutrient Re-distribution	Function	The rate of redistribution of mineral nutrients among landscape elements increases with disturbance intensity in those elements.	Nutrients are lost to the system especially from severe disturbance. They may be carried by wind, water or animals. *[Key unrecognised issue in orthodox Forestry with clearfelling & burning; also in food production by linear & monoculture approaches].*
Energy Flow	Function	The flows of heat energy and biomass across boundaries separating the patches, corridors, and matrix of a landscape increase with increasing landscape heterogeneity.	More heterogeneity means more edges. Edges are more open to wind, thus heat loss and desiccation. Perimeter-to-area ratios again important. *Also more open to human impacts such as fires.*
Landscape Change	Structure	When undisturbed, horizontal landscape structure tends progressively towards homogeneity; moderate disturbance rapidly increases heterogeneity, and severe disturbance may increase or decrease heterogeneity.	Relationships of species, energy, materials, patch type & number, corridors & matrix, describe horizontal structure. Homogenising effects: plant colonisation & growth, soil modification, animal colonisation. Severe impacts homogenise by removing elements.
Landscape Stability	Structure	Stability of the landscape mosaic may increase in three distinct ways, toward (a) physical system stability (characterised by the absence of biomass), (b) rapid recovery from disturbance (low biomass present), or (c) high resistance to disturbance (usually high biomass present).	Biomass is a surrogate for 'information in the system'. It also represents photosynthetic surface, a huge array of organic and inorganic chemical nutrients & much more. High biomass eg forest; low biomass eg a roadway.

(Transcribed elements from \Forman 1986: 38-42; *Author's comment*).

Figure 36: ES: Deep-Rooted Prairie Plants



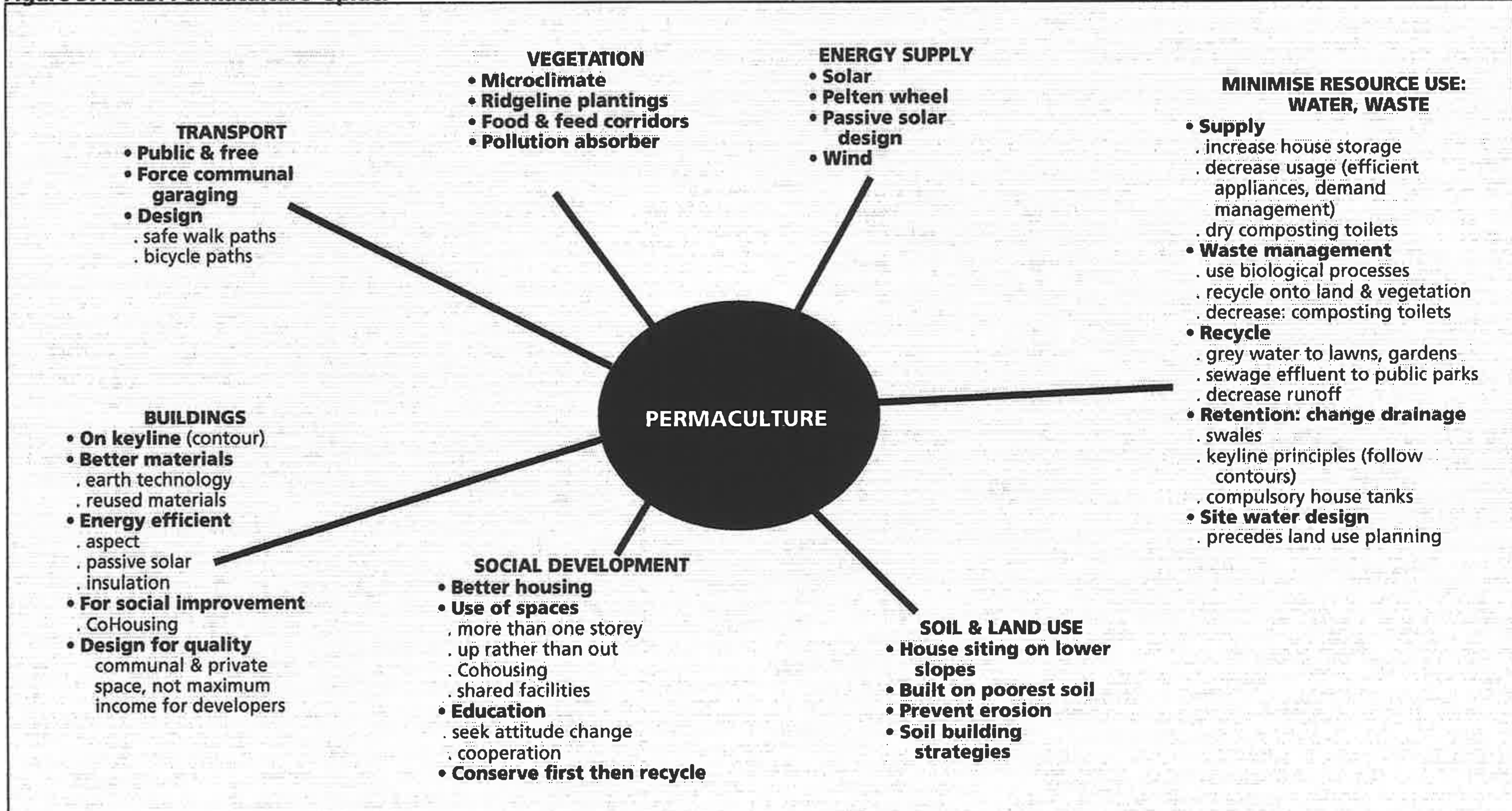
North American prairie plants, reproduced by the RMI. A key resource for integrating natural plant communities into developed landscapes. Environmental, social and economic benefits are cited (**Link: Criterion Connectivity: Table: Integrating..**). In Australia the CSIRO is searching for suitable deep-rooted perennials as appropriate cropping species {Scanned from Rocky Mountain Institute, 1998: 142: laterally distorted to fit page}. *Artist Heidi Natura, for Conservation Design Forum Inc.*

Table 72: BIES: McHarg Landscape Values x UHSE Criteria

McHarg Values	UHSE Criteria
Slope	Elements/Landscape: topology (Earth)
Surface Drainage	Elements/Landscape: topology (Water)
Soil Drainage	Elements/Landscape: topology (Water), structure (Earth)
Bedrock Foundation	Elements: structure (Earth)
Soil Foundation	Elements: structure (Earth)
Susceptibility to Erosion	Elements/Change: topology (Climate, Earth)
Land Values	Community/Genius Loci/Constraints/Organism (belief system, spiritual needs, Sense of Place, physical needs)
Tidal Inundation	Elements/Change: Water; Biotics/Landscape
Historic Values	Genius Loci/Community/Change: Initial conditions, local traditions
Scenic Values	Genius Loci: Place aesthetics
Recreational Values	Organism/Population: needs, wants
Water Values	Organism/Population: needs, recreation (subsistence related); Community /Genius Loci (place releated)
Forest Values	Biota/Population/Community/Genius Loci/ Constraints: Habitat, markets, biocentrism/utilitarianism, aesthetics, economics (multi-function)
Wildlife Values	Biotics: biodiversity, habitat
Residential Values	Landscape/Population/Community/Feedbacks Constraints: built environment, status satisfier/attractor, lifestyle, economics
Institutional Values	Community: Institutions, policy, strategic plans

(After McHarg, 1992: 33-39).

Figure 37: BIES: Permaculture 'Spider'



(Based on Rounsefell 1994b: 126). Constructed for JVNIC by Permaculturalist (Victoria); note (unusual in Australia) omission of local (indigenous) vegetation issue.

Figure 38: BIES: Aldinga Arts EcoVillage Project: Material Promoting Permaculture

Aldinga Arts Eco-Village Pty Ltd ACN 084 016 017

Addendum B

HOME GARDENS

Permaculture converts lawn monoculture into food producing polycultures. Using no-dig garden and low water use methods, work and maintenance are decreased while soil fertility is increased. The Village can grow most of its vegetables and fruits and provide some level of food self- reliance. If residents choose not to grow their own food, they may still participate in the food production process by buying it from a grower within the Village who produces it in an ecologically sustainable way

URBAN DESIGN

The design plan of the Village is aimed at creating the most appropriate urban design, which attempts to meet the real needs of people instead of catering solely for vehicles. It attempts to provide the space where socially and environmentally productive lifestyles can be developed. Urban design can minimise energy and motor vehicle use and reduce pollution. It can promote urban food production; more secure neighbourhoods, rehabilitate degraded land and provide space for recreation.

BIODIVERSITY AND WILD LANDS

Although the Village is being developed in an established semi rural area, there will be opportunities to develop areas for biodiversity. Permaculture supports the protection and expansion of wild natural landscapes and wilderness. Biological diversity is promoted when native species are planted, rare food species are cultivated and areas are reserved where indigenous plants thrive.

COMMUNITY GARDENS

Community gardening is an activity that will be offered in the Village. Stephen Poole, an experienced Permaculture Consultant, who will be living in the Village, will arrange qualified instruction and education. Community Gardens provide direct access to food production for people without land as well as to those who enjoy the conviviality of co-operative activity. As well as social benefits and food production, community gardens fill an educational role and a definite therapeutic benefit from simply working in a gardening environment in tune with nature.

PERMACULTURE

"The planning & creation of sustainable human settlements that integrate ecology and design"

PASSIVE SOLAR DESIGN

Designing our homes and commercial buildings to utilise solar energy brings energy savings and comfort. A North facing aspect with the use of deciduous trees and vines controls sunlight and heat and appropriate building materials are just some of the means to passive solar buildings design. The architectural section of the Community Title By-Laws outline building guidelines for the Village. These express clear intent to have all buildings designed and built to accommodate passive solar design and function.

COMMUNITY ECONOMICS

Keeping your money circulating in the neighbourhood by investing it in local financial projects. To know what your money is being used for, or deposit it with ethical investment organisations that support socially and environmentally progressive projects. LETS (Local Exchange Trading System) allows you to participate in the cashless trading of goods and services in your region.

COMMUNITY ORGANISATION

Individuals can accomplish more when they voluntarily co-operate in groups. Empowerment and action are the results of co-operation. Individual lives and the local community is changed for the better. The Community Title legislation, applied through the Community Corporation, which through the "Village Management Council" will administer the Village affairs, Common Land such as internal roads and open spaces, provides leadership for the overall philosophy and Community Co-operation.

SUSTAINABLE AGRICULTURE

Part of the Village property will be 17.1 hectares of land immediately to the west of the Village, where an organic natural farming system is to be established. Regulations state that building on this land is limited to minimal agricultural buildings only and thereby ensures that the sustainable agriculture principle is observed. Permaculture promotes intensive agriculture on as small an area as possible, rather than extensive sprawling agriculture, which consumes excessive amounts of energy. Integrated tree crops producing food and timber with animal production.

EDIBLE LANDSCAPES

The planting of appropriate fruit and nut trees in urban parks would turn them into productive multi-use landscapes and complement their use as passive or active recreational resources. The Village will be following this practice particularly on Common land under the control of the Village Management Council, as well as promoting community gardens for food production and suburban home gardens planted with useful species.

For Information Phone:-
Stephen Poole – 0412 797 742 or
8556 6379
Postal Address :- GPO Box 813
Adelaide – South Australia 5001

Table 73: BIES: Mollison's Design Approaches

Design Method	Description	Comments
Analysis	Listing & connecting of component characteristics.	Components: site (water, earth, landscape, climate, plants), social (legal, people, culture, trade & finance), energy (technologies, structures, sources, connections), abstract (timing, data, ethics). Connections: relative placement according to interference field of products, needs, incompatibilities, beneficial associations of components.
Observation	Expansion from direct observation on site.	Observation with attitude: non-selective wonder (why...?), thematic (eg water, energy, regeneration), instrumental (technical measurement), experiential (senses as instruments).
Emulating Nature	Application of lessons deduced from observing Nature.	Structure, process, landscape (niche, aspect, climatic, site specific opportunities), philosophy (contemplation, celebration & alignment with complex dynamic evolutionary system of Nature).
Decision Making	Selection of options or paths by decision.	Development of outcomes/goals related plan; resource identification, options, timescales, ethics, economics, *SWOT analysis*. Danger of rigidity, ground placements inappropriate if not ground truthed (can make expensive & unforeseen errors of decision).
Overlays	Comprehension of data in overlay map form.	Disadvantage of omitting minutiae & evolution; dangers of remoteness (if the exclusive method), expense, time consumption, rigidity. Advantage of clarity, visual, easier comprehension, record for reference.
Random Assembly	Assessment of outcomes of random assemblies.	Intellectual trial & error; brainstorming *[as for De Bono 'Po' technique]*. Experimentally assemble components and randomly associate through list of prepositions (attached to, beside, around, over, in, on, under, containing ....).
Flow Diagrams	Functional analysis for work places.	Process flows for work places, traffic & transport, *similar to Time-Space Prism or bubble diagram approaches.*
Master Patterning	Zone & Sector analysis according to a Master Pattern expressed as ground plan. All placements according to ground plan. Basic energy-conserving rules (:55): • Every element (plant, animal or structure) must be placed so that it serves two or more functions. • Every function (eg water collection, fire protection) is served in two or more ways.	Conservation of site energy & resources & time spent gives conceptual zones. Time, energy, activities & motion study guides placement of activities between inner intensive Zone I - low management Zone 4. Sectors reflect externally-derived wild energies (elements): sun, light, wind, rain, wildfire, water flows; choices to block, shield, screen out, deflect, collect, manage.
Information & Ethics	Human roles related to Zoning. In wilderness: visitors or strangers without right to interfere, dominate, settle, destroy "Keep out of the bush. It is already in good order."	Zone I: information developers (domestic interdependency, predator-prey-like relationship to other species). Zone 2-4: learning from other species with respect and progressive understanding.
Property	Client needs assessment.	All users including children.

Design Method	Description	Comments
Design	Skills & resources audit. Site visit. Relationship building between all stakeholders. Local knowledge (especially biotic, horticultural). Legal, financial, marketing advice.	Notes & select locations of access ways, earthworks, water management elements, energy systems, domestic biota placements. Match all to soil, slope, geomorphology, constraints.
Strategic	Adds time to technique; includes the following 4:	
Incremental	Continuous improvement model (saves time, energy, expense). Adaptation of physical systems.	Fine tuning of successful design. Culture, climate, purpose, process, context must be compatible.
Associative	Designing 'guilds' definition (:60): "A harmonious assembly of species clustered around a central element (plant or animal) *[which]* acts in relation to the element to assist its health, aid our work in management, or buffer adverse environmental effects."	Setup of companionnate aggregates of species which evolve together to produce emergent properties (eg pest control, soil enhancement ...). Benefits include anti-feeding (unpalatable deterrence), parasiticide, soil conditioning, nutrition, shelter, gathering efficiency, pest control).
Evolutionary	Designing for succession. Different products from different stages. Short-medium-long term. All planned.	Long-tern sequential planting strategy, mostly planted together: mixed tree, shrub, vegetable, livestock (foragers) Pioneer species (establish where damage or depletion) stabilise water flows, erosion; later shelter, better soil quality, mulch.
System Development	Establishment & maintenance. Staged, planned evolution.	Plan on paper. Infrastructure (fencing, soil rehab, erosion management, water supply, earth sculpture - swales, roads, dams etc). Zones 1 & 2 first. Nucleus first.

(Source Mollison, 1988: 35-69; *Author*).

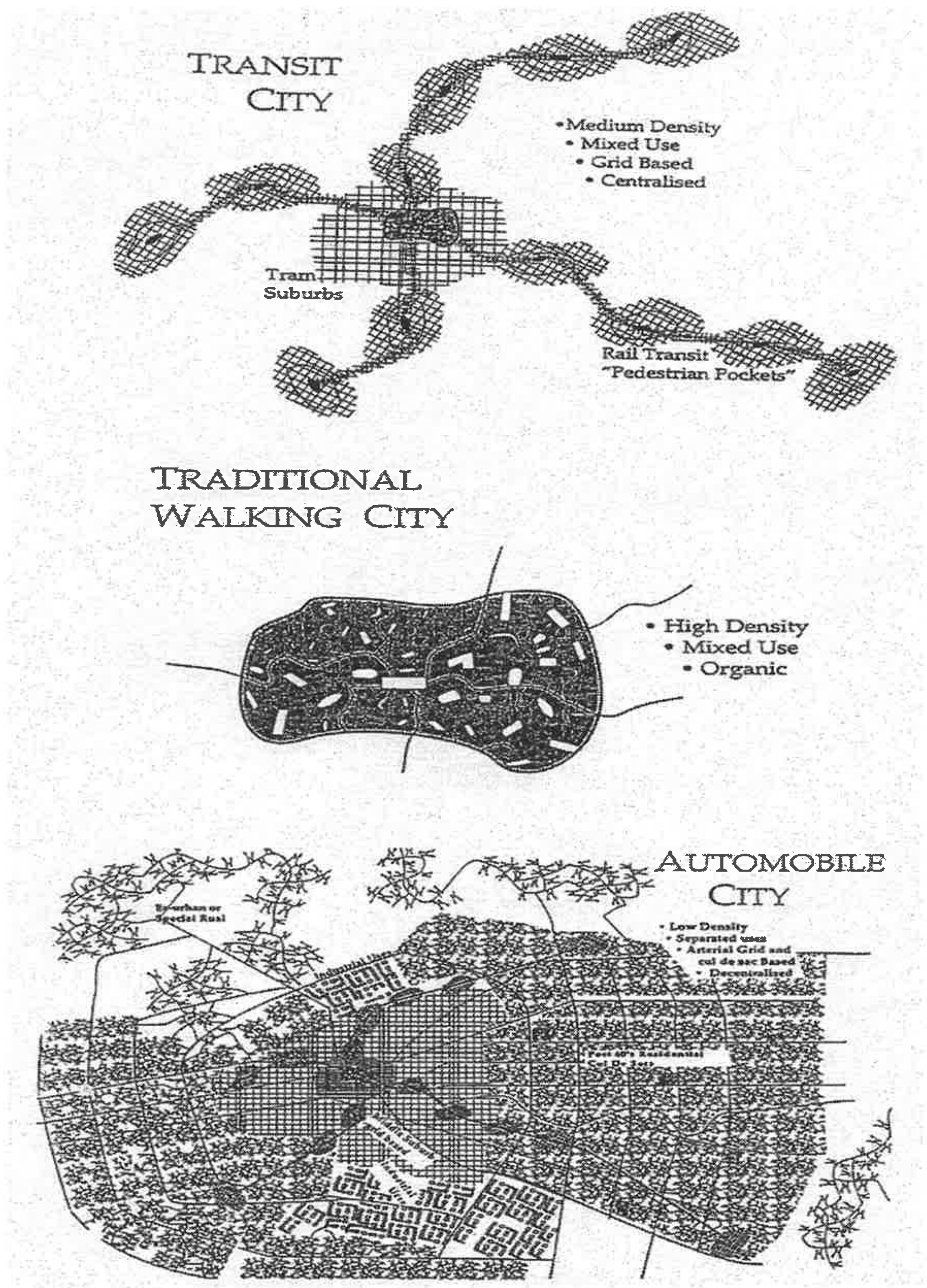
Many consultants working in Australia were part of the original group supporting Bill Mollison in his development of Permaculture. Permaculture appears to be extremely well-known and appreciated in many countries, including those I visited. It is widely used as a basis for the 'Nature' side of EcoCommunities, due to its loop work, its preoccupation with sustainable food production, ways of optimising the use of space in urban settings, and its focus of social aspects and community building. There is a similar, caring ambience at Permaculture, TA, *Reworking Tomorrow* and Ecological Economics meetings.

Table 74: CMES: Design With Nature: General Principles (after Manning)

	Principles Related to UHSE Criteria
Principles **(In Effect, for Needs-Based Design)**	Based on key questions: • Site description with constraints & opportunities • Nature, needs and management of desired biota • Specification and meeting of human and Nature's needs together • Satisfaction and coherence by design.
Full Exploitation of Natural Potential	Demands site assessment in terms of Landscape, Elements, Biotics, Population.
Habitat Conservation	Biotics: protection & manipulation of life support (habitat) systems, with special attention to complex edge zones ('ecotones').
Biotic Diversity	Biotics: presence of full range of life categories (soil organisms up), preferably native/endemic.
Evolution	Change, deterministic chaos: design for full growth cycles, uneven evolution to mosaic of differently-staged patches.
Community Integrity	Community, self-organisation: community development for balanced function, with capacity for self-sustenance and self-renewal.
Management with Minimal Intervention	Landscape, Elements, Feedbacks: design for optimal balance of physical elements with human use at lowest appropriate maintenance.
Maximal Co-Existence Humans-Nature	Community, Population, Organism, Genius Loci: design of supportive backcloth to meet basic needs of biotic and human elements (design for traffic at attractor points, protect/fence/set up repellors where survival needs threatened); spectrum of values informs activity patterns & management of conflict areas; opportunity for humans to experience embeddedness in Nature.
Sensory Landscape Coherence	Genius Loci: managed continuous sensory sequence; system based on deterministic chaotic conditions, ('variety without disorder').
Four-Dimensional Design	Space-Time, self-organisation: acceptance of an 'allowing' rather than controlling attitude to design, which expects ongoing, flexible design long term.

Adapted from Manning 1979: 23, 30-31.
Column 1 lists Manning's Principles in abbreviated form.
Column 2 explains Manning's concepts, simultaneously relating them to Unified Ecology Criteria and Complexity Theory concepts.

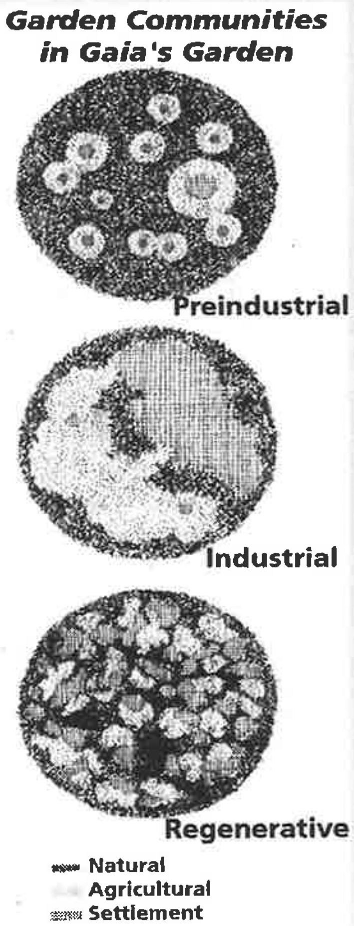
Figure 39: ESCM: Urban Form



Source: Newman 1993: 9).

Newman lays at the door of automobile dependence: oil consumption, Greenhouse Gas emissions, urban sprawl, noise, accidents, local traffic impacts, excessive urban infrastructure costs, social isolation, locational inequity and loss of public realm in cities (:8). He argues for a series of mixed use, walking sub-centres, a multi-nucleated, transit-linked city, as modelled by Register in the following Map. Loss of habitat and biodiversity are perhaps the most serious direct impacts, yet are rarely dealt with in detail by protagonists in the urban form derbate.

Figure 40: ESCM: Regererative Design Strategies



REGENERATIVE DESIGN STRATEGIES FOR THE EVOLUTION OF THE FUTURE NEOTECHNIC CITY

1. LET NATURE DO THE WORK
Local measures save distribution. Let goats eat weeds, avoid poisons. Use grassed channels not concrete. Compost & soil quality, not chemical fertilisers. Mimic and use natural processes.

2. CONSIDER NATURE AS BOTH MODEL AND CONTEXT
Mimic local proportions of plant types for agriculture: use polycultural plantings. Paleotechnics comes from Physics; Neotechnics comes from Biology. Learn how to live in a place from evidence of local Coevolution.

3. AGGREGATING NOT ISOLATING
Separate design of parts condemns them to remain separate. Avoid add-ons: go for linkage from the start.

4. SEEKING OPTIMAL LEVELS FOR MULTI-FUNCTIONS, NOT THE MAXIMUM OR MINIMUM FOR ANY ONE
Democracy towards all functions: seek out and provide optimal range for each.

5. MATCHING TECHNOLOGY TO NEED
Use appropriate technology. Don't use chainsaws to cut butter, nor nuclear energy to heat water. *'Small is Beautiful'* (Schumacher).

6. USING INFORMATION TO REPLACE POWER
Low energy society with feedbacks on both positive & negatives of technology & regulate consumption.

7. PROVIDING MULTIPLE PATHWAYS
Small scale, ecocycles: animals & plants integrated; hybrid solar-wind systems; tune to environmental change; many ways to provide resources.

8. SEEKING COMMON SOLUTIONS TO DISPARATE PROBLEMS
Multifunction: greenhouses; natural landscapes.

9. MANAGING STORAGE AS A KEY TO SUSTAINABILITY
Balance use with replenishment; recognise storage strategies in Nature.

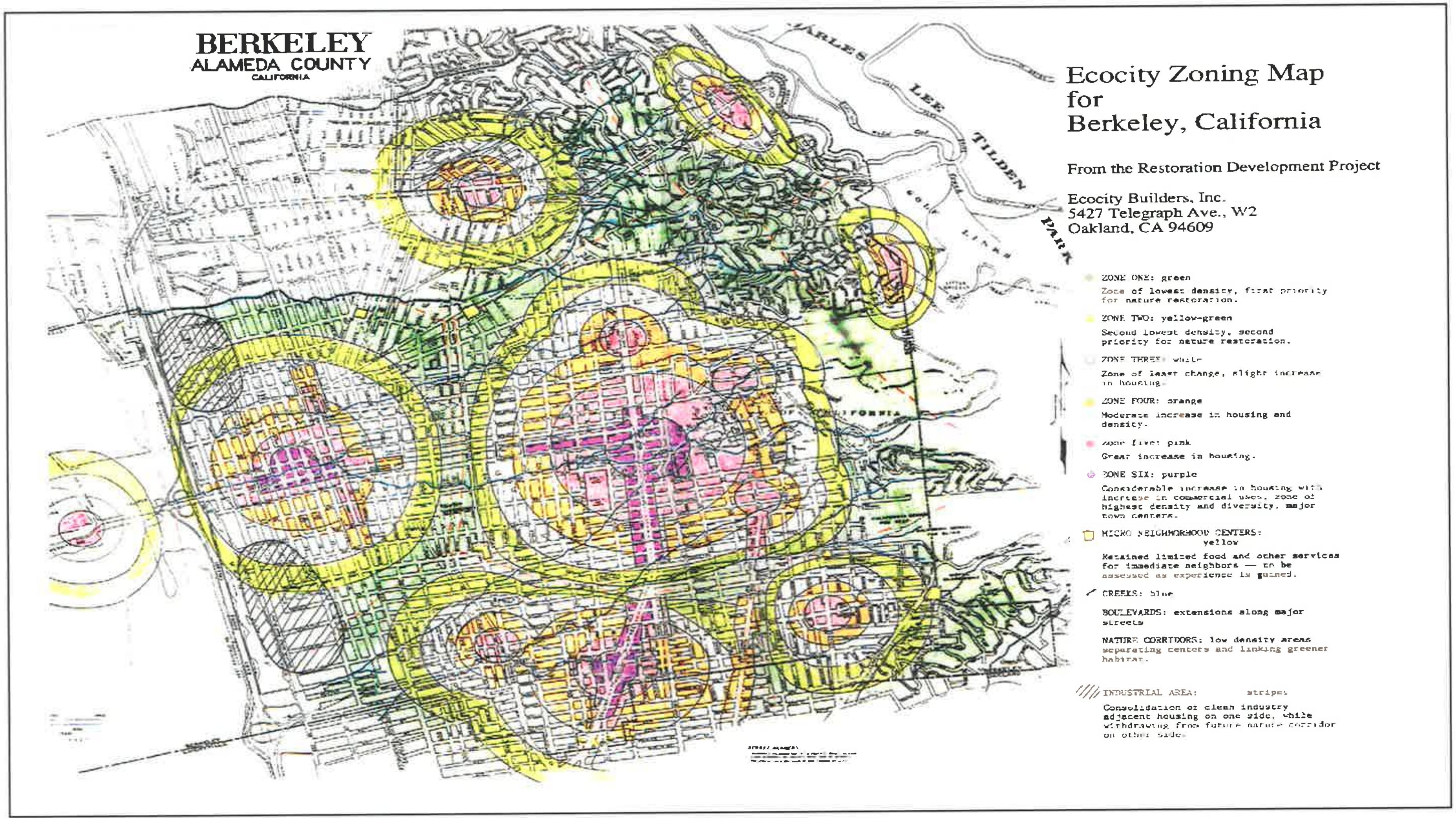
10. SHAPING FORM TO GUIDE FLOW
'Flow follows form follows flow'. Energy, materials, air, water.

11. SHAPING FORM TO MANIFEST PROCESS
Inherent elegance of ecological processes. Technophobia vs Technophilia. Paleotechnics often alienated, alienating & hidden; Neotechnics all around, distinctive forms; some may find aversive; beautiful if understood.

12. PRIORITISING FOR SUSTAINABILITY
Every development decision should be committed. Regional patterns, what & where to develop. Tree species to plant. Drainage methods, etc.

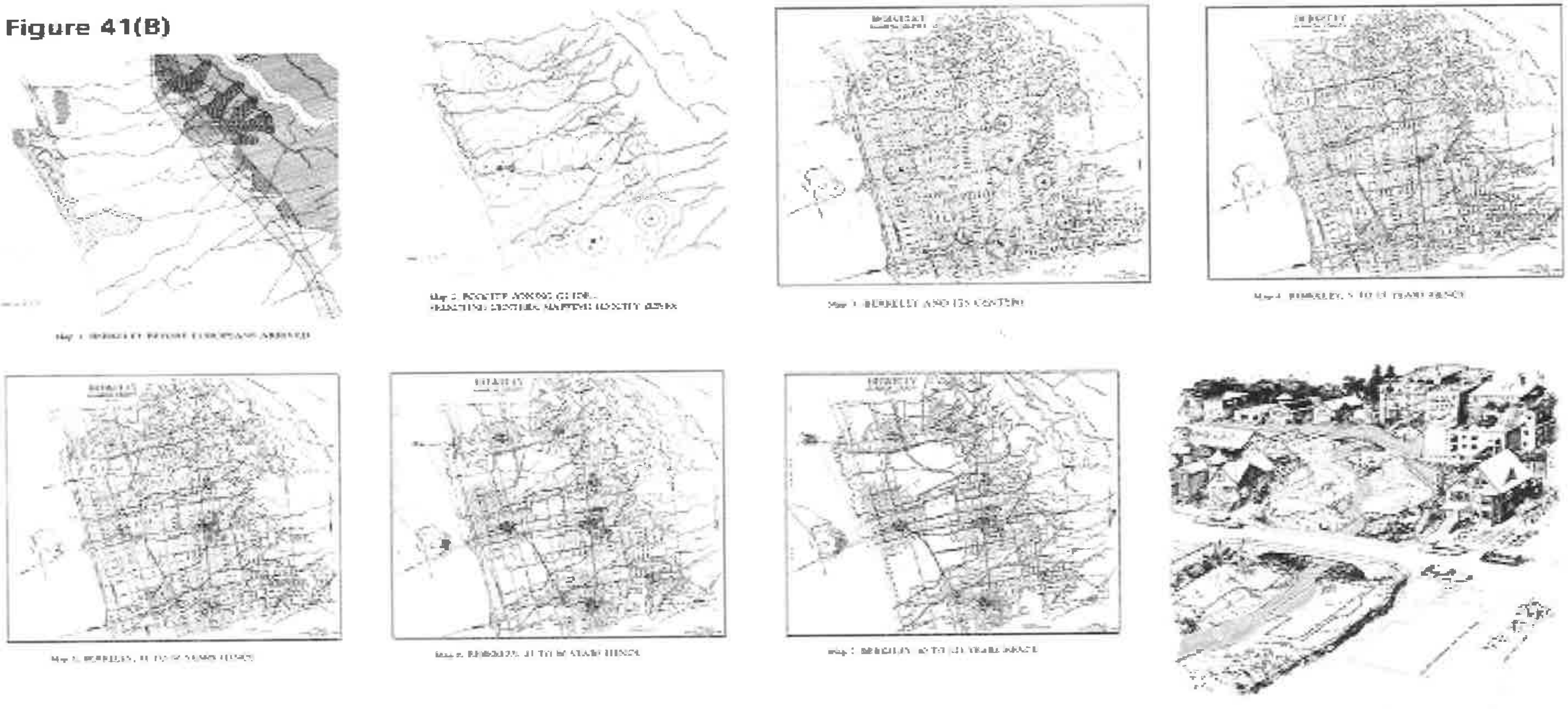
(Sources: sketches scanned from Lyle, 1994: 287; Strategies: 37-45).

Figure 41: ESCM: 41(A): EcoCity Berkeley: Rezoning Map (Register) 41(B) following: EcoCity emerging from Restoration Development Policy



(Source: scanned & colour adjusted from original purchased from Register: 1993).

Figure 41(B)



Map1 Shows the pre-European Berkeley region.
Map 2 Superimposes Zoning based on current social Attractors.
Maps 3-7 Display Register's Vision: the urban pattern evolves to a more ecologically friendly cluster form under Restoration Development policy, remodelling the city from 1987 to approximately 2200. **Map 3** is Figure 41(A).
Creek Restoration (bottom right) removes creekline buildings, replacing them with higher density structures set further back, releasing the creek from its concrete confinement. A dedicated subsystem prioritises cycling and walking, and is independent of car routes (tinted bridge area at top centre). Register has succeeded in implementing a small (one block) demonstration of how this might work[3]

Source: Register 1987: 120, 121, 124, 125, 126, 128, 129, 63 respectively. From groundbreaking work *EcoCity Berkeley: Building Cities for a Healthy Future*.

2.2.11.5 CRITERION ELEMENTS

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2.2.11.6 CRITERION GENIUS LOCI

CONTENTS

2.2.11.7 CRITERION BIOTICS

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Table 75: ES: Water Design Principles: Mollison's Designer's Checklist

Identify Water Sources	Analyse Quantity & Quality	Strategies
Reserve Sites for Tanks, Swales or Dams	Identify dam sites	Earth dams need ≥ 40% clay Analyse soil samples & reserve suitable sites for future storage Use slope benefits where possible (or raise tanks) Look for keyline system opportunities for example series of primary valleys
Dam Design		
Arid Conditions (Evaporation → Precipitation)	Runoff capture	Soil storage: rip-lines, swales, pits, sandified soakages
Humid Areas	Open dams	
Safety Precautions	Dam failure	Site housing out of way, stable spillway
	Supervise construction	
	Good advice	
Define Water Pathways	Grey water	Use in gardens (via filtration beds), forests (woodlots), village areas
	Domestic water	Efficient use, demand management
	Common effluent system	Maximum use basis (methane, plant production, irrigation)
Prevention	Avoid impeding normal régimes	Water flows, fish migration
	Plant all earth storages with trees, especially swales	Remove water (arid areas), prevent salting
	Minimise water demand	Select species not dependent on irrigation
	Pre cloud seeding	Ensure dams and swales can cope, neighbours alerted
Strategic Use of Forest	Forested ridges	Don't build on ridges, maximise forest on strategic uplands, don't assist any deforestation, especially high country
	Windbreaks	Essential for reduction of water loss in croplands.
	In-crop trees	

(Reorganised after Mollison 1988: 181).

Table 76: CECM: UHSE Criteria x Climate Change

Criteria	Climate Change: Concerns
Community	Policy responses to unpredictability in health, water, food, weather: lifestyle change; hopefully simultaneous development of local <u>and</u> global citizenship Competitiveness over scarce resources Strain on rule of law as populations & disease increase & crops fail due to climate extremity Education increasingly important (systems thinking should be taught in schools); learning society: see Indicators Fast responses required, favours autocratic leadership
Landscape	Extinctions and perturbations: increased climatic forces, resilience limited by human activity (managed systems lose resilience, fences and barriers prevent migration of ecotones)
Elements	Extreme events, erosion, effects on buildings, soils Volcanic activity, combination of raised temperatures with sun spot activity Ocean current changes Rainfall patterns, antarctic albedo, dehydration, desiccation, seasonal changes Extreme winds, cyclones, tides Weather pattern changes and consequences; instability (unpredictability) of weather (crops failure, transport safety)
Genius Loci	Likely to be a 'bad genie'
Biotics	Response of different types on plants to CO_2 plus temperature elevation; differential effects different biotic groups (fungi, bacteria, insects) Differential response (mostly negative) to elevated salinity Survival issues under changed conditions (for example loss of alpine climate, impact on food production, stone fruits, insect populations, pollination); ecotone & major biomic shifts Insolation (ozone hole): exposure effects on plants & unprotected animals
Organism	Health effects (all biota); some favoured Decreased individual disease resistance, personal resilience: genetic/environmental challenges Personal impacts from extreme events
Population	Differential effects on species; extinctions & plagues; changed Epidemiology Environmental refugee phenomenon; environmental wars
Ecocycles	Biochemical changes, reaction times changed for some aspects of ecological services; dys-synchrony, dys-integration of system synergy Differential microbial effects on Ecosystem Services Global distribution of increasing molecular pollution
Connectivity	Locational advantage/disadvantage (for example coastal, altitude) re connection to food supply, subsistence, shelter
Feedbacks	New Attractors & Feedbacks, different Constraints
Rheotics	Holling cycle predicts pattern: instability (creative destruction), then settling down to a new Attractor set; timescale long by human standards.
Indicators	Need comprehensive, integrated & regular feedback for appropriate response; Plan & Benchmarks; Compass (see Criterion Indicators).

CRITERION GENIUS LOCI

(Plate 8: Collage: Placemaking)
(Plate 9: Collage: 'Places of the Soul')

CRITERION BIOTICS

Table 77: ES: Ecotone Management to Control Patch Size

Strategies	Technical Aspects
Introduction of native plants & animals	Along edges of remnants Along natural corridors (for example riparian) Species with ecotone site specificity
Agreements with private land holders	Expand small patches by ecotone planting
Disturbed areas	Use of fire Replanting
Keep abreast of biological research	Especially for small patch size
Deal with weeds & feral animals	Small scale methods such as spot spraying & hand weeding
Assessment	Monitoring Research

(Mattiske 1987: 383; City of Burnside).

Table 78: ESCM: Wildlife Corridors

ADVANTAGES	**Direct**	Facilitate Movement Plants & Animals Between Otherwise Isolated Areas
		Increase effective population sizes
		Maximise genetic variability (long term survival, resilience)
		Facilitate recolonisation of disturbed areas (fire, clearance)
	Indirect	Biotic support in own right
		Refuge for species using cleared land (insectivores valuable to farmers)
		Support species diversity despite land clearance
		Shelter & shade for stock (but must be protected from degradation)
		Windbreaks for pasture & crops
		Landscape features (especially if in harmony for example riparian)
		Renewable timber source (firewood, posts)
DISADVANTAGES		Corridor for wildfire, pests, diseases
		Harbour for ferals & exotics
		Occupy potentially arable land.
DESIGN FEATURES		Incorporate natural features (especially denser habitat for cryptic species, riparian, and include variety of habitats) Retain: Precautionary Principle (probably can't replace it once lost) As wide as possible (minimise edge effects, fertiliser & bioicide drift) Fence against stock Retain vegetation adjacent to other patches off property (for example roadside, neighbouring land) Replant to replace lost habitat.

(Dendy 1987: 357).

Figure 42: ES: Biodiversity Principles at Individual Scale

PERSONAL SCALE BIOLOGICAL FOOTPRINT: 20 STEPS

1. Make your garden or property wildlife friendly by leaving logs and rocks, and planting local native plants to provide food or shelter to birds, frogs, reptiles and other animals. Find out how to get local native plants by contacting your local council or branch of the Society for Growing Australian Plants.
2. Reduce the impact of your cat or dog on native wildlife. Keep them enclosed at sun up, sun down and at night when native animals do most of their feeding.
3. Consider alternatives to chemical pest control in your garden or use it sparingly. Birds, frogs and reptiles can become sick or die if they feed on insects sprayed with pesticides. Useful insects, like ladybirds and praying mantis, help control pests and are killed by pesticides.
4. Dispose of chemicals, paints, oils, detergents and plastics through your special local council services, not through the stormwater or sewerage system, which will pollute your waterways.
5. Join or start a 'friends of' group to help landholders and councils in their efforts to bring back the native grasses and woodlands to their properties, river frontages, roadsides, beachfronts and public areas. Call Landcare Ph: (03) 5229 6050 or your local environment centre of council for nearest contacts.
6. When shopping, choose the more environmentally friendly products and avoid excessive packaging. Wherever possible 'reduce, reuse, recycle'.
7. Try to buy organic produce. It's better for you and better for the environment because it does not use chemical pesticides.
8. Don't dump weeds, prunings or grass clippings in the bush or local parks as they make new weeds and spread others.
9. Know your fish. That orange roughy you're eating could well be 150 years old. Find out where your fish are caught and if the methods used are ecologically sustainable. If your fish vendor doesn't know ask them to find out. For a guide to buying fish call the Vic National Parks Association Ph: (03) 9650 8296.
10. Report any new waste discharge to the sea or river. It may be an accidental spillage or a new discharge point that is not yet regulated. Councils and the EPA need to know what's going on and will appreciate your eyes and ears.
11. Be conservative when you go fishing. Only take what you can eat yourself and don't keep undersized fish. Some fish stocks are under greater threat from recreational fishers than from commercial fishing.
12. Switch to slow combustion or natural gas heaters. Firewood collection alters or removes the habitat of mammals and birds, and is contributing to the decline or disappearance. After woodchipping, firewood harvesting, at 6.1 million tonnes per year, is Australia's second largest timber extractor.
13. Keep the contents of your boat, car, bag in your boat, car, bag .... Don't throw rubbish, waste, oil or chemicals into the sea or into urban creeks or rivers - even if you believe them to be biodegradable. Australia's marine and riverine ecosystems have naturally low nutrient levels and can't easily absorb human waste or rubbish.
14. Use plantation timber, not native forest and woodland timber, in home building, fencing or firewood. Demand for plantation timber by consumers will put effective pressure on the suppliers.
15. Support conservation of coastal and wetland habitats. Mangrove and coastal swamp systems provide breeding habitats for many fish, crabs and prawns and help maintain clean waterways.
16. Speak out about new dykes, weirs or sea walls. Most of Australia's coastline relies on a natural flow of water up and down our sandy beaches. Any break in this flow disrupts and destroys local ecosystems.
17. Avoid walking on reefs. Many species are very delicate and will die when crushed under human weight. Pop on a 'mask and snorkel' and swim around instead.
18. Find out what happens to your city's effluent. Each year 10.000 tonnes of phosphorus and 100,000 tonnes of nitrogen are discharged into our seas from sewerage systems. This kills many marine ecosystems, reducing the ability of the oceans to sustain life. Domestic waste is the main culprit, so suggest to your state government representative that it be recycled back on land.
19. Contact your local elected representatives (MP or councillor) to get more areas protected for nature conservation. Ask them to address the bigger-picture issues beyond your scope, such as broad scale clearing and destruction of native plants and animals, expansion of our national reserve system, and ensuring that flows on our regulated rivers allow for environmental needs.
20. Don't leave your environmental conscience at home when you go on holidays.

(Transcribed from Glanznig & Prideaux 1999). *[Written with Melbourne contacts].*

Figure 43: BIES: Biodiversity & Integrated Pest Management (IPM)

INTEGRATED PEST MANAGEMENT
STRATEGIC ELEMENTS

IDENTIFICATION

- Similar issue to antibiotics: damage may be viral, not insect, then spraying not effective.
- Potential resources: experienced gardeners, extension agents, university departments of Entomology, Biology.

DEFINE BIOLOGY

- Learn everything possible about biology of the pest, especially susceptible times in lifecycle for specific treatments.

PESTICIDES & INJURY LEVEL

- Injury Level: Level at which unacceptable damage occurs.
- Action level is level to prevent injury. Action & injury levels often the same for insecticides.
- Relevance of injury varies: dependent on function & position & type of pest: Usually aesthetic in urban IPM.
- If using beneficial organisms or some habitat modifications after treatment, action often needs to be earlier than injury, to allow for reproduction times.
- Public education reduces demand for treatments & decreases use.

TREATMENTS

RESISTANT PESTS

- Use resistant plants. Endophytic fungi (turf). Drought resistant plants.

HABITAT MODIFIERS

- Naturalising, companion planting to attract beneficial insects. Waste management. Remove breeding sites & food sources.

ATTITUDE CHANGES

- Public education. Ensure consciousness of alternatives to pesticides.

PHYSICAL CONTROLS

- Traps: fly, cockroach; bait stations, sticky traps, dusts: diatomaceous earth, silica gel (indoor, cupboards).

CHEMICAL CONTROLS

- One well timed application = four badly: 99% can't target pests.
- Specifics with low residual toxicity – use one week pre beneficial bugs. Kills eggs & over-wintering insects in bark.
- Botanical insecticides: pyrethrin, rotenone: break down fast, highly toxic at application Always need good protective equipment.
- SF area: some trees act as hosts for pests: host tree effect: find & remove or mark, spot-spray. Among groups of a species: Norway maple, ash, elm, plum, linden, oak, hollies: one tree needs treating – have to find the right one. Host trees seem to have special susceptibility (?genetic, environmental).

BIOLOGICAL CONTROL

- 3 main ways: <u>conservation</u> of native predators & parasites; <u>inoculation</u>; <u>inundation.</u>
- Conserving beneficial populations: easier than buying & hope they survive. Plant food for natives. Wildflowers, companion plants, wildflower edge strips, diversified plantings for example aphids: reproductive strategy: live birth to nymphs with daughter embryos→ no time delay in hatch & development phases. Sprout wings if overcrowded. Rx ladybirds, predatory midge (China), syrphid flies – larvae voracious for aphids (hover flies), parasitic wasps (many species).
- Understand population dynamics: predator-prey cycles.
- Inundation: indoor urban.
- Inoculation: indoor urban: predatory mite (one of best ever) Phytoseiulus persimilus, controls 2-spotted spider mite (very serious).
  Parasites: (Encarsia) for white fly, aphids, mealybugs, scale, thrips, mites (several types).

EVALUATION

Finish up, evaluate the situation, make notes for next year.

(Based on Gilkeson 1990).

Table 79: BIES: Ecological Status, Resistance & Durability of Australian & Tropical Hardwood Timbers

Key: Termite resistant (T), resistance to borers & beetles (B&B) resistance to fungal decay (durability Classes 1-4 descending)			
Source	Timber	Key features	Comments
Note: Hardwood harvesting will damage or endanger (usually Asian or Australian in our case) rainforests. Hardwood timbers should therefore be sourced from plantation or recycled building materials			
AUSTRALIA			
Approx 1/4 of continent NSW, Qld, arid	Native cypress pine *Callitris spp: C. collumellaris & C. glaucophylla/C.* glauca (black, white)	Class 1 T Class 1 B&B, T	Best choice for availability & termite resistance: floors, panels, weatherboards; wall & roof framing only if properly cured - difficult.
	River red gum *[Eucalyptus camaldulensis]*	Class 2, T, B&B	
	Jam acacia *[Acacia acuminata]*	T	Small turnery products only
NSW	Grey ironbark *[Eucalyptus paniculata/ E. moluccana]*	Class 1, T	Ironbark group
Vic, NSW	Grey box *[Eucalyptus melliodora]* (yellow box)	T, B&B	Woodland tree, box group
Q, NSW	Turpentine *[Syncarpia glomulifera]*, red turpentine	Class 1, T, B&B	Coastal, very fire resistant, resistant to marine borers; forest-rainforest ecotone tree
(Vic), NSW, Q	Forest red gum *[E. tereticornis (E. umbellata)]* Qld blue gum, red iron gum	Class 2, T	Red gum group, broad coastal strip range
SEQ, NSW	Spotted gum *[E. maculata]* spotted iron gum	Class 2, T	Bloodwood group, coastal & tablelands, housing: flooring, construction, poles for preservative treatments, handles
North American species	Southern cypress *[Taxodium plicata]*		No other information found Western red cedar suitable against termites but threatened
DO NOT USE	TROPICAL HARDWOODS	Seek special qualities from plantations	Endangered or threatened
Western USA: North California, Oregon	American redwood *[Sequoia sempervirens]* Western red cedar	T, B&B	
Oregon, USA	Douglas fir, Oregon	Class 4	
Africa (Liberia, Ghana, Ivory Coast)	African teak (iroko, kambala)		
Burma, Thailand, Indonesia, Cambodia	Teak		Plantations in Papua and Queensland
Nigeria, West Africa	Zebrawood		
West Africa, India, East Indies, Malaysia, Indonesia, Philippines)	Ebony (batulinau)		
Fiji	Fiji birch (dakua makadre, dakua salusalu)		
African (West Africa), Ivory Coast American (Mexico, Central &	Mahogany White (avoidire) Honduras mahogany, tropical		

South America) Philippine (SE Asia)	American mahogany Philippine mahogany, meranti, seraya, lauan, narra, tanquile		
Mexico, South America	Tropical oak: roble, encino		
Brazil, Mexico, Central America	Purpleheart (amaranth)		
Brazil, Honduras, India, Ceylon Brazil Honduras Mexico, Central America, Colombia	Indian Rosewood Brazilian rosewood (jacaranda, palisander, marnut Rosewood (nagaed wood) Nicaraguan rosewood (Cocobolo)		
Location not identified	Agathis (kauri) Keruing (apitong) Pacific maple (red, white, yellow) Kapur Ramin		
Papua-New Guinea	Rwila		
AUSTRALIAN	DO NOT USE FROM NEWLY FELLED OLD GROWTH SOURCES	Seek special qualities from plantations	ENDANGERED, THREATENED OR RESTRICTED HABITAT
Common Names	Ash – silver, red, yellow Bean – black, red Beech – white, brown, myrtle Brush box Cedar – white, red Ebony – grey, black Maple – Queensland Oak – silky, tulip. blush Native pines – kauri, bunya, huon, hoop Quandong (blue fig) Rosewood Teak (white, black) Walnut (black, Queensland)		Some plantation black bean, teak & jarrah may be available
	Black Bean (heartwood) *[Canastospermum australe]*	T	
N NSW, SEQ	Narrow-leaved red gum *[E. bancrofti]* Bancroft's gum, orange gum, forest red gum	Class 2, T	Redgum group, very limited range
SW Tasmania	King William pine *[Athrotaxis selaginoides]* King Billy pine	Class 1, T	Rare, very limited range
W Tasmania	Celery-top pine *[Phyllocladus asplniifolius – P. rhomboidalis]*	Class 1, T	Limited range

SEQ, NSW	Blackbutt *[E. pilularis]*	Class 2, T	Narrow coastal strip range
SW WA	Blackbutt WA – Swan River blackbutt *[E.patens]*	Class 2, T	Very small range
NSW, NE Vic, SEQ	Bloodwood *[Eucalyptus corymbosa]*	Class 1, T, B&B	Restricted coastal range, rough uses, wide, gummy veins
NSW	Ironbark *[Eucalyptus siderophloia]* (blue-leaved, *E. fibrosa ssp. nubila*)	T, B&B	Narrow coastal habitat only 50-100km wide, restricted
NSW, SEQ, NE Vic	Red bloodwood *[Eucalyptus gummifera]*	Class 1, T, B&B	Bloodwood group, narrow coastal range
SQ, N NSW	Grey gum *[E. propinqua]*	Class 1, T, B&B	Grey gum group, limited range
N NSW, SQ	Tallow-wood *[E. microcorys]*	Class 1, T, B&B	Very strong timber, limited range
SW WA	Jarrah *[E. marginata]*	Class 2, T	Limited range, 20-30 miles wide pure stand strip = prime area; strong, durable, bridges, heavy construction, sleepers, fences (extensive re-use trade)
S NSW	Woollybutt *[E. longifolia]*	Class 2, T	Very limited range, coastal
CAUTION	UNSORTED LISTS (From Verkerk:186-7)		
Mixed sources Class 3 durability	Silvertop ash (*E. sieberi*), southern blue gum, Sydney blue gum, grey mountain gum, scribbly gum, karri, marri, messmate, brown stringybark	Class 3	Note: some threatened: avoid
Mixed sources Class 4 durability	Brown alder, alpine ash, mountain ash, white birch, yellow carabeen, coachwood, manna gum, rose gum, swamp gum, brush mahogany, rose maple, tulip/blush oak, Corsican pine, hoop pine kauri pine, loblolly pine, radiata pine, slash pine, planchonella, pink poplar, silver quandong, sassafras, red touriga	Class 4	Potential 'sacrificial lure' Note: many in threatened list: avoid
	Plywood, special cutting & layering methods, & &		Need to take resin types into account (glue, formaldehyde issues)
	Chipboard/composite hardwood products from old growth forests or with formaldehyde-based resins	T, B&B	Difficult to identify sources Less waste but may represent driver for clearfelling of non-plantation forests Health issues (OW&S and indoor pollution) with resins (eg MDF) (See Gray & Hall 1999)
PLANTATION TIMBERS AVAILABLE			Varier locally
POTENTIAL PLANTATION TIMBERS			(See Bonney 1997)
TIMBER FOR REUSE			Railway sleepers, disused industrial buildings, house wreckers Firms now specialising.

(Compiled from Chippendale 1988;Gray & Hall 1999;Hall,Johnston & Chippendale 1970;Verkerk 1990: 93-4, 182, 186-7). (See also Gray & Hall 1999).

2.2.11.8 CRITERION ORGANISM

CONTENTS

2.2.11.9 CRITERION POPULATION

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Table 80: CMES: Nature's Needs

Terrestrial Ecosystems: • A rate of soil loss no greater than the rate of soil formation. • Intact nutrient cycles maintaining the nutrient properties of the soil over long periods of time. • The absence of polluting gases or particles in the atmosphere which interfere with living processes or significantly modify the climate. • The maintenance of an intact ozone layer in the atmosphere protecting the Earth's surface from ultraviolet radiation from the Sun. • The absence, in the oceans, lakes, rivers and streams and in the soil, of concentrations of chemical compounds likely to be harmful to living organisms. • The maintenance of biological diversity.
Aquatic Ecosystems: • The absence of harmful levels of toxic products from human society. *[Including hormones and hormone-like substances].* • Phosphorus (from superphosphate *[and detergents]* at levels below those leading to eutrophication (blue-green algal overgrowth and bio-toxicity). • Stratospheric ozone levels sufficient to prevent ultraviolet radiation damage to oceanic plankton (reducing food cycles and total biomass).

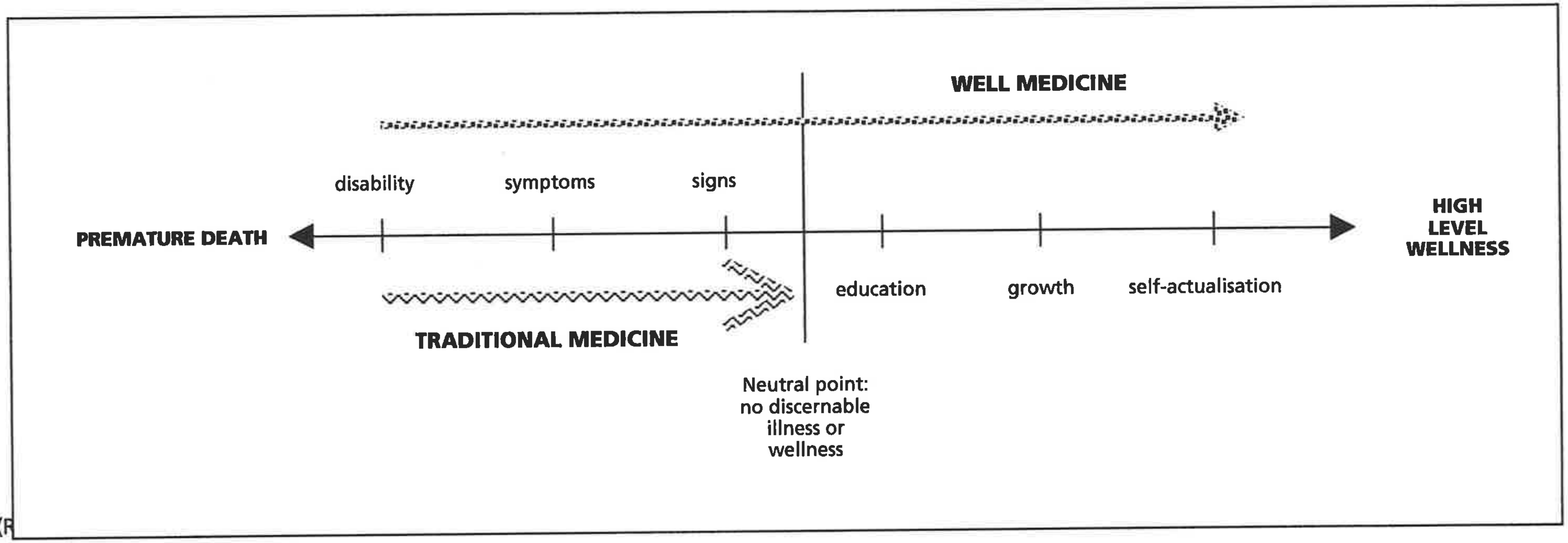
(Based on Boyden 1990: 31,32): *"Basic Health Needs of the Ecosystems of the Biosphere"* (Table 1.2; text).

Table 81: RRCMES: Human Needs - Summary

Source	Type	Needs (Positive)	Needs (Negative: 'absence of…')
Transactional Analysis (From Social Psychiatry) (Berne 1964;Berne 1972)	Basic Psychological; evidenced by psychological 'hungers': Position, Stimulus/Recognition and Structure Hungers.	Existential Position (Basic Position) about life, self, other people, biosphere. STIMULUS: depression if understimulated; STROKE THEORY and STROKE ECONOMY explain how this works. STRUCTURE: psychologically meaningful ways of filling time: WITHDRAWAL, ACTIVITIES, PASTIMES, (psychological) GAMES, RITUALS (formal, informal), INTIMACY.	
Human Scale Development (From Economics) (Max Neef 1994;Max Neef 1991)	Psychosocial	Subsistence, protection, affection, understanding, participation, idleness (downtime), creation, identity, freedom. Satisfiers, Synergic Satisfiers.	Destroyers PseudoSatisfiers.
Maslow's Triangle (From Humanistic Psychology) (Maslow 1968)	Basic Survival Needs: hierarchy.	Survival Quality Ethics.	
Third Line Medicine (From Wholistic, Preventive Medicine) (Ardell 1977: 11-13)	High Level Wellness (categories).	Productivity, relaxation, sleep. Personal care, home safety. Nutritional awareness & nutrition. Environmental awareness. Physical activity & fitness. Emotional maturity & expression of feelings. Community involvement. Creativity & self-expression. Automobile safety. Parenting. Stress control. Self-responsibility.	Dys-Stress Toxins Alienation Alienation from Nature.
Logotherapy (From Psychotherapy) (Frankl 1962)	Transcendence.	Meaning.	
Ottawa Charter	WHO Healthy Cities	Peace, shelter	

Source	Type	Needs (Positive)	Needs (Negative: 'absence of...')
	Principles: Ottawa Charter for Health Promotion.	Education Food Income A stable eco-system Sustainable resources Social justice and equity.	
Human Ecology (From Evolutionary Biology) (Boyden 1990: 44-5)	Well-being: contributors, partly substitutable; optimal ranges common.	Clean air. Natural diet (metabolically required calories, nutrients; balanced chemistry, food classes; fibre). Clean water. Protective dwellings (from climatic extremes). Emotional support network: care-exchange, information sharing. Cooperative small group opportunities. Nature-appropriate sensory stimulation. Diversity of exercise & rest patterns. Creativity & manual skills: opportunity & incentive. Recreational activities: opportunity & incentives. Interesting & appropriately dynamic environment. Spontaneity: opportunity. Variety of daily experience. Behavioural outlets: common tendencies. Realistic, achievable goals with short cycles. Environment & lifestyle: community involvement, purpose, belonging, responsibility, challenge, comradeship, love.	Contamination (hydrocarbons, sulphur oxides, lead and so on). Noxious food contaminants & additives. Chemical & micro-pathogen contamination). Harmful EMR (alpha, beta, gamma, ultraviolet & X-rays). Excessive or inadequate sensory stimulus. Excessive rate of change. Environment & lifestyle: sense of alienation, anomie, deprivation, boredom, loneliness, frustration.

Figure 44: BICM: Wellness Continuum



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[Note the use of Maslow language of 'self-actualisation. ***Link: Figure: Maslow Hierarchy below]****.*

Figure 45: BI: MDF (Medium Density Fibreboard)

This material is one weight of a range of wood panels made from plantation wood fibres, urea formaldehyde resin (glue) and paraffin wax, It is used for furniture, carpentry, doors, cabinets, backings for laminates (benches) and art works (cheap picture framing - backing), mouldings, skirting boards and general building. It has largely replaced plywood It is made by a heat-cured process under pressure. It burns, but is not a major fire hazard, developing smoke, heat and flame at levels not considered high-risk, except that accumulated dust may be explosive. It is widely used because it is cheap, versatile, does not warp, and is easy to work and shape.

he proportions of ingredients of MDF are: Wood: >85%; 'MUF' - Melamine Urea Formaldehyde (MUF) <13%, quoted as 0.025% free formaldehyde by weight; Paraffin wax <2%. The following characteristics are of interest to building biologists:

MDF should be stored in a well-ventilated place, not near heat; workers should wear skin, eye and nose protection when handling it, vacuuming dust up daily, wet mopping floors daily, wearing protective gloves, and washing work clothes separately and often.

Wood Dust

Health effects from dust: when sawn, sanded, drilled, routed, planed etc. Softwood & hardwood dusts are listed sensitisers (allergy, asthma), requiring protective clothing, face masks and vacuum extraction at point of production. Health impacts include: irritation of nose, throat, eyes, skin; allergic dermatitis, asthma; nasal & paranasal sinus cancers.

Formaldehyde (all sources)

Health impacts (MDF) include: irritation of nose, throat, eyes, skin; allergic dermatitis, asthma; nausea, vomiting, diarrhoea, dizziness, lethargy (at 0.5ppm); cancer (at 0.3ppm); aggravation of existing asthma, allergies, asthma, emphysema & hay fever (at lower levels). A sensitiser & Category 3 carcinogen (nose & naso-pharynx). Released: from stored MDF, especially when cutting, when heated (say in kitchens, near stoves or fridge backs), and over time (half life approximately 4-10 years: a function of temperature & humidity). Outgassing can be reduced by painting (assume non-toxic paint), but non-visible backs of boards not normally painted. Particularly high in new homes, renovated homes, caravans, portable buildings, and homes with new particle board, unflued gas heaters and smokers. NH&MRC standard: 0.1ppm: often surpassed in above list.

Formaldehyde outgassing comes from many other indoor sources, including carpets (moth-proofing and glue), furniture (glues, boards), paper products, floor linings, particle board, chipboard, plywood, wooden toys, tobacco & natural gas combustion, cosmetics, soaps, pharmaceuticals, cleaning agents and fabric finishes. In my medical practice I was consulted by a large number of people who were hypersensitive to formaldehyde. These people are sensitive at levels far below Worksafe Guidelines.

Paraffin

Health impacts: hydrocarbon fumes/vapour, may irritate nose, throat, eyes, skin. Sensitiser, possible carcinogen as component in multi-chemical cocktail.

In both Germany and Sweden (1993) I was informed that formaldehyde glues were banned for building: they use water-based glues or pressure treatments for fibreboards, without glue. Small businesses rarely observe OH&S procedures with materials such as MDF, and workers are clearly at risk from using it.[§]

Formaldehyde is only one of a number of hazardous chemicals found polluting indoor air. But it is second only to natural gas as a powerful, sensitiser, and associated with *Sick Building Syndrome*.

(Sources: MSDSs for CSR and Canterbury Wood Panels; Murdoch University Course Notes N222: *"Pollutants & Toxicology"*, 1989: 241-2; Author: clinical experience).

Table 82: ES: Building Biology Principles

• Houses located away from centres of industry & main traffic routes. • Houses located in spaciously planned developments with ample 'green' areas. • Use of non-toxic and untreated natural building materials. • Use of wall, floor and ceiling materials that allow air diffusion. • Use of building materials that are hygroscopic (can absorb and release water vapour) to help moderate indoor humidity. • Interior surface materials that allow air filtering and neutralisation of air pollutants (ie materials capable of 'sorption'). • Balancing heat storage (thermal mass) and thermal insulation levels to provide a comfortable interior living temperature.	• The use of radiant heating and the use of solar energy wherever possible. • Adequate protection from noise and infrasound vibration. • Maximum use of natural daylighting and colours in the interior. • Minimising artificial electromagnetic fields while maintaining natural magnetic and electrical fields. • Use of construction materials that do not contribute to environmental degradation or pollution in any aspect of extraction, manufacture, installation and use, and do not exploit limited or endangered natural resources. • *Avoidance of fluorescent lighting and 'Faraday Cage Effects' from inappropriate steel frame structures and electrical wiring.*

(Source: *"Working Papers in Building Biology"* from Talbott 1993: 1-11; *Author*).

Table 83: BIES: Sundsval Community Health Strategies: Case Examples

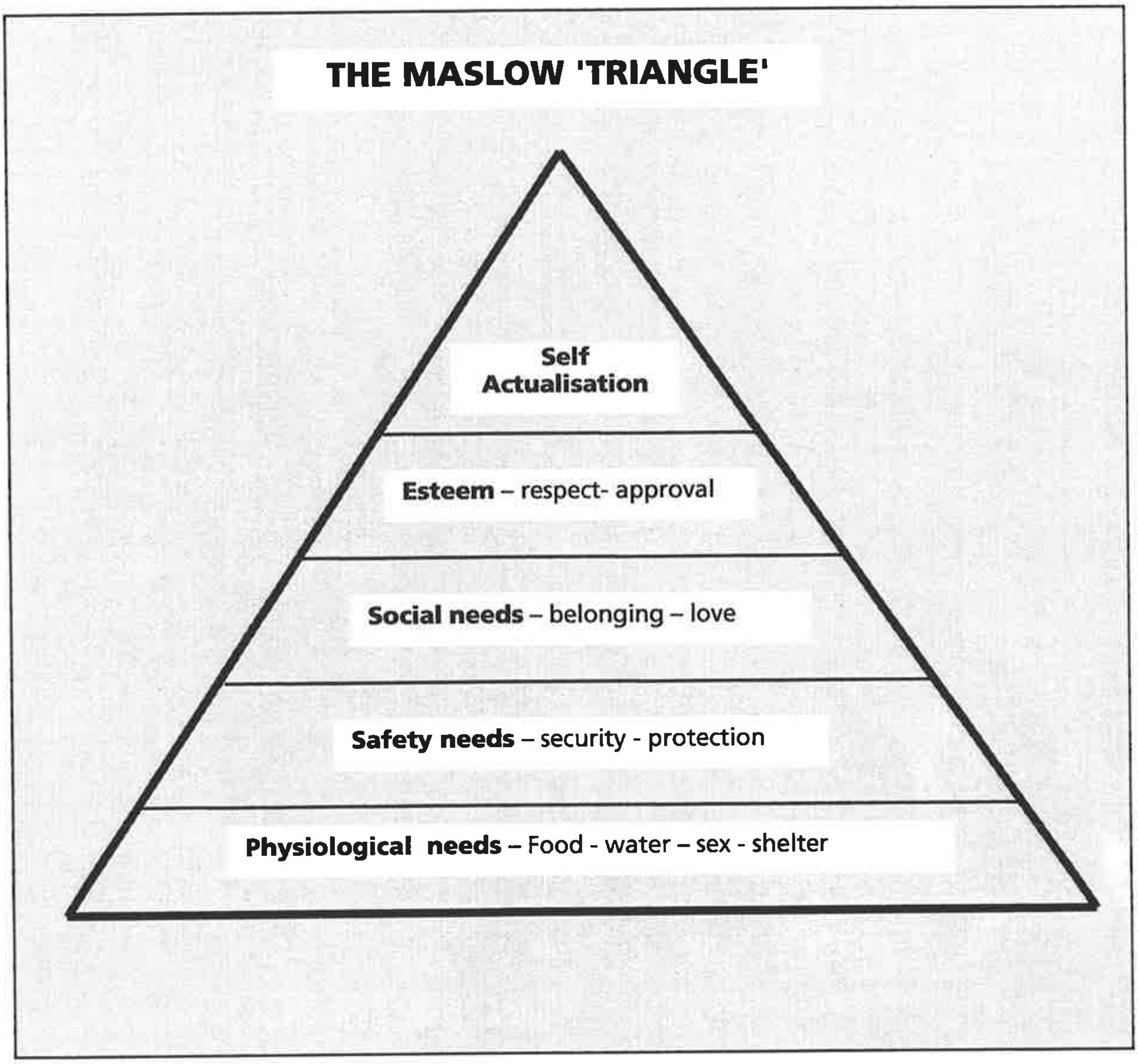
Strategy	Story (Case)	Case details
Policy Development	Food security is making your own food	Nigeria. Basic capability; regional cooperation. Increase indigenous crops, not wheat.
	Norwegian food policy changes eating habits	1976 legislation: first country to do so. Measures re agriculture & fishery, pricing policy, industrial processing, trade & food marketing, nutrition education & information, legislation, research, health policy. Reduced margarine, butter, milk; increased fresh fruit & veg., cereals, low fat dairy, cheese & meat. Agriculture-health sectors linked; new institutional framework to deal with concerns.
	Large public health gains from tobacco tax	California, forced by referendum 60/40 when officials refused to act; 1990. Recycling of taxes into education, health, research etc. Smoking levels also reduced cf USA as whole.
	Clean air policy Los Angeles	3-stage management plan.
Regulation	State & business unite behind new healthier food laws	Canada, science based, community involved. New nutritional guidelines, low fat all sectors. Multi-sectoral, multi-level; positive outcomes.
	Hard-hitting anti-smoking campaign shows progress	Mauritius. Multi-sector, NGO, task forces. Target indoor pollution public places & transport.
	Can workers regain control & improve health?	Italy, OH&S. Mass movements. Subjectivity accepted. Workers empowered. Health service set up. Ground to halt 1980 & going backwards.
Reorienting Organisations	From health care to health promotion	Oxfam, Save the Children.
	Future-oriented technology makes sustainable profits	Switzerland 1986. International business group, goal to set up sustainable technology. Issues confronted include: pollution, emissions, deforestation, metering, consciousness raising in business community. Define sustainable development: "generating maximum income from a given stock of assets without depleting the capital base". Reframing of sustainability question from 'who will pay?' to 'how can we fully integrate the value of the environment into operations & conserve for future generations?' (:13).
	Equal pay & a say for women in a Swedish garment industry	Sweden. Whole garment sewing, not piecework, employees interchangeable *[see watchmaker quote from Allen & Hoekstra]*. Work teams not personnel managers; full cycle responsibility & production decision making; same salary for all. Flexible hours; self-recording of time without time clock. Profit-related bonuses; great demand for vacancies. No new injuries (previous high, musculo-skeletil, psychologial stress, bad ergonomics, monotony, fatigue, dust & chemical exposure, no control).
Advocacy	Small lenders pay back	India.

Strategy	Story (Case)	Case details
	better	By Government directive, loans to the poor *[Grameen Bank not mentioned in these notes]*. Bank assists with capital, marketing, education.
	Disaster victims helped by state – volunteer collaboration	Canada. Networks give information, housing, emotional support. Provider partners: multi-level government services, volunteers, community meetings, counsellors, child-help group.
Building Alliances & Mediating	School children popularise health	Indonesia: 'Little Doctor Programme'. Grade IV-VI children as role models for school, home, community. Model healthy lifestyle, hygiene, avoid risky behaviour. Must participate in environmental action also: sewage, refuse, water, food storage, public health, mosquito control, feedback on health needs of others, logbooks, diaries. Trained, monitored, evaluated. Major benefits; spreading throughout Indonesia.
	People pinpoint & solve their own problems	Chile: Community Diagnosis. Communities, health workers, authorities working together. Ownership changes attitudes; much gets done.
	Scientific farmers get bigger harvests	Uganda: problems with unhygienic traditional methods, political instability, resource scarcity. Partnership: agencies, farmers, multi-departments; advice, bulletins, weather reports, scientific information. Food early warning system.
	Local skills harnessed to tackle housing & environmental problems	Scotland (Glasgow): council housing shortage, high unemployment. Council + NGO activities using unemployed & EEC funding for housing & environmental programmes: 'Heatwise', 'Landwise', etc.
Enabling	Youth farm project stimulates democracy	Bremen, Germany: poverty trap area, Neo-Nazi activity; many risks & poor prognosis for youth. Community Conference: City Farm Project: animals. gardening, building, dancing & music groups. Integrated experiences & responsibility opportunity for youngs. Major obstacle was to get politicians to invest in youth & long-term.
	Music movement empowers marginalised people	Norway: orchestras, choirs, bands, concerts by mentally handicapped. Based on system by father of mentally handicapped of easier music teaching. Sweden similar, with wide range of 'expressive art therapies'. Spreading internationally. Develops self-esteem, mastery, confidence, better health.
	Empowerment dispels humiliation in parents	Guatemala: shame preventing parents from seeking help for malnourished children. Reframing to community development of pre-school building project affirmed self-esteem + provided accepted health interventions.
Mobilising & empowering	How can good village projects be maintained?	Kenya: empowering local villages. International Swedish NGO + youth volunteers + Government + local hospital adult education programme + millet for

Strategy	Story (Case)	Case details
		income + better transport + food preparation changes. Concern re continuation when NGO leaves or if millet prices drop.
	An injury to one is an injury to all	Zimbabwe: traditional unequal wealth. Linkages between health & work conditions: Trade Union work: teach re rights, negotiate better conditions, research on OH&S, & environmental health. Capacity building = first major step.
	Tenant self-control improves housing	Netherlands: Housing Association formed. Maintains social network; renovation rather than move on; control by tenants; HA does minor repairs; green space control; opportunities for youth (paid work); reduced vandalism. *[See Plate 2: Blå Kilde Gärde Collage].*

(Based on Haglund,Petterson,Finer & Tillgren 1992: 8-20).

Figure 46: BICMES: Maslow's Hierarchy of Needs



(From Maslow 1954).

Abraham Maslow was a personality theorist whose special interests included human motivation and personal growth. His theory is still taught as central to modern marketing practice. Maslow believed each individual to have a basic drive to *'Self Actualisation'*: the fulfilment of individual potential: a will to psychological health. He proposed a simple hierarchy of basic needs, which if not met, resulted in psychological discomfort and maladjustment.

The lowest order, *Survival Needs* are fundamental, and have to be met in order to go on to higher needs.

Several layers of *Intermediate Needs* involve increasingly personal issues as the hierarchy is ascended. His term *'unconditional positive regard'* (esteem from others) is equivalent to TA's *'unconditional positive Stroking'*. The centre zone is very much about a person's relationship to society, and to quality of life, the survival needs having been met: the 'options layer' as some say.

The highest order of needs is Self Actualisation, which he termed *'meta-needs'*. These include drives to creativity (and many here include Ethics and Spirituality).

(Lazerson 1975: 435;Maslow 1970;Maslow 1954;1968).

Table 84: ES: Organic Order: Principles of Building & Planning for Meeting Human Needs (Alexander)

Organic order (Definition)
"The kind of order that is achieved when there is a perfect balance between the needs of the parts and the needs of the whole" (Alexander, Silverstein, Angel, Ishikawa & Abrams 1975: 14).

The University of Cambridge is a good example, but its organicity is disappearing as its traditions are being lost. The book *The Oregon Experiment"* demonstrates these Principles as applied to the University of Oregon (Alexander *et al.* 1975: 5-6, 15-187), as explained below.

The following Principles must guide the planning & building process if it is to meet human needs:

1. **Organic order** - allows the whole to emerge gradually from local acts.	1000s of small acts can create larger, global order if each pattern always contributes to larger pattern too. *[Emergence]*
2. **Participation** - all decisions about what & how to build are made by the users.	Enables creative control & ownership. Only way to meet user needs reliably. Users do design, architect s hired to draw it up. Max. group size = 10 for involvement directly; 50-100 indirectly; >100: delegation needed, clumsy & impersonal representation invariable.
3. **Piecemeal growth** - construction in each budgetary period proceeds overwhelmingly through small projects.	Small projects never compete for funding with large: balance required between large, medium & small. ***[Key point]*** Small projects: no waiting period, fund as lump sum. ***[Key point]***
4. **Patterns** - all design & construction is guided by "a collection of communally-adopted planning principles called patterns". "... an empirically grounded imperative, which states the preconditions for healthy individual and social life in a community." (:101)	Patterns restore traditions & shared Principles. Are general planning principles: clear problem statement + empirical evidence + examples + application range + general features required for buildings or plans to solve the problem + related Patterns. 250 Patterns identified: include 160 re interiors, gardens, building construction, non-global; 55 global, formal, <u>overarching</u>; add intuition → composite map.
5. **Diagnosis** - well being of the whole is protected by annual diagnosis of live & dead spaces.	Diagnostic Map (organic, flexible, unpredictable, repeated 'diagnose & repair', process & community driven) vs Master Plan (totalitarian, rigid, discounts humans, alienates users, fails).
6. **Coordination** - slow emergence of organic order is assured by a funding process which regulates the stream of individual projects put forward by users.	Truly organic order from individual freedom coordinated by mutual responsibility, not constraint/control. Open session decisions prioritised on agreed Patterns & diagnosis. Separate process for different Scales.

Table 85: ES: 'Large Lump' vs Patterned, Piecemeal, Organic Developments

'Large Lump' Developments	Piecemeal Developments
Assume new better than old.	
Big buildings alienate & treat people like objects; committees can't approach emotionally.	Ownership, responsibility, identification from direct involvement.
Buildings torn down, assume perfect, built complete, no change for finite period, then replaced.	Gradual series of changes, growth & repair constantly - embellished, modified, improved, reduced, enlarged; tradition of thousands of years.
"Worse than piecemeal development in nearly every way that matters." Cost. Maintenance. Tie up building & maintenance funds from small projects → uneven development, slums, dead centres, with huge funding only once every few decades; static, resource consuming.	More buildings & usable space per dollar. More prudent & multi projects for same price. Dynamic, evolving, resource conserving. Cost per sq.ft.net usable space increases exponentially with height to 2 stories & >20,000 sq.ft:, BUT 3-4 stories maximum. Dysbenefit beyond that & huge resource increase (steel frames, lifts, size, culture).
Destroys human places & replaces with a monolith.	Repairs & gives human character.
No mistakes budget; errors large scale, costly.	Assume & budget for mistakes.

(See also Alexander 1979;Alexander,Ishikawa,Silverstein & and others 1977).

Table 86: CMES: Max-Neef Social Needs

	Personal & Social Satisfiers			
	Having (options, tools, resources, institutions)	**Being** (desirable states)	**Doing** (personal & collective action)	**Interacting** (milieus, times & spaces supporting)
Subsistence				
Protection				
Affection				
Understanding				
Participation				
Idleness (downtime)				
Creation				
Identity				
Freedom				

(Reproduced from Max Neef 1994). Matrix used as a workshop tool for community building and goal setting, 1994.[§]

Table 87: CM: Satisfiers after Max-Neef

Type	Description	Examples
Singular	One need only	Water for thirst
Synergic	Meets multiple needs simultaneously	Participatory democracy, education, meditation, breast feeding, wholistic medicine
Pseudo-satisfier	Appear to meet needs but actually harm	Representative democracy, aggregate indicators, stereotypes, nationalist chauvinism, prostitution, charity, status symbols, fashions & fads
Violator/ destroyer	Prevent satisfaction, often around Protection	Arms race, exile, censorship, bureaucracy, authoritarianism.

(Max Neef 1994: 8-9).

Table 88: CEBI: Multi-Level Policy Implications of Action to Reduce Impact of Motor Vehicles Based on Car as Attractor

Scale Strategy	National Government Action	Regional Government Action	Local Government Action	Policy & Planning
Car Disincentives				
True Cost Pricing	• systemic change: TCP guidelines	• true cost: regional interpretation	• true cost: public information	• economic system
Decrease Convenience		• priority routing to transit • decrease parking available • decrease required parking • increase parking charges (?levy) • ban car from centre/ from whole development • traffic calming & speed limits	• inconvenient routing • pedestrian priority • cyclist priority • limit parking • distant parking • ban car from centre • time limited parking	• coordinated traffic plans
User Pays	• emission standards • carbon tax • emission tax • fuel taxes	• electronic tagging system • annual check roadworthiness •zoned licencing • parking levy	• parking charges • road tolls	• policy levers
Improve Alternatives	• R&D funding			• coordinated transport policy
Transit	• subsidise transit (? 'free') • rail & transit subsidy> road subsidy • transport interchange subsidy • fuel research funding	• transit early in developments policy • transport interchange • light rail • slow vehicle regulations • bicycles on transit • needs responsive (surveys) • service paradigm • quality	• sheltered waiting • reserve land for • park & ride • drop-off zones • routing location & stop frequency • landscaping	• transport integration
Bicycles	• subsidise commuter cycle systems	• land reservation • integrated cycleways/slow ways • road design • standardised common trenching (coordination, safer maintenance) • require bicycle facilities (park) at all businesses (not new buildings only) • cycles on transit	• land reservation • integrated slow ways • good lighting • building approvals require secure cycle facilities	• traffic planning • traffic planning includes bicycles • road design • service coordination • building codes • land use planning • subdivision guidelines
Other Green Modes (Small Electric Vehicles, Recliner Bicycles, Adult Tricycles, Golf Buggies)	• R&D, support battery technology, green mode devt.	• slow vehicle licencing system • slow vehicle parking requirement • legislation/ regulation for slow modes • co-ord. *slow way* system	• secure parking provision	• traffic planning • traffic planning includes green modes • road design • building codes • land use planning • subdivision guidelines

Scale Strategy	National Government Action	Regional Government Action	Local Government Action	Policy & Planning
Pedestrians		• traffic calming • guidelines for local areas • coordination of walkways	• traffic calming • design shared space • pedestrianised centres • safe walkways • separate from cycles & cars • winter shelter • well lit ways • pedestrian percolation	• safety • traffic planning includes pedestrians • subdivision guidelines
Alternative Needs Satisfaction		• policy to meet actual needs	• establish needs specifically	• needs based planning
Commuter Traffic	• IT&T, R&D	• speed limits • relatively indirect • fast, cheap, frequent, pleasant, convenient alternatives • express lanes • intersection priority • dedicated lanes • efficient routing & connections • coord. With bicycles	• coordinate sharing arrangements • park & ride facilities each area	• efficient non-car commuter policy • integrated transport modes
School Traffic		• school zoning • provide school buses • school bus times more options (meet needs)	• school bus stop supervision • safe waiting areas • density increases: surveillance for child public independence	• routing & timetables • safety issues • child-friendly city policy (*barnevennlig*)
Shopping Traffic	• housing guidelines (*AMCORD Urban*) R&d, it&t systems	• teleshopping/ virtual reality shopping • delivery coordination system • subsidise electric delivery fleet • public transport delivery system?	• community shopping • coord. Bulk shopping • delivery services • demand responsive small local systems • house design for secure deliveries	
Psychological Issues -Ego Definition -"Down Time" Commuting	• emotional literacy education guidelines • funding for emotional literacy training • R&D funding car psychology, sociology, anthropology	• emotional literacy regional policy • emotional literacy school curricula • group leader training & funding • ethical standards	• stress reduction classes • emotional literacy classes • assertiveness training • meditation training	• emotional literacy literacy policy, R&D, guidelines
Urban Conditions				• urban modelling & remodelling

Scale Strategy	National Government Action	Regional Government Action	Local Government Action	Policy & Planning
Reduce Emissions	• Clean Air Act: Health & Safety • emission guidelines & standards • GIS emission mapping • transparent emission & energy targets, public education	• emission control legislation & fines • smoky exhaust reporting system • publish emission indicators • annual checks roadworthiness • registration differentials for old & large engines • clean transit fuels • traffic light coordination	• local emission maps & targets • local eco/emission watch • plant trees • school assists with monitoring programme	• emission standards & guidelines • transparent targets • indicator publicity
Constrain Extension		• absolute urban extension limits • long term urban form remodelling	• encourage good multi-storey design • urban density minima • no extension	• planning long term • review regular • constrain urban form: urban extension policy • remodelling
Minimise Movement	• petrol taxes • fuel taxes IT&T development • home office tax benefits • home office industrial legislation • support IT&T development	• mixed use zoning • eco-zoning • local worker education (ensure locally employable • distribution/ decentralisation of facilities • IT&T development • IT&T loans with housing (lower interest) • small shops policy (no supermarkets) • home office working conditions • narrow road standards	• telecottages setup • local business incubators • small shops policy; ban supermarkets • housing provision near workplaces • pedestrianised centres • density minima • ensure cafe/meeting places plentiful: reserve space; encourage hospitality industries • reserve transit space • attractive streetscape • kerbside services: mulching, recycling, deliveries • home office standards	• IT&T development • decentralised facilities • density control • industrial issues eco-zone & home office • policy levers
Transit Access	• transit subsidy	• early devt. Transit policy • transit to workplaces • density zoning // transit	• ensure transit in site planning • TOD domestic & work, all areas serviced	• policy transit oriented work & housing
Protect Habitat	• environmental policy (biodiversity) •urban Landcare support	• biota survey • conservation plan • corridor plan • urban fringe buffers • urban catchment management	• tree planting campaigns • restore & replant watercourses • bicycle paths, maps • education encourage cycling	• strategic urban- environmental policy • urban *Green Plans* • cycling pleasure programmes • ensure biodiversity & habitat guidelines in Devt. Plans
Education				
Strategic Processes	• educate decision makers • decide on key strategies • educate public • evaluate & report to public	• educate decision makers • decide on key strategies • educate public • evaluate & report to public	• educate decision makers • decide on key strategies • educate public • evaluate & report to public • enlist public assistance in monitoring (eg schools)	• clear goals • leadership • integrated effort • evaluation.

(Rounsefell 1994d: 154-7).

This table is included not to read in detail, but to indicate why car dependence has such tenacity as a *Synergic Satisfier* and *PseudoSatisfier,* as well as its role as a *(Synergic)* environmental *Destroyer*. Voluntary relinquishment is unlikely unless these <u>needs can be met in other ways</u>, <u>and</u> the public is sufficiently uncomfortable to change. The best way to deliver such discomfort is clearly financial in our type of capitalist society (since concern about *climate change* has not worked). Where so much is subsumed and symbolised by the dollar, the *Keystone Constraint* or *Entraining Variable* of relatively severe financial levers would work, but only if promoted as successfully as the doctrine of the *inevitability of globalisation*. This type of approach has worked brilliantly in Freiburg im Breisgau, whose community became sufficiently uncomfortable to act at local, city and regional scales 20 years ago. The city has a fully-pedestrianised centre, convenient transport interchange arrangements, and a light rail system that will order taxis to meet passengers at their local tram stops. This strategy set was community driven, and would probably be hard to implement without a community-government partnership.

The table was developed during the *Content Analysis* for the Jerrabomberra Valley National Ideas Competition in 1994, as an indication of the multiple scales and policy areas contributing to *'the car problem'*.

2.2.11.10 CRITERION ECOCYCLES

CONTENTS

Table 89: BIRR: Ecological Services - Ecological Society of America Metastudy

Services	Benefits to Humans	Examples	Impacts & examples
Production of Ecosystem Goods	Wild Products	Fish (protein), sports fishing.	Overfishing, pollution, habitat destruction.
	Grasslands	Labour animals (horses, mules, asses, camels, bullocks...). Animal products (meat, milk, wool, leather...). Domestic animals source habitat (cattle, goats, sheep, horses...). Crops (wheat, rye, barley, oats, corn...). Game animals (waterfowl, deer, moose, elk, fox, boar, other wild pigs, rabbits, snakes, monkeys...).	Habitat conversion diminishes natural sources & resources.
	Vegetation	Food, timber, fuel, fibre, pharmaceuticals, industrial products. Fruits, nuts, mushrooms, honey, other foods, spices. Wood & plant materials (houses, furniture, farming implements, paper, cloth, thatching, rope...). 15% world energy. Industry inputs (gums, exudates, essential oils, flavourings, resins, oleoresins, dyes, tannins, vegetable fats & waxes, insecticides...).	Habitat conversion diminishes natural sources & resources.
Generation & Maintenance of Biodiversity	Production of Ecosystem Goods	As above.	Habitat conversion diminishes natural sources & resources.
	Human Benefits: Resources, Foods, Medicines, Well-being	Aesthetic, spiritual, economic. Agricultural Biotechnology (crop enhancement from wild strains, new species, maintenance of current species). Food security: protect against environmental change (salinisation, temperature, rainfall). Medicinal resources (9/top 10 drugs, 118/top 150 USA, $40bn pa, 85% of 80% traditional medicines). Natural functional variation within single species (different stress tolerance, pests, disease, salinity...).	Protection of only minimum viable populations (library/museum approach) leads eventually to biosphere collapse.
Existence	Life Itself	Evolution & species distribution.	Biodiversity & Climate Change: fossil fuel & nitrogen fertiliser use; unsustainable agriculture, squandering & toxification of land & water resources; overharvesting of 'renewables'; unsustainable population growth, consumption levels, technologies, social attitudes & institutions, 'rights' without 'responsibilities'.

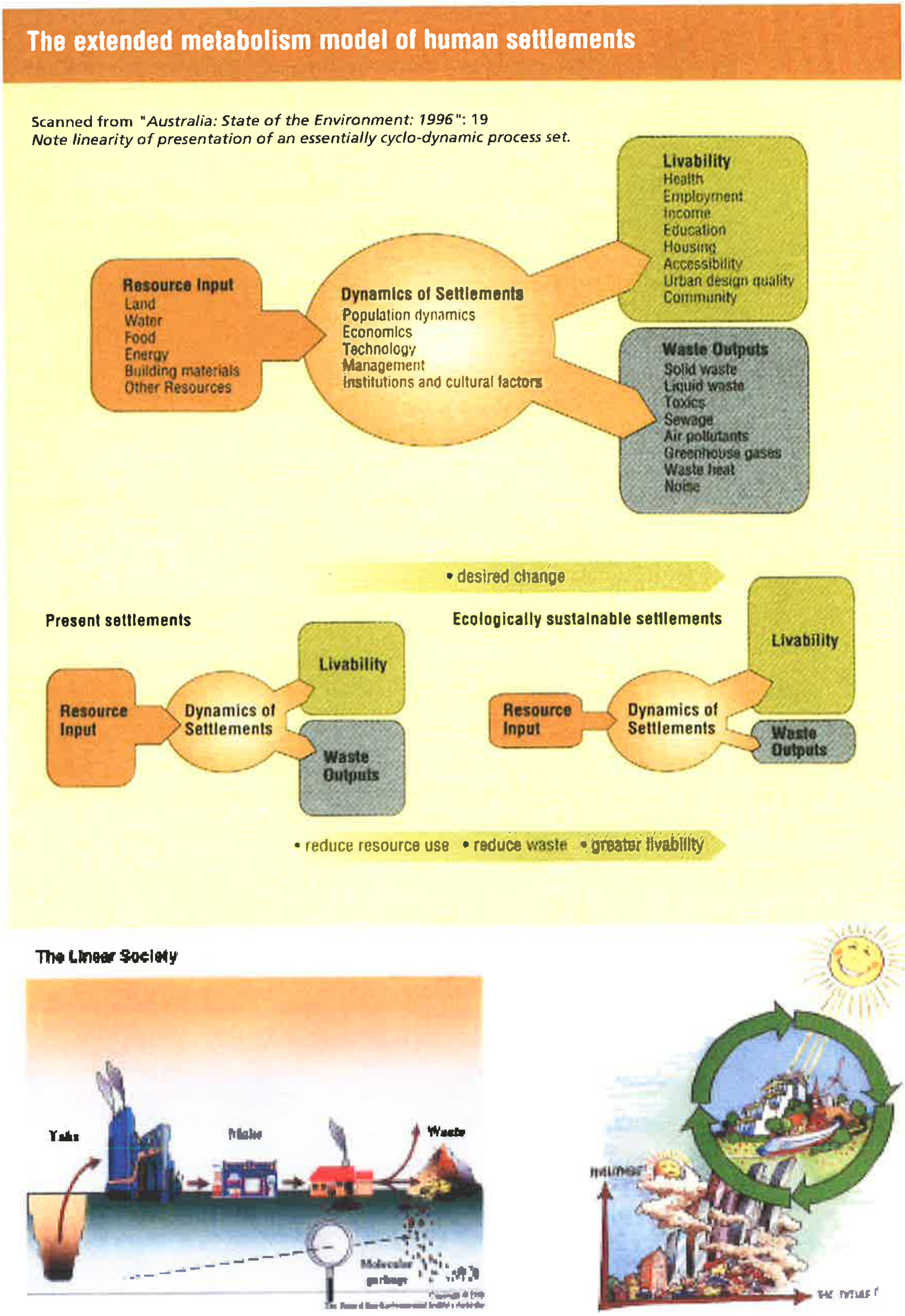
Services	Benefits to Humans	Examples	Impacts & examples
	Habitability of Earth	Regulation of global climate (stabilisation of positive feedback).	Sea level changes (cooling drops level, exposes continental shelves to erosion, habitat loss, nutrients to phytoplankton → CO_2 uptake → further cooling). Impacts on bacterial activity on detritus → increased release CO_2 → speed up warming).
		Modulate regional weather (transpiration, rainfall, insulate from temperature extremes, desiccation, cooling by winds, trap warmth), [Protection for extreme climatic events].	Transpiration → thunderstorms → limit moisture loss from region → surface cooling. Forests recycle 50% of mean annual rainfall; moderate temperature extremes; shade & surface cooling; insulation: block winds, trap warmth, local greenhouse agents.
Flood & Drought Mitigation	Productivity of Land, Water Management: Quantity & Quality of Water	Soils absorb water, filters water, deliver water to plants, aquifers & streams. Plants & litter protect soil from erosion, keep water & most nutrients in local area. 119.000km3 water = global annual total rainfall (≡ 1m average land cover). Living vegetation ≡ a huge pump (evapotranspiration), maintains rainfall. Wetlands: flood control, capture sediments, high rainfall detention, → delayed saturation of soils uphill, damp peak flows; small relative areas → mitigate large floods.	Water compacts earth, creates mud, blocks aeration, increases runoff, creates clogging, loses soil to waterways. Soil loss → silting, turbidity of aquatic systems; locally → decline in production potential, decreased filtration, lower water availability, nutrient losses; downstream → water quality & availability impacts, siltation of rivers, harbours, irrigation, hydroelectric reservoirs ($US6 billion pa globally); flooding (increased frequency & severity). Clearing → 40% increase runoff to streams, up to 5x greater; flooding, drought, soil loss & impoverishment.
Soil Services	Food & Production Seed & Plant Nurturing	Soil productivity/ fertility supports whole civilisations (1.4 billion ha global cropped area 1993 compared with a few thousand ha). Soil shelters, anchors & supports seeds & young plants ($US55,000/ha for hydroponic 'equivalent'). Nutrient holding & delivery to plants; holds cations (Ca^{++}, Mg^{+++},etc) near surface near roots for slow release; buffer for fertilisers. Waste decomposition (dead organics), decomposition of pathogens & toxins, processing of garbage, industrial wastes, residues (crops, forestry), sewage, animal dung (130 billion tonnes pa, approx 30% human origin, most agricultural); breakdown of large, complex molecules. Microbial nutrient release for use by other organisms; recycling of nutrients: denaturing, decomposition, detoxification (by bacteria, fungi, algae, crustaceans, mites, termites, springtails, millipedes, worms) of soaps, detergents, pesticides, oil, acids, paper (not DDT, most plastics). Nitrogen fixation (some bacteria) → protein component for humans, plants, animals.	Ruin of once flourishing societies historically through soil abuse. Conversion of land to agriculture, drainage of wetlands → CO_2 & CH_4 (methane) ie, Greenhouse gases. Fertiliser production & use, biomass fuel burning (including wood), & tropical land clearance → nitrous oxide (Greenhouse gas & ozone layer destroyer). Nitrogen cycle disturbance → acid rain, eutrophication of freshwater systems, estuaries, coastal waters; contamination of ground & surface water (drinking: nitrates).

Services	Benefits to Humans	Examples	Impacts & examples
		Fungi (some) → nutrients to tree roots. Mechanical soil 'blending' by ants & earthworms (10 tonnes per ha p.a. via earthworms → casts) → (soil aeration, nutrition, stabilisation, hydration, drainage channels. Regulation of major element cycles: C, N, S; soil carbon = 1.8 x vegetation carbon; soil nitrogen = 18 x vegetation nitrogen.	
Pollination	Flowering Plant Production	Animal pollination (most flowering plants: 220,000 of 240,000 species: 70% of agricultural crop species). Pollinators: >100,000 species (bees, bats, butterflies, flies, birds…). Pollinator habitats: needed to support pollinator life cycles. Wild pollinators: 1/3 human food dependent on; native habitats dependent on; worth $billions; >60 genera threatened, endangered or extinct; importance increasing with decline of honey bees (disease, African killer bee hybridisation since 1956).	Wild plants under extinction threat. Threat to plants in croplands, gardens, rangelands, forests (pollination failure). Habitat destruction → pollinator extinction (wild and honey bee).
Natural Pest Control	Crop Protection	Herbivorous insects, rodents, snails, nematodes, fungi, viruses. 99% potential crop pests controlled naturally (birds, spiders, wasps, flies, ladybirds, microorganisms…). Value $billions (direct protection, reduced need for chemicals).	Pests compete for food, wood, fibres (destroy 25-50% of world crops pre or post harvest). Weeds limit yields by direct competition (water, light, nutrients). Chemical pesticides often → side effects (resistance, habituation – increasing doses needed, kills natural pest predators). Natural pest predators: not evolved with poisons as are pests, so more vulnerable; smaller populations than their prey; explosions of prey (pest) populations from killing predators; non-pests promoted to pests by imbalance (24/25 worst agricultural pests California 1970s from pesticide overuse). Resistance to pesticides: >500 insects & mites; ±150 plant pathogens. Human & other male animal health risks (pesticides: human sperm counts). [Fish, amphibian, human sperm abnormalities].
Seed Dispersal	Plant Reproduction, Fruit, Protein Sources	Wind dispersal. Water dispersal. Animal dispersal (burial, sticky, spiny, hooks, fruit, pine nut cracking).	Clearing may disrupt complex seed dispersal services. Cones may open inadequately, forests not regenerate. New generations of replacement vegetation not advancing: disables recovery mechanisms for resilience to perturbations (for example clearing, fires). [Australian issues with sheep & rabbits interfering

Services	Benefits to Humans	Examples	Impacts & examples
			with regeneration of mulga & rangelands].
Aesthetic Beauty, Intellectual Stimulation, Spiritual Stimulation	Psycho-Socio-Spiritual Benefits	Art, photography, tourism, film-making, outdoor recreations (hunting, fishing, bird-watching, pet-keeping, hiking, camping, rafting, boating). Religion, spirituality; inspiration, fulfilment. Aesthetics: peace, beauty, awe, transcendence. [Health: rejuvenation, stress reduction, exercise] Culture. Traditions.	[See Human Needs under Criterion Organism].

(Based on Daily *et al.* 1997: 1-15) Daily et al's s sources: 69 secondary sources and Daily, G. 1997. Nature's Services: Societal Dependence on Natural Ecosystems. Washington DC, Island Press. Ecological Society of America Report.

Figure 47: CM: Extended Metabolism Model vs Linear & Ecocycles-Adapted Societies



Sources: *Ext. Metab. Model*: Commonwealth of Australia 1996: 19; The Natural Step training slide (with permission); *Ecocycles-Adapted Society:* Rolén, 1996: cover Robert Kalgren, (with publisher's permission).

Figure 48: ES: The Natural Step: System Conditions for Sustainability

THE NATURAL STEP: 4 SYSTEM CONDITIONS FOR SUSTAINABILITY (Original Form)

SYSTEM CONDITION 1

Substances from the lithosphere must not systematically increase in the ecosphere

Nature cannot take a systematic concentration of material dispersed from the earth's crust.

Matter can not disappear. Matter dug out at rates greater than re-deposition, builds up garbage in the biosphere. This implies needing to "almost phase out" mining and the use of fossil fuels and nuclear power. "every gram of mercury or cadmium must go somewhere" (eg even in the best case, 5% of battery cadmium escapes into nature for every re-cycle).

SYSTEM CONDITION 2

Substances produced by society must not systematically increase in the ecosphere

Nature cannot take a systematic increase in man-made compounds.

This happens when products or compounds are generated "faster than they can be broken down or rebuilt into new quality". We must phase out plastic, freon, PCBs, DDT and thousands of other persistent substances.

SYSTEM CONDITION 3

The physical basis for the productivity and diversity of nature must not be systematically deteriorated

Nature cannot take a systematic decrease of resources and physical function (with regard to the area of green surfaces we have, soil quality etc.)
Natural resource use must be within productive capacity (eg fishing industry, forestry, impervious covering of the earth with asphalt).

Expansion of the "hard technosphere" onto green land, squandering mineral resources and production of persistent compounds prevents nature from reconstituting itself.

SYSTEM CONDITION 4

Fair and efficient use of resources with respect to meeting human needs

Therefore we must be efficient and just in our economy.

The conditions of 1-3 constrain what can be done, and these apply at all scales and to all countries *[so that allowing LDCs to emulate profligate Western ways is not appropriate for any reason]*. To achieve efficiency for all nations, a just distribution of resources is essential *[apparently cultural change allowing this is the only Attractor which will work]*.

(Transcribed from Robèrt, Internet source Natural Step USA 1996; The Natural Step, 1999a; *Author*).

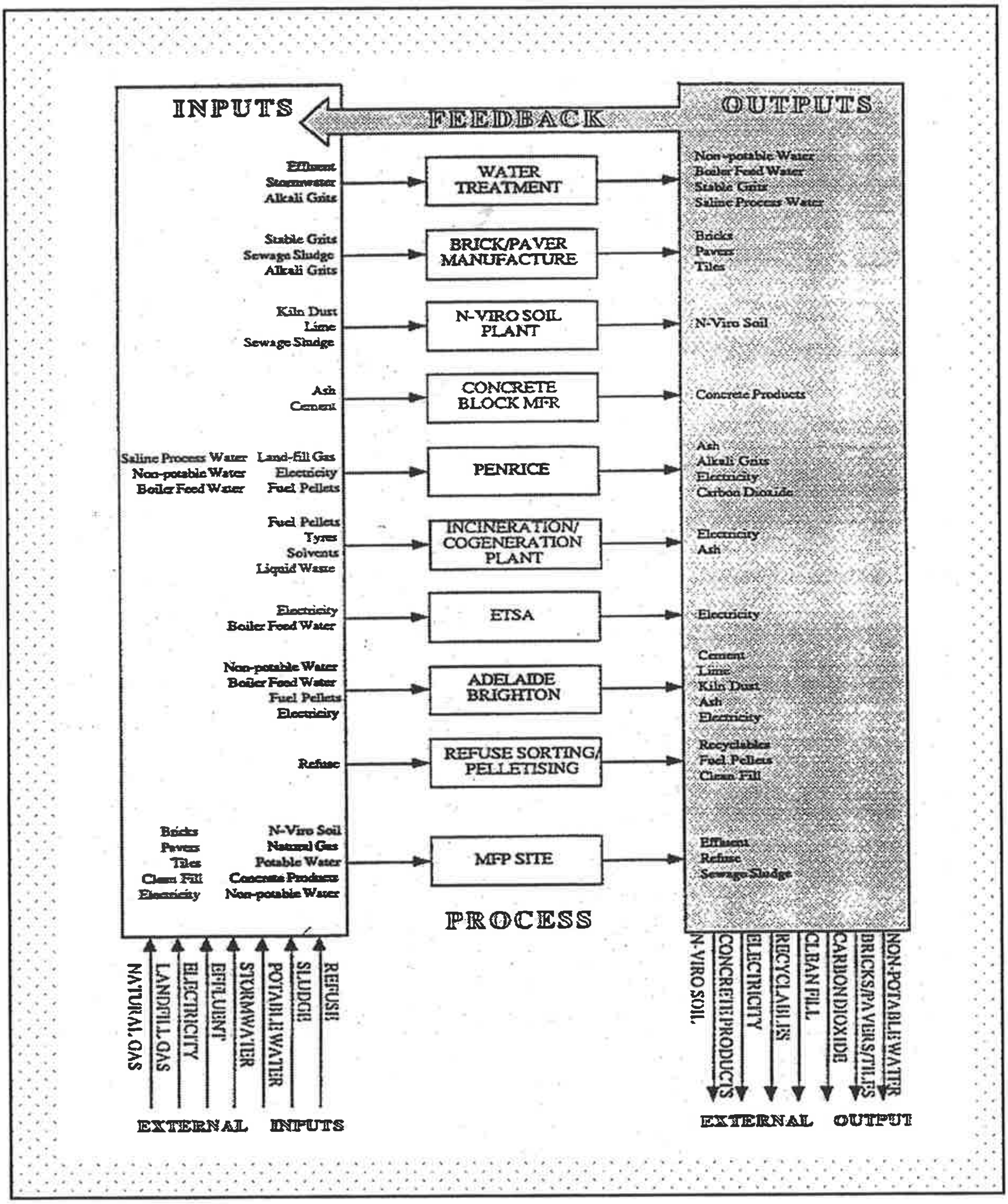
Table 90: FRRRES: MFP and other 'Loop Work' (Ecocycles)

Product & Proponent	By-Product	Use as Resource	Processing	Comment
Wool tops, scouring Geelong wool classers ('Topsoils of Australia').	Dusts, dirt (topsoil residues) (Formerly dumped as dirty water effluent).	Agriculture (topsoil) especially in vegetable-growing areas (Werribee, Vic.), direct to farm; cheaper than fertiliser Domestic gardening (bagged for consumer retail)(future).	New detox. measures for pesticides For development of collaborative effort with other scourers and plant wastes in other loops work (commercial secret, possibly involving vermiculture).	World first [Report 19/11/96 5RN news] German parent company Approved by Dept. Ag., CSIRO, EPA. Melbourne Water.
Soda ash (Penrice factory, Port Adelaide) Human waste stream.	Alkaline grits + contaminated sewage (Port Adelaide) (Formerly dumped in sea & sludge heaps).	Clean effluent for agriculture Bricks, pavers, soil conditioner.	Precipitate heavy metals (HMs) into sludge Toxic sludge + further alkaline products proportion of brick & paver mix locks HMs into brick structure.	Successful process Japan First MFP project, sold as successful business ?1994 high quality bricks MFP identified 52 opportunities for loop work in Port Adelaide factory environment 1992-3.¶
Human waste stream Agricultural waste streams Leather industry WORMS International, many sites East Coast Australia, many municipal areas.	Organic land fill (municipal) Tannery wastes Piggery wastes Lot feed wastes (Formerly to landfill).	Agricultural & domestic soil conditioning fertilisers (super-charged worm castings.	Vermiculture: compost worms + zeolites (calcium, magnesium) Change of substrate minimises toxic effect on worms Different grades of castings depending on substrate.	Large scale WORMS International Use of recycled plastic trays Use of owner land & proportion of profit incentive; far cheaper than alternatives imported from overseas (Germany).
Steel production (BHP Australia, Whyalla).	Iron oxide (Formerly dumped as landfill).	Pigment for house paint (traditional ox-blood appearance).	Mixing.	Opportunity suggested by Urban Ecology Australia.

Sources: unpublished MFP Australia Service Company Information; Thomas Williams, (then) WORMS International, Urban Ecology Australia.§

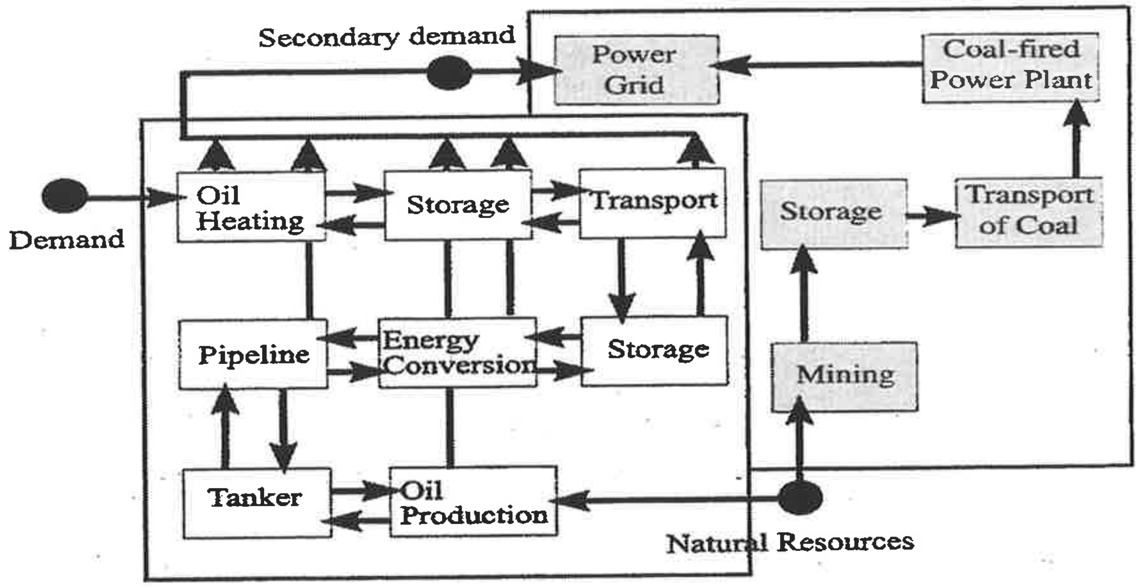
¶Product later withdrawn as heavy metal binding found not to be stable as originally thought.§

Figure 49: FRRRES: MFP Industrial Ecology
MFP LOOP WORK: ECOLOGY FOR PORT ADELAIDE INDUSTRIAL AREA



The MFP identified 51 Industrial Ecology opportunities around the Port Adelaide area. The above diagram is photocopied from an (unfortunately difficult quality) internal document promoting MFP Services in the period before legislation enabling MFP takeover of Technology Park (North of Adelaide) and Science Park (South of Adelaide).

Figure 50: ESCM: Process Chain Analysis & Ecological Rucksacks



The structure of process-chains or networks – energy supply with oil as an example. A demand is sent across the chain until it reaches natural resources as the starting point of the supply activities. Branching occurs due to auxiliary energy demands etc.

Process Chain Analysis (PCA) is a device for tracking impacts across the larger scales usually involved in ecological *Footprints* and *Rucksacks.* Impacts are usually conveniently far from the area in which processing or purchasing take place. (Source: Breuste, Feldmann & Uhlmann 1998: 56).

PCA and MIPS concepts are behind Schmidt-Bleek's Rucksack work measuring everyday materials and services, the latter and transport being the most elusive to track, as they vary so much (Von Weizsäcker *et al* 1997: 342). The following Table gives examples (Source: diagram by von Weiszäcker *et al* 1994: 243).

ECOLOGICAL RUCKSACKS OF COMMON MINERALS

Millions of metric tonnes of Rucksack per annum (global)	Raw Materials 1: Ratio base to ER	Rucksack (ER) : ER	Additional Comments
>10,000	Sand & gravel Natural stone Coal	0.65 1.2 6	Coal: 10,000m mt ER in water & tailings <u>plus</u> 10,000m mt of CO_2.
1000-10,000	Petroleum Lignite	1.01 11	
100-1000	Cement Clay Iron Rock salt Phosphate	10 1.2 14 .03 34	
10-100	Bauxite Sulphur Manganese Ore	1.5 0.9 420	Manganese measurement is for porcelain clay (ceramics & glossy paper coatings)
1-10	Talc, pyrophillite Lead	27 19	
<1	Silver Gold Platinum	7,500 350,000 350,000	A 32g gold or platinum ring represents 3 tonnes of ER.
Other items	Catalytic converter (9kg) Orange Juice (1litre) Car manufacture Newspaper (1lb)	>2.5 tonnes >100kg 15tonnes 10kg	Clear case for recycling Soil & water + transport Solid waste + water used + water polluted.

Figure 51: BIES: RAIA Natural Environment Policy

NATURAL ENVIRONMENT POLICY 1994, 1998
ROYAL AUSTRALIAN INSTITUTE OF ARCHITECTS (RAIA)

"2. OBJECTIVES

In general terms, the objective of the Policy is to conserve and enhance the natural environment such that the ecological processes on which life depends are preserved or restored, thereby providing the opportunity to maintain or improve the quality of life, for current and future generations.

To achieve this objective, the Policy advocates the following specific initiatives:

* Maintain and enhance bio-diversity.
* Minimise the consumption of resources, especially non-renewable resources.
* Minimise pollution of soil, air and water.
* Maximise the health, safety and comfort of building occupants.
* Increase awareness and perceived importance of these issues."

"5. ACTIONS FOR ARCHITECTS

To meet the objectives stated in this Policy, individual architects need to:

* Give holistic consideration to the range of negative environmental effects which may arise from intervention in existing ecosystems; and
* Make design recommendations which minimise negative environmental effects.

Ecosystems will be affected by decisions the architects may make regarding the use of resources, which must be defined to include materials, energy, amenity and waste. In making design decisions, the architects must consider the effects, both long term and short term, on ecosystems over the entire product life cycle – from materials extraction, processing and transport through to possible fire, demolition and disposal. These effects may range from the local to the global."

(Source Royal Australian Institute of Architects 1994, 1998).

This policy lists many strategies.

Unfortunately, not all architects adhere closely to these principles, and only 2-3% of buildings in Australia are architect-designed. The Australian Council of Building Design Professionals Ltd, the peak body for architects, landscape architects, engineers, quantity surveyors and similar, puts out an annually updated *'BDP Environment Design Guide'*, to which eco-conscious architects refer.

On 31/10/2000 it was announced that in view of an on-going problem of appropriateness of appearance and design, large Sydney buildings would from now on have to be architect-designed to gain planning approval.

Figure 52: BICM: Kyoto Protocol: Global Warming Potentials of Greenhouse Gases

Gas Type	Chemical Symbol	Global Warming Potential (over a 100 year time horizon)
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310
Sulphur hexafluoride	SF_6	23,900
Hydrofuorocarbons	HFC	140 – 11,700 (Australia does not report on the full range of these gases)
Perfluorocarbons	PGC	6,500 – 9,200

(Transcribed from Commonwealth of Australia 1999: 21 from IPCC 1966).

Conversion of all emissions to carbon equivalents and seeking solutions in silviculture, tend to divert attention from the real work to be done: the extent of the CO_2 work and the complementary work needed for the other substances. It is now clear that the efforts so resisted through Kyoto, and in The Netherlands in November 2000, will make no difference to CO_2 levels. Not ±5-8%, but –60-80% reductions are needed to arrest the exponential process. The head of the CSIRO Climate Change Division (Dr Graham Pearman) has been telling us this for nearly a decade.[§] In Rio it was agreed that technology transfer to LDCs was urgent, so that their development would not follow the pattern of MDCs,[§] thus bringing disaster on all of us (United Nations 1992). This has been conveniently forgotten in subsequent years.

The issue is not how much pollution we produce so much as attitudinal change and ecological wisdom. If we are to count GHGs, then those exported should be added to those used within a country. This would probably make a difference to Australia's attitude. It is dangerous to commodify ecosystems, as their 'value' will fluctuate with the markets they do or do not inspire. If the Complementarity Principle should be applied anywhere, it is in this issue.

Australia has already seen old growth forests clearfelled (Japanese company in Tasmania – Earthbeat ABC 5RN 11/11/2000), and working dairy farms taken over for Tasmanian bluegums (NSW, SA)[§] in the name of carbon sequestration for profit.

In Australia no effort has been made at all to involve civil society in personal effort, apart from the Green Power scheme available in some States. In California demand management was found commercially feasible, avoiding the need for extra large scale power generation. This started with a free home audit and provision of compact fluorescent light bulbs. It was later found that legislation had to be passed to give a fair deal to people providing surplus energy back to grid from domestic generation (solar, wind).[§]

The initial Danish Government subsidisation of windmills is mentioned elsewhere. It was part of an integrated energy & recycling approach. In Sweden I met EcoVillage developers who could not accommodate a windmill near their property, but set up a company that owned a mill elsewhere, gaining them power credits to offset against their own grid usage.

As ever, EPPs will try to behave as if such leadership were available from above. In SA, a young Queensland electrical engineer (Malcolm Green) has identified Whyalla as an ideal location for a farm of solar dishes as developed by his former Professor Kanef of ANU. This could in one stroke solve industrial water provision, provide plentiful town water from desalinisation, provide industrial grade power and avoid the need for heavily subsidised water to be taken from a polluted and dying Murray River system via a very long pipe. Malcolm has worked with the City of Whyalla and the University of South Australia Whyalla Campus to advance the project, which has completed the feasibility study stage.[§]

Table 91: ESBI: Lenzen's "Greenhouse Guide"

(DOMESTIC) GREENHOUSE GUIDE

Research-based 'Greenhouse Prices' for commonly used foods & services

"Greenhouse Guide" presents lists of domestic 'greenhouse prices' (including embodied energy contributions) for a range of foods and services.

Item	Kg Greenhouse Gases/kg or as otherwise stated
Meat	14.3
Dairy products	5.1
Fruit & vegetables	1.4
Cereal products	4.5
Sugar, confectionery	14.5
Alcoholic beverages	2.5/l
Eating out	1.4kg/$
Conventional electricity	12.2kg/$
Renewable energy	1.0kg/$
Natural gas	13.3kg/$
Bicycle	0.1 kg/km
Bus & coach	0.2 kg/km
Private car	0.45kg/km
Train	0.2kg/km
Domestic air travel	0.8kg/km
Goods excluding food	1.5kg/$
All other services	0.7kg/$

(Lenzen 2000 in press).

Note: These or similar data are often used by environmentalists to argue that humans should shift to a vegetarian or vegan diet. There are potentially serious consequences for many individuals in taking up this advice, and the advice should always take into account biochemical individuality. Examples where such advice could be harmful are:

- Where the individual suffers from Hyperinsulinaemia (a common, potentially prediabetic, stress-and genetics, chronic degenerative disease-related condition that needs strict carbohydrate limitation and high protein input).
- Where an individual is metabolically incapable of building the amino acid carnitine in the liver (some liver damage, some genetic); this nutrient then becomes 'essential' for that person, and is only found in meat.
- People, especially female, who do not take regular gravity-challenging exercise, and do not have a generous calcium input from other sources.
- Where information about essential amino acids and the body's inability to store them for internal balancing, is not understood by the dieter (ie merely cutting out meat is not an appropriate or safe approach to vegetarianism).[§]

(Sources Werbach 1986: 22-26, 75-97; Erskine, 1997:188; ACNEM Training Course Notes; Clinical Ecology general knowledge).

Table 92: ES: Individual Greenhouse Strategies

Share, fix, borrow, swap, rather than buying things.
Buy second hand rather than new.
Reuse & recycle, rather than throw away.
Consume services rather than goods.
Buy locally grown, organic food, rather than conventionally grown of imported.
Eat fruit, vegetables, bread & cereals rather than meat products.¶
Join a renewable energy scheme.
Install solar hot water system, rather than electric.
Use public transport rather than car.
Use trains & coaches rather than flying.
Plant trees.
Spend creative time rather than spending money.
Increase quality of life rather than standard of living.

(Reduced/transcribed from Lenzen 2000).

¶*[Caveat: see above table].*

Table 93: RRBI: Domestic Energy

DOMESTIC ENERGY IN ADELAIDE PUBLIC HOUSING

	% of Energy Use	**Strategies, Issues**	**Potential Savings/Usage**
Water Heating	50% (non-solar homes) 20-25% (solar homes)	Extra insulation + thermostat 60°C	Energy use 25-40% less
		Low pressure roof units no extra insulation vs extra insulation mains pressure units	Same
		Solar, booster off in Summer¶	Lowest running costs, lowest CO_2
		Shared solar or heat pump heaters (issues: tree shading, poor installation, 3 sharing)	$50 - $250 pa when shared by 2
		Gas storage	Less CO_2 except more than¶
		Storage electric vs storage gas, running costs	Less
Refrigerators	10-22%	Efficient fridges reduced but social issue since cheaper	50% less energy
Cooking	5-8%	Little cooking done	Gas use 180%> electricity use; CO_2 variable & inconclusive
Lights	4-8%	Efficient lights	50%
General power	23-35%	Digital clocks, stand-by lights	Increased importance as other efficiencies effected Can equal combined cooking & lighting in small homes
Building design & temperature control **(all R-2 roof and R1.5 walls)**	Heating & cooling: 15-20% with standard water heater 30-35% with solar water heater Supplementary heating 40% of H° energy in gas & RCAC homes	Good solar access + vertical zoning, especially town houses Increased insulation recommended	Least energy use, warmest in Winter CO_2 same in gas & RCAC heating.

From handout, research presentation, 21/1/2000, Oliphant, ETSA; RCAC = reverse cycle air conditioning; (Full path audit, user to generator, Adelaide Grid).

Table 94: RRES: Design Principles for Greenhouse Neighbourhood

- Significantly higher residential densities: higher mix land uses, increased public transport patronage.
- Large increase non-residential uses, especially employment & retail: supports high local self-containment of work & leisure.
- Walking distance clusters of non-residential uses.
- Highly interconnected street network: direct access for all modes (grid pattern).
- Street & lot layout to maximise solar access.
- Relatively orthogonal (right angled) grid layout: assist solar access, more rectangular lots suited to higher density.
- Access for all to public transport, good access to all employment centres, : minimise car advantage.
- Streets & intersections designed to maximise traffic flows at consistent speeds.
- Solar housing orientation & design.
- Attached housing, higher density: shared walls save energy & surface area.
- Increased storeys: shared floors, reduced surface area: energy savings.
- Reduce materials per dwelling: lower GH impacts from infrastructure if densities higher.
- Gas reticulation: enable use for cooking, water heating, heating & cooling.
- Gas/other technologies to reduce domestic fuel emissions.¶

(Energy Victoria,Environment Protection Authority,Department of Infrastructure & Energy Research and Development Corporation 1996: 21-2).
¶Different energy sources for electricity generation require local interpretation of such principles.

Note: Australian recommendations rarely dare to include row housing, which is far more energy and materials efficient than separate dwellings.

Table 95: RRES: Advantages of Higher Density (Energy)

Land Use Variables	Mechanism	Effects on Energy Demand
Combination of land use factors (shape, size, interspersion etc.).	Travel requirements (especially trip length).	Variation of up to 150%.
Interspersion of activities.	Travel requirements (especially trip length).	Variation of up to 130%.
Shape of urban area.	Travel requirements.	Variation of up to 20%.
Density/clustering of trip ends.	Facilitates economic public transport.	Energy savings up to 20%.
Density/mixing of land uses/built form.	Facilitates CHP (combined heat & power - Cogeneration.	Efficiency of primary energy use improved by c.100%.
Layout/orientation/design.	Passive solar gain.	Approx. 12% energy saving in cool temperate conditions.
Siting/layout/landscape/materials	Optimise microclimate.	Energy savings of at least 5%, more on exposed sites.

(Owens 1993: 17-35).

2.2.11.11 CRITERION CONNECTIVITY

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2.2.11.12 CRITERION FEEDBACKS

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2.2.11.13 CRITERION RHEOTICS

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Table 96: CECM: Integrative & Connector/Linkage Concepts

CONNECTOR CONCEPTS	Examples
Glue: **Sticks Entities Together**	Community or organisational coherence: needs, mutualism (Organism, Community) Common objectives, missions, preferences, values: survival vehicles Shared beliefs, cosmology, values Competition issues; predator-prey, food webs
Structure Of Matrix: **Holds Entities Together**	Organising principles (Hierarchy Theory, CDS) Landscape matrix: growth + expansion/limiting factors + impacts
Access: **Allows Entities to Be or Get Into Contact**	Habitat & wildlife corridors; edge effects (Landscape Ecology, Biotics) Impacts (protection issues): crime & safety, child safety, biotic breeding places Multiple stakeholder consultation Fractal structures
Flows: **Connection by Changing Position**	Information (Information Theory, Hierarchy Theory) Communication nodes (Information Theory, Hierarchy Theory) Transport people, goods, services
Emergence: **Traffic-Backcloth Relationship**	Hierarchical structures Events Buildings & designed entities Survival vehicles Landscape pattern, Biotics (Biome character)
Integration: **Links Entities by Complementary Function**	Transport people, goods, services Timetables, transport exchanges Multifunction (multiple stakeholder land use) Multidiscipline (team building, common models/languages/purposes, partnerships) CoEvolution
Ecological Relations: **Hierarchical Connection**	Power hierarchies (stress, control, psychology, allopathic stability Competition issues, collaboration, Coevolution Human Ecology approaches (McKenzie 1967) Fractal patterning, strange attractors
Ecological Flows & Vectors	Water, air, genes; moving animals, machinery
Resource Infrastructure: **Common Connection To Supplies**	Food: webs, supply, storage, shortage Subsistence: food, water, amenity, biotic breeding places (non-human biota, including microbes, micro-invertebrates in water supplies etc.); connection to all Max Neef Satisfiers

CONNECTOR CONCEPTS	Examples
	Vulnerability to impacts & challenge (protection issues): crime & safety, child safety, biotic breeding places, competition issues
Harmony: **Special Mathematical Resonance** **Clustering:** **Scale Advantages from Common Interest**	Multidiscipline (team building, common models/languages/purposes, partnerships) Flocking, scale advantages (business or collective interest networks) Intellectual chunking: Spiders (plug-in concept constellations for design)(Rounsefell 1994d)
Attractor: **Attraction of Susceptible Entities**	Needs (see Organism, Community) Population: potential & relative accessibility (Gould & White 1974: 21-6) Policy levers/economic
CoEvolution: **Linkage by Mutual Need & Service**	Subsistence (food, water, amenity, biotic breeding places (non-human biota, including microbes, micro-invertebrates in water supplies etc.); connection to all Max Neef Satisfiers Arms race; symbiosis, parasitism
Valency Of Connectance: **Number of Different Dimensions of Linkage**	q-connectance
Indirect Connectance: **Indirect Connection Through Chains of Intermediates**	q-chain Risk Analysis
DISCONNECTOR CONCEPTS	
Solvent: **Removes Glue** **Fence: Keeps Entities Out** **Gateway:** **Selective Control of Access**	Landscape: crime & safety, habitat function, species selection for plantings (Biotics) (Sarkissian 1997), Landscape matrix structure Weberian Theory
Repellor: **Keeps Entities Away**	Q-connectance Dissonance: special mathematical repellor Threat: drives other entities away Risk management: disconnection of events Economic/policy levers
Relative Disconnection: **Through Hierarchical Structure**	Spatial: separation Temporal: dys-harmonics, frequency dissonance, interference fields Dominance: ranking, pecking order, command chains Conceptual: meta-relations, esoterics, information control

The above lists are intended to reinforce connection/disconnection thinking through the exercise of reflection on each and perhaps adding others. When considering Connectivity for a particular site, each Criterion should be considered in turn, in terms of Connection and relative disconnection.

Table 97: CECM: Connectivity x Criteria

Criterion	Issues
Scale	Interscale connections & distinctions. For each Hierarchy type & each Criterion, what connections to other Scales does this project have? What is the mechanism of connection?
Community	Who are the stakeholders? (What stakeholders are connected to this project?) The neighbours? How to involve them? Rights. Connections to local government (& other levels). Regulations. Connections to each other (social fabric, community development, social capital, non-human biota: animal, plant, microbe). Pre-development network building. Town meetings. Community glue How can we enhance this? How can we serve the wider community?
Landscape	Matrix pattern? Regional Plan. Seed, weed, feral, human impacts/dissemination. Corridors. Flows. Roads. Waterways. Wind. Animal movements. Vehicles. Soil & earth moving machinery. Ecotone ratios (patch sizes etc). Need for barriers & bridges. Urban form. Transit Oriented Design. Working Landscape allocations.
Elements	Access to soil. Utilities & reticulation, water recycling/reuse. Sun access (solar cells)/wind access (turbines). Access to ocean/river and implications. (Dis)connection from/to climate/weather/microclimate.
Genius Loci	Sight lines, pedestrian city (urban form issues), Nature, odours; historic icons.
Biotics	Inventory. Urban green space, urban bushland & connections, planting policy, ecotones, tree audits/protection. Clean food, air & water (blue-green algae harm native animals, not just cattle & sheep). Context replacement. Protective fencing. Connection to life supporting Backcloth. Toxics, molecular & biological pollutants.
Population	Who is it for? Can they get to it? Supply & demand. Species inventory. Needs based design (to attract/keep in). Ferals & predatory pets (disconnecting from wildlife). Infrastructure for transient Populations, disabled access; other subpopulations (children, elderly, adolescents). Threshold populations for access to amenities.
Organism	Connectedness to needs: provision. Access to shops, supplies. Infrastructure for individuals. How together is this animal?
Ecocycles	What waste is there? How can we connect it to someone's input? Loop structures: connecting up. Waste recycling/reuse. Industrial Ecology: loops, pollution. Composting, vermiculture. Urban-rural linkages. Compensation for paper & car use (plant trees).
Connectivity	Access/barriers. Infrastructure: public utilities, amenities, Internet, society. q-Connectance. Transport access: service: frequent stops, fast, comfort, convenient timetables, pleasant colours. Roads, cycle paths, footways. slow ways, disabled infrastructure. Flows (materials, energy, information), vectors (people, water, air, animals), roads, bridges, air routes, public transport.
Feedbacks +/-	How is the Supportive Backcloth held together? (A web of feedbacks). Limiting factors, constraints (physical – geophysical, barriers, resources, predation), chemical (substrates – mass action, nutrients, toxics) regulatory, interpersonal & transpersonal (dominance, Script, normatives, belief systems).
Rheotics	Connections to past: keeping traditions alive; consulting elders for eco-restoration purposes. IT&T & computation development, rate of change, long term plans. Audit system design. Staging & managing projects.
Indicators	Resources available for Indicator development & use?

Table 98: ESCM: Ecological Site Guidelines from Rocky Mountain Institute

Design Element	Strategies, Actions, Objectives	UHSE Criteria
Create a Participatory Design Process	Education Communication Long-term stewardship	Community
Preserve and Re-Establish Landscape Patterns	Assess what is there already Rebuild whole systems Connect to networks beyond site	Landscape Biota Connectivity Scales >N
Reinforce Natural Infrastructure	Work with large-scale processes Identify patterns of the place Adapt built environment components to these patterns (buildings, utilities, circulation)	Scales >N Landscape Elements
Conserve Resources	The most efficient use of resources is represented by natural patterns: Hydrologic patterns: On-site stormwater management Infiltration (eg swales, absorptive surfaces, natural or artificial retention systems) for aquifer recharge Natural wastewater treatment systems (eg constructed wetlands, composting toilets, biological wastewater treatments, sand filters) Terrain Native plant communities	Landscape Elements Biotics
Make a Habit of Restoration	Regard site interventions as opportunities to heal & sustain the wider environment	Connectivity across Time scales Organism
Evaluate Solutions in Terms of Their Larger Context	Pre-empt & confront impacts on wider community	Connectivity across scales Feedbacks
Create Model Solutions Based on Natural Processes	(Reflect the elegance and efficiency of natural processes)	Ecocycles
Foster Biodiversity	Preserve & enhance indigenous landscapes Biodiversity Gap Analysis Program (University of Idaho) Help re-establish natural functions (support complexity) Support a rich species diversity	Biotics Population Ecocycles Landscape Organism
Retrofit Derelict Lands	"Pioneering in reverse" Common choice: restore & reuse neglected lands vs. destroy the few remaining rural or natural areas.	Landscape Biotics
Integrate Historic Preservation & Ecological Management	Opportunity to integrate overlapping interests & values with contemporary use & ecological management	Community Genius Loci Landscape Rheotics
Develop a Monitored Landscape Management Program	Policy & practice informed by Science Policy & practice fulfil long-term goals Long-term goal: sustainable landscape	Elements Population Landscape Indicators Biotics
Promote an Ecological Aesthetic	Understand, preserve, repair Celebrate the place as an integrated whole Create a powerful & memorable work of art.	Genius Loci

(Semi-verbatim, contracted from Rocky Mountain Institute 1998: 129, 125-156).
[Column 3 added].

Table 99: CMES: Integrating Natural Plant Communities into Conventional Landscapes

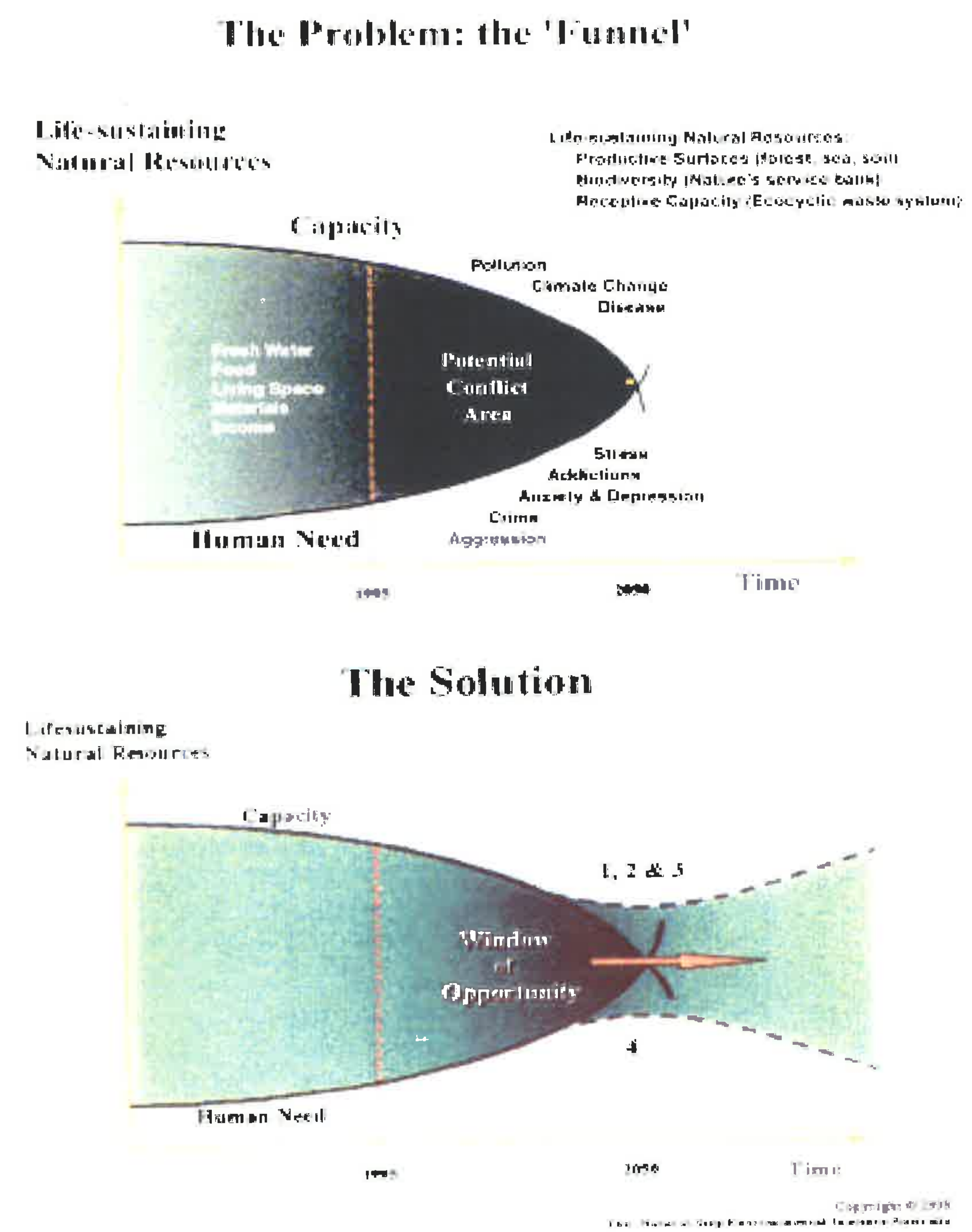
"INTEGRATING NATURAL PLANT COMMUNITIES INTO CONVENTIONAL LANDSCAPE AREAS: BENEFITS ALL ROUND"

Environmental • Promotes long-term landscape stability & sustainability • Increases biological diversity • Enhances groundwater recharge through increased absorption • Regenerates organic soil layer with decomposition of above ground growth • Reduces soil erosion with soil-holding root systems • Reduces downstream flooding by virtually eliminating surface water runoff • Preserves and/or restores existing plant & seed banks; maintains genetic memory • Improves air quality through permanent carbon fixing in the soil • Improves water quality through filtering of dirty water and slowing of surface water velocities • Reduces maintenance impacts through reduction and elimination or herbicide, pesticide, and fertiliser applications, mowing emissions and irrigation.	UHSE Criteria: Landscape, Biotics (biodiversity, toxics), Elements (water, soil, air), Ecocycles
Social • Creates a strong sense of place and regional pride • Promotes a sound development ethic • Provides public education & interaction opportunities • Develops aesthetic richness • Provides emotional & physiological relief from the built environment • Promotes stewardship of the earth's plant & animal communities.	UHSE Criteria: Genius Loci (Place, aesthetics), Community (Ethics, glue, education, cooperative paradigm), Organism
Economic • Significantly reduces maintenance costs • Significantly reduces infrastructure costs • Offers comparable installation costs • Creates new markets for related services • Promotes environmental responsibility with improved public relations.	UHSE Criteria: Feedbacks, Population, Community (Education, relationship), Indicators

(Transcribed from Rocky Mountain Institute 1998: 143). Source (Column 1): *Conservation Design Forum.*

CRITERION FEEDBACKS

Figure 53: BICM: '*The Funnel*' (The Natural Step)



We are already seeing the symptoms of ecological damage. The top diagram spells out a grim picture, as net natural resource availability diminishes. TNS research concludes that the sustainability problem comes down to misappropriation of natural resources and the overwhelming of ecosystem services. The '*Funnel*' or '*Resource Funnel*' is used for education and work with organisations on sustainability. It is, they say, as if we were entering a funnel, with the walls getting closer and closer. As it narrows, every decision we make becomes increasingly important. If we apply the four System Conditions to every decision and action, and honour their meaning, we start to avoid the fate of 'hitting the wall', and instead, start to open the funnel out again.

(Source: The Natural Step training materials; explanatory words from course notes added to top diagram: with permission).

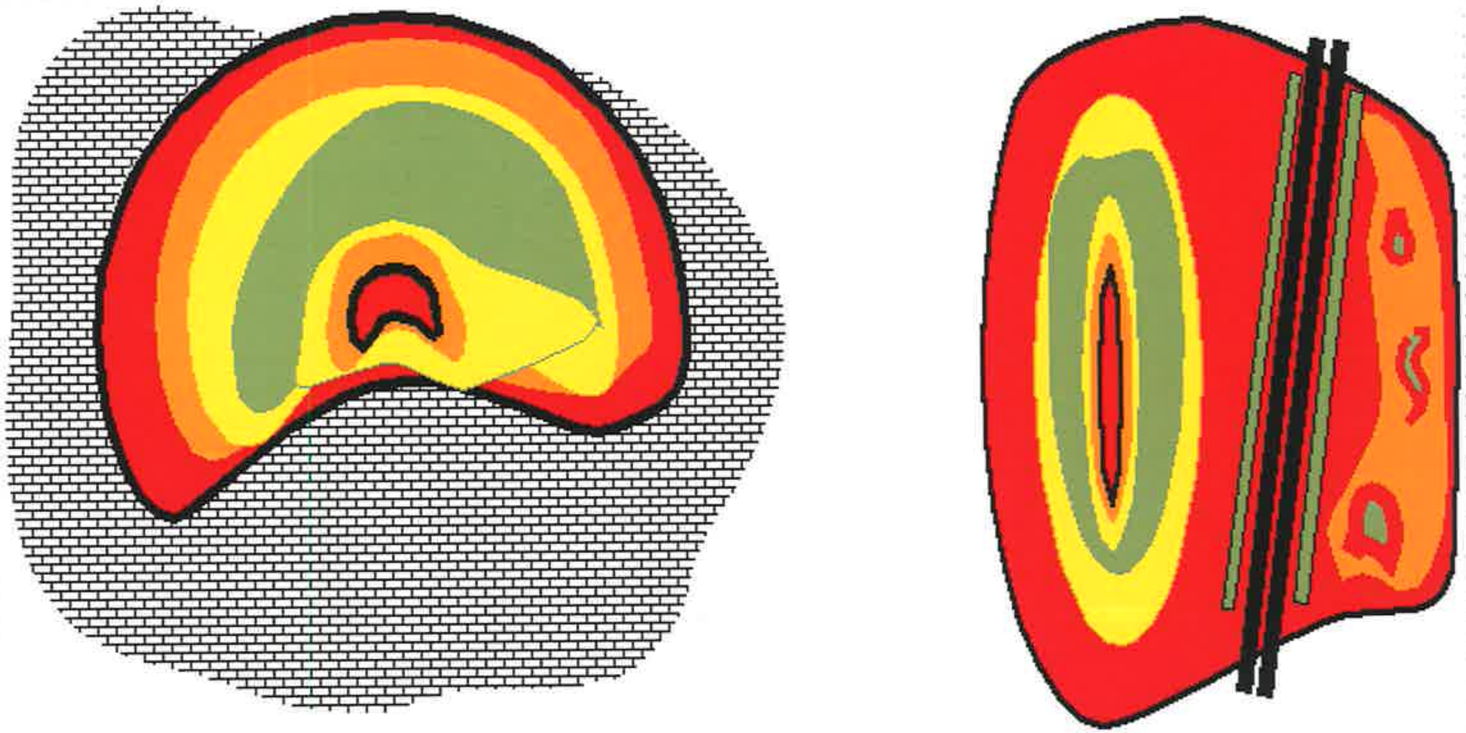
Table 100: BIESCM: Principles of Natural Capitalism

Principles	
1	The environment is not a minor factor of production but rather is "an envelope containing, provisioning, and sustaining the entire economy".
2	The limiting factor to future economic development is the availability and functionality of *natural capital*, in particular, life-supporting services that have no substitutes and currently have no market value.
3	Misconceived or badly designed business systems, population growth, and wasteful patterns of consumption are the primary causes of the loss of natural capital, and all three must be addressed to achieve a sustainable economy.
4	Future economic progress can best take place in democratic, market-based systems of production and distribution in which *all* forms of capital are fully valued, including human, manufactured, financial, and natural capital.
5	One of the keys to the most beneficial employment of people, money and the environment is radical increases in resource productivity.
6	Human welfare is best served by improving the quality and flow of desired services delivered, rather than by merely increasing the total dollar flow.
7	Economic and environmental sustainability depends on redressing global inequities of income and material well-being.
8	The best long-term environment for commerce is provided by true democratic systems of governance that are based on the needs of people rather than business.
Four Central Strategies	
1	Radical resource productivity: slows depletion, lowers pollution, provides work; most eco-social harm comes from wasteful use of human & natural resources.
2	Biomimicry: producer/consumer system becomes service/flow: no waste, closed cycles, low toxics.
3	Service & flow economy: values change from accumulation of goods to quality/utility/performance of services.
4	Investing in Natural Capital: restoring ecological services & abundance.

(Transcribed & contracted from Hawken, Lovins & Lovins 1999: 9-11).

(Tool 3.7: Fuzzy Sustainability Space Structure)

Figure 54: CM: Fuzzy Sustainability Space Impacts



Analogic representation of compression and impoverishment of FSS of native vegetation by encroachment of urban development (left) and a road (right). As the FSS becomes smaller, the relative areas change and increased connectivity between danger zones and Sustainability Space increases and threatens or delivers precipitous change. Only a small percentage of vegetation is able to stay in any sort of FSS, and that is endangered by reduction of resilience (loss of adaptive ability) due to size reduction and access to perturbation (small patches on right of road). Town (bricks) -vegetation edges may spell immediate disaster for biota or be more complex (centre of left diagram). The roadside green strip is disconnected and vulnerable, having lost its healthy *Edge-of-Chaos* functional insurance. Opportunities for replenishment from nearby patches are only fortuitously present, as connectivity is poor between surviving patchlets and remnants are vulnerable to fire, clearing, disease and other disasters.

(Tool 3.78 Boundaries & System Constraints for Hierarchy Types & Criteria)

Table 101: BIRRCM: Constraining Variables

	Fast	**Medium**	**Slow**
Forest Ecology	Insects, fire intensity, pine needles	Foliage, fuel available, crown	Tree populations
Savannah Ecology	Grasses (annual)	Shrubs, perennial grasses	Trees, herbivores, shrubs
Fisheries	Phytoplankton	Zooplankton	Fish populations
Human Disease Epidemiology	Pathogens	Vectors, susceptible populations	Human population
Human Settlement Form	Economic factors, individual proclivities	Planning controls, road design,	Transport system, infrastructure, ideological issues
Social Justice	*Political activities, economic activities*	*Voting system, economic Ideology* *Social movements*	*Governance system, community Cosmology*
Settlement Sustainability	*Availability of information, time, funding, individual actions & impacts*	*Public pressure for sustainability vs entrepreneurial activity & opportunism, 'tyranny of small decisions', economic constraints*	*Legislative framework, public awareness.*

(Sources Holling 1986: 301;1992: 479;1995: 27; *Author*).

Table 102: CECM: Criteria: Change of Emphasis with Project Phase (1)

	Assessment phase	Design phase	Implementation & Evaluation
Scale	Site scale Bioregion + site Scoping (development of brief) Scale of Project design: same Principles for smaller sites Spatial & temporal Cross-scale impacts	Scoping: full context: Biosphere, international, national, state, bioregion, city/town/suburb, locality, site, buildings, smaller elements, microscopic, subatomic, energy Scale of site & Project relative to long & short timescales, larger & smaller contexts (scaling of project, grain & extent Scale diagram	Project in context Relationships to neighbours, neighbours, City, Bioregion, Biosphere
CRITERIA			
Community	State of Environment Assessment (SoEA) Existing Community & types of relationship Existing Contracts, ownership. Strategic context (Plans, Acts, Regulations, LAPs) Identify all stakeholders Early relationship building, team + public Identification of indigenous associations	Research & collaboration as indicated Deal with (all Scales) law, regulations, visions, public roles, policies, Landscape & Development Plans Alexander patterns	Contracts Regular review & adjustment Broad stakeholder involvement, ongoing Trust level in public spaces EMS
Landscape	SoEA Geomorphology, pattern time series, temporal patterns of growth & impact	Long-term Bioregional Landscape Plan Sustainable urban form & matrix integrity, remodelling Landscape-based design; Alexander patterns Link with Biotics	Time series / dynamic GIS Complexity audit Connectivity audit EMS
Elements	SoEA Physical & climatic data	Design responses: harness, align Water-based design, soil building, ground water, river, lake Benchmarks Set Benchmarks for microclimate Set Benchmarks for contribution to reversal Climate Change Link with Indicators	Audit & manage soil, air water, microclimate, CO_2 emissions, power bills etc. Manage ongoing data & response
Genius Loci	SoEA Past-oriented Aboriginal history Settlement history Cultural/social Bioregion (Place attachment)	Future-oriented but incorporating past Design for healing & positive ambience	Satisfier-oriented Ambience (valence) EMS
Biota	SoEA Habitat & biodiversity audit (inventory) Identification of original biota (lists) Identification of toxic sites	Needs-based design: Biome Habitat healing design, corridor reconnection, restoration, preservation, recovery & protection Plans & Benchmarks for habitat Link with Organism & Population	Protection during building Repeated audits Gradual removal of exotics & replacement of indigenous biota Deal with toxics EMS

Population	Identification of existing Populations, wanted, unwanted Current uses, SWOT	Design for existing and future Populations Plans & Benchmarks for Populations (Attractor/Satisfier Landscape) Marketing Alexander patterns Link with Community	Review Populations & impacts & adjustment Weed, feral, satisfaction levels Marketing EMS
Organism	Needs audit for relevant Populations	Function map (bubble diagram) Form follows function Needs-based design, including exercise, recreation, contact with Nature, & healthy food outlets for humans Link with Population	Ongoing function of whole & different elements Incremental improvement of function EMS
Ecocycles	SoEA Resource & waste audit Infrastructure & sustainability	Local materials, energy & materials efficiency, parsimony; waste Connected Ecocycles Design for zero emissions, small footprint, rucksack avoidance Link with Elements	Maintenance programme & incremental improvement of efficiency EMS
Connectivity	SoEA Site connections with wider networks: streets, utilities & locations, transport timetables, infrastructure, utilities Identify entities for protection & connection Gateway(s)	Connection to precinct, city, state, interior, nation Design for access: connection, disconnection (Populations), safety Intra-site connectivity: paths, fences, barriers, security systems etc.	Satisfier & Protectorate audit EMS Traffic management
Feedbacks Catalysts (funding & other enabling resources)	SoEA Constraint map (physical, legal, ecological, financial) SWOT Define constraints required for maintenance, including artificial replacement of context for unsustainable elements	Design to reward wanted behaviour & set up desirable positive feedbacks, especially funding & Community support Respect constraints in design Funding & finance	Assess project re Sustainability Space & adjust Funding EMS
Time/ *Change* (Rheotics)	SoEA History: pre-, Aboriginal, settlement, recent Vegetation (original patterns), archives; speak to Aboriginal elders & old people	Scoping Staging Review intervals	Benchmarks, objectives followup EMS
Indicators	Search for any existing Find indicators for city, region	Define Fuzzy Sustainability Space Backcasting for Preferred Future Set Stretch Goals, Compass framework, indicators & benchmarks EMS setup, each Criterion	Assess FSS EMS Tune for site & Bioregion Compass tracking (see Indicators below)
Unspecified Criterion	Define project themes & objectives used in matrix once design concept clear, to re-check against all other Criteria to ensure sound standards)	Ensure all criteria linkages in harmony with objectives	Review project objectives.

Link: Confluence: Opposing City West Case Study: Table: Change of Emphasis with Project Phase (2). This is a simplified version of the above, demonstrating different possible levels of detail in using this as a teaching model. The content of neither is particularly important, as every project is different: both serve to demonstrate the need to keep referring back to the generic framework at different stages of the process.

Table 103: BICM: Spatial & Temporal Self-Organisation

Model	Example	Comment
Temporal Self-Organisation	*Nonlinear Business Cycle Theory.* Capital accumulation // boom → gradual reduced investment demand → decreased expenditure→ boom collapses → stock decline// slump → gradually increased investment → rising capital. Potential stationary equilibrium unstable if achieved (sensitive to external economic flux).	Order through instability. Limit cycle with areas of unstable equilibrium. Variably-sized booms & slumps. Originated Goodwin, Hicks, Tobin 1940s thrown out with Keynesian 'bathwater'. *[Similar to predator-prey cycles (Lotka-Volterra)].*
	Percolation Economics (chain reaction). Layered input-output structure. Inventory at each level (manufacturing). S-s rule (make 2 units if none on inventory, → increased ext. orders). Generates cascade/chain of orders to intermediate suppliers. Described by a power law (after Bak).	Order from random growth (self-organised criticality). Inventory level throughout chain tends to hover near critical level. Similar to *Percolation Theory* in Physics (describes how far chain reaction will spread). Work of Scheinkman & Woodford. *[Applies to many physical & social systems (see fractals)].* *[Related to Diffusion Theory (Hagerstrand; theoretical basis for Global Action Plan (NGO for sustainable lifestyle), Transcendental Meditation].*
	Phase Locking & Global Business Cycle (proposed by Krugman to explain global recessions when only actually tiny economic interdependence between major trading blocs[7]). Mechanism reciprocal cascades in internationally- related suppliers (power law, poised systems).	Similar terms: mode locking, frequency pulling, oscillator synchrony. Examples co-oscillation: adjacent clock pendula, asteroids/Jupiter *[menstruating women, oscillator experiments].* Link: Hierarchy Theory: upper level Constraints.
Spatial Self-Organisation	*Zipf's Law* (rank size rule). Log linear relationship between city rank & population with slope near -1 (1/(1-π):a power law). Operates for cities 200,000-20,000,000.	Applies in USA since 1890. Does not appear to include primate city political capitals. Not explained in essence by hierarchy *per se*.

[7] USA and EU exchange only about 2% of output as exports. Income elasticity of import demand ≈ 2. USA 1% GDP recovery stimulates 2% increase EU exports to USA. This = 0.04% of EU output. This suggests limited interdependence despite rhetoric. BUT: global scale recessions including Great Depression plus 1974-5, 1979-82, 1990-92 (Krugman 1996: 71-2).

Model	Example	Comment
	Schelling Segregation Model. Small local behaviours produce large segregated neighbourhoods.	Examples: racial, business type, social class/ income level. Based on mild preference to have similar neighbours (not to be in minority).
	Edge City Model. Centrifugal & centripetal interdependence (connectance) forces. Multiplier effect from modest force balance plus centripetal shorter that centrifugal.	Pattern emerges from any initial distribution with centres approx. evenly spaced. No. of centres depends on system parameters. Greatest instability acts as multiplier *[Attractor]* in landscape, *Slaving Principle [Synergetics].*
	Central Place Model (after Krugman). Tradeoff between economies of scale & transport costs. Lösch hexagon lattice = best tradeoff structure.	Classical *Central Place Theory* classifies & describes, doesn't explain self-organisation. Krugman demonstrates lattice from unidimensional economy & predicts similar from two-D. Applies to internal metro structure also.
	Simon Urban Growth Model. Almost all new economic activities emerge from existing clusters. *Power Laws* emerge from scale-independent random growth. Business sizes follow a *Power Law.*	Krugman questions some conclusions re maximum city size for efficiency (200,000, whereas most *Edge Cities* service >250,000).

(Source Krugman 1996: 15-29, 63-8, 87-98; *Author*).

Table 104: CM: Elements of Incremental Progression

Component Theories	Explanations & Comments	Extensions & Examples
Current Model: (Static) Systems Theory	Believes in Master Plans, all can be specified and controlled, helped by data management and electronic appurtenances; detailed specifications can be implemented.	'Best laid plans' subject to incremental forces the more so the larger the scale the system in spacetime. Works best for local level. Regional level rarely tried, rarely successful. Increasingly comprehensive.
Fashionable Fallacies	Illogical & difficult to dislodge.	Decision by reference to market forces. Concept 'conservation costs jobs'. (Later remediation costs far more).
Threshold Effect	For most development applications; crucial stage; hard to reverse once barrier crossed.	Rezoning. One permissive decision disables objectors, establish acceptability. All steps are small thresholds: some are more important than others. Causes reliance on conditions rather than principle to inform decisions.
Details Matter	Details can determine big outcomes.	Frustration of commendable policy: loss of key file, appeal on a technicality, ambiguous wording, absence of key staff, objector unable to establish 'standing', action delayed beyond deadlines, papers not served in time, unhelpful lawyer behaviour in court, drafting errors in Acts: careless, ignorant, deliberate.
Chaos Theory	Turmoil & unpredictability are normal; cause-and-effect are aberrant.	Large scale changes from minute fluctuations. Amplification through positive feedback.
Tragedy of the Commons	Individuals progressively destroy common resources through self-centred over-use.	After village commons (Hardin, 1968). Major threats: privatisation by powerful individuals (enclosures in the original case); individual exploitation. Antithesis of market forces balancing competing demands on resources.
Tyranny of Small Decisions	Series of small changes may cause large changes (Kahn).	Cumulative negative of 'free' choices modifies situation so that subsequent choices not made freely (even if the original were).

Component Theories	Explanations & Comments	Extensions & Examples
		Dunal erosion from housing location, gravel dredging, tree cutting for campfires; substantial remediation long term, individual events appear minor.
Unintended Consequences	Events & decisions may cause surprises elsewhere through interconnectedness.	Universal interconnection in Ecology, similarly administration: simple decisions → complex effects. Indirect effects on tourist projects secondary to lowering tariff barriers. Groyne construction → sand stripping down-coast; may need retaining walls.

(Contracted from Edwards 1997: 2-6).

Table 105: RRES: Identified Causes of Coastal Incrementalism

WHAT WENT WRONG? REASONS FOR COASTAL INCREMENTALISM
FINDINGS OF STUDY: ~ Council energy is divided amongst thousands of allotments; developers perhaps one. ~ Public spiritedness vanishes where resident's own allotment concerned ('special case'). ~ It is easier to process applications than not, especially if: • Inappropriate zoning • Local precedents. ~ Several similar files are not challenged by other planners. ~ Delay may affect planner's auditable performance throughput. ~ Tangible arguments (jobs here and now) are easier to support than intangibles & maybes (maybe future jobs, loss of amenity long term). ~ All planning decisions create precedents. ~ Permits & conditions depend on enforcement: out of sight, out of mind (in rough proportion to distance from admin.) ~ Force of conditions wanes over time & weakens with staff turnover. ~ 'There's plenty left until it's all gone'. ~ Long-term conservation (decades) succumbs to politics: development decisions need making once only; protection decisions need frequent re-iteration. ~ People don't understand permits, especially if motivated not to.

~ Council conflict of interest over subdivision through rate base gains. ~ Local government too close to the people to say 'no' as easily as at State scale. ~ Approval easier (and often cheaper than rejection). ~ All planning instruments have escape clauses to protect clients; but these become loopholes for persistent applicants.
RECOMMENDATIONS (FOR PLANNERS) ~ Take long-term view & persist. ~ We need many committed people acting on all fronts over long periods. ~ Remember mission to society (planners'). ~ Awareness of <u>reality</u> of *Incremental Progression* for common <u>good or ill</u>. ~ Awareness of <u>limitations of forward plans</u>.

(After Edwards 1997: 7-10).

Table 106: CM: Cumulative Environmental Change: Typology

Type	Description	Example
Time Crowding	Frequent repetitive environmental change. Exceeds environmental capacity for recovery from that change.	Harvesting forests at above regeneration rate. *[May be in region 150-500 years cycle or longer].*
Space Crowding	High spatial density of change. Enough to alter spatial pattern of region or its spatial processes.	Habitat fragmentation. Merging of air pollution plumes.
Synergism (Compounding)	Two or more environmental changes interact to produce a third.	Toxic byproducts of interacting pesticides.
Time Lags	Between perturbation/ exposure & response.	Carcinogenesis.
Space Lags (Extended Boundaries)	Environmental change appears at a distance from source.	Acid rain.
Triggers & Thresholds **(Emergent Behaviours, Positive Feedbacks)**	Fundamental alteration of system behaviour by disruption of environmental processes.	Climate change phenomena.
Indirect Effects	Higher order environmental change. Space or time distance from original perturbation (scale) OR By complex pathway (ecosystem effects).	Biomagnification (for example industrial methyl mercury in fish). Contamination of aquifers.
Nibbling (Patchiness)	Incremental or decremental forms of above or groups of above.	Gradual fragmentation & loss of natural areas eg wetlands, woodlots; piecemeal shoreline developments eg marinas, ports, housing. *['Tyranny of small decisions'].*

(After Spaling & Smit 1993: 592-3 from CEARC, NRC, Sontag *et al; Author*).

Table 107: ES: Hollick's Evolutionary Management

To Foster Self-Organisation:
• Consider ecosystems as parts of larger wholes • External stimuli may trigger major system change
• Managers are part of the system • Other system participants are also managers
• Don't try to control systems • Support systems' capacity to self-organise
• Learn to tolerate change and uncertainty • Go with the flow into appropriately-timed new structure
• Try to understand change processes • Identify key variables (fluctuation amplifiers)
• Avoid prediction • Explore alternative futures
• Monitor key variables & processes • Seek potential discontinuities
• Maximise flexibility • Apply to plans, programmes, infrastructure, organisations
• Always maximise available options
• Support creative-looking processes • Stop unpromising processes • Eliminate uncreative processes
• Manage by frequent incremental adjustment • Avoid major change
• Avoid imposing technologies on natural & social systems • Use technologies that harmonise with eco-social systems.

(Source Hollick 1993: 627).

2.2.11.14 CRITERION INDICATORS

CONTENTS

Table 108: BI: Approaches to Finding Suitable Indicators

	General Description	Evaluation
Model-based	*Quality of Life* indicators derived from models of biophysical relationships between socio-economic behaviours and environmental impacts.	Not recommended, as too expensive and impossible in that Quality of Life (QofL) and environmental variables are tenuously connected and not able to be modelled as linear relationships. Acknowledged as having a role in selecting SoER subset variables.
Comprehensive SoER	Likened functionally to economic indicators, allowing judgments about environmental health standards.	Considered arbitrary and not recommended at that time; such a study (Australia) was in fact completed in 1996, enabled by extra environmental funding related to the *National Heritage Trust*. This comprehensive audit has been followed by a *Gap Analysis* project and the recent release of a *Technical Paper Series* auditing Natural and Cultural Heritage at National scale. Similar inventory processes are proceeding regionally and locally, recognising that conservation needs first to answer the question 'of what?'
Core set	Parsimoniously selected to "reflect *priority environmental issues* or *critical environmental conditions*" (Commonwealth Environment Protection Agency (CEPA) 1992: 10). To be defined by policy makers with input from Science and the public, and produced for National, State & local scales; subject to periodic review in case new issues emerge.	Recommended for Australia. Selection of such indicators is largely intuitive or experiential - respondents to CEPA *Discussion Paper* were asked to nominate up to 10 priority issues. Environment Australia's work consists in both an <u>SoER system</u> and a <u>*Thematic Core Set* system</u> to describe human settlements. The recently released major *Environment Australia* indicator series, the *Montreal Process* forestry indicators, CSIRO *Catchment Health indicators* and the comparative *Indicators of Transport Efficiency* (Murdoch University for World Bank) use this type of approach (Commonwealth of Australia 1997;Kenworthy,Laube,Peter & Barter 1997;Venning 1996;Walker & Reuter 1996).
Opinion surveys	Qualitative, for fast appraisal and identification of priority areas.	Adjudged to have "unappreciated potential" and demonstrably capable of remarkable perceptiveness. In fact represents in informal version, the standard Australian process for public consultation at National level.[8]

(Commonwealth Environment Protection Agency (CEPA) 1992: 10-11).

[8] To take this concept a little further, Government decision-making appears increasingly to be mandated by short-term social feedbacks derived from telephone polling (ANOP, Gallup etc), and talk-back radio, which does speed up response times and may arguably in the longer term be a forerunner to large scale participatory governance by electronic referendum using secure coding systems.

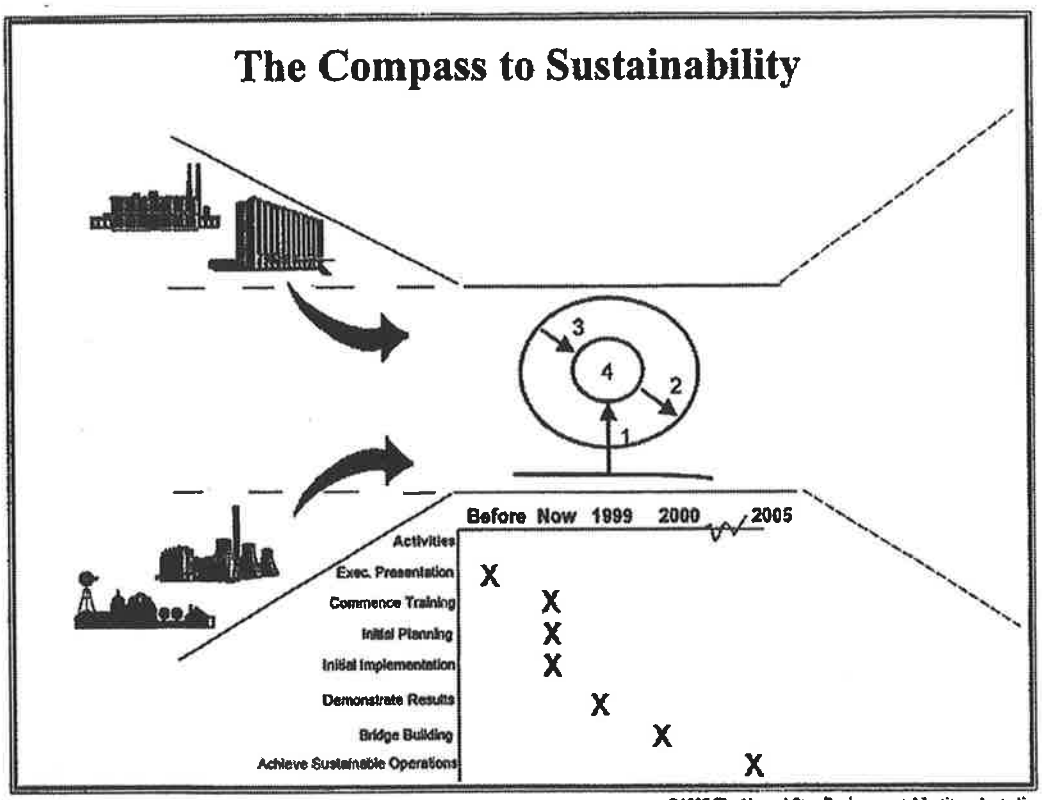
Table 109: CM: Sustainability: Priorities in Development

Frontier Economics	Resource Management	Sustainable Development	Selective Environmentalism	Deep Ecology
Economics takes complete priority, importance of environment denied, completely anthropocentric.	Environment discounted in favour of economic interests.	Wholistic approach recognising society, environment & economics as one connected system.	Selective support of economics in ecocentric context.	Ecocentric position completely subsumes economic interests to ecosystem integrity.

(Transcribed from: Professor Martin Williams (Indicators Seminar, ANZAAS '97 Conference, Adelaide 1997).

Link: Models & Mindscapes: Ecology of Paradigms.

Figure 55: BIES: The Natural Step 'The Compass'



The Compass is an educational and management tool which can assist organisations to become sustainable.

The '*Compass*' combines the key TNS concepts into a planning tool.

The diagram includes the *Funnel* concept, and the small, numbered figure represents other teaching material that explains the '4SCs'. The four System Conditions for Sustainability are elegant *Compass Indicators* that give immediate feedback about the sustainability of any contemplated plan, action or decision.

An exercise in '*Backcasting*' first establishes a sustainable Scenario in the area of interest, using the 4SCs to radically redefine & verify the objectives and guide visioning as to how this operation could look if sustainable. Then the attention is brought back to the present, to work out a series of feasible steps to be taken to reach that future Vision, acknowledging work already done, and reaching first for the 'low hanging fruit', to give an early sense of progress.

A protocol is taught, for assisting businesses of any scale to set up and run a sustainability Plan, using their own expertise as to how best to achieve that in their own situations.

The simplicity of concept and language, and the enjoyable, consensus-building learning process, are very helpful to ensuring that everyone in the organisation understands and can participate.

Most recent work emphasises *Backcasting* in particular.

(Source: TNS training material 1998). *[With Permission]*

Table 110: BI: City of Manningham: Sustainability Plan

Elements	Sustainability Plan
Definition of Ecological Sustainability (the Key).	"To ensure that the ecological processes on which life depends are maintained, and that the total quality of life we enjoy now and in the future can be increased." Erosion of life support systems is not sustainable. "Sustainability is about ensuring that we meet our environmental, social and economic commitments without trading off these commitments against each other. In such a scenario we should be able to reach our economic goals through our environmental roles and vice versa." (:8)
Mission Statement.	"Our mission is to ensure that the City of Manningham becomes a sustainable community committed to the well-being of citizens, future generations and the natural world - both locally and globally."
Agenda 21 Responsibilities.	As iterated in Section 28.
Stretch Goals for Continuous Improvement.	Zero Climate Damage. Zero Extinctions. Zero Pollution. Zero Soil Degradation. Zero Waste.
Targets.	
Indicators.	
The Natural Step.	Four System Conditions for Sustainability.
Implementation Through EMS.	EMS Ecocentres similar to cost centres: nominated key person each department. Continuous improvement. Improvement opportunity alert system. Regular audit.
Distribution & Updating of *"Greenprint"*	Booklet explaining the system & principles behind it, strategies & indicators lists.

(Adapted from Manningham City Council 1998: 1-2) *(United Nations 1992: 233-4)*.

Table 111: BIES: City of Manningham: Stretch Goals & Strategies

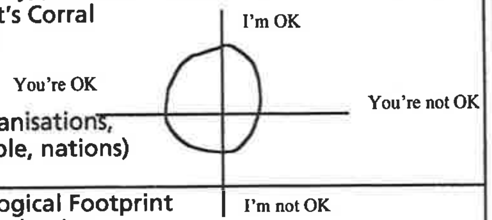
Stretch Goals	Strategies
Zero Extinctions	<u>Database Development</u> Inventory update, comprehensive listing all flora, fauna, significant sites Coordinate community groups for data collection & baseline Map all high quality remnants for preservation (public & private land) from all available information sources (assist Council decisions) Study to identify biotically significant character in specific sites Identify wildlife road kill black spots for modification Locate & identify weed species for management Environmental checklist for new Council facilities. <u>Local Environmental Assistance</u> Indigenous flora & fauna on private land: investigate opportunities Liaise with real estate agents to ensure positive message to buyers about indigenous vegetation. <u>Domestic Animals</u> Domestic Animals Strategy (minimise impact of domestic cats & dogs on wildlife). <u>Pest Plants & Animals</u> Pest Plant & Animal Strategy Special emphasis on State Catchment & Land Protection Act 1994 and liaison with Catchment Implementation Committees Ensure all priority reserves have implementable management plans Programs to encourage nurseries not to stock weed species Environmental weed species booklet with colour photos & full information Operational guidelines for all Council chemical use: policy & implement Lobby State Government for increased pest control resources (private & crown land) Training for all chemical-using staff on storage, handling, usage. <u>Community Education & Information</u> Indigenous gardening: complete & distribute widely Private conservation covenants, 'Land For Wildlife', other programs: promote Advantages of using indigenous species: promote to residents Green Gardening Awards program (conserve water & remnant vegetation): investigate reinstatement, maximise corporate funding 'Land For Wildlife' Scheme & Trust For Nature's 'Conservation Covenant': promote, maintain a register: Environmental sustainability education programs: develop for community & maintain. <u>Roadsides & Remnants</u> Prepare a consolidated Strategy for 'Roadside Maintenance (maybe including

Stretch Goals	Strategies
	Streetscape Strategy, including remnant vegetation techniques: Site assessment prior to any road works Education of roadside contractors Use of suitable indigenous species Development of Action Plans along all environmentally significant roadsides to ensure the protection of any indigenous vegetation Require each relevant Service Unit in Council to include an assessment of remnant vegetation as a requirement of and development. <u>Water Quality & Conservation</u> Promote private rainwater tanks Promote xeriscape gardening in new landscaping & developments Wetlands: identify high nutrient/sediment runoff sites (eg roads, subdivisions), create new Require developers to create natural biological filtration systems along significant drainage systems within bushland areas subject to development Promote use of water saving measures: dual flush toilets, drip irrigation systems, low-flow shower heads, front-loading washing machines.
Zero Pollution	<u>Database Development</u> StreamWatch: continue program, build community monitoring skills for database building Minimise waterway pollution: mandatory stormwater treatment during development & construction. <u>Education</u> Extend StreamWatch program to include awareness of pollution sources: runoff, illegal connections, septic tanks etc. <u>Partnerships</u> Encourage a Friends Network for stormwater quality improvement Co-operative management of water systems with water authority Liaise with EPA, industry, CBOs on effective chemical collection programs Investigate composting toilet option. <u>Transport</u> Public Transport, Road Safety & Bicycle Strategies Approach EPA on more stringent controls on diesel vehicle emissions.
Zero Waste	<u>Kerbside Collection</u> Waste management strategy Performance review of kerbside collection & disposal systems. <u>Organic waste</u> Promote household worm farms

Stretch Goals	Strategies
	Composting/mulching seminars for residents Investigate wet organics waste stream Continue Leastwaste Green Organics facility. <u>Community Education & Information</u> Continue Curbwaste waste minimisation system for schools Internet education program Curbwaste training programs: review future need 'Take your rubbish home' strategies eg bin removal (parks & reserves) Appraise role of Curbwaste in community/school education programs. <u>Partnerships</u> Continue shopping centre/public place recycling program 'Waste minimisation for stall holders' program (annual festivals) Investigate opportunity for commercial vermiculture in businesses Develop integrated waste minimisation/education program with Leastwaste & Council contractors. <u>Municipal Waste</u> Support Government packaging reduction agreements Minimisation & recycling program for development & building sites.
All Stretch Goals	Purchasing Policy to reflect stretch goals Manual for internal & external contractors (encourage stretch goals) Life cycle analysis for all major developments to maximise efficiency Measuring & monitoring Baseline data Measurement techniques: ensure indicators developed.

(Summarised from Manningham City Council, 1998: 8+).

Table 112: ESFRRR: Indicators for a Learning BioRegion

UHSE Criteria	Stretch Goals	TNS System Conditions	Data, Indicators Needed (Examples)	Selected Available (several larger scale, should be applied at lower scales)
Community: Relationship (Bioregional Governance)	Cooperative Paradigm I-Thou interpersonal Universal social participation: a role for all with social wage Zero alienation Community: majority sustainability-trained & invested in outcomes Elected Members ditto	SC4: Social Justice	% population ESD training (all levels) Social role census Quality of Life Indicators in general Psychological stimulus data	Genuine Progress Indicator (GPI)[9] COMLE[10] UEQ[11] Habitat (international) SEA[12] (overview of EIA processes, policy)(Therivel 1997;Therivel & Stone 1997) Ernst's Corral Map  (organisations, people, nations)
Landscape: Spatial Pattern	Matrix connected Landscape dictates Planning Human footprint benefits biodiversity (both/and)		GIS-based matrix quality (wildlife corridor connection, patch size) Urban form; compactness x area Agricultural land & habitat conversion to residential	Ecological Footprint Fractal Index
Elements: Physical Quality & Climate	Zero Soil Degradation Soil net build-up Air & water clean & clear Natural fire & stormwater régimes All building & site projects passive solar Zero Climate Damage		Quality indicators: air, water, soil	NAMEA (2,3) snapshots of damage themes (pollution) (Adriaanse 1996: 6-7)
Genius Loci: Sensory	Bioregional identity		Aesthetic Index, Quality of Sensory Life	GPI Urban Greening Index
Biotics: Life	Zero Extinctions 30% minimum residual vegetation; patches min 1000ha or connected Zero exotics, weeds, ferals Zero toxicity (soils, water, air) 150-Year Habitat Restoration Plan in action	SC3: Nature's productive surfaces; over-harvesting	Appropriation of ecological services, over-harvesting 'Museum' reports ('Biotic Portfolio') Urban biodiversity/ habitat indicators (land, aquatic) Pollinator lists & needed habitats x area	Ecological Footprint Montreal Process (associated with best practice forest destruction not conservation) SoER Fractal Index (complexity)

[9] (Hamilton 1998).
[10] Community Oriented Model of Lived Environment.
[11] Urban Environmental Quality.
[12] Strategic Environmental Assessment.

UHSE Criteria	Stretch Goals	TNS System Conditions	Data, Indicators Needed (Examples)	Selected Available (several larger scale, should be applied at lower scales)
	Zero monocultures			
Population: Attractor Landscape	(Bio)regional Footprint < Carrying Capacity All projects synergic High Level EcoSocial Wellness Satisfiers		Public reporting of population x resources x living standards (equation)	Habitat (international) Demographics, Population Geography Indicators
Organism: Function, Needs, Health	High Level Wellness all biota (attractor meets physical, emotional, intellectual, creative, social, spiritual, sensory needs) Zero social & psychoactive drug dependence (substitutes for happy, healthy life) Universal exercise minima (human)		Stimulus addiction indicator (conditional stroking, low stimulus personal life, vicarious activity) Stress (human, ecological) Snapshots on Biotics, Landscape (matrix), Elements Health indicators (all types biota) (Bio)regional Exercise indicator (human) (Wright,MacDougall,Atkinson & Booth 1996)	Antidepressant & antihypertensive medications Suicide rates Poverty & homelessness TV viewing patterns Passive sports participation High Level Wellness Habitat (international) Extinctions rates Human biomass appropriation Morbidity statistics
Ecocycles	Zero Pollution (Sinks > Sources) Zero Waste All resource loops connected Zero emissions (vehicles & industry)	SC1: substances from crust SC2: substances produced by society (synthetics) SC4: efficient use	Source & sink reports; net overshoot Species lists for ecological functional capacity: CO_2 absorption x species x age Carrying Capacity, Critical Thresholds Bioregional imports & exports of materials, energy, water, wastes Ecological rucksack table Regional footprint Import replacement	Extended Metabolism Model Resource Accounting Industrial Metabolism: MIPS, WASP, WASD (Hinterberger *et al.* 1997: 1-14) (Wuppetal Institute); Ecological Footprint, Ruchsacks NAMEA (1) polluting substances sources & sinks (part economic); NAMEA (2,3): pollution, resource use Manfred Lenzen energy/CO_2 lists Software: Optimize; EcoCost; UET; NatHERS
Connectivity	Full integration all governance elements (Visions, Policies, Protocols, Action Plans, LA21, Development Plans, EMS, training) Universal access to services & needs Motor vehicles unnecessary	SC4: just resource distribution (access)	150-year landscape plan Long-term stepwise Plan for comprehensive governance integration (funded, reporting regularly)	Public transport use
Feedbacks	Economic security for all Bioregional governance Bioregional sustainability indicators reported monthly All subsidies transparent & justified (zero subsidy for damaging processes) Min 10% development experimental	SC4: equitable distribution	System Drivers & Constraints	Constraint OORs Attractor Indicators Key Biota Health Indices

UHSE Criteria	Stretch Goals	TNS System Conditions	Data, Indicators Needed (Examples)	Selected Available (several larger scale, should be applied at lower scales)
Change	Time Series pos & neg constraints acted on Zero Social Traps		Rheomode awareness Accounting for the future	Dynamic GIS (pc-raster)[Ψ] Time series Bioregional
Scale	All (multi-scale integration) Bioregion = pivot		Bioregional Scale indicators all categories	A-B-C Amoeba[‡]
Integrated Action Orientation	Transparent, community-wide EMS (Bioregional Scale) All projects benchmarked & audited		Continuous Learning models Integrated management Stepwise Adaptive Management Lists of embodies energy, vegetation species uptake differentials for CO_2 Dynamic GIS on ecological issues raising consciousness of past change Much more public reporting of indicator findings Much better documentation & assessment of effectiveness of interventions & policies	Amoeba EMS: 'Plan-Do-Monitor-Review' (Institute of Environmental Studies 1997: 13); 'Design-Describe-Diagnose-Do' (Brown 1996: 6) TNS Compass (The Natural Step 1999b)
Economic Indices (not useful for local decisions & policy unless at lower Scales for example Bioregional/ Regional)[13]	Bioregional reported regularly (eg. monthly)		Taxonomic model for sustainable development economic-environment integration (Adriaanse) *[Change 'environment' for 'ecosphere']* Import replacement (Jacobs 1984)	GDP/GNP/GWP GEP: Global Ecological (Services) Product[14] NDPI (Repetto 1993: Resource Accounting) Valuation of Diversity: Ecosystem > Economy > Market; value prevention; relate Economics to EMS; measure all impact, include paid, unpaid, all ages, genders; chaos, hierarchical modelling; sectoral impact; audits on impacts[15] Green GNP (bottom up aggregation).

(Tool 3.9: Traffic Light Indicator)

(Tool 3.10: UHSE Basic Framework)

[13] (Hamilton 1993: 8-9).
[14] (For instance Alexander,List,Margolis & d'Arge 1998: 161-70).
[15] (Brown 1993: 18-19).

Table 113: CMES: Relationship of UHSE Elements to Aspects of Complexity Theory

This Table demonstrates the comprehensive array of concepts across disciplines that are capable of being addressed under a generic UHSE Framework.

Elements & Issues	Complementary Aspects	Representation in UHSE
Ecosystem Definition; Nature's Needs	Animate Theory	Biotics (biodiversity), Population, Community, Organism
	Inanimate	Elements, Landscape
	Process cycles/transformations	Ecocycles, Connectivity, Feedbacks
	Functional redundancy	Biotics, Population, Feedbacks, Backcloth design/management
	Structure	Pattern, UHSE Matrix
Human System Definition	Collective	Community structure cascade (cosmology/values, ideology, politics, laws, governance, regulations, contracts, institutions, education, glue, collective demands)
	Physical	Organism (needs, function, physiology), Connectivity Spatial Hierarchy
	Mental	Community (education, institutions) Organism (needs, connection to Nature) Conceptual Hierarchy
	Emotional	Genius Loci (sensory, emotional), Organism (survival & other needs), Population (wants, proclivities) Dominance Hierarchy
	Spiritual	Genius Loci Conceptual Hierarchy Community (cosmology, relations with biota) Biotics (interface in Nature) Organism (needs for contact with Nature)
	Economic	Location <u>within</u> CDS, <u>tool</u> (like Science & developers), not driver Footprints, rucksacks, externalities Feedbacks/Constraint (positive/negative feedback); funding, finance, catalysts, gatekeepers
	Built environment	Landscape (patterns, matrix, site design, Urban Ecology, Landscape Ecology, fractal index) Community (cultural landscape) Elements (materials, solar, wind, climate, water, soils, energy) Ecocycles (technology, industry, manufacture, ecological rucksacks)

Elements & Issues	Complementary Aspects	Representation in UHSE
Human Needs (Maslow Triangle)	Survival	Organism (needs), Biotics, Ecocycling Ecosystem, Elements (nutrition)
	Quality	Population, Landscape, Elements, Ecocycling (including technology), Biotics, Organism (needs)
	Ethics, spiritual	Community, Genius Loci, Organism (needs)
Hierarchy Theory	Time hierarchy	Unified Ecology structure Evolution, emergence, rate dependence
	Spatial hierarchy	Unified Ecology structure Landscape
	Power hierarchy	Organism (inter-scale relations), Population (predator-prey) Community cascade
	Mental hierarchy	Backcloth, traffic Logical types - conceptual hierarchy
	Internal structure	Scalar structure Interscale relations & transitions, emergence, relativities, holonics, dynamism (bond strength, relative frequency, context, containment, constraint) Constraint (feedback) systems, Limiting Factors, Interference Fields Attractor Landscape Integrative, holistic, substance monistic
Q Character	Backcloth	Ecosystem, Landscape, Connectivity
	Traffic	Population, Biota, projects
Pluralism (Conceptual)	Multifunctionality Wholism	Multi-scale, multi-Criteria Diverse lenses on reality (UHSE Matrix)
Complement-arity	Intangible	Genius Loci, Community (cosmology, ideology), Biotics, Time, Population (wants, drives)
	Tangible	Landscape, Elements, Population, Connectance, Ecocycling (materials, transformations, manufacture), Organism
Sustainability	Sustainability space	Fuzzy control systems, Fuzzy Sustainability Space, optional operating ranges
	Scalar approach	Think globally (Ecocycles, scale, Community) Think & act locally (Community, Biotics/bioregionalism, Genius Loci) Respond personally (Organism, Community)
	Criterial definitions	See separate table

Elements & Issues	Complementary Aspects	Representation in UHSE
	Standard definition (Brundtland) Development (Landscape, Ecosystem, Time/process, Constraints)	Present needs satisfaction (Organism, Population, Biotics) Long term needs (Ecocycles, Elements, Time, Organism, Population, Community, Biotics)
	Directional definition (The Natural Step)	4 System Conditions for Sustainability Ecocycles (SC1,2) Biotics (SC3) Community, Population, Organism, Ecocycles (SC4)
Complexity	Constraint (positive/negative)	Feedback loops (catalysis, homeostasis, feedbacks) Resource availability (Ecocycles, Organism, Population, Feedbacks) Relationships (Community, Population) Biotics (disease, health), Organism (needs) Community (legal, social) Backcloth design
	Signal transmission	Connection, relative disconnection, frequency, oscillation, synchronicity, holonics
	Mathematics	Fuzzy Logic/Possibility Theory, FCMs, FCSs Medium numbers Q-chains, networks Transition (Synergetics) & catastrophe Theory
	Hierarchy	Web structure Theory of Scale, 4 hierarchies, emergence, holons, especially time or frequency hierarchy Scalar management, planning & design
	Rate character	Time hierarchy
	System characteristics	Dynamism, self-organisation, medium numbers, equilibria, dissipation, ch
	Change	Evolution, emergence, dynamic attractor field, dynamic equilibrium, Catastrophe Points, zones of instability, Edge of Chaos, Being & Becoming, hysteresis phenomenon
	Feedbacks	Indicators Catalysts Social traps, Game structures, Archetypes Experimental thinking
Thermo-dynamics	First & Second Laws	Dissipative systems, CDS, SOS, organic approaches
Indicators	Cross-Scale integration	Sustainability Space, Optimal Operating Ranges, thresholds Compass indicators, directional indicators, benchmarks, threshold indicators, health indicators, Traffic Light indicator.

2.2.12 CONFLUENCE

2.2.12.1 OPPOSING CITY WEST CASE STUDY

CONTENTS

(Plate 10: Collage: OCW Givens)

Table 114: FRRRES: OCW 'SWOT' (Constraints & Opportunities)

Constraints	Opportunities
• Transport (railway yards, station, and proximity to North Terrace vehicular thoroughfare; the potential tram connections from the city; the need to rethink interstate, metropolitan and historic train activity.)• Perceived use of Parklands: vigilant public attitude to Parklands preservation • Political pressure: governmental, and local opposition which views railway precinct as "stolen" Parklands • Railways: cost of relocation & redesign of existing structures and systems • Railways: privatisation & land reallocation making "irreversable" land use commitments • Site Topography • Significant contamination: several types • No residential, Community hard to define (ephemeral, fragmented purpose, seasonal) • The West End Urban Development Strategy (with the potential of increased population and changing function of the Hindley Street area, from entertainment to education, the arts and business).OHP for W/s	• Proximity to Adelaide centre • Significant improvement of access to and integration of Torrens Precinct • Parkland linkages & substantial increase in available recreation area close to city • Rejuvenation of Site: decontamination, constructed Wetlands, Adelaide Plains Dryland Botanical Demonstration Park (implementing early colonial plan to locate botanical gardens on part of the Site) • Enliven key Site and provide passive surveillance by attracting numbers of people round the clock • Demonstration of solutions to 21st Century issues: educate public on sustainable design, lifestyle, transport, technology, recreation and horticulture • Transportation hub and links emphasising "Gateway to the State" and "Gateway to Adelaide" notions • Historic Site with multiple interpretive elements: rail, gaol, Aboriginal, riparian, white history, past uses, tourist linkages, culture, planning, Parklands • Provision of outdoor and greenspace access for University • Emphasis on Adelaide as a centre committed to education and culture • Investment in cultural capital: including Aboriginal and multicultural heritage and ongoing cultural activities, and activities for young adults • Emphasise sense of place in unique Adelaide & unique site. • Planned major upgrading of North Terrace with an accent on the notion of an entrance to Adelaide • Recreational activities (rowing, walking, jogging, cycling) • The new City West campus of the University of South Australia (which has the potential of filtering students into the Site) • Historical reference points (the Old Adelaide Gaol, old signal box, and River Torrens Weir).

(Source: *"Weavings"* 1997).

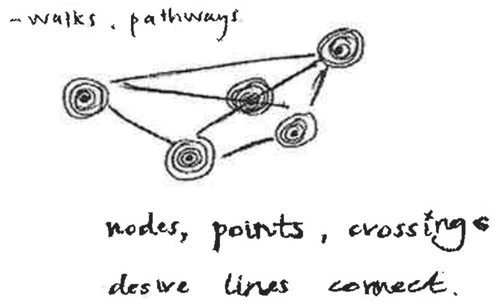
Table 115: FRRRES: OCW Process

STAGE	ACTIVITY	TYPE
Setup	Group dynamics, introductions, self disclosure exercise	Inclusive, individual to large group
Intuitive Response	Site visits	Individual, group, directed, undirected
	Esquisse (first intuitive "take" on site, pre-requisite to walk the site personally)	Individual, presented to group
Early Intellectual Response	Site analysis (intuitive site plan, contrast to esquisse)	Individual, presented to group
Early Intuitive-Intellectual	Logo design (first experience of group process)	Individual, large group argument, evaluation, refinement
Preliminary Groupings	Grouping for personality balance (self-nomination as "mind, body, spirit" / "earth, fire, water, air" types. Nomination of group reps for leader liaison, data collection, computing tasks, model building (all members to do all tasks)	Four groups of six students
Bonding	Class party	Large group
General Data Collection	Seeking strategic plans, Site history, visiting lecturers (typical team professionals on large site development projects)	Individual, shared with group, large group
Development of Brief	Brainstorming, list of required elements, scope of project, stakeholder role-play (group practice)	Large group
Continuing Intuitive Work	Functional assessments of Site subsections: bubble diagrams	Small groups, individual
Emergence of Early Patterns	Emergence of desire to work with large scale model, frustration at lack of specificity	Individual, shared in large and small groups
Mental framework development	Presentation of theory behind data collection system, exposure to small exhibition of concepts	Large group
Collection of Hard Data	Stakeholder interviews, telephone work, library, lectures, directed data gathering using classification system to suggest data types required	Small group coordinating larger, task divided and shared
Evaluation Interviews	Leaders interview students, feedback on process & progress, student self assessment, feedback on data classification system (strong individual internal process reporting - very confronting to some, undervaluing of self by most)	Leader group, individual students
Construction of Model	Finding the right maps, enlargement, materials preparation, building	Small group coordinating larger: using all available help
Collation And Summary of Data Collection	Directed classification, summaries of data category key elements, beginnings of document writing	Editorial team (initially group data reps.), Concurrent with model work
Large Scale Work	Work with large scale maps and completed model as a whole	Large group
Site Energies Identification	Directed feng shui work (optional session)	Small interested group

STAGE	ACTIVITY	TYPE
Emergence of Solutions	Flow from individual to large group, "bouncing off" each other	Large group discussions, individual concept sketches
Regrouping	Re-arrangement of groupings based on design tasks relating to specific areas of model	3 medium size design groups (8)
Rough Models of Buildings	Tools for discussion, difficulty of dealing with large site, minor border disputes	Large group, concentrated design groups, also present to large group
Data Documentation	Work on major documentary outputs, ongoing	Self-nominated editorial team, data reps.
Solution Appraisal	Assessment of design ideas in complex relationship on model, reality checking	Small & large group & individual work
Conflict Over Work Load	Group dynamics/ conflict resolution session, reiteration of desirability of student responsibility for work staging (emphasis on student responsibility for arranging own timetable and rosters for implementation)	Large group, individual protest and response, whole group effort to redirect energies
Firming Up of Design Elements (Clarification)	Argument for different approaches to some problems	Individual, small & large group
Group Work on Site Subsections (Refinement)	More detailed plans, rough models of buildings and site entities to scale (reference to large scale photocopy map on floor)	Small group - large group flux
Photographic Record	Throughout	Nominated individuals
Major Documentation Efforts	Reviewing, revising, rewriting, clarifying, reorganising	Editorial team, leaders, pressure rising
Model Layout	Remassing, remodelling, revising	Large group
Model Detail Construction (Resolution)	Decisions about materials, construction, degree of realism, colour, tasks assignment, building design, site layout plans	Individual, small group, large group
Visual Journal	Scanning, detailed work on document; CD documenting all work done distributed to students for portfolios	Visual journal reps under supervision
Exhibition	Preparation all details of exhibition: plan to present concept to limited number of stakeholders, key government and interest group people; and large posters for University open day; venue issues defer large event; decision to work with small key stakeholder groups after pressure of exams; preparation of display infrastructure, documents, posters, display boxes, press releases, invitations, arrangements for donated printing	Small self-selected group involved in ongoing preparations for display & promotion early 1998. Unable to locate affordable display space (insurance). Leaders eventually presented to Adelaide 21 Committee.

(Plate 11: Collage: OCW Process)

Figure 56: FRRRCM: Teaching About Connectivity

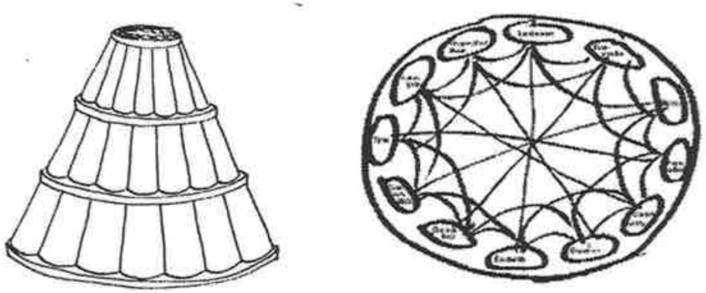


(b)

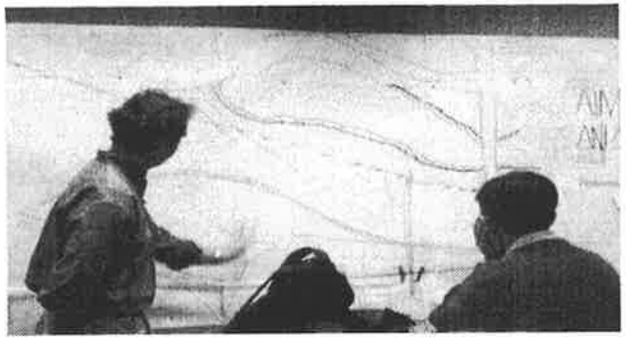
TEACHING ABOUT CONNECTIONS

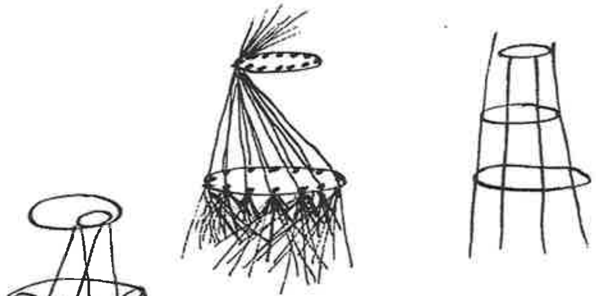
(a) A site map sketch reveals marked, unconnected horizontal land use bands across the site.

(b) Designing connectivity in theory.

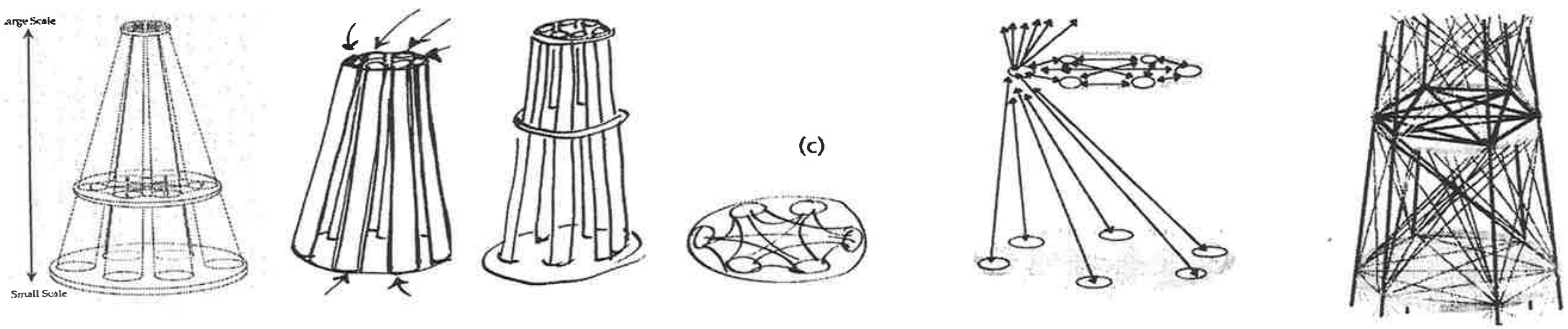


(a)





(c) Starting with Allen & Hoekstra's Unified Ecology Layercake, the extension to Urban Design and the complex connectivity of all the elements across many scales are explained through a series of sketches, making up an small, informal 'exhibition'.



(c)

Table 116: BIFREC: Change in Emphasis of Criteria with Project Phase (2)

CRITERIA	ASSESSMENT PHASE	DESIGN PHASE	IMPLEMENTATION & EVALUATION
Landscape	+	+	
Genius Loci	+	+	
Elements	+	+	
Biotics	+	+	+ +
Population	+	+	+
Community	+	+	+ +
Ecocycling	+	+	+
Connectance ***[Connectivity]***	+	+	+ +
Organism	+	+ +	+
Time ***[Rheotics]***	+ (past)	+ (resonance's)	+ (future resonance's)
Catalysts (funding & other enabling resources) ***[Feedbacks]***		(+)	+
Undefined Criterion: ***Design Concept*** (used in matrix once design concept clear, to re-check against all other Criteria to ensure sound standards)		+ + (ensure all criteria linkages in harmony)	+ (build in review and revision) *[Criterion Indicators subsequently added to account for this].*

(Source: *Weavings* Document ©1997; updated 1998).

Table 117: BIFRECRR: Criteria x Time - Second Order Matrix - Opposing City West Project

CRITERION	Relation to Time
Landscape	Geological time (ancient patterns), Scale of geomorphology. Human evolution, Aboriginal induced patterns. Creation of City of Adelaide & impact upon the landscape over time. Changes in patterns of State & bioregional land use over time, vegetation cover and water bodies. Changes proposed: Wetland development (Site pattern change); railway track patterns changed, with removal of substantial area of track plus extension of platform 1; soil remediation may change contours in some areas.
Genius Loci	Aboriginal history, sacred sites (Red Kangaroo Dreaming). European settlement, construction of Site entities (Gaol, Weir, railway station and railway yards); history of uses and meanings, struggles over land use., Aboriginal school site. Changes proposed: attention drawn to Site meaning through project; new uses will change sense of place; attempt to work within the local Mythology but extend it to look forward as well as backward.
Elements	Water elements. History of Torrens River behaviour, Weir No 1 building, silting problems, flooding patterns, flood mitigation attempts, changes upstream (eg developments, clearing) which influence river behaviour cycles. Changes proposed: soil condition, clay lining, excavation (wetlands), Torrens Lake silt removal soon in progress, (support for) proposed island refuge construction (habitat); microclimate changes from plantings, buildings, albedo; macroclimate issues & climate change (Accelerated Greenhouse Effect) addressed through celebration of public transport, limitation of cars, choice of materials, energy-sensitive designs, locational elements.
Biota ***[Biotics]***	Biodiversity, habitat: destruction since settlement; loss of fauna (native fish) since damming river & introduction of carp; introduction of exotic species, weeds, ferals; culling of feral duck & geese & exotic tree removal programme. Changes proposed: wetlands, new habitats, new species, promotion of endemic native vegetation, formal (Botanic Park concept) demonstration of low water gardening using local flora; detox Site.
Population	Aboriginal presence, European settlement, density of city living, changes in demographics, introduction of student culture to the area with the University of SA's City West Campus, different visitor groups. Quotidian variation, weekend visitors, exhibition-driven fluxes, seasonal Population variance. Future changes proposed: significant increase in Site visitor/resident populations through provision of backcloth supporting life, liveliness, learning, tourism (large hotels, transport, Casino, cultural & historic), extended education (botanical gardens, Science Centre, University of SA, Adelaide West End redevelopment, student accommodation), tourist accommodation, historic sites (gaol, rail, Aboriginal, white settlement), culture (cultural centre), transport (interchanges, railway features), recreators (walkers, runners, skateboarders, rowers, lunchtime visitors from city), feeders (restaurant precincts)

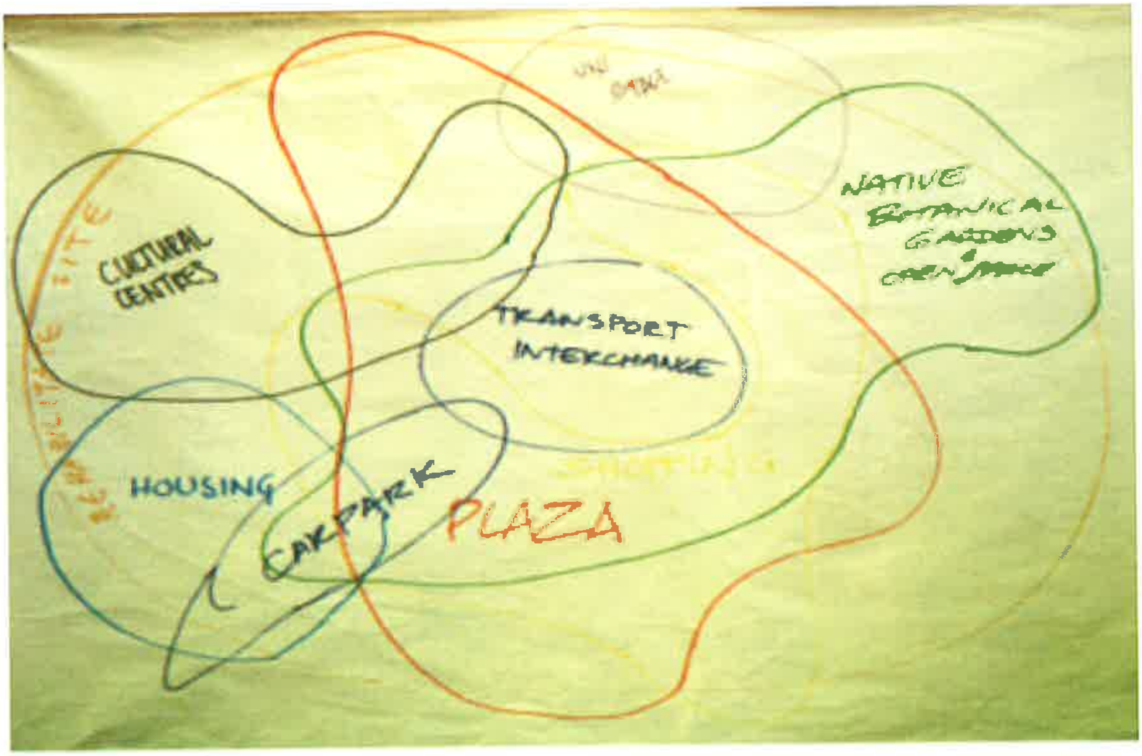
Community	Changing attitudes over time (increased importance placed on preservation of Parklands), Strategic Plans, development controls, surveys, public input, activities; development or relationships on/with site; Ecocommunity modelling for long term change. Changes proposed: review of land use and zoning; new strategies for economic development through unique approach to development and realism about ecological and social needs issues.
Ecosystems *[Ecocycles]*	Change from natural energy and materials conserving systems to human influenced systems with technology-driven, high energy & materials consuming disruption & overwhelming of ecological services, refuse-resource loop disconnection; impacts on carbon, nitrogen, sulphur, phosphorus cycles; waste dumping, water system interference & pollution (water being Nature's principal transport system). The Site functions as a closed loop - waste, water, energy are used and reused and dealt with on Site. Over time the Site becomes rejuvenated; Site becomes part of Adelaide organism, subsections develop own integrity over time. Changes proposed: seeking to harmonise with natural systems & cycles; energy, materials & refuse-resource coupled loops integral to design & materials selection and available as demonstrations for education; allowing for evolution in design, life cycles of people & materials; re-establishment of local endemic biota as adapted through evolution to local conditions & thus more efficient in materials & energy terms.
Organism	Site presently dysfunctional as a whole; some subsystems functional (eg railways as entity, car park, river path). Over time the Site becomes rejuvenated; Site becomes part of Adelaide Organism, subsections develop own integrity over time. Changes proposed: review of function of all subunits and relationships of Site to City of Adelaide and State of SA; commitment to needs-based planning and design (rather than pseudosatisfying wants. Site self-sufficient as far as possible: functions as a closed loop - waste, water, energy are used and reused and dealt with on site.
Connectance *[Connectivity]*	Present arrangements affirm disconnection and emphasise East-West movement. Psychological disconnection from Adelaide as a whole - "wasteland". Changes proposed: improved access to and within Site, transport hub and interchange, tram, local & interstate trains, bridges, meandering low-flow road, whole Torrens precinct minibus cycles; disconnection from utilities as practicable (eg on-site sewerage and waste management, disapproval of pipes in & out of Site).
Catalysts *[Feedbacks]*	Present situation: a number of relatively vague proposals for site in general, Torrens Lake precinct & Old Gaol plans more focussed; University of Adelaide Landscape Architecture student project and this project both approaching & approached decision makers, major stakeholders; media article on our project 24/5/97. Changes proposed: further promotion and consciousness raising of public through planned exhibition and direct approaches of decision makers, especially State Government, Local Government, precinct development, Adelaide promotional & economic development people; further development of concepts through continuing involvement of interested OCW team members; later attention to alternative financing modalities.

(Source: Vanda Rounsefell & student editorial group, 1997). *[Note variance of Criterial headings from that presented, due to earlier version of concept].*

The base Scales for OCW were (Time) 6 months (concept), ±200 years (potential implementation); (Space) 100s of hectares (very large site; smaller sites need simpler approaches, but the same issues pertain and the same headings can be used.

Figure 57: FRRRES:: OCW Bubble Diagrams

Bubble Diagram: Site Function (brainstorm)



Resolution

One of the many creative group processes from OCW Project. Photographs from *Visual Journal*.

Figure 58: BIFRRR: OCW Resolution: Key Concepts Identified for Built Environment, Transport & Landscape

BUILT ELEMENTS

Bridges (also public art opportunity) connecting North Terrace precinct with riparian precinct in three places across railway lines & opening access to Old Gaol and Bonython Parklands and Torrens Linear Park system; links - primary and subsidiary access within the Site, and to the city proper

Cultural centre incorporating flexible outdoor & historical interpretive opportunities , sculpture park, public art (including bridges, walls), Aboriginal, multicultural and Fringe Festival infrastructure: located at "Gateway to Adelaide" near beginning of North Terrace (West)

Exhibition spaces indoor & outdoor

Amphitheatre

Investigator Science Centre extended concept to include emphasis on appropriate and especially Australian technology for ecological and social sustainability; possibly align with sustainable energy and gardening information centres; "inside-out" (transparent workings as public "art") on-site sewerage system demonstrating stages of processing

Transport rearrangement: bus terminal: interstate, intrastate, and local with bus parking & feeder bus linkages; replace rail maintenance and cleaning services - shift to Keswick, retain signalling system

Transport loop connecting North Terrace, Adelaide Railway Station, Torrens Precinct North and South of River: could be feeder bus, tram, mini train (as in Monaco), monorail; connect with aquatic commuter Popeye.

The Ghan and other major standard gauge trains back to centre with extension of platform one to emphasise tourism to interior

Tram linkages (standard gauge, as for interstate trains) utilising heavy rail lines (extra rail required where SA wide gauge in place); entry from North Terrace

Transport resident exposition with opportunity to integrate interpretation of Site activities; advertise linkages as part of re-emphasis on public transport for 21st Century; history of trains, trams, buses; promote tourist opportunities including historic train access from Site and desert country connections; tourist centre associated with transport and train museum together with departure point for historic trains.

PRECINCTS

Adelaide Plains Park linking North Terrace West Gardens throughout Site to Torrens, demonstrating Adelaide Plains flora and appropriate indigenous native species for water conservative gardening

Wetlands for biodiversity, interpretation, amenity and partial water management

Skate Park (with retention of Road Safety School); attention to needs of adolescents

Residential as demonstration of 21st Century approaches to land use & Site design (eg community title rather than investment opportunity for developers; developer as instrument of residents, no speculation): would include solar and energy optimisation through design, development & building, materials and planting, modern Eco-community approach (as distinct from hippie-style communal); high density small footprint student and visitor housing conserving green space; car access minimal and calmed; advanced local area management of water, wastes, sewage; community gardens and effluent forest plantings, natural surveillance in area currently dangerous after hours

Retail/mixed use incorporated into lower levels of residential; small scale, servicing residents and visitors

Vista to Torrens Lake from North Terrace opposite City West Campus

Many Site opportunities for watching things (especially in Winter) as well as participating outdoors: vistas, wildlife, train activity, art shows, river, cultural events.

OTHER SUGGESTIONS

Green business clearing house

Nature Sanctuary suitable for multi-faith spiritual ceremonies

Rethinking use of Old Adelaide Gaol: retain & improve presentation of present collection, consider housing museum of whole precinct; consider housing Blue Light type disco (note Police presence locally); opportunity for better restaurant facilities

Opportunity to have landmark building ("entrance to Adelaide") visible from West Terrace axis hotly disputed within group.

(From *"Weavings"*; Updated by Rounsefell for *Catalyst Conference 1997* presentation).

Table 118: BIFRRR: OCW Synopsis of Concepts

Site Entity	Location	Reasoning	Facilities	Links	Other Information
Cultural Centre	North terrace	Continuing the cultural boulevard along North Terrace	Museum Interactive gallery Site interpretive centre Workshops Ampitheatre Plaza Café Restaurant Kiosk Ticket sales (transport) Contemplative gardens Informal, native planted areas exist within & around the centre	This is a nodal point, from which stem the following links: A footbridge to the far side of the interstate rail platform Footbridge from Cultural Centre Plaza to perimeter of the residential zone Ramp from North Terrace / Morphett Street Bridge for bicycle & disabled access to the centre	Footbridge to the residential zone: intimate, small-scale, lightweight timber structure, with both covered & exposed sections. Constructed & naturally landscaped exhibition & performance spaces for local & visiting artists. Cultural Centre Plaza: open, accessible space, partially shaded by pergola - a place of interaction. Traditional, formal frontage to North Terrace filters informally into the site.
Investigator Centre **(Public Science Education)**	Adjacent to wetlands area, flanking the North bound railway line	Challenges current preconceptions & challenges the public in relation to the environment, energy & its consumption	Three-level, unique structure which incorporates: Ecological information centre Interactive galleries Workshop space	A footbridge to the wetlands Path linking Investigator Centre to the bus terminal corridor Path to the Skate Park	The building displays ecological principles, & passive design techniques. It maximises solar gain & natural lighting. Opportunity for hands-on demonstration of eco-social principles.
Bus Terminal	Off North Terrace	To bring bus passengers into the heart of the city, close to the transport hub for ease & convenience of local & visiting commuters	20 bus shelters Taxi terminal 99B bus link Retail provisions Café/restaurant Backpacker accommodation Baggage/waiting area	A corridor which crosses the heart of the bus terminal, links the bus terminal complex to other activity nodes within the site: Investigator Centre Railway Museum] Additional metropolitan train	The "North Terrace West Gardens" are to be maintained & linked with the dry plains Botanical Gardens. The bus terminal utilises historic features of the existing train shelter & re-uses structural elements & materials. Landscaped outdoor/indoor waiting spaces (demonstrating indigenous xeriscaping for Adelaide home gardens)

Site Entity	Location	Reasoning	Facilities	Links	Other Information
			Ticket booths/offices 2 carpark areas Metropolitan bus parking	stop Skate park	
Interstate Train Platform & Terminal	Adelaide Railway Station, extension of platform1	Platform1 extension accommodates longer train. Terminal relocation heightens the Adelaide "entrance".	Shelter for arrivals & departures	Footbridge to Cultural Centre	The platform is an architectonic element which functions as a focal point of departure & arrival.
Tram/ Train Museum	Adjacent to the Investigator Centre	Provides an historical perspective on past tram & train transportation modes	Two lines pass through the building which contains a tram & a train stop. Platforms link to a main walkway, taking visitors on an informative & educational tour of historic railway relics.	A meandering path links: The railway museum The Skate Park The central corridor of the bus terminal	The tram extends the Bay-City line. Route: Victoria Square, via King William St, & North Tce, through the museum, terminate Port Adelaide. Additional routes mooted.
Skate Park	North of the Bus Terminal	Provides a gathering place for the youth of Adelaide.	The Skate Park has 3 bowls, 3 ramps, and off street skating space for specialized competition &practice,	Path to investigator centre	In the future, the this youth zone will change to meet the social & cultural needs of Adelaide's youth.
Residential	Between the railwaylines & Torrens Lake, the retail/mixed use area & the wetlands, West of Morphett Street Bridge	Provides a passive security system through residential vigilance	Apartments, constructed such that there are a maximumum of 3 storeys adjacent to the railway lines, & 1 closest to the Lake. There is a gradual reduction in density towards the wetlands. A section of the residential zone is devoted to the experimetal use of shared facilities (laundry, kitchen, & grouped letterboxes) in an drive to enhance community interaction	Paths to the retail plaza Perimeter of residential zone is linked via an intimate, small-scale footbridge to the Cultural Centre	Strong sense of community has been a prime consideration. Recommended pattern: <u>demonstration eco-village</u>, shared community facilities. Not primarily an investment opportunity; suggested funding alternative. Vehicular traffic: status inferior status to pedestrian & other transport modes. Street width kept minimal - single vehicle passage only, passing allowed via pedestrian path.

Site Entity	Location	Reasoning	Facilities	Links	Other Information
Retail/ Mixed Use	Between the railwaylines & Torrens Lake, East of the residential area, West of Morphett Street Bridge	To provide tourists with opportunities to shop. Provide locals with necessary amenities & daily essentials.	Eating places Gathering spaces Local art retail Deli Newsagent Commercial enterprise	Footbridge from North Terrace to the plaza (the main link)	Footbridges (lightweight elements) present opportunities for the gathering of people. Spaces may convert on weekends for markets. The buildings on the West boundary between Ecovillage and plaza serve both retail & residential functions.
Wetlands & **Adelaide Plains Drylands Botanical Park**	Land surrounding by the North & South bound metropolitan & freight trainlines. Adelaide Plains Park throughout.	Three wetlands combine to balance the Sites ecosystem. Adelaide Plains Drylands Park implements an early colonial plan and demonstrates water conservative gardening	Treatment of greywater produced on the Site Bird sanctuary Walkways for observing & experiencing wetlands	Access to the wetlands may be gained from: The Weir overpass Gaol Rd. Footbridge Investigator Centre footbridge	The wetlands provide the dual function of educating the community whilst maintaining the balance within the Site's esosystem.
Exhibition & Amphi-theatre Spaces	Constructed & naturally landscaped areas include the Cultural Centre, Skate park, Old Adelaide Gaol	A means by which the community can fel that they 'own' the space, & use them as they desire	Gathering spaces Intermittent medium to low-height walls that meander through the Skate Park provide points of rest, & areas for the display of community artwork & culture	Exhibition spaces occur throughout the Site, with access points from: Cultural centre Skate park Bus terminal Retail/mixed use zone Residential The Old Adelaide Gaol	In addition to these, undefined spaces may be used. The constructed spaces will transform over time to suit the needs of particualar perfomances & exhibitions.

(Source: *"Weavings"* Document: Table constructed by Design students; updated by Rounsefell, 1997).

Table 119: BIFRRR: Development Type, Floor Ares & Footprint

SITE ENTITY	#	FLOOR AREA/BUILDING	TOTAL FLOOR AREA	FOOTPRINT INCLUDES ROADS AND CARPARKS	
Cultural Centre	4	approx. 320 m2	1275 m2	2625 m2	2.17%
Investigator Centre	2	525 m2	1050 m2	1050 m2	0.86%
Bus Terminal,	5	average 547 m2	2735m2	27200 m2 *	22.52%
Interstate Rail Platform & Terminal	1	n/a	length 350m	53200 m2	44.04%
Train Museum	1	525 m2	525 m2	525 m2	4.44%
Skate Park	3 bowls, 3 ramps, off-street	110 m,2,50m2, 150m2	600 m2	600 m2	0.37%
Residential	15 buildings, 63 dwellings	100 m2 /dwelling	6300 m2	6300 m2	5.22%
Retail/Mixed Use	8 buildings + plaza	approx. 525 m2	4200 m2	4700 m2	3.89%
Greenspace (Wet/Riparian/Dry Lands)	3 constucted wetlands	average 3730 m2	11200+16800+	28000m2	24.75%
Exhibition/ Amphitheatre spaces	2	50 m2	100 m2	100 m2	0.08%
Constructed Links	6	n/a			

(Calculated by Design Studio Students; from *"Weavings"* Document).
(Site total area approx. 120 800 m²).

Table 120: FRRRES: Educational Outcomes

Strategy	Positive Student Response	Negative Student Response	Comment (by Author as Leader)
Sensory experience first, structure delayed	Strong ownership & deep understanding of site through repeated visits at different times	Discomfort about not getting straight into design; one small visit is enough	Allows sensory, intuitive time to impact and affect process.
Mixed large & small group & solo work	Good range of experiences (large group., individual, attachment to one of 6 functional groups + one design group)	Large groups tedious; "too many" groups to keep track of; prefer working alone	Flexible, maximises opportunity for accessing inputs; training in collaborative attitude plus periodic accounting for individuality.
Talking around issues, brainstorming	Appreciated integrative & creative aspects	Waste of time compared to designing something immediately; why isn't there any direction? Taking too much time	Allows community process, discourages ego. Allows emergence of intuitive processes.
Group dynamics	Got to know each other, sorted out conflict, learned issues about working in group: good	Leaders (student group & academic) should tell us what to do; it's all a waste of time; hard for shy people; group meetings are tedious	Useful learning about communication, conflict, tendency for differential investment & responsibility for process & how to cope with this; self-starting rewarded. Non-participants discomforted & missed out on potential learnings.
Individual exercises	Good as contrast to group style work	Relief to go back to 'normal' methods	Undid blockages in creative process; ensured individual participation in direct way; affirmed individual; attended to personal grounding (sense of control).
Selection of huge site for project	Chance to find out what's involved in comprehending such a site, work at higher scale with wholism, integration	Don't care about whole as much as designing buildings; confusion about multiplicity: why aren't we designing buildings?	Large sites are not a normal subject for Architectural Education, yet are becoming increasingly important.
Experimental nature of project	Glee	Confusion, disorientation	Wonderful opportunity to have time enough for creative process.
Site Analysis	Invaluable; reality of site, of interviews, contact with stakeholders much appreciated as training for real practice	Question relevance of in-depth understanding of context, of data collection	May be their only opportunity to comprehend the depth required of sustainable design; opportunity to understand roles of other professionals in future teams.
Small groups based on personal style (earth, water, fire, air)	Working extremely well; excellent bonding	None noted	Prevented usual isolation in friend groups; more realistic; insisted on new relationships; good balance of abilities per group.
Assessment	Appeared fair	Unhappy to rely on leaders' assessments; should be rewarding for enthusiasm regardless of standard	Assessed on design input & quality & 10 other individual parameters: benchmarking system; non-orthodox caused problem re University Policy when challenged.
Teamwork	Vital learning	Unequal effort	Depth aspects of teamwork fully revealed with good learning opportunities.

2.2.12.2 STRUCTURE

2.2.12.3 PROCESS

CONTENTS

Table 121: BIES: Simplicity after De Bono

	The Ten Rules of Simplicity
Rule 1	**You need to put a very high value on simplicity.** To want to get simplicity you have to put a high value on simplicity. In fact very few people do. Simplicity is not often treated as a prime objective. It is very unlikely to just happen. Simplicity is not natural. You have to choose to make it happen.
Rule 2	**You must be determined to seek simplicity.** To get simplicity you have to want to get it.
Rule 3	**You need to understand the matter very well.** In order to design something you need to know exactly what you are dealing with and what you intend to achieve.
Rule 4	**You need to design alternatives and possibilities.** Simplicity has to be designed. The emphasis is on 'design'. Analysis plays an important part in simplification but in the end you have to 'design' a way forward. That design process needs creativity and lateral thinking. It is not a matter of designing the 'one right way'. It is more a matter of designing alternatives and possibilities, and then selecting one of them. The first idea that comes to mind is unlikely to be the best. That is why it is so important to go on thinking and to produce some further possibilities.
Rule 5	**You need to challenge and discard existing elements.** Not everything that is there really needs to be there.
Rule 6	**You need to be prepared to start over again.** Modify if you can - start afresh if you cannot. Be clear about what you are trying to do and then set about designing a way to do it - ignoring the existing system entirely. This is more difficult, more expensive and less likely to be acceptable. So you will have to show the benefits of the suggested new system and explain why modification would never achieve the same benefits. This restructuring can apply to a whole operation or to part of it.
Rule 7	**You need to use concepts.** Concepts are the human mind's way of simplifying the world around. Concepts provide the first stage of thinking in setting the general direction and purpose. Once you have this then you can find alternative ways of delivering that concept with specific ideas and concrete detail. Remember that it is the precise purpose of concepts to be general, vague and blurry. That is how they work.
Rule 8	**You need to break things down into smaller units.** Complex systems work best when there are sub-systems, each of which has a simpler organization which is integrated into the whole (like the tiny cells in the human body).
Rule 9	**You need to be able to trade off other values for simplicity.** If simplicity is a real value then you must be prepared to trade off other real values in order to gain simplicity. It is usually not possible to have everything, so there has to be a choice between different values. It is important to be deliberate and conscious of the choices that are being made. You may need to trade off comprehensiveness for simplicity. Then you design a parallel system to deal with the exceptional cases.
Rule 10	**You need to know for whose sake the simplicity is being designed.** For whose sake is the simplicity being designed? Who is going to benefit from the simplicity?
Comment: Caveat: Rules 1, 3, 9. **Link: Models & Mindscapes: Characteristics Required of an Ecological Model.** After coming to terms with a project's Complexity, the best resolutions are emergent, multifunctional and elegantly, deceptively simple.	

(Contracted/transcribed from De Bono 1998: 44, 279-87).

Table 122: FRRRES: Green Mortgages - New Haven Project

GREEN MORTGAGES (BANK SA)
Specially negotiated for New Haven Project
(None taken up)

- Are ordinary home loans
- Lend more than standard to account for green technology up-front costs
- Conditions apply; the property must incorporate:
    - ~ Geothermal heating/cooling
    - ~ Solar hot water service
    - ~ Stormwater capture, underground storage then irrigation
    - ~ House pre-wired for computer access
    - ~ Fully automated metering, to minimise paper and plastic card use.

(Source: advisory letter from Bank SA 1996).

Figure 59: FRRRES: Mariendalsvej Cohousing for the Elderly

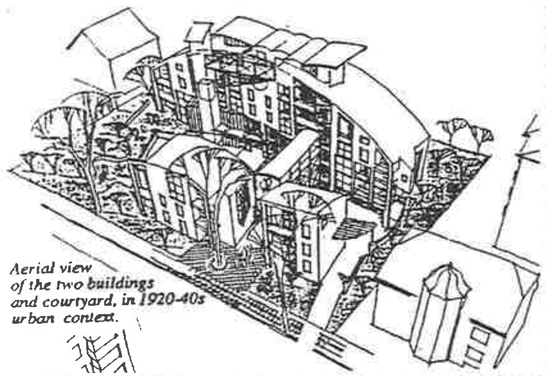
MARIENDALSVEJ PROJECT (KØBENHAVN)

Sources: Interviews & materials Perks Univ. Calgary, Van Vliet U. Calgary & Vancouver, Innovative Housing Conference Vancouver, site visit København.

Demonstrates Importance of Pension Funds in Leading the Development Industry
Project Description
Frederiksberg, København, Denmark, 1993.
22 units, Cohousing for elderly, comprehensive user participation in design; multi-storey, human scale.
Supported by Ministry of Industry, Department of Energy.
Design architects: K Zahle & PD Mortensen.
Finance: Lawyers' & Economists' Pension Fund.
Cost (total project with land): DKK 32,000,000.

Pilot project based on Principles in Report on *"Elderly Housing and Co-housing in the City"*.
Extended participation process; full-scale modelling workshops; site visits to other projects.

Urban Ecology elements: energy, water, waste, urban nature, healthy building materials, rainwater use, active & passive solar, heat recovery from exhaust, extant & edible landscape, low maintenance plantings, kitchen gardens, public participation at highest Arnstein (1969 'ladder') level: "genuine participatory & democratic planning process" (Perks, 1993: 20).

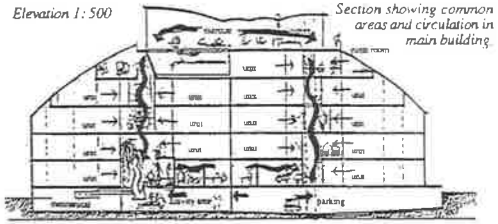


Aerial view of the two buildings and courtyard, in 1920-40s urban context.

"The full and successful engagement of the dweller group was a key factor in the advanced housing design and to the community development process founding a high degree of competent resident based stewardship."

(Mortensen & Dahle, 1988 *"Boliger Egnede for Aeldre"*; source: information sheet, Poster Presentation, *"Innovative Housing"* International Conference, Vancouver, 1993).

Elevation 1: 500



Section showing common areas and circulation in main building.

Table 123: RRES: Danish Building Research Institute Conclusions

STUDY: SOCIAL PROCESS IN PLANNING PHASE: OUTCOMES OF HIGH LEVEL PUBLIC PARTICIPATION PROCESS (COLLABORATIVE DESIGN)

CONCLUSIONS OF DANISH BUILDING RESEARCH INSTITUTE STUDY ON CONNECTION BETWEEN SOCIAL PROCESS IN PLANNING PHASE AND SOCIAL ENVIRONMENT OUTCOMES: MARIENDALSVEJ AND OTHER PROJECTS)

User Participation	Type: varied; degrees of influence: different for each project.
User Turnover	If high, indicated interest, but not at any price.
Recruitment Time & Organisation of Planning Process	Important in motivating participants. Implications for development programme: new member integration must be strong; needed to shorten design & construction phase & review continually to minimise costs.
User Needs	Good initial overview very important, topics, decisions to be made, when to be made, implications for future process (sound, clear orientation to process).
Learning Phase	Minimum knowledge required: planning-design process, biotic & abiotic systems: use experience from advisory groups.
Organisation of Meetings	Care needed: best appears to be regular meetings, smaller groups, chaired by users; working parties on topics between general meetings.
Decision Making	Important to agree in advance on decision procedures & conflict resolution approach.

Based on information David Van Vliet personal communication[#]; *Innovative Housing International Conference*, 21-25 June 1993: Information Sheet from Poster Display; (Minister of Supply & Services Canada 1993;Perks & Van Vliet 1993: 20, 31-2, 42, 59).

Other examples of leadership in design and development include the Cohousing projects initiated by McCamant & Durrett of Berkeley, California (architects and designer-developers), where instead of taking an entrepreneurial stance as is common in Australia, the developer takes a longer-term, relationship-based approach founded on servant leadership and example-setting.[§]

Table 124: BIES: Community Title (SA)

COMMUNITY TITLE ACT 1996 (SA)

Main Features	Advantages Of Community Title	Disadvantages Of Community Title
• Creates land parcels called lots defined by measurements: ~ Community lots ~ Community strata lots ~ Development lots • Allows a combination of common and privately owned property • Allows for mixed development subject to planning constraints • Allows commerce • Membership is by lot ownership • Managed by a community corporation • May have nested secondary and tertiary corporations • Will replace strata title (SA); SA modelled on NSW.	• Flexibility • Schemes can be tailored for any size group, family, resort, theme • By-laws not prescribed by the Act • Allows social and environmental covenants • Ease of administration • Clarity of structure and process, disclosed up front • Facilitates refurbishment of existing buildings (conserves resources) • Mixed use is environmentally desirable • Allows incremental development and addition of additional lots • Suited for leaseback arrangements (favoured by resorts & foreign investors).	• Tendency to self-containment encourages paranoid arrangements of wealthy: gates, guards & guns lock the well-healed in and others out • Above seen as a strong selling point but encourages alienation.

(Source Rounsefell 1997). From OHP.

(Tool 3.11: Scale Analysis Table)

Table 125: CEES: Chunking (a) by Spacetime (large) & (b) by Functional Region

	Chunk Biosphere	Chunk Bioregion
Community	UN Treaties, Conventions and Action Plans, global governance, work of/funding from global foundations, *Healthy Cities, Cities for Climate Protection;* Globalisation	Community Glue Catchment & Local Government Acts Development Plans; Regional development controls, Local Action Plans in force
Landscape	Deforestation	Fractal Index, Matrix quality, patch size
Elements	Climate change, sea level rise	Catchment management (water quality, wilderness conservation, indigenous plantings, swales, absorptive surfaces); climate (biome)
Genius Loci	Global despoilation processes, urbanisation	Sense of Place, territory
Biotics	Loss of habitat; migratory birds & animals; loss of Natural Capital	Matrix: 30% retention indigenous habitat; desertification, toxification, salinisation; hard engineering/industrial paradigm impacts
Organism	Geophysiology (disturbed), famine, disease (plagues), global misdistribution; rich-poor divides; social justice	Overall regional function, local meeting of needs (resources, food, water, work), import replacement (economic self-sufficiency)
Population	Population crashes, war, global for scarce resources	Carrying capacity; Attractor Landscape; indigenous populations, ferals, exotics, dog & cat control
Ecocycles	Diffuse molecular pollution, collapse of ecological services, fossil fuel issues, *Ecological Footprint*	Regional ecocycles: waste management: net dumping to higher scales for biological servicing, self-sufficient ecological services, Ecological Rucksacks
Connectivity	Air travel, IT&T, connection to global markets: imports/exports	Regional connection & disconnection; inputs & outputs (infrastructure, IT&T, wastes)
Feedbacks	Global constraints; technology, resources; climate, population; global governance; health of United States economy, globalised economy, free trade,	Regional policies, economic activity, indicators; Indigenous vegetation industries
Rheotics	Slow variables, geological time	Medium frequency variables: minutes to 100s of years
Indicators	Global scale	Ecological Footprint, MIPS, Ecological services.

Table 126: CEES: Chunking (c) by Project Site (spatial) & (d) by Functional Element

	Chunk: Project Site	Chunk: River Path (Project Element)
Community	Contracts, ownership, Strategic Plans in force, local regulations in force	Education opportunities, site rules & regulations, fencing issues, dog droppings & facilities, bicycles & facilities; management subgroups; crime & safety
Landscape	Geomorphology, orthocadastral map of locality, aerial	Large scale plan of path
Elements	Soil characteristics, soil building; water map, rainfall, seasonal information, water plan, stormwater management, swales, wetlands, absorptive surfaces; fire regulations & hazards, local seismology, air & water quality, wind roses; microclimate	Construction materials, drainage & water management; microclimate: air, wind, shelter, water, sound
Genius Loci	Feng Shui, entrance, centre, aesthetics, theme, sensory, vistas	Sensory (Nature, vistas, colour, public art, bridge & building design, theme, character, variation, texture); activity variation: exercise, sitting, loitering, watching; plantings: backdrop, flowers, scents); meaning, stories, interpretive signage, local history; view from above & distance, elevation; cyclic changes
Biotics	Remnant vegetation, restoration of indigenous; Retention, healing, enhancement of Nature's productive surfaces	Plantings, protected vegetation, habitat reconstruction, deciduous vs evergreen species; pesticide policy, mulching
Organism	Needs for maintenance & long-term survival, safety etc: funding & management to maintain context replacement;	Needs for maintenance & long-term survival, safety etc: funding & management to maintain context replacement; overall function required
Population	Xeriscape, avoid lawns, user populations, exotics	User population definition, weed & feral control issues
Ecocycles	Internal management of wastes, food production, water collection & reuse	Waste management, bins: separation for recycling, access, number & placement
Connectivity	Infrastructure (utilities), transport connections; site traffic	Traffic plan, sacrifice area nomination, areas for disconnection (fencing), entrance, exit, access policy; differentiation from surroundings
Feedbacks	Marketing; finance	Information; management & maintenance budget; suggestion box; usage indicators
Rheotics	Long term management, reassessment, maintenance, upgrading	Future development; vegetation management with growth; improvements
Indicators	Observation; annual reviews, EMS	Infrequent audit; observation & informal feedbacks.

(Plate 12: Collage: Site Plans)

(Tool 3.12: 20-Step Design Process)

(Tool 3.13: Design Process Loop

2.2.12.4 TECHNOLOGY - TOOLS

(BP 5.10: What Mathematics for the Divergent Sciences?)

(Tool 3.1: Introduction: Use of Matrices)

(Tool 3.2: UHSE Tools & Uses)

See Section 3.0 Appendix C

2.2.12.5 CONTENT

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2.2.12.6 INTEGRATIVE MODELS

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TOOLS

(BP 5.10: What Mathematics for the Divergent Sciences?)
(TOOL 3.1: Use of Matrices)
(TOOL 3.2: UHSE Tools & Uses)

CONTENT

(DB 4.2: Sustainability Principles & Strategies)

Table 127: ESCM: Australia's Goals, Core Objectives And Guiding Principles for the Strategy

AUSTRALIA'S GOAL, CORE OBJECTIVES AND GUIDING PRINCIPLES FOR THE STRATEGY

Goals, Objectives, Principles	Comment, Critique
The Goal Is: • Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.	This definition of 'sustainable development' takes no account of the high absolute and relative quality levels at which Australians presently live, and tends to be expressed in materialistic terms, discounting the lot of those who have not benefited from economic rationalism, indeed the social safety net is being substantially and somewhat vengefully contracted.
The Core Objectives Are: • To enhance individual and community well-being and welfare by following a <u>path of economic development</u> that safeguards the welfare of future generations. • To provide for equity within and between generations. • To protect biological diversity and maintain essential ecological processes and life-support systems.	Note that economic development is assumed to be the 'sine qua non', and the sole arbiter of community well-being, welfare and survival. through ecological protection.
The Guiding Principles Are: • Decision making processes should effectively integrate both long and <u>short-term economic</u>, social and equity considerations.	Short-term economic considerations have become ever more dominant in an economy driven by economic rationalist principles and severe 'across-the-board', rather than strategically targeted cost-cutting.
• The Precautionary Principle: • Where there are threats of serious or irreversible environmental damage, <u>lack of full scientific certainty</u> should not be used as a reason	The reluctance to act on greenhouse gas emissions has been based by the present Federal Government amongst others, on the very reversal of this principle.

for postponing measures to prevent environmental degradation.	
• The global dimension of environmental impacts of actions and policies should be recognised and considered.	One wonders if this consideration was at any stage made when the Queensland Government decided to approve the building of a number of coal-fired power stations. One wonders what the Australian Government was considering with regard to the future effectiveness of its own and other governments' environmental and social justice laws, when it initially embraced the Multilateral Agreement on Investment.[16]
• The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised.	The concept of environment as contingency persists.
• The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised.	International Trade Agreements signed since the ESD Strategy, have ensured that environmental soundness is constantly under challenge, as Australian efforts to protect its biological integrity are routinely challenged on the grounds of vexatious protectionism.
• Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms.	Most 'low hanging fruit' options have not been taken up (eg carbon taxes, subsidy removal, container deposit legislation, full cost pricing); responsible consumerism could be assisted by better information (eg comprehensive labelling) and education.
• Decisions and actions should provide for broad community involvement on issues which affect them.	'Broad community involvement' has recently come to mean pollster feedback or 'consultation with stakeholders', the latter often excluding the public, especially with national scale issues.
• These guiding principles and core objectives need to be considered as a package. No objectives or principle should predominate over the others. A balanced approach is required that takes into account all these objectives and principles to pursue the goal of ESD.	An ecological approach would demand that the health of the environment is paramount, on pain eventually, of human survival, and that all other objectives and principles should flow from this.

(Commonwealth of Australia 1992: 8-9).
[Right hand column transcribed directly from source, underlining added].

[16] An initially secretly negotiated OECD scheme that sought to nullify any local or national laws which may inhibit investment and the generation of profits in any signatory country, by not requiring any responsibilities of the (mainly multinational corporate) investors, by making any protective exceptions time-limited, and by legally enshrining the right to sue a resistant member government for perceived loss of profit due to local regulatory or legislative constraint.

Table 128: ES: Ventura County Citizen Planners: Summary of Planning Principles

Principles and Expansion (Columns 1-3: direct transcription Citizen Planners of Ventura County 1991: 20)			**Summary**
Principle 1	PROTECT, PRESERVE & RESTORE THE NATURAL ENVIRONMENT	Acknowledge that undisturbed natural beauty enriches our lives and that the natural environment, functioning in a healthy manner, is basic for a healthy world, a healthy economy and healthy society, and that in fact, it is our life support system.	Accept humans' relationship to nature; note health as a sustainability issue
Principle 2	ESTABLISH TRUE-COST PRICING ECONOMICS	Establish true-cost pricing as the basis for economic viability. Utilize whole-system thinking to recognize the true long-term costs and benefits of actions from an economic, environmental and social standpoint.	Ecological Economics
Principle 3	SUPPORT LOCAL AGRICULTURAL & LOCAL BUSINESS PRODUCTS & SERVICES	Use community products and services for the cycling of economic wealth within the community. Integrate basic food production within and near the community to support local self-sufficiency.	Regional basis for action
Principle 4	DEVELOP CLUSTERED, MIXED USE, PEDESTRIAN ORIENTED ECO-COMMUNITIES	Clustering reduces infrastructure costs and pays for the reclamation of open space within existing communities, and protects and pays for open space within rural areas.	Land use pattern remodelling
Principle 5	UTILIZE ADVANCED TRANSPORT, COMMUNICATION & PRODUCTION SYSTEMS	Reduce automobile dependence, traffic congestion, ait & noise pollution, and operating and maintenance cost by establishing rail-centred transportation which uses clean, locally renewable fuels. Utilize advanced communication systems to move information in preference to people and materials. Employ advanced production technologies to reduce cost, increase quality and production *[sic: read 'productivity']*, and reduce pollution and energy use.	Modern IT&T; old fashioned transport with sustainable technology & fuels ie harness technology to reduce costs like pollution & increase productivity
Principle 6	MAXIMIZE CONSERVATION & DEVELOP LOCAL RENEWABLE RESOURCES	Maximize the use of conservation technology and practices, reduce the use of non-renewable resources, and develop local renewable energy, water and material resources.	Smart resource use
Principle 7	ESTABLISH RECYCLING PROGRAMS & RECYCLED MATERIALS INDUSTRIES	Expand recycling technology and establish extensive recycling and composting programs to supply local industries with raw materials. Encourage the use of non-toxic, reusable and recyclable products. Redesign products for longer life and to reduce consumption of energy and materials.	Smart resource use
Principle 8	SUPPORT EDUCATION FOR PARTICIPATORY GOVERNANCE	Build educational awareness and public consensus for ecological planning and policy issues both locally and countywide, through broad-based citizen participation.	Consciousness raising through community participation (learning by doing)

(Citizen Planners of Ventura County 1991: 10-17).

Figure 60: FRRRES: JVNIC Theme Report

INFORMATION SPIDER GROUPINGS: EMERGENT THEMES FROM JVNIC

Transport & Traffic	16
Water	12
Biodiversity & Biotics	10
Global Issues including Climate Change & Energy	9
Finance & Funding	8
Housing & Land Tenure (alternative forms like Community Title)	7
Social Issues	7
Building Design	6
Resource Management	4
Education & Information	3
Technology	3
Employment & Industry	3
Process	3
Urban Form	3
Air	2

Numbers represent number of 'spiders' on each topic.

The **Jerrabomberra Valley National Ideas Competition** asked Australian urban designers to develop a concept plan for a very large, specific area straddling the border between the Australian Capital Territory and the New South Wales town of Queanbeyan. The Tables, left and below, illustrate the level of consciousness of different urban sustainability issues, emerging from *Content Analysis* of competition entries in 1994.

Table: Information Spider Groupings: Emergent Themes from JVNIC indicates topic density across 32 entries. As seen elsewhere, 'Spiders' are an information storage device designed to preserve a level of detail normally lost in reporting.

Table: Concept Constellations from JVNIC presents groups of issues that tend both to occur together and to support synergistic solutions.

Table: UHSE Criteria x JVNIC Sustainability Strategies sorts all JVNIC Spider topics (each representing between 3 and 24 concepts, desirable qualities or strategies), and some Report topics from entries, not represented by spiders, by UHSE Criteria.

Noted to be missing or sparse in competition entries: comprehensiveness in response to brief; policy and implementation strategies for ideals stated; sound translation of generics; practical strategies for getting regulators to accept new approaches; advanced energy, engine & transport technologies; industrial & transport energy sources; IT&T; response to incremental growth; governance; biodiversity planning and TCM.

(Source Rounsefell, 1994A: Rounsefell, 1994B; Rounsefell, 1994C: 23-39).

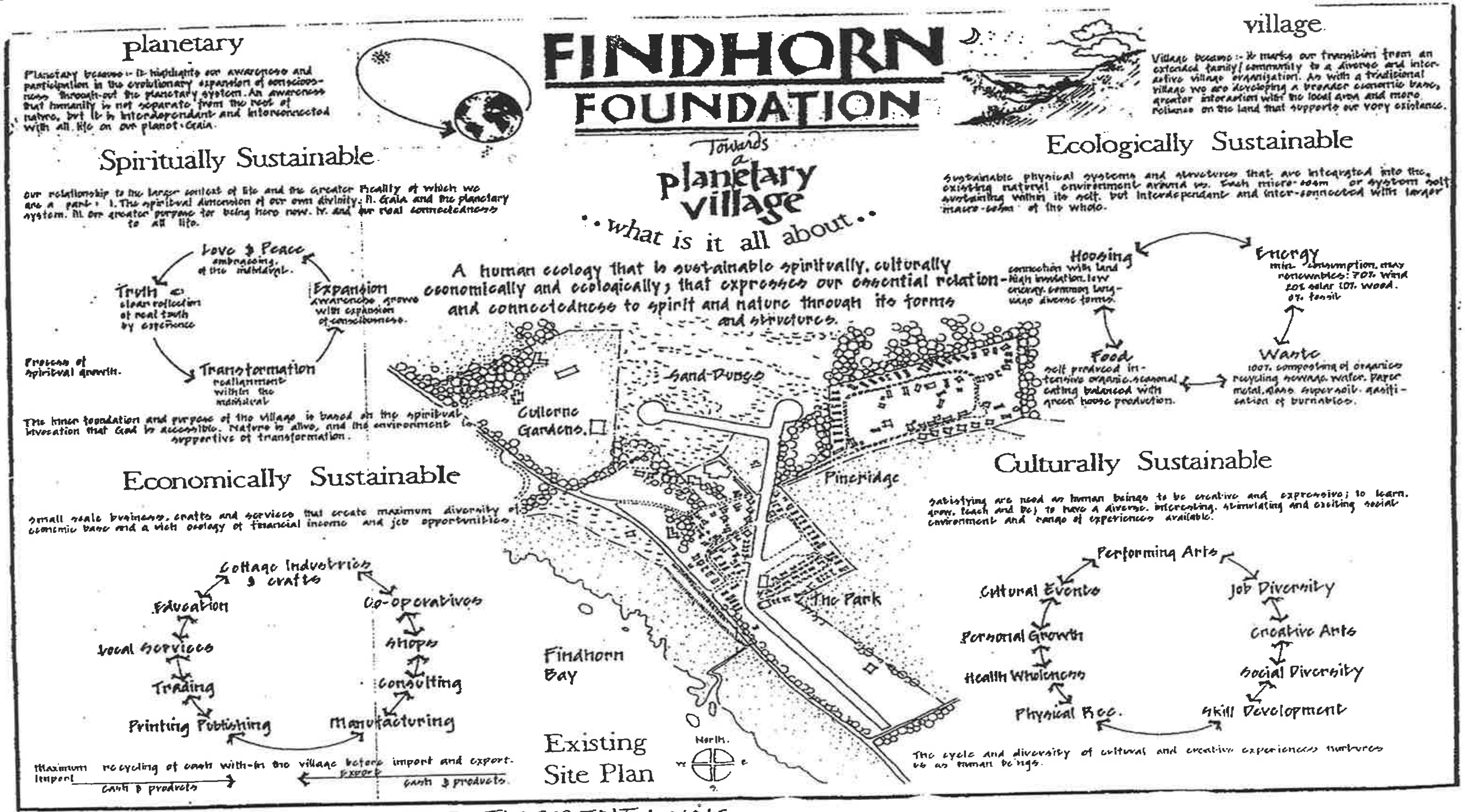
CONCEPT CONSTELLATIONS FROM JVNIC

Biodiversity, habitat, corridors; water management; Permaculture; regeneration, conservation, stewardship; gardens; urban-rural connections; TCM	Housing structure & materials; materials sources, soil, earth; function; site design, block design; cars	Sense of place, amenity, convenience, recreation facilities, public buildings, design of spaces, conviviality, ambience, access, freedom from cars
Water re-use, grey, storm & black water; storage, capture, processing; effluent forestry, wetlands; ecosystem protection during construction	Local democracy, education, research, creativity; multifunction, localism	New eco-industries, recycling, refuse-resource loops, gardens, food production
Transit, urban form, density, nodes, mixed use zoning, cars, pedestrianisation	Lifestyle, employment, IT&T, small transport, freedom from cars, meeting needs, access, self-sufficiency	Energy generation, industrial emissions, proximity, freight, district heating, transport connections.

UHSE CRITERIA X JVNIC SUSTAINABILITY STRATEGIES

UHSE Criterion	Sustainability Strategies
Community	Community management of open space; consciousness raising; eco-social education, community building; Cohousing; Alternative land & housing tenures: Tradeable Equity Cooperatives; Community Land Trusts (2), community housing cooperatives; diversity principle in planning, small scale processes; development process, 'Ecocity Canberra'; Permaculture (1/2 recommended).
Landscape	Ecosystem fragmentation (prevention); wetlands; urban design to reduce traffic; streets shape urban space; high density development; Transit Oriented Development/ 'New Urbanism' pattern (2/3 recommended), Permaculture landscape; Permaculture blocks; water-sensitive landscape, TCM (Total Catchment Management).
Elements	Swales; drainage systems; absorptive paving; water management, stormwater management, water reuse; water conserving toilet; system from available components; creek management; lake issues (hydrology); air quality problems; air quality strategies; causes of climate change; microclimate consciousness; passive solar design; building function (physical).
Genius Loci	Sense of Place; lively; (universally mentioned); build Sense of Place on historic localities & sites, local endangered species; NeoTraditional neighbourhood; visual axes; pedestrian emphasis; design for community meeting, gathering, communing, adolescent needs, Child Friendly; butterfly tourism.
Biotics	Wetlands; Pre-Aboriginal vegetation; tree corridors, native grasses (advantages); ridge plantings; animals (needs); urban bushland; alternative sewage treatments, TCM; gardens (Permaculture, effluent, edible/productive landscape, food-productive wildlife corridors, organic, community, roof, biodynamic: often mistaken for 'biodiversity'); plantings (green, wetlands, forests, pre-Aboriginal fire sensitive: often mistaken for 'biodiversity); six endangered species; companion animal control; wildlife under- and over-passes; endemic vs. exotic native plants.
Population	Needs satisfiers (Max Neef); needs of children & adolescents; diversity in planning; satisfaction of community needs; cars (issues, satisfier status, solutions, alternatives); public transport (increase use, service, convenience, utilisation for freight); smart transport; smart taxi; slow vehicles; slow ways (dedicated roadways); lake uses; retrofit, not sprawl.
Organism	Building function; lake function (recreation); roof gardens; Healthy Housing; green jobs, work near home, pedestrian priority (nearly universal); needs of children & adolescents; lively, convivial; self-sufficiency.
Ecocycles	Building function; housing (earth; green; local, recycled, low energy, low CO2 materials; glasshouse; underground); EcoCost building materials; recycling; light rail; public transport for freight at night; fuel cell buses; energy systems; mini hydro; cogeneration, demand control; SPVs; solar thermal HWS; design to avoid air conditioning; avoid wood heaters or cold burn; district heating; electric vehicles; slow vehicles; vanadium battery; wind energy; resource conservation; pollution issues; vacuum system waste transport; advanced techno-housing; advanced recycling with computerised resource tracking; information ecology; cycling; biological solutions.
Connectivity	Urban design to reduce traffic; separate water streams for reuse; system of sustainabilities: ecological, economic, spiritual, social, cultural, industrial, educational, intellectual, health, ethical, temporal (time horizon); no pipes in or out; access: equity, opportunity, work, social facilities.
Feedbacks	Funding sources; lending; community funding; community land trusts & other housing access; funding types; benefits & advantages of cars; control car speed; green transport; barriers to ESD; car disadvantages; car costs; support experimental development; fair pricing for local energy generation (surplus to grid); transparent cross-subsidy; same authority manages all energy.
Rheotics	Sustainable time horizons; organisational structure for overseeing ecological development (tightly associated with University).
Indicators	Evaluation process; indicators.
Scale	'Fractal' design (macro + micro together), precinct focus.

Figure 61: BIFR: Findhorn Foundation



FINDHORN FOUNDATION DEVELOPMENT WING

(Plate 13: Collage: Findhorn (A))
(Plate 14: Collage: Findhorn (B))
(Plate 16: Collage: Overdrevet)

Figure 62: FRRRES: Advantages & Disadvantages of Cohousing

ADVANTAGES OF COHOUSING

ADVANTAGES FOR MODERN LIVING

- Instant community: equivalent to extended, unrelated family
- Child-friendly
- Cooperative purchasing power
- Share expensive equipment
- Share arduous tasks (eg routine cooking, gardening, cleaning, child minding)
- Increased free time for socialising, parenting
- Privacy retained
- Benefits for 'DINKS' (Double Income, No Kids), unemployed, aged, singles, children.

COMMUNITY BUILDING THROUGH CO-HOUSING

Addresses 20C failings: community breakdown, alienation of individuals, neglect of disadvantaged (eg single parents, elderly, young), human ecological impacts.

HARDWARE: site layout, shared resources, building design, usually medium density.

SOFTWARE: participatory process, shared decision making, rich social agenda
participation: joint visioning, participatory planning, social bonding
inclusion: wide mixes - age, social, tenancy, family structure
territories well defined, allowing easy casual socialising and privacy
decision making: open, fair, usually consensual
shared responsibilities: decisions, maintenance, repairs, environmental & energy policies, sustainable lifestyle
shared voluntary social activities: meals, workshops, parties, meditation, outings, shopping, gardening.

OHP From presentation ANZAAS Conference 1997 (Rounsefell 1997); *[Based on Author inteviews of Cohousing residents, UK, Denmark, Sweden, USA]*. (See also Fromm 1991;McCabe 1995;McCamant,Durrett & Hertzman 1993;Meltzer 1995;1997a;1997b).

DISADVANTAGES OF COHOUSING

The following were regarded as tradeoffs - not bad enough to discourage them from participating in the lifestyle (participants do self-select):

- All the meetings drive you mad eventually (may be solved by committee systems)
- People know your business
- Less flexibility around having to consider the collective in many areas
- Having to accept collective decisions you may not agree with
- Can't get the kids away: when parents want to leave, the children often strongly do not.
- Quite demanding on you as a person if your natural style is not openness, frankness, mutually respectful & trusting
- Other people's habits can be as issue, but community pressure is available: conflict resolution must be spelt out in advance.

Figure 63: FRRRCM: Report Card: Vårst Cohousing Community

CASE REPORT CARD: VÅRST COHOUSING COMMUNITY
September 1993

LOCATION
10-14km out of Ålborg, near Lindenborg.

TYPE
Vårst ('Windmill') Cohousing community.

CONTACTS
Henrik Lund (civil engineer: energy), wife Søsser (industrial ecology)
via Prof. Gitte Marling, Ålborg University, Department of Development & Planning.
0011 (45) +98 33 34 99

COMMUNITY
Planning System
Community Title, big problems getting approval (need to change regional plan; farmer resistance; villager support - rural fringe).
Internal governance
Community organisation into 'roles':
<u>Heat master</u> (2 assistants)
<u>Oldfrue</u> runs common house, organises cleaning, lists, etc., harvest feast with local farmers, community recognition of new babies (flowers etc).
<u>Food Mama</u> coordinates meals (Tues, Wed, Sunday + one Friday/month): have to say when you'll be in.
<u>Chief buyer</u> (especially ecological, seeds etc).
<u>Chief beer & soda pop</u>.
<u>Rappenskralde</u> (tough person).
<u>Waste chief</u> (sorting, organising, critique).
<u>Road chairman</u>.
<u>Ethical</u>.
<u>Chief gardener</u> (common gardens).
<u>Building inspector</u> (common house; maintenance & repair.
<u>Ceremony master</u>: harvest, flags, parties.
<u>Food cook</u> makes all meals, sets up, plans, washes up.
<u>Machinery chief</u>: materials (lots), trailer.
<u>Ecology chief</u>.
<u>Plus Board</u> & <u>Committees</u>: Building, Accounts, Community Regulations, entry rules (need sponsorship from a resident), environmental accounting (measures energy use, waste, water; compares each household & whole community against external standards; playground committee (presently no children; discussing to have 6-7 year olds soon.

Education
Community: Very important: much energy put into contacting, informing, inviting over farmers & local community, & participating in local activities & festivals (badminton, orchestra, harvest festival committee etc).
Children: Nursery (?also under threat); private school since public school closed.
Visitors: many.

Glue
Common activities, roles & responsibilities.
Whole idea started over coffee at University (shared Vision).

LANDSCAPE
Native vegetation not noted (farmland area); no indigenous matrix apparent.
Cluster low density separate houses.

ELEMENTS
Earth (Soils)
Agricultural area: soils ✓ growing vegetables.

Water
Bath water to be stored in ground plastic tanks for toilets. Roof water collected for vegetables, animals, reuse.

Fire (Heat, temperature)
Engineer-designed, low energy housing. Solar collector integrated into roof of common house provides 20% of heat, waste wood burning → 80% of heat; double glazed argon windows, 30cm insulation in rooves, floor insulation, passive solar opportunity missed (combination of architect not pursuing & community self-selecting sites & orientations, heat exchange; room thermostat & water pumps on grid energy; computer controlled temp. regulation.

Air
Some involved with windmill 400,000Kwh.pa owned by 40 families: av. Danish use = 4000pa, credits for 10,000Kwh/family; Henrik uses 2000Kwh (energy fanatic); 150Kw mill costs DK 10^6; local grid is 90% coal, Danish coal is very clean except CO_2.

Climate
Many CO_2 reducing strategies.

GENIUS LOCI
In progress look, early days; practical; gardens underdeveloped.
Free choice colours.

BIOTICS
Life support
Human modified.
Life supported
Humans (part), domesticated animals, poultry.
Vegetable garden(s).

ORGANISM
Meeting Needs
Søsser keeps a sheep & spins; grows chooks, eggs, ducks.
2 eating pigs, compost. Not vegetarians, pets OK.
Eat together.
See Connectivity re local resources.
Wholistic function
Doing well 1993. See Indicators.

POPULATION (Attractor Landscape: Who, where, when, why, how?)
16 houses; University people; all 20-40 years, 30 adults, 20 children.

Research re reasons for coming there: 1.Exciting community; 2.Space, animals; 3.Renewable energy; 4.Type of housing; 5.Water saving; 6.Price; 7.Other; 8.Location near Ålborg (some 80 questions; responses from stayers; non-stayers not followed up).

ECOCYCLES
Ecological Services & Loop Work
Composting✓: → hen house, garden; rat-safe containers with tiny holes.
Organics → pigs & chooks.
Recycling (sort at source; past problems with mixing): paper, cardboard → Municipality; glass → containers in town; beer bottles - refund; cans banned (Denmark); leftovers, plastics → kerbside collected & ?burned weekly; metals all together, heavy metals & batteries: 'toxic waste': personal handover.

Materials & Energy Transformations
Transformer system in progress (self build): for 12V & 24V systems to be completed for further development.

CONNECTIVITY
Connection
10-14 km to Ålborg. Work commutes (see Indicators). Private car solutions (not communal).
On grids for water, electricity, sewer. Cooking electric or gas.

Relative Disconnection
Local outlets: few & diminishing. Shrinking local community so school closed, industry closed, shop under threat, therefore all consciously support shop & buy everything possible there.
Low need to lock doors.

FEEDBACKS (Supportive Backcloth)
Positive (Catalysts)
Private long-term funded sharehousing, some rent subsidy from Central & Local Govt; similar to hire purchase scheme. Loans allowed 10% extra for energy infrastructure because experimental. Initial township attitudes supportive. Support from knowledgeable local planner (suggested location).
Community lifestyle very good: positive feelings from quiet country life, living with animals & doing something for environment.

Negative
Planning & development constraints & delays → persistence needed.
Initial local farmer attitudes competitive → meet them at their world model.
Concern about loss of town facilities → active involvement with local community activities.

RHEOTICS
Past
Farming area on urban-rural fringe. Took 2 years' planning.
Present
Time over all: less doing chores, more at meetings.
Future
High fronts of houses above window level for future expansion.
Plans for children & teens in common house, + guests maybe.

INDICATORS (Learning System)
Findings of environmental accounting committee: Co_2 50% of Danish average, wastes 1/2, water 25% less, expecting 50% next year; cars slightly > average, grid power less.
Space heating 50% of usual requirement.

Table 129: BIFRRRES: Senior Co-housing (Odense)

Danish Definition	Co-housing: 'housing together'
Institutions with Experience	Building Societies/Housing Associations. *Andelsboligforening Housing Association*§ Housing is built by quota and central Ministerial approval, to constrain building for the wealthy, ensuring all social groups are taken care of.
Co-housing Residents' Goals	Social: networks, shared activities, like-minded people, threat of loneliness & anxiety. Need to act 'in time' (before someone else or an authority may take over & institutionalise). Self-help; facilitate continuing mobility, preventive health, improve quality of life; practical, daily, mutual support. Replace some family functions (care & support of elderly members).
Co-housing schemes in Odense	*"Optiminternes Fællesbo"* (23 in 22 houses) *"Det kreative seniorbo"* (18 in 12 houses)§ *"Hammerenen"* (24 in20 houses)
Advantages	Professional expertise from institution. Institution takes care of process and has past experience. Keeps ageing residents active, often avoids care, broad social & quality of life advantages: savings on home help, home nursing & institutional care. Family substitute, especially valued when widowed. Ability to pool costs for eventual household cleaning & other help.
Disadvantages	Risk of group splitting up. Risk of different rates of movement among group members. Institutional resistance, inertia, misunderstandings, passive resistance, conflicting rules, prohibition, plans may not fit rigid planning rules/policies: not presently on same footing as ordinary housing, so disadvantaged *[even in Denmark!!]*. Organisational structure/jurisdictions between institutions may create conflict: co-housing is board-governed, so is District: may be hard to please both. Direct responsibility for maintenance can be disadvantage (solutions possible). Possible illness & caretaking issues with age. Extra strain on municipality as coordinator, adviser, supporter.
Differences from Ordinary Housing	More space for indoor communal activities. Common areas must be designed for many different uses.
Key Learnings	Collaboration should include all intended residents in all decisions. Building committee needed for large groups, to negotiate & form agreements. Architects & engineers etc. need to respect users' wishes & keep them well informed.

	Future residents from waiting lists should also attend meetings. Clarify sub-letting before issue arises: check renting rules. Contact waiting list people well in advance of moving. Design phase: cost-cutting efforts (painful): options for residents to supply own appurtenances to some extent. Initiative for building must come from residents and their interest organisations. Process takes about three years: hard work for all; practical support needed. There is a need for organisations able to arrange contacts between: individuals, senior citizens' groups, potential funding organisations: municipality is ideal. Efficient, internal information structure needed, integrating Social Planning & Housing & Town Planning.
Establishment: Ten Process Stages	1. Scope of the individual citizen 2. Forming a group & building an identity 3. Formulating the problem 4. Formulating project proposals 5. Municipal planning 6. Funding 7. Approvals 8. Dispensations & special agreements 9. Planning, design & economies 10. Moving in & starting up.
Possible Funding Sources	Grants from Foundations for furnishing. Municipality, pension funds, lending institutions, housing associations, building societies.
Tenancy types	Private cooperative; freehold; rental.

(Source: *"Summary, SBI Report 97"*: <u>Establishment of Senior Co-housing Schemes</u>: 101-110; provided to me by Finn Jensen, Head of Odense Municipality *Social Services & Health Department; also of* Andelsboligforening Housing Association; Interviews with Finn Jensen).

(Plate 16: Collage Permaculture)

Figure 64: ES: Eight Steps to a Sustainable Community

Eight Steps to A Sustainable Community

1. Recognise it will be a journey – and enjoy it (great love, persistence & patience over years).
2. Develop a Vision – and keep developing it (clear, shared, *"Yes!"* response from all concerned).
3. Build relationships and bonding (heart, glue, solid interpersonal relationships).
4. Make the whole-system challenge explicit (balance planning and experiment).
5. Get help to become self-reliant (budget for all to learn group process & management skills).
6. Develop clear procedures (written: decisions, disputes, finances, meta-procedures).
7. Maintain balance – sustainably (important balances: group/private, hardware/software, heart/mind/will, talking/acting, time & money in current consumption/investment/sustainable service).
8. Be open & honest (sensitive issues: sex, power, money; power gradients are universal, go for equal fairness, complete equality is a destructive fiction)

(Contracted from Gilman 1991). Advice from an experienced *Communard.*

Table 130: RRES: EcoCommunity Implementation: Issues & Solutions from Swedish EcoVillages

Problem Area	Issue	Reasons/ Outcome	Solutions, Corrections
Repetition of Mistakes	Under-design of glazed house extensions & greenhouses Incorrect house orientation Excessive shading Inadequate community space Inadequate garden space Information not passed on	Heat gain/loss Community needs not met Wheels get re-invented	Do research in advance Pass on how to deal with planners/builders, avoid compromise & control costs Don't rely on inexpert consultants Using competent builders with sustainability experience Deal with reluctance of local government & developers to repeat successful demo projects.
Limited Features	Despite an 'ecologically minded' market segment, most developments claiming sustainability only focus on one or few sustainability features	Claim admin, regulatory or financial barriers	There are 9 basic performance characteristics that distinguish a full-featured sustainability project: community design, land & community space, sustainable housing design & materials, resource conservation, waste management, transportation & street use, open space & urban greening, community-based food production, soil, air & underground water protection.
Pace Slow	Poor diffusion of information, news of success, knowhow	Mainly government & Municipality inertia Claim unmarketable Insincere industry	Government grants for research & design Financial incentives Local admin. Needs knowledge, attitude, political will, structural change.
Insufficient Financial Allocation	Failure to adjust government allocations for ecological housing construction	Inadequate funding for full system-wide applications	Incentives for consumers & industry Quality costs money Pays off in long run: long-term view required Recognise importance for everyone.
Increased Time	Innovative planning, design, building all take longer & cost more for supervision, costs more	Community design (laypersons) take longer than experts Local government inexpert, poor facilities Extra consultants, facilitators needed Public initially unsupportive, now impatient	Innovative finance Municipal task groups to help proponents with codes & speed up protocols Delegate standards & code judgments to proponents Provide financial support for planning, design & development for ecological projects.
Reliance on Individuals	Firesoul phenomenon ("exceptionally-motivated, assertive individuals prepared to invest considerably of their personal capacities and financial	'Motivational dependency': uncertain pool size of motivated, committed people Impatience & frustration in officials keen to implement	Projected need for Municipality to fund training & facilitation services (& find funding) Community management an open question.

Problem Area	Issue	Reasons/ Outcome	Solutions, Corrections
	resources in an experimental venture")(P&VV: 55): all phases.	while the interest is there	
Corporate Structural Barriers (Mirrored Between Municipality & Development Industry)	Professional & specialist territoriality Lack of human resources Lack of will to assist/facilitate Power & authority Cross-departmental communication & decision-making: organisation-focussed problem-solving Technology transfer, training programmes Inertia of protocols & efficiency measures	Inhibit cross-sectoral collaboration Extreme sectorality in business structures	Required: synthesis of complexity, collaborative 'give & take', client focussed problem-solving Tax incentives, grants, performance-tied.
Futures Payoff	Today's cost vs tomorrow's benefit (social, amenity)	How to account for Complementary aspects: cannot be justified using conventional accounting Difficulty attracting funds	Public funding a proportion Re-allocation of infrastructure funding in longer term; eco-development avoids marketing costs (pre-sold) Look forward to economies of scale & economic benefit Cost saving from self-sufficiency around governance, services and infrastructure Reduced maintenance budgets Benefits from self-provision of food, re-cycling, revenues, resource saving.
Human Resources	Emergent issue Professional vs voluntary Issue in Scandinavia & Canada Not enough eco-architects and so on to go around	Committed architects work voluntarily, gain hands-on experience; other architects come along and want to learn without paying, then run off with the projects; volunteer architects increasingly unwilling to work voluntarily	Professional eco-consultants forming a union for self-protection Need for training architects, planners Train the trainers Universities need to support (urgently), including partnerships with industry to produce demonstrations.

(Based on Perks & Van Vliet 1993: 53-9).

(Plate 17: Collage: ESD (1) Der Seepark)
(Plate 18: Collage: ESD (2) Arabella Park)

2.2.12.7 TRANSITION

CONTENTS

2.2.13 CONCLUSION

CONTENTS

Table 131: BI: Eight Major Uncertainties on Biosphere 1

1. Relative impact of human activities on supply of ecosystem services.
2. Relationship between ecosystem condition (pristine, heavily modified) & quantity & quality of services supplied.
3. Extent to which services depend on biodiversity (all types: ecosystem/landscape, species, genetic).
4. Extent of impairment to date, & distribution of impairment & risk by region.
5. Interdependence of various services; thus secondary impacts due to exploitation of one service.
6. Amenability to repair & restoration: extents & timescales.
7. Foreseeable technological substitution: effectiveness, scale, side effects.
8. Required proportion & spatial pattern of relatively undisturbed land required to sustain delivery of essential services: local, regional, global scales; given technology & human activities.

(Based on Daily *et al.* 1997: 17).
"The disastrous experiment of Biosphere 2 helped underline the human hubris of assuming we knew enough to construct artificial ecosystems."

Table 132: ES: Adam Smith's Ten Rules for Mindful Markets

The following Rules form the framework for Korten's recommended policy agenda.

Rule 1 Use life as the measure.	Money is not a proxy for well-being: it has different priorities. If life were the currency, improved quality of life and planetary health would become priorities, & broadly inclusive decision making. Best indicators for human societies: condition of the most vulnerable, especially children (infant mortality, childhood malnutrition, teenage crime, illegitimate pregnancies); for natural systems biodiversity, populations (size of fragile fish, birds, frogs …).
Rule 2 Put costs on the decision maker.	Stewardship incentive: correct market distortions favouring private decisions by distant corporations with serious consequences to public. Government intrusion proportional to absentee ownership. Favour local ownership (stake in community & long-term survival). Fees to offset substandard working conditions, environmental costs, faulty products. Regulation & enforcement: living wage, working conditions, environmental protection *[note this refers to USA, a model we seek to emulate in Australia.]*
Rule 3 Favour human-scale firms and stakeholder ownership.	Available in SMEs: avoids monopolies, size compatible with trusting & caring relationships, higher productivity & innovation; builds local social capital & job satisfaction, less bureaucracy, more participatory decision making; model assumed by Adam Smith.
Rule 4 Strive for equity.	Wealth, gift, inheritance & progressive income taxes. High priority to dignified livelihood for all, avoiding extremes of income.
Rule 5 Favour full disclosure.	Consumer's need to know: needed for mindful choice-making; policy should always support in full: products, processes, toxicity etc.
Rule 6 Encourage the sharing of knowledge and technology.	Define intellectual property rights narrowly & with time limits. Reasonable livelihood for the creator (who usually misses out). Return to joy in creative expression & knowledge sharing as a way of life.

Rule 7 Seek diversity and self-reliance.	Model on biocommunities in Nature. Global system of local biocommunities living within environmental means. Material & energy self-reliance at high level. Key to local stability in uncertain global economy. Renegotiate trade agreements to return economies to local ownership.
Rule 8 Pay attention to your borders.	Manage borders. Live within eco-means. Attention to ecological footprint. Stop appropriating other countries' carrying capacity.
Rule 9 Honour government's necessary role.	Making democratic market rules, enforcement by due process, guardian of conditions for efficient market function, protection of rights, control of monopolies, maintenance of public infrastructure. Reclaim control of government & business to human scale.
Rule 10 Maintain an ethical culture.	Ethical behaviour central to market efficiency & social health: central. Individualism invokes coercion. Social identity invokes trust & mutuality.

(Source Korten 1999: 156-62: *Rules transcribed, explanations summarised*).

Table 133: CM: Elements of Ecological Model Contributed by UHSE Approach

Characteristics Required of Model	Satisfying Unified Human Settlement Ecology Elements & Aspects
Provide a framework for an 'ecological approach' to human communities	*UHSE framework* emerging from complex systems underpinning; human & ecological systems seen as similarly CDS
Provide a generic approach that encourages but does not require an ecological attitude (to enable comparison of ideal and current practice)	*UHSE framework*
Locate humans and their settlements within the natural world	Complementary consideration through full set of Criteria
Assist in reconceptualising the human relationship with Earth *'as if the eco mattered'*, *'as if people mattered'* (and indeed also *'as if the ego mattered'*	Complementary inclusion of ecological with social and social as ecological Ego concepts integrated through TA, POP, Criteria Organism & Population; *Deep Democracy* (Mindell)
Allow the translation of ecological knowledge into a human dominated context	Scale, Hierarchy Theory, Criteria all allow direct ecological knowledge especially Landscape, Biotics, Organism, Community, Population, Ecocycles, system Criteria
Take account of complex, dynamic, nonlinear and evolutionary aspects of relatedness	Inherent in structure; application (20-step) process based on this, Criterion Rheotics (unfolding); links via *Infinity Loop*, Fuzzy Logic, q-Analysis, Chaos, Fractal, Catastrophe, Hierarchy Theories, matrices, tables & other tools
Provide an understanding of the place of mechanistic explanation within the complex world	Complementary Theory: balance in each Criterion (measurement/meaning); Hierarchy Theory expects 3-scale investigation, with mechanism scale below scale of interest; Classicism affirmed/refined by Subatomic Theory
Provide concepts for working with process and complexity	*20step process*, UHSE framework, matrices, Hypercyclic Systems Theory, *Infinity Loop*, *Fuzzy Sustainability Space*
Take account of all scales and translation from one scale to another	Hierarchy Theory, different hierarchy types, holons, multi-function, *Scaling Tool*
Take account of time issues	Hierarchy Theory, Criterion Rheotics
Allow for structural and functional aspects	*Layercake*, Multi-scale, multi-Criteria, System Criteria, *Backcloth & Traffic*, *Rheomode*

Characteristics Required of Model	Satisfying Unified Human Settlement Ecology Elements & Aspects
Connect the ecological and the social; internalise the 'externalities'	Multi-Criteria plus Unspecified Criteria; consider social in ecological ways; needs vs wants
Take account of relationship issues such as values, ethics, politics and policy	Criteria Community, Organism & Constraints, Organising Principles
Suggest new approaches to the solution of eco-social problems	Possibility Theory, Fuzzy Logic, *Fuzzy Sustainability Space*; new/old ideas with new technological options (eg participatory processes, inclusiveness, global community, love,); systems training YK-12; Cohousing, Permaculture
Be compatible with scientific research and current practice	Effort made throughout to base statements on relevant Science; checked wherever possible in original authors' papers & publications for general readership
Support Eclecticism and the practical reality of Conceptual Pluralism	Exemplified by whole dissertation
Build on known strengths of other approaches	Active use of compatible models from several disciplines; Classicism has a place (constrained)
Maximise opportunity for creative problem solving	Framework supports (*Edge of Chaos*)
Provide an educational and integrative framework for planners, policy makers, urban designers, academics, students	Trial with OCW Project encouraging
Co-orientate multi-disciplinary communication	CDS is equivalent to a language for cross-disciplinary translation. Could apply actively across 1^{ary}, 2^{ary} & 3^{ary}; few clashes expected (for example 'large/small scale' opposite definitions in Cartography and Ecology)
Provide a framework for implementation and evaluation of eco-integrative strategies	Criterion Indicators and underlying revision of theory; *Fuzzy Sustainability Space, Infinity Loop, Traffic Light Indicator*
Locate the author's work on a framework which allows translation across disciplines and subject areas.	UHSE meta-model; Criteria represent disciplinary clusters.

(Plate 19: Rainforest).

3 APPENDIX C: TOOLS

3.1 INTRODUCTION: USE OF MATRICES

USE OF MATRICES: CONCEPT GENERATION AT THE EDGE OF CHAOS

The use of matrices in this dissertation is related to both the *Interference Field* concept of *Ecological Field Theory* (EFT) and the concept called *'PO'* by Edward De Bono (De Bono 1972: 81).
Links: Criterion Feedbacks: Natural & Institutional Constraints & the Replacement of Context.

De Bono uses the device (PO) as an 'intermediate impossible' to escape from a fixed logical point of view and induce lateral or creative thinking. PO can be used as a challenge to absolutist statements ("x always happens..." "PO!!!"), or to provoke new ideas by temporary use of illogical statements ("PO to reduce pollution a factory should be downstream of itself on the river" may lead to "the idea of having the factory inlet pipe ... downstream of the outlet pipe...") (De Bono 1972; De Bono 1976: 145-8). Or unlike concepts may be temporarily aligned for generating new ideas (as by 'brainstorm', as widely used in organisational development).

For example 'women PO buses' may generate concepts such as appropriate timetabling, review bus sizes, seat and step design for smaller scale people, provision for parcels, pushers and bicycles, disadvantaged group input in decisions, colour schemes for stress reduction, service attitude in bus company, communications training for drivers, review of location and frequency of bus stops etc.).

Many of the 'Tables' presented throughout this work are 'right brain' or 'mosaic' tables: they are not intended as statements of best practice nor of researched results making any claim to correctness. The sole intention is concept development: to demonstrate the type of thinking required when generating ideas for work with complex systems, as each team must do its own thinking. The essential technique is not to logically think through an idea: this left brain work is appropriate to the implementation of the generated concepts. With right brain and mosaic matrices, the creator needs to do an intuitive PO or brainstorm with each combination, then 'float with' all the information until an appropriate solution for the site emerges (logical thinkers who have not developed this ability may experience negative symptoms from the apparent loss of control! An 'allowing' attitude is essential). The table headers are a discipline: they insist that one at least consider all those combinations.

Options for organising such emergents include lists, Buzan *Mind Maps*, filling the Matrix with simple descriptors or the strategies, or functional chunking in ways that will be evident for any particular project and its local conditions.

This approach is not prescriptive. It relies on having a combination of working Principles and a repertoire of possible strategies. The goal of all this is to find a way to make the material teachable. Thus, we would approach a group of students and use the headings as a prompt list instead of just asking (for example) 'What features do we want in this design?', we would say 'What is the key Vision?' (Unspecified Criterion); 'What relationship do we want with the community/ within our team/with authorities/with the local community of living beings?'; 'What are our pattern goals for the Landscape?'; 'How will we approach the meeting of different needs?'.

Having allowed a coherent and wholistic concept to emerge, the left brain will be needed again for implementation, costings, and so on, and for knowing which type of expert to bring in to deal with unfamiliar areas (such as Landscape Ecology). And 'Why not?' and 'How can we find a way to do this?' should prevail, not 'We can't afford that'.

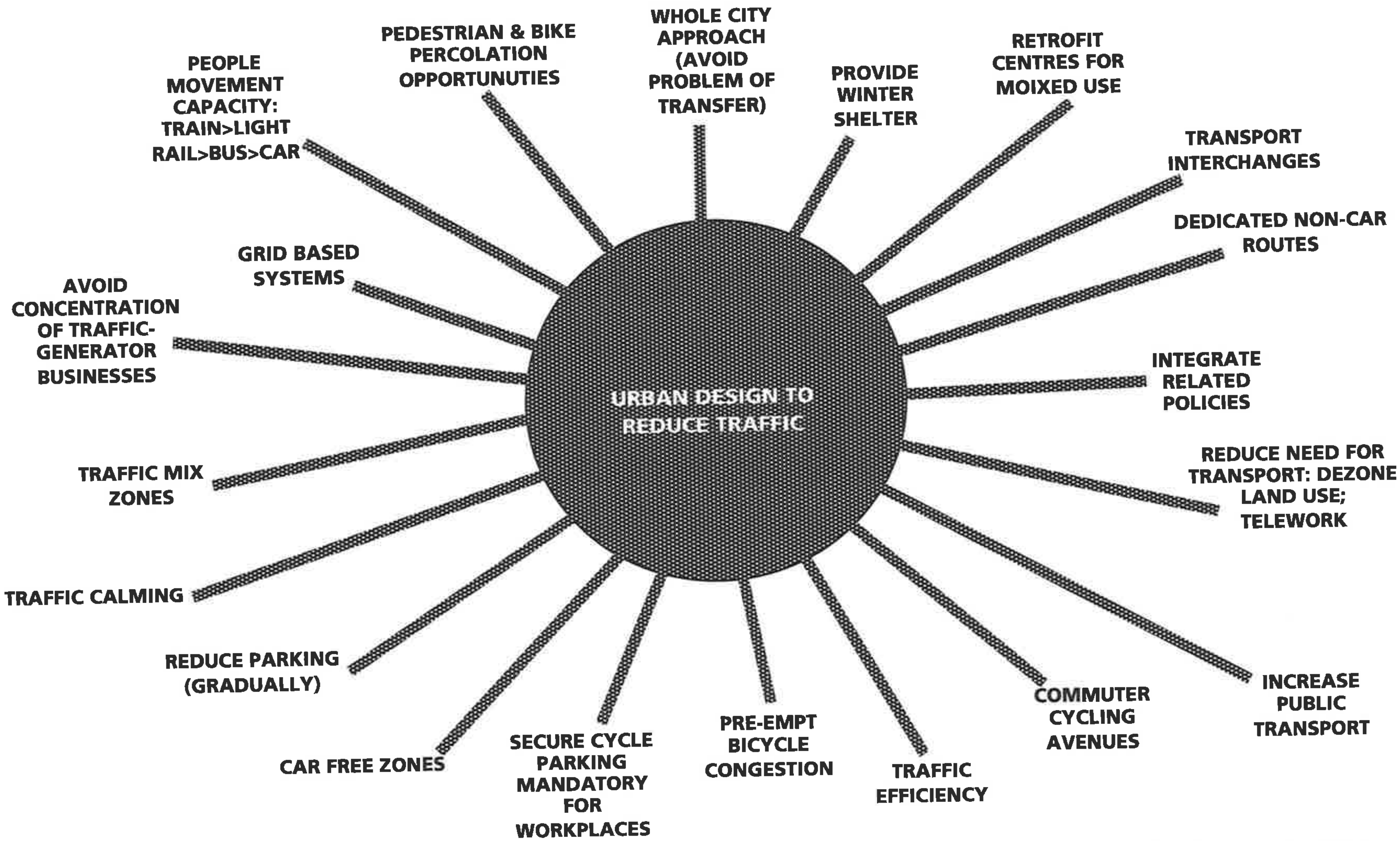
The following Table overviews the 'Tools'.

3.2 TABLE: UHSE TOOLS & USES

Tool	Purpose
Use of Matrices	Distinction between left brain tables and right brain (and mosaic) matrices. A table is a two-dimensional exposition of facts or relations in compact, comprehensive form (TMD). A matrix gives origin or form to a thing, implying a skeleton on which other elements are built (TMD). Fuzzy Cognitive Maps are matrices, which represent complexity and the connections between elements in a way that allows emergence of complex interaction outcomes.
Tool: Information Spider - Traffic Reduction through Urban Design	Organisation of information (chunking). This format was used for a JVNIC Exhibition as a casual form of information analysis (from the content of the JVNIC entries). 90 'Spiders' were included in the Report to the OECD because of the remarkable interest shown by professional visitors, who were noticed to be (often covertly) copying the content down. This suggested a hunger for information about what sustainability was supposed to be about (1993). It is an efficient way to gather and present information informally, and has structural affiliation with Buzan's *Mind Maps*.
Tool: UHSE Criteria: Essences & Themes Tool: UHSE Basic Framework Tool: UHSE Matrix	First order versions of the UHSE Matrix, of increasing complexity. Used for teaching, concept generation, guiding date seeking, data organisation, wholistic integrity checking for projects.
Tool: Hierarchies Implicated in Different Criteria	Most Criteria can be related to any Hierarchy Type, but this Conceptual Exercise lists the common associations. Hierarchy Theory works where the system can be deconstructed into larger, slower entities in relationship with smaller, faster ones (Rate Hierarchies). Where entities are not affected by how fast they cycle, as for rate-independent perspectives like Concept and Dominance, longer and shorter Persistence as in concepts like 'emergence', 'cover set' and 'context' may provide useful ways to think about the embeddedness of system relationships. This Conceptual Exercise is a starting point for such considerations.
Tool: 'Community Cascade': A Tangle of Processes	Criterion Community is complex and multi-facetted. This tool is a set of subheadings that help not to miss relevant aspects and set up appropriate research and stakeholder consultation or consideration. It is called a 'cascade because it may be seen to flow downwards as an approximate Dominance Hierarchy. Culture, values and belief systems tend to persist longer than the legislatures than enforce the rules based on those things. Contracts are shorter still, quotidian relations shorter still. Competitive and Cooperative paradigms can both be described by a Dominance Hierarchy: one has a pecking order structure, the other has a flat structure. The Organising Principle is still 'power relationship'.

Tool: Boundaries & System Constraints for Hierarchy Types & Criteria	This Conceptual Exercise helps identify two things: what elements will need to be replaced (context replacement) if a system is to be managed artificially; and what might be the natural constraints which, if disrupted, are likely to perturb or disrupt the system. Constraints (here negative or balancing Constraints) help keep a system in tune with its environment; otherwise runaway positive feedback may destabilise and set up a perturbation powerful enough to pull the system off its Attractors, and even destroy it.
Tool: Fuzzy Sustainability Space Structure Tool: Traffic Light Indicator	Diagram illustrating 'sustainability' (also a challenge to define it appropriately). Possible basis for new conceptual approaches to complex system function and its relationship to 'sustainability'. Traffic Light: a simple means of presenting sustainability progress information to the public.
Tool: Scale Analysis Table	Used to think through and record relevant scale ranges for each Criterion. Mainly for teaching and consciousness raising (for instance a reminder to consider Biosphere Scale in local projects, especially re resource/materials selection, functional site design and building/urban form. (After White).
Tool: 20-Step Design Process Tool: Design Loop (after Holling)	Tools to assist/suggest/teach <u>a</u> design process (stepwise), emphasising staging of project life cycle, and where the various stages fit into a bigger timescale.
Tool: Design Process Loop	
Tool: Self-Referential Matrix (Tables of Criteria x other Criteria or subsets)	Second Order Matrix: used to track more complex linkages between Criteria. Best used as a separate exercise for each Criterion to explore the connections. Examples of such exercises include: 'Community Cascade' (Community x Community); 'UHSE Criteria x Climate Change' (Elements - Climate Change x Criteria); 'Criteria x Boundary Types' (Feedbacks - Constraints x Criteria); 'Connectivity x Criteria' (Connectivity x Criteria); 'Criteria x Time - Second Order Matrix' (Rheotics x Criteria).
Tool: Questions for Human Habitat Designers	Teaching aid for student designers.
Tool: Conceptual Tools for an Ecological Approach (all sources)	
Database: Places & Learnings	
Database: Collated Lists x Criteria (Resource Tool)	Resource tool, indicating patterns of suggested solutions from many hundreds or thousands of 'list builders'.

TOOL 3.3: INFORMATION 'SPIDER'



(Based on Rounsefell 1994a: 145)

3.4 TOOL: UHSE CRITERIA: ESSENCES & THEMES

Criterion	**Essence**	**Themes**
Scaling	*Set Limits*	Criterial Scale Ranges
Community	*Relationship*	Mutual accommodation
Landscape	*Pattern*	Functioning Landscape
Elements	*Physics*	Physical conditions
Genius Loci	*Sensory*	Sense of Place
Biotics	*Being*	Conviviality
Organism	*Function*	Health & wholeness
Population	*Satisfaction*	Magnetism
Ecocycles	*Processes*	Nature's cycles Human cycles
Connectivity	*Flows*	Barriers & Bridges
Feedbacks	*Supportive Backcloth*	Positive & negative Constraints
Rheotics	*Becoming*	Volution
Indicators	*Learning*	Wise management
Unspecified	*Integrity check*	Holding the Vision

3.5 TOOL: HIERARCHIES IMPLICATED IN DIFFERENT CRITERIA

Criteria	Principal Hierarchy Types	Comment, Significant Elements
Unspecified		
Community	Dominance, Concept (Humans), Space Time, Opportunity, Constitutive.	Humans & animals (especially domestic, herd & colonists) supra-individual attachment, vegetation. Human-Nature relations. Strategic Planning & legal contexts.
Landscape	Space, Time, Nested, Constitutional.	Spatial patterns emergent/time, proximity.
Elements	Space, Time, Constitutive.	Physical description + rates of change (geological time; climatic events, weather).
Genius Loci	Space, Concept, Time, Nested.	Emergent/ aesthetics, events.
Biotics	Space, Time, Constitutive.	What lives where & spatial scale of ranges emergent function (for example habitat); vegetation, climate, biomes at different scales.
Population	Space, Time, Conceptual (Decision, Opportunity).	Location & fluxes over time, resonance, lumpiness, single species. Satisfaction. Nested Populations eg bowel flora, skin flora, mitochondria (physical bounds).
Organism	Space, Time, Nested.	Location, process rates, life cycles, resonance, whole function. Parts in wholes. Holons.
Ecocycles	Time, Space.	Process rates, diffusions, boundaries. Systems in systems. Many scales.
Connectivity	Space, Time, Conceptual, Constitutive.	Resonance, fluxes, location, access. Road hierarchies, Information Superhighway.
Feedbacks	Time (Frequency), Space, Concept, Dominance, Constitutive, Conceptual, Opportunity	Entrainment, limiting factors, catalysts. Drivers, Stoppers, Gatekeepers, Attractors, Repellors.
Rheotics	Time, Constitutive.	Change/time, evolution, emergence. Landscapes (tangible & intangible), Backcloths: evolving.
Indicators		

Link: Table: Criterion Feedbacks: Boundaries & System Constraints for Hier. Types & Criteria.

Sample questions (refer following Figure 'Community Cascade'):

How far do we need to go with this project? (Hierarchy Types)

- What is the state of the community-of-living-beings on our site? (Time - interaction frequencies - what scales? - what *interference fields*?) Where are they? (Space - what scales?)
- How thick is the glue? (Constitutive). How do we tap into it? (Space, Time, Opportunity).
- What is the local culture? (Dominance, Conceptual) Will our EPP culture clash & how to manage (local scale)? Dominance Hierarchy can include cooperation within stratified structures, within or between levels.
- What levels of government can involve us directly? (Dominance: potentially all scales, especially State, Local)
- Who owns the land & the land next door? (Dominance; Conceptual: social Contract with government; local, State, other scales)
- What sort of experts do we need? (Constitutional, usually local scale x other Criteria)
- What Strategic Plans affect us (all scales?) (Dominance, Conceptual).

3.6 TOOL: 'COMMUNITY CASCADE': A TANGLE OF PROCESSES

BELIEF SYSTEM
Cosmology/Culture (especially relevant when working internationally or with subpopulations).
Ideation (including notions of rights and obligations; vision).

GOVERNANCE SYSTEM
Institutions (Parliament, Executive, Judiciary).
Statutes (Ratified Treaties, Conventions, Formal Rituals, Rights & Responsibilities, Duty of Care, Codes, Licences).
Subsidiary & lower scale institutions & instruments (especially regulatory context: Planning Law, Development Plans, regulations, required permissions, Codes & standards, Strategic Plans, contracts).
Policy.
Police & Enforcement.

FORMAL CONTRACTS
(including legal ownership, partnerships, legal duties, Permissions, Standards).

FORMAL EDUCATION & TRAINING

STRATEGIC PLANS ALL SCALES
Strategies: International (Biodiversity, Social, Population, Health etc), National, State, Regional, Catchment, Local.
Local Action Plans (project implementation plans: roles, accountability, benchmarks, management plans).

COMMUNITY OF LIVING BEINGS
Bioregion, plants, animals including humans, fungi, microbes.

COMMUNITY GLUE
Shared values, activities, bonding, sharing, reciprocal behaviours, mutual support, tolerance for diversity.

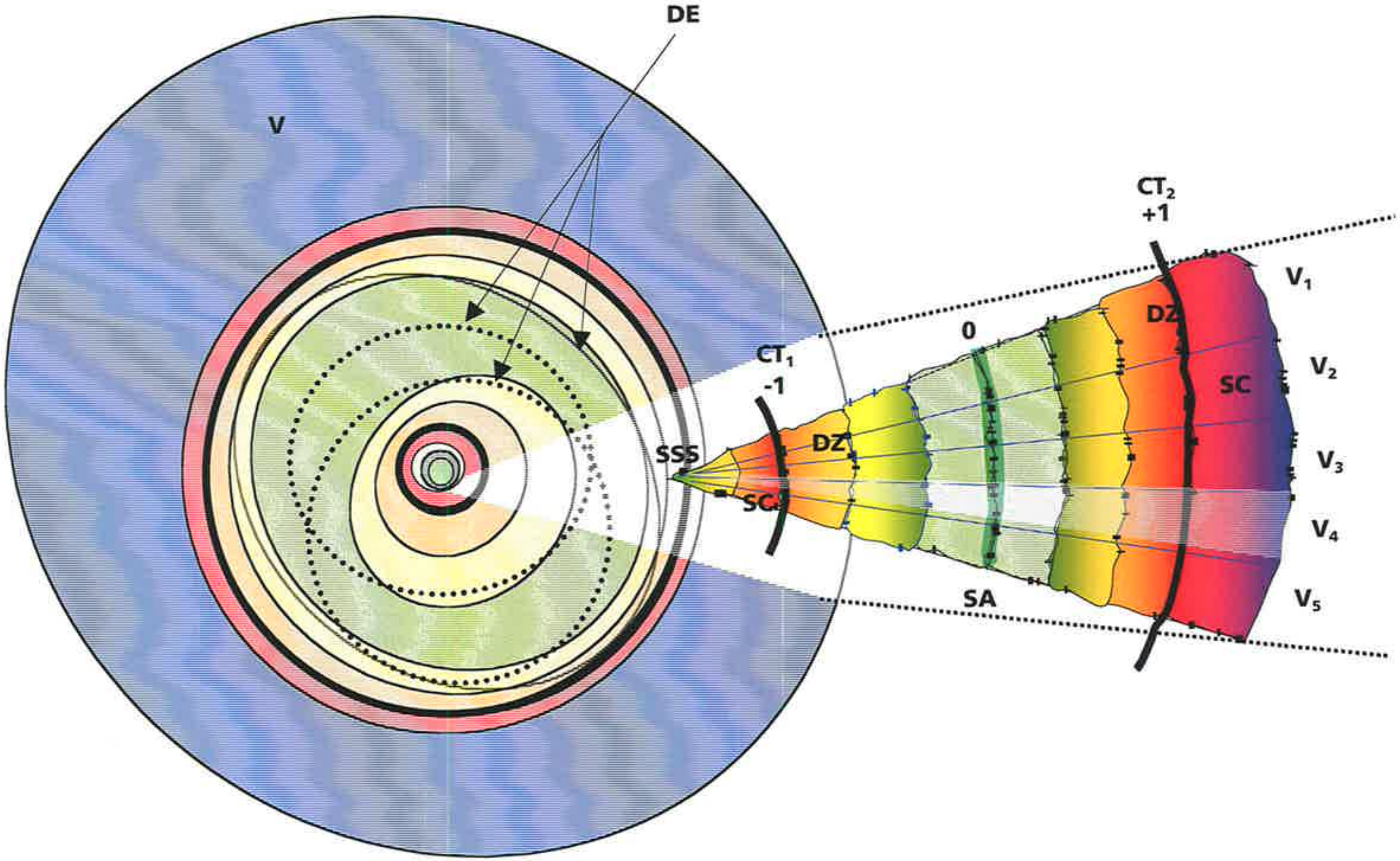
COMMUNITY OF PROJECT STAKEHOLDERS
(Including human users, other Biota and water at each scale, and Partnerships between designers and interested groups).
Authorities, developers, NGOs, CBOs, competitors, supporters, envious others.

'OUTSIDERS'
Represented because of the special role often played by people labelled outsiders (See Mindell 1988). These include vociferous activists, some mentally ill, people with AIDS, NIMBY protectionists, and other difficult or alarming polarisers who must be dealt with, heard and have their concerns met.

INFORMAL RELATIONSHIP & EDUCATION
Building & maintenance (glue): ecological relationships, agreements, deals, reciprocation, obligations, expectations, community. development, stakeholder consultation, family obligations, duties, Group Learning; workshops, educational campaigns.

INTRAPERSONAL RELATIONSHIP
Individual personality, personal standards, Frame of Reference, Parent Ego State, personal learning, serenity.

Tool 3.7: Structure for Fuzzy Sustainability Space



SA System Attractor: can be thought of as 'glue' or Supportive Backcloth

DE Dynamic Equilibrium

V The 'void': the 'space' between a system and a larger system to which a system may collapse from overconnection

CT_1, CT_2 Critical Thresholds

DZ Danger Zones (orange, red)

SC System Collapse

SSS Smaller Scale System, to which an impoverished system may collapse

V_{1-5} Variables expressed as unitary value range; running from -1 (CT_1: underconnected system collapse zone) - +1 (CT_2: overconnected system collapse zone). Each element has its OOR (Optimal Operating Range), from -1 to +1. OORs are dependent in turn on lower scale entities, which also have OORs.

When a variable (system component) is running at either of its extreme values, or one variable is privileged above others it sensitises the whole system to perturbaton (Variable V_4).

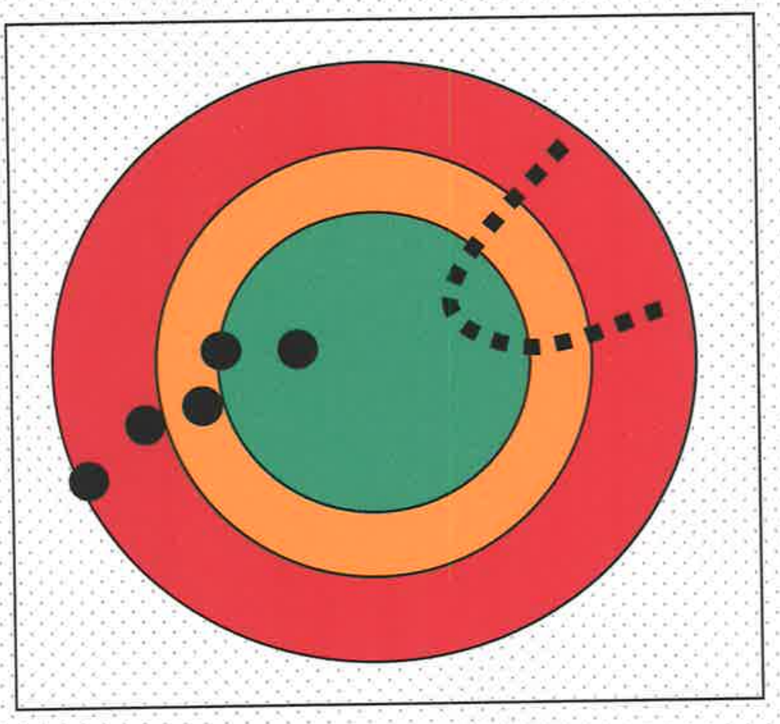
The Fuzzy Sustainability Space includes a 'steady space' (plain green) and an 'adapting space' (green-yellow boundary zone), which represents the edge of chaos zone of creative adaptation to external environment. A healthy system remains flexibly in the green, moving around its Attractor, able to resource itself, and constantly testing its boundaries, adapting appropriately in a dynamic equilibrium (represented by circuits 'DE'. Crossing the orange danger zones, Critical Thresholds are crossed, and tend to be sudden (creative destruction). In these zones the system is prone to collapse, from underconnection at C_1, or overconnection at C_2, but the system may slip to new local Attractors (dotted lines) at different OOPs (after Kay).

3.8 TOOL: BOUNDARIES & SYSTEM CONSTRAINTS FOR HIERARCHY TYPES & CRITERIA

Entity	Boundary Type
Rate Hierarchy	Frequency, resonance, synchronicity, harmony (congruence/ dissonance of timescales).
Spatial Hierarchy	Physical limits & barriers, distance decay.
Dominance Hierarchy	Control, rules, regulations, enforcement; surveillance, Plans, Project Briefs.
Conceptual Hierarchy	Education & training, information availability, knowledge, ignorance, intelligence; classification models (blind to things omitted), Frame of Reference, paradigms, definitions.
Community	Cosmology, belief systems, Metaphors, Values, Ethics, expectations, obligations (social constraints); Frame of Reference limits; Terms of Reference; extent of social (in)justice or Satisfaction/ neediness (Max Neef).
Landscape	Natural (climate, soil, geomorphology, fire, pests & diseases) & human ('development', roads, exotics, fires, clearing, monocultures, toxins, slaughter/hunting & gathering, trampling, disturbing) impacts. Spatial, fractal index shift, scale of observation.
Elements	Limits of medium: soil type, water body: biome. Physical limiting conditions (flows, shading, temperature, pressure etc), Laws of Nature. Climate character.
Genius Loci	Perception, home range boundaries; frequency range/ sensitivity of perceptual apparatus.
Biotics	Habitat resources (survival, quality), ecological services (availability of ecological, co-evolved relationships), climate character & reliability, physical constraints, toxics. Key constraining variables (see next Table).
Population	Availability of resources: needs, wants, proclivities (Satisfiers, Pseudosatisfiers). Population size; relative predator population/potency. Ability to mobilise, collectivise (functional boundary).
Organism	Physical boundary(ies). Overall function status: availability of resources/needs for maintenance through life cycle. Limiting factors (Constraints) at higher & lower scales (slower & faster); health & function of its components; nutrition, micronutrients; relations with symbionts (eg gut flora). Existence of a life cycle; oxidative processes.
Ecocycles	Physical limits (process limits): temperature, pressure, humidity, albedo, climate, reliability of climate patterns. Loop integrity, substrates, feedstocks, functional thresholds.
Connectivity	Connections & valency, barriers (natural/geomorphology, human). Relative disconnection (spatial, temporal, emotional, spiritual, intellectual, informational, nutritional).
Feedbacks	Signal paths, receptor function, action potentials, cycle frequencies, diffusion rates. Capital availability: financial, social, ecological, intellectual. Response-ability. Network structure.
Change	Timing (stage of Infinity Loop/ life cycle), capital resources, balance.
Indicators	Understanding (limits to knowledge), research, finance. Commitment (or lack of) to learning & change (measurement so as to divert energy for action).

Tool: 3.9: Traffic Light Indicator

'TRAFFIC LIGHT' INDICATOR FOR PUBLIC REPORTING



Condition indicators tend, like pathology tests, to indicate dysfunction. Indicators should also be sought which emphasise system health and lead to preventive measures rather than the so common situation of crisis management.

The same indicators often express either health or dysfunction. Thus *Optimal Operating Ranges* (OORs) can define what we believe is the *'Sustainability Space'*: as long as all the indicators are in this range we can be confident that we're on track.

Benchmarks (black circles) can then relate to achieving or staying within the Optimal Range. For a simple diagram, one could look at the sustainability space as green, with orange alert areas outside this, and a red zone outside this. With better knowledge we may find the best health (resilience) in a changing environment is achieved when variables fluctuate near the orange-green border (creative adaptation).

It has been my observation that decision makers whose job it is to respond to indicators often have a significant level of confusion about what they are and how to tailor and them for continuous improvement objectives (notwithstanding their high status and assumed intelligence). This diagram appears to fulfil such an aim, and to be suited to public reporting (say to accompany the weather or government reports).

A caveat: professionals constructing such diagrams need to remember that in an OOR, in health, Nature and elsewhere, too high and too low are both a problem. Thus this diagram looks similar to the FSS diagram, but if 'variables were expressed as 'rods', they would have to be bent into U-shapes, with the rounded end in the green space (dotted line).

3.10 TOOL: UHSE BASIC FRAMEWORK

Criterion	Essence	Themes	Subsets & Tools
Scaling	Set Limits	Criterial Scale Ranges	Scale Range each Criterion
Community	Relationship	Mutual Accommodation	Culture & Belief System Governance System Formal Contracts Formal Education & Training Strategic Plans (all scales) Community of Living Beings Community Glue Community Of Project Stakeholders 'Outsiders' Informal Relationship & Education Intrapersonal
Landscape	Pattern	Functioning Landscape	Existing Landscape Indigenous Matrix & Patches Links & Buffer Zones Working Landscape Built Environment Bioregional Restoration Plan Maps
Elements	Physics	Physical Conditions	Earth ⇔ Water ⇔ Fire ⇔ Air Climate
Genius Loci	Sensory	Sense of Place	History & icons Bioregion Definition Spirit of Place Sensory: Visual, Auditory, Kinaesthetic, Olfactory, Tactile, Gustatory, Emotional, Spiritual, 'vibes', *Feng Shui* Stimulus
Biotics	Being	Conviviality	Life support Life Supported Restoration
Organism	Function	Health & Wholeness	Basic Needs for High Level Wellness Holonic Function
Population	Satisfaction	Magnetism	Populations & Subpopulations (Attractor Landscape) Traffics on Attractor Backcloth 'W' questions
Ecocycles	Processes	Nature's cycles Human cycles	Materials & energy transformations Resource Conservation Ecocycles & Loop Closure Dissipative structures (Negentropy) Ecological Services (all scales)
Connectivity	Flows	Barriers & Bridges	Communication Connectance & Access Disconnection & Risk Relative Disconnection Multifunction Partnerships
Feedbacks	Supportive Backcloth	Positive & Negative Constraints	Positive Feedback (Catalysis) Negative Feedback (Limiting Factors) Return Times Emergence (of desired Traffics) SWOT Analysis; Constraint Map
Rheotics	Becoming	Volution	History & Change Periodicity Project Staging
Indicators	Learning	Wise Management	Sustainability Definition Scenarios (Compass to Preferred Futures) Staging (planning), Benchmarks Indicator Selection Monitoring & Improvement Programme: PDARWW[17] Public Reporting
Unspecified	Integrity Check	Holding the Vision	Contract Framework Concepts Extra Criteria

[17] Plan-Do-Audit-Review-When-Who.

3.11 SCALE ANALYSIS TABLE

Spatial Scale / **Criterion **	**Subatomic/ Radiation**	**Submicroscopic/ Molecular**	**Microscopic**	**Minibiota/ Fittings**	**Human Individual/ Furnishings**	**Macrobiota/ Room**	**Building**	**Building Cluster**	**Neighbourhood CBOs**	**BioSubregion/ Creek Catchment Local Government LG Bodies**	**Suburb/ Town/ Small City/ City Centre Service Bodies**	**Metropolis Heritage**	**City-Region Bioregion/ Conurbation Catchment Boards**	**State/ Province State NGOs**	**Nation-State NGO Peak Bodies**	**Global Region**	**International/ Global**	**Biosphere**
COMMUNITY Relationship Regulation Education																		
LANDSCAPE Pattern																		
ELEMENTS Physical Climate																		
GENIUS LOCI Sensory																		
BIOTICS Life support Life supported																		
ORGANISM Needs Function																		
POPULATION Satisfaction																		
ECOCYCLES Resources Eco-Services Pollution Waste																		
CONNECTIVITY Connection Rel. Disconnection Access																		
FEEDBACKS Catalysts Limits																		
RHEOTICS Short Term Medium Long Very Long Term																		
INDICATORS																		
UNSPECIFIED **Vision**																		

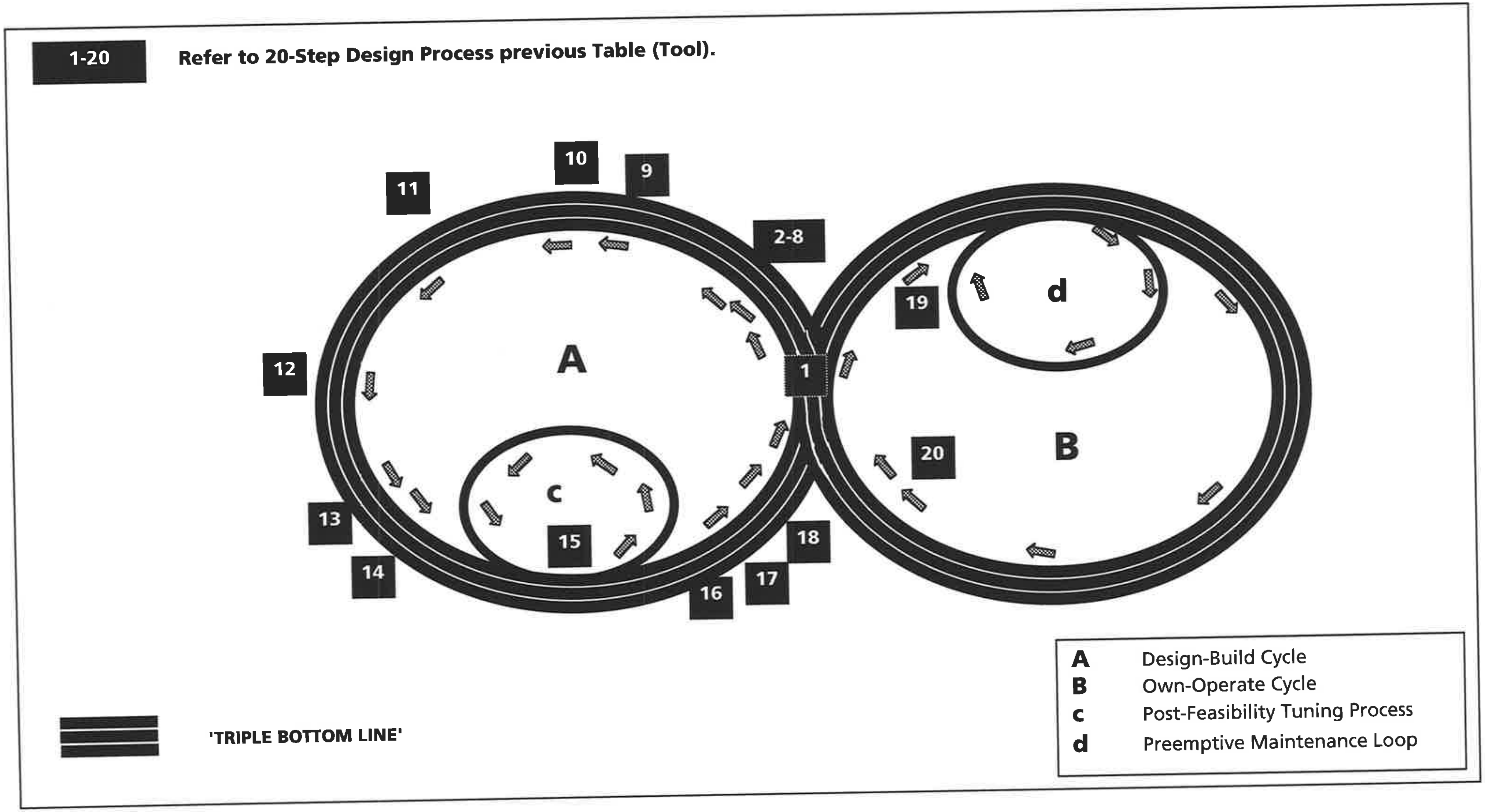
3.12 TOOL: 20-STEP DESIGN PROCESS

STEPS	ACTIONS	EXTENSIONS
1. VISION	Establish what Contract is about, for whom, what themes, what objectives. Logo; Vision Statement. Initial publicity.	Establish scope for concept evolution. Obtain maps.
2. GENIUS LOCI	Esquisse: walk & feel out the land, record sensory impressions. Dowsing, Feng Shui, Crystal Metaphor activity; spiritual issues.	Creative expression.
3. SCOPING	Concept flexibility. Scale x Criteria; Criteria x Scale Ranges (Scale Plotter); Chunking. Space: Bioregion vs Site. Time: Rheotics (systems, frequency & resonance thinking mode). Function: Fuzzy Sustainability Space (4).	Connect with Constraints (10).
4. DEFINE BIOREGIONAL & PROJECT SUSTAINABILITY SPACES	Criteria x Project objectives: FSS for Bioregion and project.	'Preferred Future' definitions.
5. COMMUNITY & POPULATIONS (Relationships, stakeholders) (Regulations)	Formal: Contracts, legals, ownership, obligations; Strategic/planning context: list needed approvals & time lags. Informal: Deals, relationships, alliances, friends, enemies, gatekeepers, stakeholders: identify. Stakeholder List: include ecosystem, biota, local government, catchment boards, Urban Forest Biodiversity Pgm.. Glue (internal/external): Cohesion, existing community, interest, commonality; project team building; plans for glue development (internal, external). Education: Community, owners, government & team needs for bringing all 'up to speed' for informed consultations: define needs & means. Seek further publicity. Communication & reporting system (relationship systems); decision making system; records system; dispute system. Written records of all meetings, including informal notes on informal meetings. Subpopulations: identify potential age, gender, purpose, timing (traffic, transport, origin). Relationship style, quality: political scene, cooperative/competitive; active stake and client inclusion: aim for good working relationships; collaborative & group activities balanced with clear action & responsibility structures.	Appropriate inclusion of stakeholders from this point on. Remember Nature & Ecocycles as key stakeholders. Information open, respectful, appropriate level: keep accountability, research & learning in mind. Ensure funding for Community relationship. Start approvals process 'in principle'.
6. SWOT ANALYSIS	For site/project combination: superficial & intuitive analysis; map results.	Record obvious Constraints.
7. START MATRIX	Describe site x Criteria, Scale Ranges for each, start to record under matrix headings, identify data gaps, start data collection; call in data needed later.	Fill in as you go: loose leaf folder system/computer DB.
8. DEFINE NEEDS	For project as Organism/Traffic; for all stakeholders, including design team & owners.	Health concepts required.

STEPS	ACTIONS	EXTENSIONS
	Clients, Stakeholders, design team, builders, visitors, users. Needs, wants/satisfiers: Maslow, Transactional Analysis, Max Neef. Approximate, for whole life cycle (Infinity Loop). Avoid transient fashion & ephemeral values. For Backcloth elements. Nature as a stakeholder: indigenous flora & fauna: needs for regeneration, protection. Long-term maintenance needs: artificial context replacement (eg watering systems, shelter).	Distinguish between wants & needs. Note any trends to harness (cater for). Note: democracy towards stakeholders places Constraints on land-owners' 'rights': EPP expects such Ethics of owners.
9. FUNCTIONAL DESIGN	Brainstorm desired functions: list elements needed. Bubble diagram: work from list & relate to site & Criteria.	Feedbacks, Organism. Needs (8).
10. CONSTRAINTS	Constraint Map; more detailed SWOT Analysis. 4 Hierarchies: spatial, frequency, conceptual, dominance. Limiting factors: x Criteria. Catalysts: full Resource List x Criteria; startup & maintenance funding, separate major & minor budgets.	Review Scaling for overlap. Backcloth: how will this show be kept on the road?
11. COLLECTIVE DESIGN PROCESS	Preferably Charrette, or in-house. Strategies: start with land; build Nature in; needs-based design; seek learning opportunities; Complementary switching (perception /measurement /interpretation, rate dependent / rate independent; subject /context; structure /function). Floor map tool for stakeholder-designer group: (walk about, build & place elements intuitively/experimentally + discuss); photocopy enlargement of site map (approximately x300), rough cardboard models. 'Emergence time' important to allow time at this stage, 'sleep on it', ask for individual concepts. Sustainability Space: keep checking sustainability of solutions. Unfolding: final concept gradually emerges.	Good facilitation = key strategy. Listen to dissenting voices & seek both/and solutions. Publicity opportunity.
12. DATA MANAGEMENT	Complete data collection. Write up: under Unified Human Settlement Ecology headings. Finalise Indicators: refer to Sustainability Space; organise appraisal pattern; establish specific responsibilities for reporting, appraising & action.	
13. REFINEMENT & EXHIBITION	Check final concept & modify: against Sustainability Space, original Vision, Constraints Map, SWOT Analysis, any other tools. Build final conceptual models; plan & present Exhibition. Publicity opportunity.	First left side Infinity Loop subcycle. Continue/repeat stakeholder input.
14. 'WEATHER REPORT'	Glue Appraisal (stakeholder community); FEEDBACK from Stakeholders & Exhibition. Listen for dissenting voices & new ideas.	Preempt rear-guard & other activity; keep processes open & respectful.

STEPS	ACTIONS	EXTENSIONS
15. FEASIBILITY & TUNING LOOP	Modification & acceptance process based on feedback. Check all with project Vision (Criterion Unspecified). Final Plans & working drawing; final approvals. Re-exhibit if needed. How well is Nature doing? The neighbours?	Seek 'both/and' solutions. Avoid tradeoffs damaging eco-social.
16. STAGING	Document steps & stages: elements, what, where, by whom, how, by when. Set long-term appraisal cycle, review Indicators: Plan – Do – Audit – Renew - When - Who. Resource List: confirm & action; budgets, accountability, negative & positive constraints; follow up non-financial resources & catalysts. Marketing: plans & strategies. Ensure management structures, roles & personnel in place, clear & updatable; education.	Community Land Title needs Company & management structures, and Covenants expressed as By-Laws.
17. SITE POLICIES	Set policies on site management & materials (estimates, sourcing materials for best eco-outcomes available, OH&S, waste, water & pollution management).	Local input, 2nd hand materials, purchasing policy.
18. BUILD	Self-build needs management to ensure conformity with OH&S and other Regulations.	Careful quantity estimates to avoid waste.
19. MOVE TO SECOND PHASE OF INFINITY LOOP	Maintenance & Review. Audit & renew cycles. until renew/repair no longer appropriate. Continuous improvement.	For EcoVillages, ongoing funding and waiting lists may be issues.
20. CREATIVE DESTRUCTION	Reuse/recycle materials.	

TOOL 3.13: DESIGN PROCESS LOOP



3.14 TOOL: UHSE MATRIX: EXTENDED

Criterion	Essence	Themes	Subsets & Tools	Extension
Scaling	Set Limits	Criterial Scale Ranges	Scale Range each Criterion	Scale Analysis Diagram
Community	Relationship	Mutual Accom-modation	Culture & Belief System Governance System Formal Contracts Formal Education & Training Strategic Plans (all scales) Community of Living Beings Community Glue Community Of Project Stakeholders 'Outsiders' Informal Relationship & Education Intrapersonal	Culture & Belief System : define local situation Governance System: relations with officialdom, plans, approvals, permissions required; internal governance, decision making, structure, tasking; positive relationship building with authorities Formal Contracts: existing Constraints; land ownership; Formal Education & Training: personnel selection; information sourcing Strategic Plans: define strategic context all scales Community of Living Beings: define for local area; retain awareness Community Glue: current cohesion; neighbourhood relations & inclusion; community development activities; community service Community Of Project Stakeholders: including Nature & neighbours; early inclusion, continuing inclusion 'Outsiders': 'loose cannons', NIMBY people: inclusion, active listening, information sharing, I-thou Informal Relationship & Education: inclusive workshops on project aspects Intrapersonal: listen for & respond: external, internal (project team)
Landscape	Pattern	Functioning Landscape	Existing Landscape Indigenous Matrix & Patches Links & Buffer Zones Working Landscape Built Environment Bioregional Restoration Plan Maps	Existing Landscape: mapping: geomorphology, terrain, vegetation, water bodies, all Elements (link Criterion Elements) Indigenous Matrix & Patches: audit & map patterns (Link Criterion Biotics) Links & Buffer Zones: audit & map: edge effects, water-borne pollutants, human & natural barriers (Link Criterion Elements) Working Landscape: audit & map; Nature's work, human work (food production, mobility, major works, buildings) (Link Criterion Ecocycles) Built Environment: map patterns green spaces & connections Bioregional Restoration Plan Maps: check other Criteria for mapping needs
Elements	Physics	Physical Conditions	Earth Water Fire Air Climate (Maps)	Earth: topography, seismology, geology, soil types, minerals, chemistry, radioactive substances (eg radon), heavy metals, salinisation, erosion, land sculpting present or intended Water: catchment, seasonal rainfall , rain shadows, surface flows, hydrology, aquifers, wetlands, drainage, river systems, water bodies, quality, sources Fire: natural fire régime, explosions & hazards, vulcanism, seasonal & diurnal temperatures, seasonal solar exposures, solar access, frost pockets, energy sources, urban heat island, building & road albedo Air: wind roses, urban wind tunnel effects, airsheds, quality, noise, odours, gases

Criterion	Essence	Themes	Subsets & Tools	Extension
				Climate: local régime, project interface with climate/weather/microclimate.
Genius Loci	Sensory	Sense of Place	History Bioregion Definition Spirit of Place Sensory Changes	History: prehistory, Aboriginal, settlement, recent; mythology Bioregion: sense of local territory: catchment, vegetation, water, community Spirit of Place: local sense of place, icons, interpretation, meaning, ambience Sensory: visual (vistas, visual axes, æsthetics), auditory, olfactory, gustatory (taste, flavour), tactile (textures), kinaesthetic (movement), emotional, spiritual, Feng Shui energies, EMR, intangible 'vibes' Change: planned or projected
Biotics	Being	Conviviality	Life support Life Supported Restoration	Life support: Ecological Services: pollination, insect & predator balance, flood control, water & air quality, soil building, health & stability, terrain, waste assimilation, vegetation, food production; psychological well-being Life Support: Habitats: audit & map vegetation & biotic associations & quality (no of storeys vegetation, patch sizes, connectivity); 30% indigenous matrix, abundance; radiation effects, toxicity audit & map (seek history of land use), Carrying Capacity, Critical Thresholds Life supported: biomass, biodiversity: plants, animals, humans, microbes, fungi (genetic library): audit & map Restoration (8 Strategies)
Organism	Function	Health & Wholeness	Basic Needs for High Level Wellness Holonic Function	Basic HL Wellness needs: Nature, humans : physical (including exercise, safety, access to healers & free recreation), psychological, mental, spiritual (including contact with Nature), emotional, social, economic, occupational Holonic Function any aspect of project: Bubble Diagram; Animal metaphor; resilience, stability
Population	Satisfaction	Magnetism	Populations & Subpopulations (Attractor Landscape) Traffics on Attractor Backcloth	Populations & Subpopulations: 'W' questions: Who (Traffics on Attractor Backcloth): demography, population, including biotic populations , subpopulations (elders, adolescents, younger children, infants, disabled, gender) Where: (location) Why: Attractor Landscape: needs, wants, proclivities, fashion; markets; project aspects
Ecocycles	Processes	Nature's cycles Human cycles	Materials & energy transformations Resource Conservation Dissipative structures (Negentropy) Ecological Services (all scales) Ecocycles & Loop Closure	Materials & energy transformations: processes, manufacture, industry, materials streams, Ecological Footprints & Rucksacks; animal, human & machine labour, Industrial Ecology, wastes, molecular wastes/pollution Resource Conservation: (5 Rs): Reduce, Reuse Recycle, Reform, Repair Dissipative structures (Negentropy): Nature's factories, service providers & waste management Ecological Services (all scales): relationship to project decisions (materials selection, sourcing & processes) Ecocycles & Loop Closure: especially waste & resource streams; special attention to carbon cycle integrity (carbon sinks [soil. vegetation], non-clearing, avoid fossil fuels)
Connect-ivity	Flows	Barriers & Bridges	Communication Connectance & Access Disconnection Relative Disconnection Multifunction	Communication: interpersonal, stakeholders, IT&T, clear English, access to information, networking Connectance & Access: appropriate & overconnectedness; underconnectedness; access to infrastructure (utilities), transport (timetables, routing, integration, service approach, alternatives, transit subsidy/population density/urban form, traffic calming), amenity, influence/gatekeepers, supply chains, food webs Disconnection: barriers, exclusion (eg protective)

Criterion	Essence	Themes	Subsets & Tools	Extension
			Risk	Multifunction: synergy, integrative strategies, multi-use issues, functional redundancy, multifunctionality Partnerships: task teams, subcommittees, networks Risk: q-Connectance, impacts, protective sub-unit structures
Feedbacks	Supportive Backcloth	Positive & Negative Constraints	Positive Feedback (Catalysis) Negative Feedback (Limiting Factors) Return Times Emergence (of desired Traffics) SWOT Analysis Constraint Map	Positive Feedback (Catalysis): implementation: funding, finance, support, shared vision, need, attraction (see Catalyst list) Negative Feedback (Limiting Factors): ecological Constraints, resource Constraints , legal, statutary, government/public support; attitudes/Ideology, barriers (physical, emotional, ideological, informational etc) (see Constraining variables tables) Conditional feedbacks: resource levels(human, natural, social, financial, intellectual, skills, material, systemic, design, function), geomorphology, climate, time available, EMS Feedback Return Times: short-medium-long-very long Emergence (of desired Traffics): design Supportive Backcloth SWOT Analysis: do for site & for project Constraint Map: map SWOT results
Rheotics	Becoming	Volution	History Change Periodicity Scenarios (Compass to Preferred Futures) Staging (planning)	History: link with Genius Loci; speak to elders about site history Change: volution (unfolding): seek patterns & punctuations Periodicity: return times: quotidian, seasonal changes, flux ranges, economic/business cycles, floods; life cycles of present elements, of materials used, of project Scenarios (Compass to Preferred Futures) Staging (planning)
Indicators	Learning	Wise Management	Sustainability Definition Indicator Selection Monitoring & Improvement Programme Public Reporting	Sustainability Definition: Fuzzy Sustainability Space boundaries Indicator Selection: Audit (inventory), Snapshot (SoE) Time Series, Benchmarks, Threshold Alert, Compass, HLWellness Monitoring & Improvement Programme: Plan-Do-Audit-Review-When-Who Public Reporting: Traffic Light Indicator
Unspecified	Integrity Check	Holding the Vision	Contract Framework Concepts Extra Criteria	Contract: clarify expectations (written) Framework Concepts: Vision, Mission, Logo Synthesis Extra Criteria: any special themes to track?

3.15 TOOL: SELF-REFERENTIAL (SECOND ORDER) MATRIX

	SCALE	*CTY*	*LSC*	*ELS*	*GL*	*BIO*	*ORG*	*POP*	*ECOCYC*	*CONN*	*F/B*	*RHEO*	*IND*	*UNSPEC*
Scale Boundaries Critical Ranges														
Community Relationship Mutuality														
Landscape Pattern Working Landscape														
Elements Physics Physical Conditions														
Genius Loci Sensory Sense of Place														
Biotics Being Conviviality														
Organism Function Health														
Population Satisfaction Magnetism														
Ecocycles Process Ecocycles Wastes & Pollution														
Connectivity Flows Barriers & Bridges														
Feedbacks Supp. Backcloth Constraints +/-														
Rheotics Becoming Volution Staging														
Indicators Learning Wise Management														
Unspecified Integrity Check Holding the Vision														

USE OF THE SELF-REFERENTIAL MATRIX

To use this Matrix, the question of a Project Theme or Vision is first addressed. This is attached as a few-words expression to the Unspecified Criterion. Any other issues thought to be crucial are also assigned a specific cell. The process is then to take each Criterion in turn, and proceed across all the others, brainstorming each combination according to the project stage. Thus, if data collection were the first issue, one would identify the Scale of the project, and then ask at what scales information is already known or should be collected for Community (Cascade headings), Landscape, Elements (Earth, Water, Fire, Air, Climate) and so on. This can be recorded on Tool 3.11 Scale Analysis.

When this information is collected, it is stored in files under these headings, and written up the same way.

With the Criteria, it is helpful to work through the themes of each in turn, in relation to those of each of the others. The general approach has been demonstrated through the conceptual exercises in Tables 76 (Climate Change), 97 (connectivity) and 117 (Time/Rheotics). Different Criteria will have different purposes in exploration, for instance Connectivity will have a lot to do with infrastructure design, service provision and social justice; Population assist marketing and activity analysis.

This Matrix can be extended to any relationships and in any direction. One just needs to be willing to be reflective and creative.
Thus, using it in a fragmented way will have similar benefits to those presently available to professionals who have a few headings under which they work ('environment', 'social', 'economic', 'legal', 'stakeholders'), but the headings are defined with ecological entities and ecological thinking in mind.

Used as a whole, it has a different function: to come to terms with a mass of complex information. The relationships are approached in a systematic way, but only some may be recorded, or none may be. I have found that recording everything can be very tiresome, but quietly thinking it through, heading by heading, in the context of the project and at the scales thought important, is a useful approach to 'getting a handle on' the mass of data, organising it and identifying gaps.

I have tested this Tool on myself, using large sheets of ruled paper. The City West Project did not allow sufficient time to use the model with students at this depth. I used an early version for integrating needed information for the Jerrabomberra Valley National Ideas Competition, and a much better-developed version for the Opposing City West Project. The former contributed greatly to the latter. I find its best use as a whole is for mentally checking for omitted items. Used cell-to-cell, it is more for exploring functional relations between different aspects at different scales, and identifying where third order issues constellations may lie. A number of issues constellations are identifiable in human settlement work. Those emerging from the JVNIC entries are listed in Figure 60: JVNIC Theme Report. There is an initial learning benefit in filling out all the cells as a conceptual exercise. But this should perhaps be finished off with circles using a highlighter to indicate the areas of greatest importance. Once completed, such a record can be left on a wall or kept for future reference, but the tendency is for it to be too complex for everyday use. It could be computerised, but the product would be different. One of the early issues with a very large site is to integrate all the information in order to be in a position of good judgment, and to allow creative ideas to emerge. This Tool assists that process in particular, even if only done mentally as a solitary, reflective exercise.

3.16 TOOL: QUESTIONS FOR HUMAN HABITAT DESIGNERS

Criteria	Essential Ingredients	Questions to Ask About Site or Project
Community	Relationship Power Human-Nature relationships Social control Group and community processes Institutions	**Relationships between different human groups:** What do the people here believe in? Making money? Following a religion? Having peace and quiet? Having fun? Who has the power around here? Who is disempowered? Who are the stakeholders? Does everyone have a voice? How can we involve the local community? The community of users? Community leaders? Any conflicts? Can we get them talking to each other? Can we run a Charrette or a Round Table to get some understanding? Do we have allies? Enemies? What educational opportunities are available? **Relationships between humans and biota:** How much space can Nature have here? Can we make it more visible or accessible? How can we prevent damage? How do companion animals fit in? Should they be banned or controlled? Could we grow food here? Could there be any health issues with water? sewage? air? **Formal relationships in society:** How is this place managed or governed? What laws or regulations may impact on what we want to do here? Who owns the land? Are there any covenants on it? Who owns next-door? What are ALL the strategic plans for this area?
Landscape	Patterns of spatial relationship	Where is it on the map? Locations of elements on aerials? Maps and plans? What landscape and built features are there already? What patterns are there? Where & how might our design fit in?
Elements	Physical features Climate and weather	**Earth:** What are the characteristics of the soil?, geology? Slope? Seismology? Engineering issues? **Water:** What water bodies are here and what are their flow patterns? How much rain? Ice or snow? What extremes? How does water drain? Does it leave the site? Where are the water tables? Where does the water supply come from? Water management during building phase? **Fire:** Where is the Sun through the year? What angles? What temperature ranges are there through the seasons? What extremes? Is solar access a problem? How well would solar power or hot water generation do here? Where is the grid supply from and how generated? **Air:** What are the prevailing winds? How strong are they and when? How would wind power do here? Are there any air quality issues? Odours coming from nearby of on the wind? Salty air from the sea? Temperature issues? Cold air drainage? Frost pockets? **Climate:** What sort of climate is it? Is there a special micro-climate? What happens seasonally?

Criteria	Essential Ingredients	Questions to Ask About Site or Project
Genius Loci	The spirit of place Meaning Sensory quality	What meaning does this place have and for whom? For what? What memorable events happened here in the past? Geological? Indigenous? Local history? What sorts of 'vibes' do we pick up here? What are the energies? How does it look from a distance? From high up? From all sides? From its lowest points? Voice of the land? Colour? Sounds? Odours? Texture? All senses. Does our design want to align with this spirit? replace it?
Biotics	Life and its support systems Animals, plants, microbes (Biota) Habitats Toxins	**Habitats:** What habitats are here (large and small)? Are they connected or fragmented? How do they fit into the Bioregion? The larger scales? Are they healthy? Is there any significant contamination? What is the local history of chemical and other toxin use? How to deal safely with termites? **Biodiversity:** What animals and plants live here? What used to live here? Should or could they be restored? What algae, bacteria, moulds, fungi, viruses and parasites are supported here? What is the ferals and weeds situation? Are there migratory birds?
Organism	Individual living or non-living entities Health and function issues, basic needs	For which species (including human) do we need to know the basic individual needs here? What are these needs? Is health of humans, animals or plants an issue here? Allergies? Disabled? What are our standards? What are the relevant regulations? How can we design for health and safety of workers on site, & occupants? How does/will this site function as a whole? What is the optimal operating range for each part, living and non-living? What do the separate non-living parts (eg paths, recreation areas, specific rooms in buildings) need for optimal function internally and integration externally?
Population	Numbers of a species present	**How many** of each species come or live here? **What** attracts them? **What** repels them? **Where** do they come from? How many can the place cope with? Are there there species or groups of biota or humans to protect or discourage here? **Who or what** do we want to attract here? **What** do we need to know about their special needs? **How** can we support that in our design?

Criteria	Essential Ingredients	Questions to Ask About Site or Project
Ecocycles	Processing cycles of matter (materials, resources), energy Technology Pollution	What processing is going on around this site? What enters? What leaves? Can any of the wastes be reused? Can we design this in? Stormwater? Green organics? Energy? Personal effort and efficiency? Technologies? How do we deal with building wastes? Should we have purchasing policies? Can our design encourage recycling? What are the ecological costs & life cycle of materials used? CO_2 release? Embodied energy? Can they be reused easily? Are they toxic? Polluting? Could we do better? What can we do locally instead of importing? Are our choices damaging to other societies or ecosystems? How can we minimise resource use? Could we use renewable energy? Local materials? Local sewage treatment? Water strategies? Local people? What are we relying on Nature for here? At higher or lower scales? Are we adding unnecessarily to the ecological burden? To Greenhouse gases? To long term energy use? Are we closing eco-cycle loops or exporting our impacts?
Connect-ivity	Linkage & access Communications Services Transport: people & goods	How is this site connected to the rest of the settlement? Power? Water? Information technology? Roads, traffic patterns, parking? Public transport, access, timetabling, support facilities? Pedestrians? Cyclists, bike parking, cyclist facilities? Emergency vehicles? Deliveries? How is the project connected internally? Are there any areas we should disconnect (eg wildlife breeding areas)
Feedbacks	Enablement Implementation	Who owns this project? Do we have an agreed, focused vision we can present? Who owns the land? Is it financially feasible? What non-financial help do we need? How could the Government help? What promotion do we need? SWOT Analysis?
Rheotics	Change over time Bio- & Eco-cycles Life cycles Evolution	What change has this site seen before? What is the Preferred Future? What are our future goals? If not the preferred future, why not? What are our staging plans? Is redundancy built in to facilitate change? Have we allowed space for evolution and change over time? How do all other Criteria change over time? What long term maintenance is needed? By whom? Are funding in place & roles defined?
Unspecified	Any special project theme(s)	Check theme(s) against all other Criteria: are they taken care of? Examples: Aboriginal, feminist, minority group, educational purpose.
Indicators	Continuous learning	How will we know when our objectives are achieved? How will we measure progress? Benchmarking, indicators, evaluation, who is responsible for this? How & how often & to whom will it be reported? Has a learning structure been agreed on?

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3.17 TOOL: CONCEPTUAL TOOLS FOR AN ECOLOGICAL APPROACH (all sources)

Complex Realm	Theoretical Concepts	Applications	Thesis Area references
Optimism	**Appropriate Optimism**	Why not? rather than Why? 'Can do' but with other-consciousness Barrier thinking Experimental approach Government and other incubators	Danish attitudes
Metaphor & Mind	**Ecosystem** **Fuzzy System**	Permaculture Bioregional thinking Transpersonal Ecology, ecospiritual, ecophilosophical & ecometaphysical approaches; Deep Ecology Mind games: De Bono Po technique, other De Bono, brainstorming, 4-year-ole regression, visualisation & imagery, personal growth techniques (human potential movement, Human Scale Development) Human Brain for pattern recognition, 'fuzzy computing', overnight program for problem solving (go to sleep with a question in mind).	Unified Human Settlement Ecology Matrix Philosophy CDS, HST Metaphor, Mindscapes Mathematics
	Organising Principles	Structure: Tangible/intangible Classification, Chunking Backcloth Development Connection, disconnection, Constraints & Limiting Factors, Context Replacement Lean Thinking Buzan's Mind Maps	UHSE Being/Becoming Complementarity Hierarchy Theory, Constraints
	Organism	Wellness Thinking Needs Based Thinking Functional 'Organisms' Bioregional Thinking	Criterion Organism
	Machine	Complementarity	Criteria Ecocycles, Feedbacks (Catalysts) Subatomic
Thermodynamics	**First Law**		

Complex Realm	**Theoretical Concepts**	**Applications**	**Thesis Area references**
	Second Law	Negentropy, Entropy	Thermodunamics (HST)
Chaos Theory	**Attractors & Repellors**	Rename Policy Levers; think of in Sociology, Community Development, Marketing, EcoEthics, Population strategies	CDS/HST
	Fractal Theory	Multi-scalar connected thinking in all planning & design areas Seek patterns in nature & emulate (Permaculture, Landscape Ecology Biotechnology) Function Thinking Fractal thinking; pattern change; pattern simplification, monoculture/polyculture distinction Harmony: Symphony Metaphor	Complex Dynamic Systems, Criterion Connectivity
Systems Theory	**Catastrophe Theory** **& Bifurcation Theory**	Perturbation consciousness: know your system before disturbing it (respect local conditions) Design & manage for Surprise; avoid rigid control; invite flexibility Ecotone appreciation	HST, SOS, Catastrophe Criterion Biotics, Criterion Landscape
	Holling Cycle Theory (Infinity Loop)	Design in 'soft redundancy' Allow for creativity, change, evolution: evolutionary thinking Life cycle thinking	Ecology
	Feedback System, Homeostasis	Dynamic equilibrium Constraint consciousness Multiple equilibria Scalar thinking (Hierarchy Theory)	Ecology Hierarchy Theory
	Preventive Design	Triumph of Small Decisions Preventive Design (preemptive EIA) Cumulative Impact avoidance	Criterion Rheotics
	Learning Organisation	Systems thinking, cybernetic approaches Social trap avoidance (long and short term thinking Continuous improvement Indicators & action: 'Plan, Do, Review, Renew' (Plan-Do-Audit-Review)	CDS Backcloth Design Criterion Indicators

Complex Realm	Theoretical Concepts	Applications	Thesis Area references
Subatomic Theory	**Relativity Theory**	Connectedness of everything: wholism Universe concept: a 'self of selves' Enlightened Relativism (with Values)	Criterion Community Criterion Organism
	Complementarity Principle (Quantum)	Work with structure and meaning in design; 'both/and' thinking (not 'either/or', inclusive design Distinction between rate dependent laws & rate-independent, locally specific rules & values: implication-collaborative community planning Individual <u>and</u> group; particle & wave Left/right brain function Quantum society (individual/group)	Subatomic
Evolution Theory	**Emergence Theory, Time Considerations** **Rheotics** **Fitness Theory** **Co-Evolution** **Catalysis**	Allow emergence time in community work; consistent regulations across small & large scale developments; generous foundation-laying period; tap into Nature's creativity Allow for evolution & self-organisation after projects & buildings complete; 'grow housing' 50-100+ year urban remodelling planning Anticipatory and posticipatory evolution: apply to planning & ongoing processes; preserve system integrity for future generations; recognise connections between now and future Needs based planning; wellness indicators, fitness landscapes; diversification for resilience Allow for co-evolution in design, policy, planning & regional development; refuse-resource loop work in industrial development Economic/commercial/industrial clustering, networking, integration Humans AND Nature, not OR Intelligent economic efficiency (includes long-term, eco-social and Complementarity thinking)	Criterion Catalysis HST/Ecology, Evolution Criterion Rheotics

Complex Realm	Theoretical Concepts	Applications	Thesis Area references
Hierarchy Theory	**Relative Disconnection, Connectance, Feedback Loops, Constraints** **Time, Space & Power Hierarchies**	Work with & within natural constraints Loop work: refuse-resource coupling, urban footprint work: distant time-space effects; regional self-sufficiency Indicators, audits & continuous improvement Bioregional thinking Connectedness thinking: networking, marketing, collaboration, energy, water, population, materials flow paths, ecological rucksacks, fractal thinking, refuse-resource loops, zoning, urban form, access, membership, alliances & partnerships, community education and Internet access Disconnectance work: structure, policy, marketing; thresholds & indicators, q-chains, fences, zoning, limits, strategic taxes, institutional constraints, sacrifice areas, earth berms maybe put list here from Criterion Connectivity Multi-function work; holon consciousness & balance in design, functional units/basic needs consciousness Challenge governments and developers on timescale fraud in EIS (inadequate timescale allowed to study full seasonal variation in biota Scalar thinking Hierarchy thinking, especially frequency thinking (time hierarchy)	Criterion Ecocycles Criterion Organism Criterion Connectivity Criterion Organism Theory of Scale/Hierarchy Theory HST/CDS
Set Theory	**Fuzzy Logic**	Fuzzy cognitive maps (FCMs); fuzzy control systems; fuzzy decision making, fuzzy entropy, fuzzy expert systems, pattern recognition, interface vagueness with science FUZZY SUSTAINABILITY SPACE	Representation/Mathematics (Volume II papers) Criterion Backcloth Criterion Indicators
	Q-Analysis	BACKCLOTH & TRAFFIC thinking Q-chain risk analysis Pattern recognition	Background Papers/Mathematics
Unified Ecology	**Multi-Scale, Multi-Criteria Grids ('Layercakes')**	Criteria & matrices for generation of design issues & concepts; educational grid for student training: multi-scale, multi-criterion thinking Multi-lense Complementarity (Criteria) & System rules for Sustainability Space definition Wholistic thinking	Criterion Connectivity

(From Rounsefell, 1995b: 402-3; updated 22/05/00).

4 APPENDIX D: DATABASES

4.1 RESEARCH JOURNEY: PLACES & LEARNINGS

Note: Dates were June-September 1993 unless otherwise stated. Entries below are temporally ordered, by geographical location.
EcoCity II, Global Forum, EcoTech and RAPI Canberra were preliminary orientating events close together in 1992.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Brazil							
Rio de Janeiro							
	Rio de Janeiro	We were told that there were 70,000 registered, but reports later say 12,000. A temporary compound housed over 300 booths and over 30 activity marquees.	United Nations International Forum in parallel with UN Conference on Environment & Development (UNCED)	2 weeks June 1992	All	Treaty-writing parties produced an array of NGO treaties for all areas of environment &b development. Extraordinary networking opportunity. Guards with machine guns every 10 feet along route to compound. Locals excluded and begging for passes. Street kids shot in preparation for our visit. Schoolboy said "who cares? They live like animals anyway". Tree of life' with paper leaves made by school children from all over world. So many they had to pin them onto a long fence as well as the 50 foot tree. Da Tse Bao daily communication system. Daily briefings with Australian delegation. Dalai Lama lead 40 religious leaders in simultaneous meditation for peace with all congregations across the planet, numbering billions. Greenpeace Rainbow Warrior & youth-sailed Viking ship in port. The American President arrived, took over a whole hotel, whose guests were all displaced for 24 hours, then left half a day later.	As things are going global, we will clearly have to fight for global scale suffrage in the same way as we had to as states and nations formed, if we expect to have a global scale democracy. This implies appropriate institutions to set this up. There is a 'Save the UN' movement: the UN is being starved of funds, especially by the USA. Amazing difference in hotel price between main road opposite and one street back ($120 vs $12 US). Conviviality of street music. Joyful experience of free networking with anyone wearing a tag from all over world. I-thou. Surprise to hear that Australian press was reporting Rio meeting as a waste of time, and copy sent from Rio being changed before printing by editors. Clearly someone has a vested interest in ensuring UNCED doesn't work. My first exposure to how big UN Conferences work. Useful experience for later application in Istanbul.
São Paulo							
EcoTech Exhibition	São Paulo (also Rio)	16ha	Environmental technologies trade exhibitions	June 1992 1 day (+1/2 day)	Mainly Ecocycles	Included part of a train, a bus (Germany: gas), solar (especially Japan), water testing, management, waste management (especially Israel); recycling, pellet making machines (burnable wastes for LDCs), GIS advanced systems, wind energy. One small Australian company selling gas conversion gear from domestic to car. Preceded by EcoTech in Rio, with sophisticated presentations downtown (wide range of ecotechnologies).	No other representation from Australia. Australia noticeably absent. Memtech® people were at the Global Forum, but not apparently here. Australia seems to be turning its back on environmental issues & technologies, while other countries are rushing to fill the niches for international trade.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Australia							
Australian Capital Territory							
Royal Australian Planning Institute	Canberra, ACT	Many hundreds	Annual National Conference Theme 'Sustainability'	2 days (part registration) Ran workshop for planners *Council of all Beings* (Joanna Macy)	With Wendy Sarkissian, social planner	ESD papers. Award breakfast: I approached President to suggest concept of a special award for sustainable development. He said that would be the thin edge of the wedge: all the other little issue areas would want their own awards too!	RAPI not serious about promoting sustainability.
Jerrabomberra Valley National Ideas Competition	Canberra	Bioregion	OECD Ecological Cities Project, Australian Case Study	6 months Competition preparation ± 2 months 1994 Report to OECD ± 4 months 1994.	All	Discovery of current leading edge ecodevelopment. Major content analysis of 32 entries. In Progress Seminar Canberra.	Very large scale, multi-focal research & assessment. Integration. Folly of design at distant desk without site visits. Habit of governments of setting up competitions on the implication that work may ensue for the winners, thereby collecting thousands of free consultant hours' worth of creative energy: seems a very inefficient, resource-high process, where properly organised collaborative design with an aware community could access very different, longer term and possibly cheaper resources. See Table 123.
South Australia							
Adelaide							
EcoCity II	Adelaide city		International Conference	Easter 1992	All	Hosted by Urban Ecology Australia. Wide selection of international speakers & also international researchers and speakers from senior local government & private industry. Introduced to Australia the concept of integrated, ecologically sustaining urban development from Bottom-up perspective.	The Ecological City is a concept capable of aligning all aspects of human health and interest, as it includes physical, social, psychological, spiritual and economic health as built-in aspects of local Ecology, Biodiversity and environmental management.
MFP Australia	Adelaide (core site) New Haven ('step-up' project) Mawson Lakes (privatised outcome)	Neighbourhood ⇔ international Population urban development Mooted 200,000 → 40,000 → 12,000... 30-year project.	Top-down ESD project	1992-2000 Case study (depth) early in process. Interviews CEO & many staff, Attendance public consultations, consultant work (Social Issues Team), attendance at events, launchings Presentation of paper at Helsinki 1993 (BP5.1).	All	Large scale urban development & Technopole Top-down TCM Triple Bottom Line 30-year project 32 environmental projects 51 identified Industrial Ecology linkages. Not just urban development: see text. Concept elusive to public. See text, Plates 5, 6, 7, 12, Figure 4, Table 6, BP 5.1.	Importance of political aspects Folly of ignoring Community Importance of transparency Much lost by labelling 'white elephant' & cancelling Much lost by privatising Importance of accurate & timely marketing Importance of media support to project survival & perception.
Fuzzies Farm	Norton Summit, Adelaide Hills	Bio-subregion (42 acres)	Small farm; 3 permanent residents (former anthropologist, former social planner); two bringing up	Live-in working guest 3 days Discussions with community members Weekly contributor to community meetings for	All	Small Permaculture community based on Findhorn & Crystal Waters principles. Political issues re land & community objections, case won by self-representation & boning up on Planning Act. Common purse (not common assets). Strong Social Security assistance in initial 12 years to time interviewed; more recently, income from free range eggs, produce, goat skins, café,	Fast approaches to getting information in intentional community setting (preparation for overseas journey). Carefully thought out values structure (see in part Table 45: Developmental Stages of Human Society). Impact of interpersonal competitiveness on community productivity.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
			children of member's deceased daughter.	approx. 1 year, 1993, 1994.		workshops, rental of building adjacent (deal with Conservation Park to lease & do up). Commitment to community service after Findhorn model. Attempt to set up large Eco-Education Centre similar to Macynllyth Wales supported by LG then 'plug pulled' on it (political).	Value of skilled management of backpacker volunteer labour: exemplary positive feedback system: appreciations round before eating each evening: 'Positive Stroking' ambience. Value of respect for tools (carpentry): individually named, as at Findhorn.
Alan Hickinbotham	Hickinbotham Homes Offices Adelaide	Suburb	Individual: senior partner, family development business	1 hour interview, 1992	Landscape Community Feedbacks Genius Loci	Developer role in deciding what 'choice' implies Pragmatic planning for multiple use where forced by inadvertent purchase of flood plain "We have a sustainable house design but nobody asks for it". "Do you promote it?" "Of course". "As hard as you promote the others?" "Yes but it costs more." Penchant for rural village style development surrounded by fields as seen in France.	Developer proclivities may have very personal origins. Resistance to new ideas (for example Cohousing) Impossibility of implementation of eco-building concepts at large scale without developer understanding & active promotion.
Halifax Project	Urban central Adelaide Old City Council Works Depot Murray Bridge land	2.2 Hectares urban	'Piece of EcoCity'	1993-2000 Attended all public consultations (early phase) Attended most public consultations (late phase) Cohousing subgroup Human Scale Development training groups Urban Ecology Australia (UEA) meetings, seminars, workshops Visit to rural property near Murray Bridge: source of earth from creek restoration; potential food production; launch of book of Halifax stories from glider (Emilis Prelgauskis, architect). UEA delegate to Istanbul Habitat II 1996.	All	'Bottom up'. Urban-rural linkages. Guideline principles. Large volunteer community worked millions of person hours. Hijacked by orthodoxy to build expensive terrace & townhouses ($205,000-$450,000 price range) Delays from serious land contamination (mixed types). Huge demonstration potential & several international awards (Council too short sighted to appreciate potential).	Never let orthodox partners submit documents unseen by non-orthodox group. Quality of human relationships lubricates or blocks new ideas. When orthodox developers claim sustainability they may well have no idea what they are talking about, and because low priority, sustainable features are the first to be sacrificed to short term thinking. Volunteers gladly give time worth millions to projects they believe in: this could be harnessed by a smart government (it was by the SA Housing Trust for the retrofit project mentioned in 2.1.1).
Golden Grove Development	North-East periphery, Adelaide	Very large tract (kilometers)	Interview with chief planner, tours (2) of estate & energy village	1.5-hour interview with planner & tour of estate; 3 hours, 4 hours, 1994, 1995	All	Compulsory proportion of public housing identifiable by fence design. Little claim to sustainability except 'energy village' (see text).	Insincerity of suburban development claims to 'ESD'; ignorance of admiring & concerned public. Pooling of private-public secondary school resources (innovative)

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
New Haven Project	Osborne, Le Fevre Peninsula, Adelaide	62 lots	'Step-up' for MFP. Conditioning of local developers & builders. Benchmarking trial.	3-years intermittent interviews from 1992-3 (especially Leon Byass, originator of energy concepts & SA Housing Trust engineers), visits, attendance at meetings, public meetings.	All, mainly Ecocycles Elements	On site sewage treatment, stormwater, grey water reuse. Common trenching, common & remote metering, kerbless roads, shared roads, roads = water collectors, all site water captured for treatment & reuse. Energy housing built to a price. 'Green Mortgages'. Youth Community Arts project for station. 'Phallic symbol' (waste of money & energy in steel monstrosity) mail centre with no rain protection, no parcel capacity, nowhere to sit. (see Plate 3). Xeriscape plantings (but not indigenous; disliked by residents). Indefinite public/private boundary in hope that residents would take care of public side of their gardens.	See notes in text, Table 122 & Plate 3. Serious deficiencies in sustainability, eg use of steel frames for houses because beholden to BHP for project money; 'Green Mortgages' dependent on Geothermal temperature management systems, requiring air conditioning (no take-up). Promised connection to railway & renovation of station as designed by Youth Arts project has not happened. Community development not at project scale. Wrong location for innovation, & not followed through for eco-educated Community development. Agent offered to remove mail centre but residents opted to keep it.
Local Government Biodiversity Advisory Committee	Adelaide	Metro-region	Committee	1995-7	Biotics Community Feedbacks Population	Promotional events for Local Government Councils, advice, partnerships. Major fund-seeking from NHT for distribution. (management through Urban Forest Biodiversity Program).	Funding sources. Impressive number CBOs working on biodiversity. NHT funding aspects. Considerable waste of National Heritage Trust funding due to fragmented character of funding & no attempt to orchestrate.
River Torrens	Adelaide & hinterland Most of River length	Bioregion	TCM demonstration associated with ANZAAS 1997	4 hours interpreted bus trip	Biotics Elements (water, earth) Landscape	Restoration, exotic removal, fencing, indigenous plantings, funding.	TCM, river functions. Rehabilitation process. Shock of appearance of denuded riverbanks preliminary to replanting (removal of olives, willows etc, also culling of domestic poultry).
Urban Forest Biodiversity Program	Adelaide	Mainly Metro & hinterland.	Consultancy Local Government training package development (research)	1999-2000 City of Onkaparinga Local Government Biosphere linkage Bioregion CWMBs (TCM). 2 reports written on biodiversity training requirements for LG.	Biotics, Community Elements Feedbacks Landscape Organism	Strategic context for biodiversity. LG staff training needs. Catchment Board interviews. CBO liaison. Competency Standards: collation of all standards affecting Local Government & biodiversity. Competency-based training system with outline design of 2 courses. Macquarie Council Biodiversity booklet for planning applicants (how to audit etc). Information resource packages for LG staff (sounds a very good model, but promised sample never received.	LG/CWMB jurisdiction overlaps. Local causes of loss biodiversity (all ultimately systemic, eg failure of proper supervision, interdepartmental interference, LG Councillor interference, or time wasted training staff because mowing & other tasks outsourced & Engineers refuse to write in competency standards to contracts because it may cost more). Restoration of habitats & corridors: NSW work with 7 LGCs for Central Coast & Lower Hunter River: substantial integration; hints at hooking in developers.
Aldinga Arts EcoVillage	Aldinga: Southern Adelaide suburban/rural fringe	32 households at 03/2001	EcoVillage: full featured, bottom up Permaculture farm Arts & community cnetre	Ongoing contact with organisers (offered place on Committee: will take up later) Approx. 1996+	All	Community driven. On-site infrastructure/ management of wastes, water, sewage, power generation (off grid in as many ways as affordable). Strong green covenants on Community Title land (24-page document). Active work with local community. In progress and too early to judge outcomes. DB2 housing strategies largely sourced from By-Laws.	As usual, resource drain from fighting authorities re unusual infrastructure plans; very little support from SA Government since assistance with securing land given. Persistence about intentional community may be needed for over 15 years in this climate of resistance by orthodoxy. Signs of shift in public perceptions & government acceptance of green issues now, as the *Greenhouse Effect* starts to bite (climate change).

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
City of Whyalla							
'EcoCity Whyalla'	Whyalla, rural SA	45,000 → 24,000 Core Site:	'EcoCity Core Site' Solar dish project Recycling Arid lands Centre for Urban Ecology (ARCUE)	3 trips of several days 1998-2000. Contact, host & guide Jo-anne Waters (now LG Councillor), then manager of ACUE. Core site visits to see Buddhist Temple, railway carriage disabled facility, toilet block. *EcoFest 1999.* Phone work +++b	All	Despite extensive consultation work by Ecopolis, Urban Ecology Australia and others, and the setting up of a UEA-trained Arid lands Centre for Urban Ecology, the Mayor and Corporation, Council staff and Economic Development Authority have made no general effort to understand what an EcoCity is, and are thus no longer able to run with the idea now that the consultation period is long over. As with the MFP, considerable funds have been wasted because investment has not been followed by further development. Unsustainable buildings are to be allowed on the eco site in desperation to have 'development' at any cost. The Anglican Church's site has been rezoned and reassigned to commerce, an action that has resulted in probable litigation, as considerable effort has been committed to fund-raising, planning & design. Buddhist Temple started in 1998 with 10 day strawbale workshop facilitated by *Huff 'n' Puff Constructions*. A lumber yard fire destroyed uninsured timber window & door frames, and another fire in stored second-hand jarrah in the Temple building resulted in substantial damage to one wall, subsequently rebuild under insurance. Council conservative engineer insistence on orthodox slab and heavy iron framework for building and other unexpected expenses have escalated estimated cost by 3x. 2000 followup: change of name of core site, removing reference to EcoCity. Malcolm Green, University of SA at Whyalla, electronic engineer. Conceived solar dish project for 'Solar Oasis' Project, including desalinisation of sea water, saving imports from dying River Murray via Adelaide. Project apparently taken out of his hands first by University, then by SA Business Coop, which has set up a management company but not made him a Director, and LG slow pace (but they have invested $25,000 in it). Waiting (2000) for next stage, feasibility done. Solar roofing commercialisation (seeking grants). Water Conservation Partnership Project (River Murray urban users region) finding alternative ways to source water. 1995-2000 4,330,568 kl, last 4, population down, water up. See text & Plate 4.	There needs to be a *firesoul* team living locally in the long term. Top priority for such a project is to entrain the Local Government Council, which must understand & own/partner the project. Community must be involved, educated and included in visioning to tailor the EcoCity vision to the local area: make them shareholders (says Waters). It is not realistic to define one small area of a city and believe it to be an EcoCity. Bioregional Landscape Ecology is crucial. Big engineers are capable of disastrous judgment: the constructed wetland system is unusable by wildlife because excavation has broken into a highly saline aquifer. Big Landscape Architects can make bad recommendations: EcoCity landscape should have a planting policy of 'indigenous species unless a very good reason exists for selecting otherwise'. Temple: very different stories about the fires from Buddist contact person and locals. Temple building is the first of five planned (central octagonal, subtending four radial rectangles). Group of 30 Buddhists. Surprised at how hard the project has been. Should be complete (this building) in the next few months.
NSW							
Sun Village (formerly 'SUM':	Queanbeyan NSW	Neighbourhood for 55 mixed dwellings @ 135	Cohousing, planned for 16 years to 1993.	Several hours 1994, Site visit & discussions	All, especially Community, Ecocycles	Small core group (12-15) developing Cohousing ecovillages now for 48, all approved & to be built 2001. 3 demo building to be built at same time on	Importance of having L G Council Planners, architects & local community on side. Community tendency to 'NIMBY' non-tract

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
'Synergistically Unifying Matrix')		persons/ha. Rural property (no details).	Business name: *Integrated EcoVillages.*	Followup 2000 (phone).		rural land. "Co-housing is a way of consciously creating the community that used to occur naturally" *Bogong 1993*, vol 14 no 4. Hexagonal modular building design & grid, with community hall & common room; flexible architecture including prefab, high thermal mass, standardisation. Focus on recreation opportunities for all age groups: adolescent hangout, children's community learning/ care/ adventure; gym, tennis, swimming pool; music, meditation, craft, machinery, library; op shop; grey water reuse, recycling, low cost & running cost housing; common gardens, bulk buying, E-networking; SPV & wind supplemented power, recycled timberprivate & open spaces; car pool & PT access.	developments. Hexagonal grid avoids rectangular metaphor of solid materialism; fosters community values & sense of belonging but with individuality. Learned from? Need to have a supplementary income to support radical ideas. Successful eco-projects bring credibility than can then spread to more radical works (in this case, composting toilets and small water management systems). Age brings credibility. Support from Environment Australia brings credibility & opportunity.
Pathways to Sustainability	Newcastle	2000 approx.	Pathways to Sustainability International Conference: Local Initiatives for Cities and Towns, Newcastle, NSW, 1-5 June 1997, City of Newcastle.		All	Broad-spectrum, multi-stream conference on LG & regional scale applications of sustainability. Eco, environmental & social. Participatory workshops, papers, posters etc (I did a poster on . Useful set of papers & handouts. Env. Technology expo. Interesting side trips on wind energy & sustainable development (no funding to enable my attendance).	Sophistication possible in small community. Black, home-made beer. Effectiveness of raising the voice on microphone in drowning out anti-uranium hecklers (Senator Robert Hill). Amazing advance in eco-consciousness in local government since I went around in 1996 asking about progress with LA21. Awareness in LG (warning from Irish Mayor) that Competition in policy & process was having us (LGs) all damage each other instead of cooperating, which is what we need to do..
Victoria							
The Natural Step Environment Institute of Australia	Koonwarra, Gippsland, Victoria	Small Institute, brilliant Board of prominent people with full spectrum of credentials needed for an eco-educational business.	Training in Swedish Natural Step concepts, with unique Australian extensions. New package *Sustainability Made Easy.*	Beginners & Advanced Distance Learning, consultant accreditation, 1999+	All Especially Ecocycles	See text, Criterion Indicators, Figures 48, 53, 55. Simple system, easily understood, forms common language of sustainability for business, industry, local government, schools etc: all scales. Funded initially by Foster Foundation; shares building with *Forest for Cars, Green Fleet* (car drivers' $15 donations pay for forest & regeneration projects) & GoMark Foods (works on sustainability from farm to consumer: process chain sustainability in effect). Community building activities have entrained many locals into sustainability behaviour & consciousness.	Benefits of working in a team of like-minded people. Obvious, but good to see working minor green miracles in commercial setting.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
City of Manningham	Outer Melbourne rural fringe North-East.			Contact first through The Natural Step training. Visit to LG offices 2 hours & subsequent contacts re their training programmes and EMS, ISO14000, 9000.	All Mainly Ecocycles & Biotics	'Most advanced' LGC in Victoria re Agenda 21 and EMS. First to take up The Natural Step. See Criterion Indicators, Tables 110-111. Set up EMS using TNS, then selling tailored EMS to local government. Conflict of interest here re own intellectual capital and being beholden to (old version) of TNS system. Complained TNS too expensive, too intellectual, so invented 'Stretch Goals' which act like metaphors (see Criterion Indicators). Merger of economic development with environment department & social services.	Stretch Goal concept. (Actually a succinct expression of a preferred future). Workings of EMS in local government. Corporatisation of LG → confusion about who owned the infrastructure with which the 'corporation' makes its income ie incomplete differentiation. EMS + ISO14000 + ISO9000 + TNS = a huge amount of effort for all concerned, especially environment department. How do they have time to do anything else???
Queensland							
Brisbane							
University of Queensland Department of Planning	Brisbane, St Lucia			Prof. Jerzy Koslowski	Landscape Biotics All	System for Environmental Planning based on 'Ultimate Environmental Threshold': modified Delphi-based assessment of sensitivity of land on any chosen parameter, attributed to modules on a grid of defined scale.	Preempts EIA & builds into planning process. Successfully applied in Tatry National Park Poland, Barrier Reef Island. Was being computerised (1994). See Koslowski 1993, 1986, Criterion Landscape: Landscape Architecture training..
Gold Coast							
Robina	Gold Coast hinterland		12 large department store shopping & business complex	Guided tour of site in progress with landscape architect from EDAW. 1995.	Biotics Population Connectivity	Location at new railhead. Park & ride to city (Brisbane) nearby. Huge hole in ground at stage seen. Very shoddy road construction already breaking up after 6 months. Very little sustainable strategy to recommend it. Orthodox horticultural landscaping; area rife with exotic palms (tropical iconography for resort areas in Queensland).	Consumerism rampant. Curious to see end result in terms of Community, Connectivity, Landscaping outcomes.
Rural							
Crystal Waters	Conondale near Maleny Queensland	150; 30% children For approx 250 long term	Permaculture Community	2 visits, one for one week as guest of Late Stewart Sherwin	All, especially Community Biotics Elements	Site plan issue: initial conditions demanded by LGC planners ensured substantial car use and fragmentation of community. Community centre. Communal meals. Small Permaculture activity, but those who do it , do it vigorously. Approx. 150 different occupations supported. See Plates 16, 9.	Impressive care for elderly. 'Old Dave' just had his cataracts done; the community rallied to put his eye drops in every 2 hours day and night for several days. Long-tern, self-sufficient communities need cemetries. Alexander *Pattern Language* application makes beautiful, welcoming houses.
Forest regeneration	Crystal Waters	Hillside	Replanting of cleared rainforest.	2 hours conducted walk with Sherwin.	Biotics Landscape	Land purchase & plantings funded by Stewart Sherwin's *Genesis Foundation*. 30% on dole.	Impressive determination of a committed old man who felt he had made a mess of some aspects of his life, and wanted to make an impact for the better in the long term.
Maleny Township	Coastal hinterland North of Brisbane		Alternative activities Broad spectrum	1 day 1994 Meal at health food shop, shopping. Visit to people planning radical school. Visit & interviews at community centre,	Mainly Community All	Alternative lifestyle centre (Attractor). Child friendly. Visitor friendly. Creative ambience. Low income & dole common.	Response: I wouldn't mind living here! So many coops they have a club. Approximately 15 in 1994.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
				coop. Visit to Dowmus office.			
Dowmus composting toilets	Main office Maleny attached to private house.	National Subsets sold off more recently.	Sewage treatment	Tour of experimental new models on Crystal Waters estate	Biotics Ecocycles	Experimental models using Crystal Waters to test pre-commercialisation. New (then) sand filter (example on Crystal Waters Community House system. Takes sewage, vegetable scraps, newspapers (torn), any organics, tissues, paper; makes attractive compost (Plate 16). Approved in Eastern States for use in large urban buildings and clusters of 2-300 (as used in the Army in rural SA). South Australia is lagging behind other states in approving for urban (non-rural) use. Community scale (2-300) systems used by Australian Army (Arid).	Character of compost. Breadth of range of things that can be composted.
Kingfisher Bay 'Ecotourism' Resort	Fraser Island Queensland		'Ecotourism' Resort	3 day visit (door prize, Municipal Conservation Association Conference, Melbourne, 1994)	All Mostly Ecocycles	'Self sufficient' sand island nearly logged out, with remnant rainforest, perched lakes, scribbly gum woodland, wild dingoes, rich birdlife. Rubbish returned weekly to mainland. Envirocycle type sewage treatment. Diesel power generation, self-sufficient. Allowing tremendous 4WD impact by free access all over island.	Problem disposing of compost on a low-organic-adapted sand island: need to re-export. Claim to be 'ecotourism' but are negotiating to bring a $4m power cable across from the mainland, in the presence of generous solar & wind energy potential. Also presiding over massive destruction of delicate sand island structure.
USA							
California							
Berkeley							
'EcoCity Berkeley' Richard Register	Berkeley California University town, constrained municipakity (bounded by heavy development)		City-region Long-term planning (50-100 years) Local, neighbourhood & Community Individual block consultancy House scale strategies	Guest Richard Register 1993 (attendance many Register presentations Adelaide, USA, Istanbul 1992-6) Meeting Lord Mayor Berkeley (Loni Hancock) & several LG sections Fritjof Capra (chance meeting) McCamant & Durett (Cohousing) Visit Urban Ecology (USA) EcoCity II meetings (Register, Hancock) Adelaide Visits, interviews, guided tour of Register projects Book purchases Green Builder , Green Home (visit)	Community Landscape Elements Biotics Feedbacks Integration (All)	Urban remodelling plan (see Figure 41). Community activities. *'Creek Critters'* (creek marking on kerbs) project. Creek restoration. Community garden & coffee area (low income carpark reclamation). First formal (global) recycling system. Traffic calming.	One firesoul isn't enough It takes huge work to get small gains with ecological development There has to be 'something in it' for the dedicated 'NIMBY' or indifferent individualist, or nothing radical enough will happen

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
City of Berkeley	City of Berkeley	City	Series of interviews	Mayor Loni Hancock 1 hour & manager of housing department 3/4 hour.	Community	Town planning, concept of 'EcoCity Berkeley' (from Register), housing, recycling. Low density approvals for downtown development allowed because faster & easier (3 sets permissions needed to have integration).	I have never seen so many poor & begging young people in one place before. Berkeley is a well-heeled area, a university place (UCB). City losing large amounts of money from theft of recycling wastes awaiting collection kerbside. Mayor's rhetoric at both EcoCity I & EcoCity II not implemented. Richard's EcoCity Zoning map, on her wall, is a 'nice idea'.
Kathryn McCamant	Berkeley		Architecture, development, especially CoHousing	Correspondence with office, coffee meeting 1 hour with Register.	Community	Directions to several projects. Busy & preoccupied.	Logistic aspects of organising CoHousing. Length of time it takes to organise & build a community in preparation for building (min. 18/12-2 years, often many more). Need a firesoul group to start off. About 30 households is enough: tend to split above that, into factions. 15 is a good number.
Fritjof Capra				30 minute chat on chance meeting while on walk with Register.			You meet some amazing people on the street in Berkeley.
People not seen	University of California at Berkeley			Correspondence with Dr Lynn Lofland & Christopher Alexander, both at UCB, but away for Summer		Lofland: Public, Parochial & Private Realms. Alexander: A Pattern Language (see text, Tables 84, 85).	
Oakland							
Urban Ecology (USA)	Oakland	All, mainly San Francisco Bay Area, but considers all scales & transmits information & knowledge globally	1 hour visit (3 hours to get there from Berkeley without motor transport!)			Latest project (reclamation of former military land).	Like so many powerful places, minimal office infrastructure, clutter, great warmth. American public transport is appallingly inconvenient, even to a South Australian.
San Diego							
Jim Bell	San Diego, California		Consultant Activist Otay Ranch Joint Project Team	1993, overnight visit	Elements all integrated	Ecological design. Large scale, low cost solar-aquatic sewage treatment (Mexico). Edaphic mapping for long-term revision of planning patterns & restoration. Regional. Long-term planning (50-100 years). See text.	Regional soil typing as policy basis for large scale, long-term remodelling of land use Integrated development LDC sewage treatment system can be very simple, cheap
Otay Ranch	San Diego		Ecologically designed New Town (planning stages)	Described by Jim Bell	All	Plan for 80,000 pop., 27,000 houses by 2020: 11 villages, 170ha town centre, demo intent, xeriscaping, public transport. 60% open space + habitat. Design starts with landforms; highest density on cleared land & gentle slopes; no *culs de sac*: permeable design.	Gift from Bell: Bell, J, Snow, L & Vary, D (1991). Ecologically Integrated Planning: A Case Study: Otay Ranch: Maximising Eco-nomic Sustainability. Ecological Life Systems Institute, San Diego. March 1991.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Davis							
City of Davis	California	City	Tour of Davis with environmental planner Visit University Centre for Cooperatives Book purchases Muir Commons Cohousing Village Homes Several experimental developments	2 days	Ecocycles Community Elements Biotics	Muir Commons Cohousing designed by McCamant & Durett Village Homes (Michael Corbett) = original energy housing, integrated, edible landscape, earth berms sculpted from flat plain for drainage & interest; vineyard; road layout Davis: Energy Plan; goal: first energy town (electric vehicles & golf buggies on roads). Buried highway reduces sound. Wildlife refuge (island in wetlands in suburbia). Banned supermarkets: lively downtown (strip shops). Drain marking scheme.	Experimental & committed approach in local government can make a big difference to actual implementation of sustainable strategies
University of California at Davis, Center for Cooperatives	Davis	Centre for larger network	Semi-academic resource centre on campus.	2 hour visit, interview, book purchases		Studies, projects, contacts, historical re coops. Cooper, D & Mohn, PO (1992). The Greenbelt Co-operative: Success and Decline. The Center for Cooperatives, University of California, Davis, Davis.	
Muir Commons Cohousing	Davis	26 households 4 years to plan	CoHousing	2-3 hours visit, conversation, guided tour.	All Especially Community Organism	Systems for organising cooking, shopping, other tasks. Meditation room. Key: developer driven. Resident input extensive from start. Middle Class type residents.	Process likely when people don't fit in (they eventually write themselves out). Dispute over community no-fence rule: resolved by allowing enclosure of back yard with coarse lattice. Need to keep tabs on quality of architecture and building (issue with long-term plans to extend upwards not possible due to structural unsoundness for task). Pleasure in sitting round after work with neighbours & children safely playing nearby. Need for clear rules from outset. Energy distribution between community house & unit design: needs clarity & rationality (reality).
Los Angeles							
Los Angeles Individual (wealthy firesoul couple)	Beverley Hills/ Hollywood	Local	EcoCity people Follow-up post Rio	2-3 hour inteview Genevieve Marcus & Robert Lee Smith	All, Ecocycles, Community	Plans for EcoCity in Utah; brochure picked up at Global Forum, Rio 1992: relinquished for battery reuse project based in low income community: very much smaller scale aspirations. Cagey about why ecocity failed.	Community building comes first; funding source with capacity building priority for low income (similar to LA EcoVillage – CRSP – conclusions).
Southern California LA21 Action Group	LA city	Regional community of interest	Group workshop Well-heeled, middle class type group. Fee $US15.	1-day presentations & commitment workshop	Community all	Second regional meeting to advance action around LA21. Presentations am; workshops pm; invitations to action group activities last (quite poor commitment eventually ? related to presumptious/ badgering attitude of organisers or lack of Contract clarity).	USA well ahead of Australia in implementing Local Agenda 21; objectives for workshops need to be clear or plans not owned by groups

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
LA EcoVillage	LA low income suburb	Neighbourhood	Community building	Several hour visit, pot-luck dinner, discussion with visiting speaker from US Housing Department	Community Organism Population	Plans for greenfields site cancelled in favour of community building in poor area Child guardians of street trees appointed; small community organic garden	Community building precedes sustainability strategies.
Ventura County							
Ventura County		Region	Recycling seminar	Private conducted visits, meetings, interviews, site visiting Ahmanson Ranch ecovillage property (San Joachim Valley)	Elements Biotics Organism	Gildea Resource Center. Aquifer recharge. Strawberries & avocadoes. Genetic Pawlonia nursery: a great idea of undefined market (project subsequently failed). Pawlonia grows fast (30 feet in 2 years), fixes nitrogen like a legume, Chinese origin, strong hardwood; genetically engineered first in Melbourne, promoted at Rio, re-financed in USA, whole nursery hired, used in schools to great effect (so fast growing), but NO Market identified. Medium density closed community development	Strategies for traffic reduction: high occupancy lanes, worker subsidy for PT, ride sharing, park & drive; if all else fails, cancel Friday !! (4-day week). You can't assume a brilliant idea will be embraced in a market-driven society without target market analysis & promotion. Commonly seen unreality of eco-visionaries.
Thousand Oaks	Near Los Angeles (1 hour North)	Suburban		5 days driving & private conducted touring (Jeanette Scoville). Broad spectrum learning experience. Cable TY interviews on Halifax Project & sustainability.	All Biotics Connectivity	Thousand Oaks Urban Forest Program City of Thousand Oaks Traffic strategies (highway to LA)	City-wide urban forest can be managed as a whole by local government if committed
Ahmanson Ranch	San Joachim Valley	Acreage		2-hour visit Follow-up from EcoCity II (presentation on Ventura County Citizen Planners)	All	Ecocommunity planning (contested): see text.	Communities work hard not to allow ecovillages, using all sorts of ecological excuses yet readily accept large, unsustainable tracts nearby Partnership with CBOs may allay community concerns 'Ecocommunities' could have far less conflict if they avoided planning golf courses; sometimes used as an ambit claim by developers (eg at Wilpena Pound SA).
Gildea Resource Centre	Santa Barbara	Region, city, acreage	Visit	Several hours Talking, interviewing, photocopying.	All Ecocycles Community	Gildea Resource Centre: consulting to all scales of government on recycling; community centre, strong on education; large community garden Glasshouse & sod roof; education centre	Waste stream destination must be planned along with the collection of recyclables or end up in landfill anyway; glut of recyclables causes drop in price: warning to local governments intending revenue stream from waste; new ways to use waste; importance of support for local small businesses to use waste streams as feedstock

Washington State							
Dorothy Craig & partner	City of Olympia	City, household	Sustainability Plan	2-3 hours Breakfast meeting	Community all, Organism	Cohousing plans City of Olympia sustainability activities & strategies	Value of visuals in public consultation. Strategies to involve community in urban change (including semi-instant feedback & targeted use of visual images). I never before saw a publically committed, long-term, non-sexual same gender relationship.
Oregon State							
University of Oregon	Eugene, Oregon			30 minute interview seeking outcomes from Alexander's "Oregon Experiment" (Alexander sought in Berkeley, but away for summer)		Multi-disciplinary Faculty.	New potential direction for training for partnerships to solve global problems. Suggestions of same to University of Adelaide not received with enthusiasm.
Individual	Oregon suburb		Urban Permaculture	3 hours interview with activist	Biotics		Use of space in urban setting; solar access crucial.
Lost Valley Community	50 miles from Cerro Gordo	Hectares	Visit Exploration Book purchase	2-day stay Guided Firesoul & most of community away	All Community	Former summer camp in attractive forest setting: educational centre. Promotion of sustainable tourism Straw bale house construction in progress. Organic garden. Special interest: sustainable tourism.	Difficult to implement full range of sustainability strategies without capital. Food production may only be supported by a small proportion of a community, available area & expressed keenness notwithstanding.
Cerro Gordo Community	Doreno Lake near Eugene, Oregon	1200 acres, 25 residents 1993. Start 1971, site Cerro Gordo Ranch 1973, 1974 first investment group to buy land, ecological inventory, 1975 eco base plan, 1978 approvals. 1980s disputes County & State Planning, causing financial problems; final battles over 1989; outreach, building, networking 1990s+.	EcoCommunity, forested mountains 3 sides.	2 days + 2 days Interviewed 1-2 hours Chris Canfield (originator) Assisted building cobb house (Yanto Evans) Host & guide firesoul Brady Peeks, stayed 2 B&Bs on site. Interviews community members, Brady Peeks, Shirley Campbell, Yanto Evans, & community initiator Chris Canfield (2hrs). Sustainable forestry workshop & open day.	All, Biotics Community Elements	Clusters in forest clearings/natural meadows. Run by CG Coop; for Community Trust & Community Development Corporation. Many sorts of governance plans still not functioning in 1993. Eventually for car-free. Disastrous ending to early phase experimental relationships, still hurting. Sustainable forestry 450 acres 'Individual Tree Selection Management': lumber $800/tree or harvest for 25 houses pa within annual yield; low impact harvesting with tiny machinery, conserving old growth, undergrowth, meadows & age range of trees. Organic gardens. Individualism a feature: appears to constrain Community aspirations. Sustainable industries development (eg bicycle trailers). Horse owner early residents → dissonance by desecrating some areas	Importance of clear values & local governance: establish early & act on firmly. Things left too long often don't get done. Sustainable forestry can be done with very little impact Some very expensive-looking buildings there, plus full range of types, including very low cost self-build, tiny caravan, cedar multi-storey. Funding from memberships of different types, many external: 'Town Forum'. Many own an interest but live elsewhere: funded Idealism. Community members asked for a conversation with me, expressing gratitude for what they saw as my 'postman' role: bringing news of other communities & activities. I wondered if with their busy lives they felt a little lonely or isolated in their idealistic efforts.
Alpha Farm Community	Rural 50 miles from Lost Valley (3 communities in approximate 50 mile triangle)	Hectares		1 day joining open day activities Exploration, shared meal, outdoor ritual (100 people) Interview with firesoul Caroline Estes.	All, Community Organism Feedbacks	Common purse. Very strict rules, no personal possessions. Large scale food production; high self sufficiency. Several external businesses including café/ gift store & postal run.	Stringent rules lead to apparently high productivity if communards accept the discipline. Very little money needed with this type of system. Leave with no equity, but entry needs none, all needs met for good non-consumer life.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Canada							
Province of British Columbia							
Vancouver Island							
Bamberton Project	Vancouver Island	10,000 residents	Ecodevelopment planned by DPZ developers	Trip several hours, conducted by Chip Kauffman (now urban designer in Australia). Interviews then and later by phone with Guy Dauncey (social & spiritual aspects).	all	Pension funding. Extensive community consultation. Probably lost to environmental concerns (see text). Located in & around old cement works with very high damage level. Saanich Inlet & forest in Bioregion. Plans included CoHousing, organic agriculture, shared community facilities, biodiversity policy, vegetation protection codes, the Arts & culture. See Plate 8.	Developers wanting to do things in sensitive places <u>must</u> consult environmentalists first, and include them all along. Developers need to find out what 'sensitive' means - urgently. "What would you do better next time Mr Kauffman?" "Even more public consultation". "What do you think of the Bamberton Project Dr Russow?" "A good project in the wrong place".
Dr Joan Russow	Vancouver Island	Global	Activist PhD President Canadian Greens more recently (1997).	10 days NGO co-work at Habitat II Conference, Turkey + Discussions, email, shared conference paper preparation, in absentia presentation Catalyst Conference 1997	Community (International Law)	PhD & Report on International Relations: Analysis of countries x Treaties & Conventions signed & subsequent fate (few fully implemented through 4 stages: sign, ratify, enact, enforce). Alternative version of Bamberton Project story. Contact with Derek Mallard who sent substantial information on ecological issues of Bamberton.	Parlous status of International Treaties & general failure to ratify or enact. Countries sign up to look good, then ignore the next 3 steps. Few implement them.
Vancouver							
Vancouver	**City & suburbs**		Staying & travelling (private & Youth Hostel)	Approx. 10 days.	All	Skytrain: automated transport system. Granville Island & False Creek. Innovative Housing Conference. UBC visits. Course on alternative energy: assessment of system size required. Vancouver Island side trip to conference. Visits to specialist housing. Trade Exhibition, especially advanced insulation materials. Interview with architect contacted earlier on lifetime assessment of energy & CO2 characteristics of building materials.	Skytrain disconcerting to travel fast at ground level with no driver. Difficult to trust computers! Insulation in Canadian style asks for heat exchange machinery, whole underground floors devoted to furnaces, computers, hitech gear; often made of fossil fuel based substances blown with Greenhouse gases. Presumably have outgassing potential.
Innovative Housing Conference	**City of Vancouver**	2000	International Conference, 8 streams.	21-25/6/93	Ecocycles All	Multi-stream annual, international conference. Deep involvement of Canadian Government with many free publications, prepared to send anywhere in world. Enormous Proceedings: very useful reference.	Impressive attitudinal difference between Canadian & Australian National Governments re sustainability & real strategies for real change - impressive support for those wanting to work & research in this area.
Housing demonstration trips	Vancouver		Side activities to IH Conference	2-3 hours x 2	Ecocycles Organism	Healthy House, Energy Efficient House. Part of series of demos across Canada subsidised by Government (CHMC). Documents received later (free): useful manuals, many of them, technical level.	Pretty expensive stuff.
Alternative Energy	Vancouver		Workshop	2 hrs. Side activity to IH Conference.	Ecocycles Organism	Given energy budget & list of appliances & energy ratings & asked to choose what you would run in your house within that alternatively generated budget.	Appreciation of energy draw for different appliances & challenge to choose what is and isn't essential.

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Granville Island	Vancouver		Substantial docklands type retrofit	Several hours in company.	Ecocycles, Population Community	Retrofit dockland area (tourism). Admired by Jan Gehl (Adelaide 2001).	Quick place to empty your purse. Relative attractiveness of coopting old forms to new precincts.
False Creek					Landscape	High quality highrise, high density	Issue with student renters not taking as good care of buildings as owners.
University of British Columbia, Centre for Human Settlements	Vancouver		Broad sustainability agenda, focus on social.	Interview with Mathis Wackernagel (Bill Rees away), 1 hour; library followup 2 hours Publications bought. Library visit (UBC).	Organism Ecocycles Community	Urban Footprint work	Notion of 'appropriation of carrying capacity'.
Province of Alberta							
City of Calgary	Downtown	City		2 hours Interview with environmental planner	Biotics Connectivity Community	Undercover city for winter Yellow Fish Road Programme New Environmental Laws (Province & National)	Laws holding planners personally responsible for the impacts of their decisions on the environment have major effects: planners become very stressed, search desperately for ways to cover their backs, and become far more inclined to consult the public.
University of Calgary Interviews	Faculty of Environmental Design	Calgary		Several hours David Van Vliet (for Prof. Bill Perks), others	Community, all	Scandinavian EcoCommunity studies. Effectiveness of Demonstration projects. Intention to develop EcoCommunity in Calgary.	Power in having university professor interested in such projects (funding etc). Interest of CMHC in assisting with funding for better information about housing alternatives (impressive contrast to Australia).
Province of Ontario							
Toronto							
City of Toronto	City centre		Visits over 3 days.	Interviews Senior Policy Planner (Lynn Morrow), sewage engineer, given any City publications I wanted, tour of waterfront & sewage works (external). All morning.	Connectivity Biotics Ecocycles	Bioregional planning, large scale, integrated. River rehabilitation, wildlife corridors. Bicycle path system. Park & ride, close transit stops, customer service, transport interchanges, integrated timetabling & other transport strategies. See also text Criterion Connectivity. Pedestrian-prioritising, underground connectivity *FreeCool* system (concept). WHO Healthy City. Treated sewage effluent → lake! Waterfront soil decontamination. Habitat for humanity. Several large integrated projects recommended by Lynn Morrow (not seen). Dr Rosalie Bertell.	Communter cycles & pedestrians do not mix (2 pedestrians killed in 2 years after bike paths completed).
Waterfront Commission	Toronto		Major soil decontamination project	Dennis Lang interview 2 hrs.	Elements Biotics	Major task to clean contaminated soil from extensive waterfront area. Video & printed materials given. Project complete & soil passed Dutch standards.	
ICLEI	Toronto		Global network committed to consciousness	Interviews Jeb Bruggeman & others.	All	International Council for Local Environmental Initiatives. Committed to environmental consciousness raising	Details of some of the projects.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
			raising about local government sustainability.			by disseminating news of local projects & strategies to member LGs. Some Australian LG staff told me it is an expensive organisation so their LG won't join.	
FreeCool	Toronto		Deep lake water cooling system under proposal.	30 min interview + reading time.	Elements Ecocycles	Concept stage, but may not be implemented. District scale cooling system relying on characteristic cold temperatures of deep levels of Lake.	
Healthy Cities Office	Toronto		Resource & activity coordination centre.	2 hours+	All Especially Community, Ecocycles Organism	Much material collected & printed items. Lifestyle Indicators developed locally. Public consultation material.	Quality of Life Indicators. Public active participation in processes.
Dr Rosalie Bertell	Toronto		Activist	2 hours+	Organsim Ecocycles Elements Community	Ageing researcher, special interests include environmental heal & pollution, military impact on Stratosphere & Biosphere (sourced from military publications), peace.	Extent of military impact on energy, CO2 levels, stratosphere holes (experimental damage with rockets), resource capture: never listed as causal entities with other impacts (cars, industry, domestic etc). Sources from public domain military journals.
Waterloo							
John Maskell	Dept. Geography, University of Waterloo Canada Toronto Istanbul Turkey	Biosphere	Individual	House guest 1993 for 1 week. Guided tour of Waterloo Green Home 2-3hrs. Shared team work for UN at Habitat II, 1996	Community Feedbacks All	PhD on tuning environmental education to assessing issue sensitivity of public. Activist: various altruistic, environmental, large scale.	Survey methodology, alternative Economics framework Alternative Economics concepts (Tobin tax, credit generation system). Contacts eg Bertell.
Waterloo Green Home	Waterloo	House	Demonstration of state-of-the-art recycling & energy efficiency	2-3 hours	Ecocycles Elements	See Plate 7. Computer controlled air management system: totally sealed house. Many environmental technologies. Most materials recycled. Video borrowed by MFP for translation & 'lost'.	Carpets made of polyethylene bread bags are a bit of a worry on health grounds, sealed housing entraps internal outgassed substances (sealed system anathema to many European designers): awareness that health issues may conflict with resource reduction desires (eg some people need to eat meat). Sealed gas unit would be excellent for gas-sensitive people (commonest chemical sensitivity). Tiny computer chip flakes for lightbulb sockets can be set to turn light off after a set period.
United Kingdom							
Milton Keynes							
City of Milton Keynes	North of London		New Town Energy housing CoHousing Coop.	Interview with planner & LG information file 2+hours.	Ecocycles Community	New Town likening itself to Almere The Netherlands. Looks like Australian sprawl, very poor public transport. Energy housing & audit systems for different sectors (BREEAM: promoted at Innovative Housing Conference Vancouver).	New Towns seem to be about sprawl & control (no visible signs, so visitors get lost).

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Energy Information Centre			Clearing House on energy & environment, community projects etc.	2 hours & arrangement to be sent photocopies	Ecocycles Community All	Archives. Information. Inadequate time to do it justice.	
Energy Housing	Milton Keynes suburbia	600	No details	Taxi tour in heavy rain!	Ecocycles	Time & transport issue here & not much gained.	
Rainbow Cooperative Cohousing	Milton Keynes outer suburbia	2 rows Victorian attached housing with street	CoHousing	Afternoon several hours, mainly interview with resident & shown around.	All	Very attractive stone row houses. Common spaces include street between rows & back garden areas. Small scale organic food production. Log circle round fire used for sharing sessions. Rooms set aside for community activities. Long waiting list for entry. Private ownership. Financially healthy.	Substantial contrast between ambience of separate suburban sprawl housing & community.
Oxford							
Dr David Pepper	Home		Department of Geography, Oxford Brooks University	2-hour visit, interview/ conversation.	Community	Main conversation about his study of communards & structure of Geography courses. See text.	Orientation.
Forres							
Findhorn Community	Findhorn Bay Caravan Park near Forres, North Scotland	200	Catalysis of new society.	3-4-day residency, assisting in community tasks, attending meetings, meals, lecture by (now the late) Peter Caddy (co-founder).	All, especially Organism Community Ecocycles	See Plate 13, Figure 61 & text. Bioregional engagement. Model village including EcoVillage demonstration. Experimental housing. Building biology. Concern for teens, singles. Attunement compulsory weekly (a type of psychological 'insurance'). Emphasis on spiritual, meditation, consensus. Common purse.	Basis for modelling of many other communities I visited. Longevity through *attunement*. 'Feel' of living in a lively, eco-spiritually-driven community (ie 'feel' of living a 'walking-the-talk' lifestyle. Implementation of EcoVillage & other experimental housing. *Nature Sanctuary* impact (undefined).
Cluny Hotel	Forres, North Scotland		Conference & training centre owned by Findhorn community.	Guided tour 2-3 hours	All	See Plate14. Conference, training, education: subset of larger community. Superb gardens. Huge building in poor repair, slowly being improved.	Naming of tools as respectful practice.
France							
Sophia Antipolis	Nice hinterland.	1974 start, 40ha → 2300ha+ (ha of industrial development) >800 enterprises, 14,000jobs Related population 100,000	Technopole Computing IT&T Electronics Energy research Biotechnology Pharmacological chemistry	Interview by arrangement with management. Visit at request of MFP Australia (seeing MFP as a technopole & Sophia Antipolis as a worthy model to emulate).	Ecocycles (energy) Landscape (housing on site) Connectivity (issues re commuting)	Traffic management & flow issues. Designed with few parking spaces. Residents demanded & got more. Internal transport not adequate to obviate need for cars. Big proportion of residents work on coast & vice versa. Serious bottleneck at urban exit. Similar to Technology Park Adelaide but does have housing integrated.	In no way 'sustainable'. High level sprawl with no connection except MV. Not a good model for MFP as site design, but no doubt inspiring in industrial terms.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Samur	La Rochelle	Town	Wedding	2 days	Community	Walk to Mairie through town; reception at local castle; 7 courses of amazing French food; wonderful African band imported from the Sudan (friends of groom).	How it's done in rural France.
Strasbourg Institut Pour Le Conseil en Environment		Continent, Nation	Training EcoCounsellors for local government, firms & other policy level positions.	Interview Esther Peter-Davis 2 hours	All Connectivity Community	EcoCounsellor Training Centre for 'environment-capable generalists': community leaders, senior local government officials, people of decision-maker level; trainees sponsored by their institutions; trained in media, Transactional Analysis communication skills & other support skills, environmental law, policy etc. EcoCounsellors often work for local government in a role that includes vetting all legislation & significant decisions for eco-sustainability, information resource & internal education. Linkage with centre in Freiburg im Breisgau (inter alia). This latter trains plumbers.	Different target levels for eco-training are needed. Environment is very much more in public consciousness & publically expected & funded than in Australia. Impression: due to problems more obvious & imminent where population density & industry density much higher.
Paris: La Défense			International Trade Centre	Foot exploration.		Large scale precinct design. International commerce.	Interest.
Paris: Les Halles			Shopping precinct	Foot exploration of precinct.		Major retrofit. Public art.	Interest.
Principality of Monaco							
Monaco: tourism	**Vicinity of Palace**			Tourist visit 3 hrs	Ecocycles Population Organism Feedbacks	Very high quality, high density highrise with marinas & expensive yachts (photographed from distance). Tourist transport (mini train) Recycled rubber paving (playground) Public art	Tourist machine, well-oiled.
The Netherlands							
Almere							
Almere	Randstad, East of Amsterdam	Town, for 100,000 by 1995.	'New Town' to take pressure off Amsterdam & serve Schiphol. To reduce car commuting. 1,000,000 population to be housed in Randstad by 2015, most by 2000.	Han Wezenaar (city planner) 1 hour; his office 1 hour. Hired bicycle, exploring 3 days.	Connectivity Organism (needs based design)	Integrated transport system: dedicated car, bus, bicycle, pedestrian routes. Experimental housing. High proportion of connected housing; very creative appearance. Pedestrian mall with interesting sculpture; shops below businesses blow residential. 3-4 storey walkups; numerous large apartment blocks, especially in the centre. Several development areas and industrial sites. Environmental conservation, restoration, integrated leisure planning, rural 'preinvestment' & rural-urban integration.	Residents say public transport not frequent enough so car commuting is rising. Most of the hiogh quality features originated from a group of 4 planners: little community consultation. All organised at National & Amsterdam scale, with land deals etc. Wezenaar compares it with Canberra (doing PhD on urban fringe leisure planning). See Milton Keynes. Urban fringes have special qualities, especially re recreation planning.
Germany							
Freiburg im Breisgau							
City & suburbs	Freiburg im Breisgau	City City Region	City	4-day visit with hired bicycle & several interviews, including City Engineering Department	All	Walking centre; canaliculi with water flowing in pavement, said to be for climate modification & appearance; water oxygenation by inserting rocks into local river; bicycle path network; graffiti; public art; Macdonalds in heritage building; plumber training; bicycle parking at station.	Literally thousands of bicycles parked at station, most unlocked or flimsy lock: storage issue if really serious about no cars. Wild modern public art in very modern suburbs of very old town. Graffiti look the same in Australia, Rio de Janeiro, Freiburg im Breisgau.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Civil Engineering Department	City of Freiburg	City	Local Government Development process Transport system Suburban developments	Interview 1+hour Herr Fischer	Community all	Information re transport system, developments Der Seepark & Riesefeld. German planning system: developers do what they are told: 10 year Strategic Plans taken seriously; admin orchestrates competition (architects, plans), Admin decides which is best & finds a company to build it; 2-year process for residents with 4-5 workshops on traffic, water, children & schools etc; site plan developed; detailed planning workshop (residents: "we want this + this + this"; detailed plans drawn up by Admin, architects & developer; allocations of houses for buying, rental, social, & land for sale.	Non-entrepreneurial development systems are possible and work well: it needs a disciplined Admin. which takes Strategic Plans seriously & which involves residents fully to discover & act on their needs. There seems to be something about respecting the customer in this that is lacking in Australia.
City-Region transport changes	Freiburg im Breisgau & region	Region	Transport & traffic legislation & results City Region (Transport Plan reducing cars)	From Fischer interview; local experience with bicycle, walking, trains, trams (4 days).	Connectivity	Decisions for car-free city 1970; for extension by increments; severe limitation of public parking (all full by 10am), residents only, need permits, visitors can not park anywhere; city region traffic & transport plan; generous cycle routes, bus lanes, trains & new bus lines emphasised; expense of PT reduced by universal monthly transport card; 24 hour cards for visitors; trams will ring for taxi to meet you; absolute pedestrian priority in city centre. Regional integrated transport planning & monthly ticketing system. Top-down & bottom up drivers, Greens Party locals, tourism (death of Black Forest from pollution), industry: City Parliament made the decisions & implemented.	Results: In city: Car use 1976 60%, train & bus 22%, bicycle 18% of trips. 1992: 46%, 26%, 28%. For region: 1989-92 car use dropped 4%, train & bus increased 20%, bicycle increased 6%. Very significant demonstration of what can do if will is there. Pedestrian means walker, not bicycle! Ausfahrt means Exit!
Der Seepark	Freiburg im Breisgau	Suburbs	Suburban developments (Der Seepark, Riesfeld)	1-day visit to Der Seepark. Details of Riesfeld given by Herr Fischer, but unable to fit in.	All	Der Seepark: new concept; low density, built 1986; Rieselfeld in progress 1993, further west for 10,000, higher density; schools, industry, streets, all infrastructure paid for by land sales; storm & grey water reuse; open channels as in City (appearance & climate modification); 200-300 apartments no car space: must sign relinquishing right to use a car (some legal issues); gas cogeneration power plant; BUT sewage → river! See Der Seepark Collage Plate 17.	See Plate 17 Environmentally interesting features. Impressive Community effort in building Ökostation; ongoing activity in community eco-education. Tobacco plants are a good indicator for ozone.
	Freiburg im Breisgau	City	Plumber Training Programme (sustainable technology choices)	1 hour interview	Ecocycles Community	Links with EcoCounsellor Programme Strasbourg. Germany chose to educate blue collar level, where France chose to do decision makers.	Importance of targetting training to people who have big long-term impacts ('keystone' people).

Donaueschingen							
***'Archi Nova'* housing**	Donau-eschingen	9 connected units	Earth-shelter self-builds	2 hours, interview with one resident (Heinz Bunse)	Ecocycles Community Elements	Half cylinder, earth-covered rooves with grass, bushes, beans, vines (thermal mass). Compact, double glazed, insulated with paper, coconut fibre (sound), special 'popped' cork matting; solar HWS, revolvable solar panels (large SPVs), heat exchanger, experiments comparing heat from water or air circulation and use of oiled wood or not. Natural materials (wood, lime, p[aster, cork). Building cost 1/3 lower than conventional; heating & hot water reduced from 2200 to 400 marks. Chemical toilet & rainwater purification save water. Organics composted. Community self & mutual help.	Busy professionals can make time to self-build (my contact was a doctor). Roof sandwich: (earth); plastic; newspaper; curved wood; plastic: does keep the water out. One central garage plus bicycles seems enough for 9 households (impressive because mountainous terrain: can't imaging Australians doing this!).
Tübingen							
Glasshouse architecture	Tübingen			Visits to 2 studios. 1 day including much walking & bus.	Ecocycles Biotics	Architects here designing very large buildings with baubiologie & glasshouse technology. One office located in a glasshouse next to others growing tomatoes in a field. Specialising in indoor air modulation by appropriate indoor planting. Australian evergreens, esp. Eucalypts favoured. See Plate 9. One small gas heater serves whole building in winter. Also has a small Danish electric car (range 100km) plugged into power cord. (Noted in Tübingen: community gardens, dedicated bicycle paths, excellent bus service in centre, poor in sleeper suburbs, pretty river).	Applied Physics can help substantially with energy conservation with a little creative thought. We should try growing some of out own trees indoors, especially short types of Eucalypts: those in the glasshouse office looked extremely happy.
University	Tübingen		School of Architecture	2 hours interview	Organism Elements	Baubiologie: standard part of undergraduate course.	It's not the fluoro light above you that may cause you damage, it's the one on the ceiling of the room below, which can easily be within radiation range of you at your desk (magnetic radiation can't be shielded, as can electro, and extends about a metre (information from ETSA Environment Department, 1992[5]).
Münich							
Arabella Park	Münich	Neighbourhood	Top-down integrated mixed use, high quality	Several hours, Saturday late morning on.	Connectivity Community Ecocycles Population Organism Genius Loci	See Plate 18. Bus-train transport interchange (bleak). Office, commercial, residential, bicycle shelters, sitting places, underground car parking. One restaurant open on plaza. No internal cars. Recreation area with table tennis & play houses as fixtures. Public art.	All very orderly. No wildness here: cycling could help.
Berlin							
Block 6 Project	Berlin		Integrated sewage & waste water treatment facility, high-medium density urban area	1-hr visit Information from Permaculture publication & Prof Udo Simonis.	Biotics Ecocycles Landscape Organism	Urban integrated, on-site water & sewage management, well established. Constructed wetlands process all sewage from apartments. Located on land enclosed by apartment buildings in rectangle. Small effluent forest, sitting places, play areas, grass.	Pleasant little area of open space & greenery.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
East Berlin				Conducted bus tour.	Organism Landscape Genius Loci	1960s style, for refugees etc Novel public consultation method Careful preservation of relics of war amongst modern buildings. Berlin wall & cemetery. New apartment buildings. War remnants as icons.	Takeover of former grand Places for car parking. To demonstrate how a large building will look restored, drape a life-size, painted image of its final appearance across its façade. Then seek approval (Plate 8). Building sense of place from macabre history: powerful impact. I had thought they gave up building 1960s buildings in the 1960s. Note this type of development ubiquitous in LDCs: (Plate 7): good design could consider more ecosocially sustainable options.
Denmark							
København							
Walking streets	København	City centre	30-year process of gradually squeezing cars out & focus on space for people.	Many visits, 1978, 1993	Population (Attractor)	Ground level action. People oriented. Open spaces. Sitting places (for watching people).	Seems more people oriented than Adelaide, even though Adelaide has had Rundle Mall as a walking street for many years. Difference appears to be that the latter was an add-on, where the Danish predecessor is part of a whole-of city attitude and commitment to nurturing a Backcloth for conviviality wherever possible.
Danish Planning Institute	København	National	Research into Urban Ecology experiments & database	Anette Thierry (architect), Dansk Byplanlaboratorium Unable to keep appointment but left me literature & information.	All Community Ecocycles Elements	Short descriptions many small projects. Literature for some places I didn't visit (eg Torsted Vest (Horsens), Valdemarsgade Slagelse, Slagelse Kommune, GunilshøjFrederensgade/Hollændervej block (Kolding Kommune).	Value of official recognition of UE experiments, experimental attitude: so much less community energy spent /wasted on struggling with authorities.
Christiania Community	København Old naval base.	1000 5000 tourists	Intentional 'squat' community (long standing)	Brief visit of inadequate time	Community Organism	Squatted on ex-military land. Hippies, police, dramas. Community values. Scary past reputation for drug, crime, gangs, guns, alcoholism; now drugs self-banned, only sell hemp, . Anarchy system. 10 departments, all decisions consensual, common meetings, nakedness in common bathhouse, sauna (hard to carry on fights), community values emerging, many hopeless people from many countries: opportunity for self value.	Creativity with found objects
Mariendalsvej	København suburban central	22 units	Cohousing for the elderly	Discussions with David van Vliet in Vancouver, Calgary; brief visit to photograph on site.	All	Self-design Pension fund finance Fully implemented See text	Elderly options much broader than we allow in Australia. Excellent model that should do well here. See Tables 129, 59.
Lyngby							
Technical University of Denmark	Lyngby		Institute for IVTB	Series of meetings: Elle, Jensen, Hoffman, Læssøe.	Ecocycles Community Population	Morten Elle (community development through recycling programmes, Scenario Workshops: Table 4). Jeppe Læssøe (Green Municipalities, local democracy, 'fire souls' research: 4 types, not all charismatic).	Urban Ecology quite widely embraced in Denmark. Strength of relationship between community & municipality (traditional); municipality provides services Australia would go to States for. Strong emphasis on community development, extreme localism.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
						Birgitte Hoffman 'Quark Programme' (see tables 2,3 on 'Danish Research'). Ole Mikael Jensen (Social Philosoph, Dansk Building Research Institute UE team). 2 expert camps with different paradigms: ecocentric & anthropocentric; dualism traced through all scales re ways of thinking, eg male/female, cultural/social, Gesellschaft/ Gemeinschaft: different systems for sustainability needed to match different belief systems.	'Fire soul' (ild-sjæle) a useful term. Brilliant projects (Hoffman): centres of action & learning for community based in schools. Reputation has tainted some other groups trying to plan intentional communities & get Municipal approval. This Gesellschaft/ Gemeinschaft differentiation seems to align with my differentiation into ESD and ECD (Table 5).
Hundsted (North-Eastern Denmark Journey)							
Torup Village	50km north of København, northern Sjælland (Zeeland), Hundsted (dog land)	Tract 10,000 tourists pa. Idea from 1982, land bought 1988, approved 1989, construction started 1990.	Experimental housing estate: 'ecological village society'. In conjunction with existing village of Torup. For 100 dwellings when complete.	Car day trip with Morten Elle.	All	Several sub-communities: geodesic domes, public housing, community centre, miscellaneous self-builds (features include home-made solar collector, glasshouse technology, underground, found materials) On-site flow-down sewage treatment (root zone system). Income from conducted tours, wood & metal workshops, 2nd hand shop, café, crafts, nurses, social care, ceramics, skins, organic produce, rent out rooms, camping sites, international working camps (exchange labour for keep - see Fuzzies Farm). Local laws. First generation left, bankrupt. Now increasing. 3000DKr annual membership fee, manages & sells sites. Social housing in progress, low income, elderly.	Built near railway but little used for commutes to work (surprised, since so 'alternative' in other ways). Underground housing & glasshouse: important temperature regulation options not used much in Australia (my own home is half underground: very effective, but damp issues at 120 years). Great freedom to experiment if so classified. Big mistake: early meeting with Christiania, then nobody wanted to go to Hundsted, fearing drug culture.
Svannholm Community Butikken (shop)		Largest rural commune in Denmark	Organic produce, especially wine, grain	Ditto	All	Tight organisation, not for individualists. Difficult history of buildings, debt. Present apparent prosperity & efficiency. Many members high positions in København. Half live & work there.	Commercial success at fairly large scale possible for alternative producers.
Blå Kilde Gärde			800 resident low income Cohousing apartments (1960s)	Ditto	Community Ecocycles Feedbacks Population Organism	1960s retrofit based on community action, starting with recycling, composting. Low income. See text & Plate 2. 50% car parks → playgrounds.	Inspirational story of firesoul at work. Effectiveness of having a common task for entraining community activity. This seems to be the key to community activity: people have a pattern of coming together on an issue, then disbanding. As in business, the 'product' has to be invented every few years to remain current.
Miscellaneous, N-Eastern Denmark trip		Region & less		1 day	All	Recycling depot (steel) for all Denmark. Water management Energy saving strategies Recycled tyres: rubber speed humps & traffic calming items. Wind energy: Denmark's first generation windmills (IKEA): thought to disturb landscape so trying to move them to parks. 'Ecological food': eggs, milk increasing, prices reducing; not yet meat.	To save nearly half the energy used on country highways: remove 50% of the light bulbs! (Used after oil crisis). A City of Norwood speed hump was quoted (1992) at $11,000. A recycled rubber one can be bolted directly on the road for a fraction of that cost, and is easily removed if necessary.

Århus							
Frederiksbjerg Byfornyelses-center	Århus	City 1600 buildings potential	Town Renewal Co: mixed private & public: 'Ecological City Renewal Programme'	Ulla Egebrecht: explanation & directions for Retrofit Programme buildings; 1 hour; 2-hour walk around retrofits.	Ecocycles Feedbacks	Free architectural advice, low interest loans, many incentives, yard cleanup & much support for landlords to do eco-retrofit old, inefficient apartment buildings; resident newsletters &c.. Generous & comprehensive eco-retrofit programme funded to 1994. Huge maintenance savings available if undertaken.	Programme hardly any take-up, as landlords already making money: "why should we spend money to make no more?" Motivation/coercion issue. LG can only intervene on health grounds.
Århus Miljø - og Energikontor:	Århus	Building/City	Energy Advisory Centre	Interviews, 1-2 hour visit	Ecocycles Elements	Information centre. Energy, water management. Diversion of roof water to toilets. Low flush toilets freeze up in Danish winter. Centre has invented a tank system that collects sewage and releases it intermittently in large boli.	Everywhere I went in North America & Europe, use of rainwater from rooves was banned for drinking, due to pollution; but much energy put into thinking of ways to use it as grey water. People were shocked to hear that Australians drank their roof water.
Andelsanfund	Hjortshøj near Århus	Cluster, 1-200 houses approved, population 500	Experimental earth housing (self-builds). 3 houses built by 19/993, started 1986.	2-3 hours tour & meetings with Hans Jacob Jacobsen		Experimental earth housing (self-builds). 4-5 years to get land, approvals, test materials. To have 20 rental units (social housing): future residents known. Rent will pay for common house. 4 building groups (LG2), present self builders (LG1), living group (LG3, high school people), LG4. Intention to share meals, shared economy: some have left because don't want to give & take. Solar heating, energy, grey water, rain water systems. Dutch mud small brick machine: 5 bricks/minute. Experimental demo mini-building (to get LGC approval). 'Ecotek' small Company. Mud bricks, rammed earth, not straw Composting toilets. Many other details of eco-building systems.	Costs about normal (more for labour, less for materials); maintenance very much cheaper. Insulation 20cm paper + rock wool. Rock wool used a lot in Scandinavia. High energy windows have metal in the glass, which splits up light waves as they cross, becoming trapped inside. Low income techniques a specialty. One similar used in Lost Valley USA (stacked logs). Idea of small demo building to demonstrate to LG & personal training for self build: excellent idea. Once all proven here, LG has been extremely helpful, & sees the project in terms of own kudos. See Sun Village NSW.
Overdrevet Cohousing	Hinnerup near Århus	Cluster: 45 adults, 40 children, 28 buildings, started 1985.	Cohousing	Evening meal & overnight; meeting with 6-8 residents; overnight with small family: Poul Tang, Matte, Jens Ulrich, Dorte Bollerup.	All, Ecocycles Elements Community Organism	See Plate 15 32 shares. Teachers, nurses, blue collar, work in town. Heating energy self-sufficient, all computerised: space heating 20% solar, 80% oil; HWS solar 49%, oil %1%; total 30% solar 70% oil. Power: windmill 55Kwh, rented footprint on ridge (need 100, can no longer get <200Kwh), 414m² panels. 2x20,000l solar HW storage. Big drying area under common house near energy works. Total energy consumption 1/3 normal, but increasing slowly (8-10 cars/community originally → 1+ car/household now). Issues: need educating to live in community & distinguish between important & not, what is essential to personal OKness & what not; unequal participation (single mothers common, community accepts they have less to give than a couple; people very in ability to work outside paying job). Issues about costs & loss of choice on entrants: have to hope they are good people. Water & sewerage grid, no reuse. Coop buying, eat together all days for 10 years, now week days, Friday off, weekend evenings. Voluntary working group, veg. growing, sheep,	Even in Denmark, where only 15% max. of power can be generated by SPV collectors, they invest in whole roofs-full of panels or black plastic and tubing sandwiches (seen in several places eg Vårst). Danes in Cohousing groups are most impressive in their pragmatic communal problem solving & acceptance of democratically-achieved decisions. Impressive concern for adolescents in planning & running their community: made me realise how little respect we have for this age group in Australian planning. We have playgrounds for under-5s, but that is about all. No originals left. Some couldn't afford. Early technical problems with unknowledgeable building supervisor, had to drop many ideals & all luxuries. Wanted to reduce private consumption by sharing. One TV for all didn't work. Communal cars didn't work. Waiting for each other doesn't work with small children. Sexual looseness, some swapping & instability; marital: escape from nuclear family; tend to Rescue sufferers; not so good at emotional issues, but have mediations sometimes. Guilt about wearing new clothes. New trends

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
						energy, wine & beer, pigs & hens, common house, buy & sell, introductory (new residents). Non-voluntary: cleaning & kitchen groups (rotate). Shop-clean-cook 1 hour/day. School age children. Monthly meetings: budget (6% of households minimum), food (next about badly cleaned tables, more ecological food wanted)	("the new generation people are crazy!": having defensible space, door bells, thefts, fights over spending of social fund (importantly to help each other out in crisis, now some want tennis courts), objection to animals, social interest only, not eco-, huge issue over colours to repaint, replacement of old windmill vs going on grid.
Odense							
Finn Jensen, Head of Odense Municipality Social Services & Health Department & Odense Andels-Boligforening (Housing Association).	Odense, several sites.	City (of 185,000); communities small (16) - 2-300	Processes (Cohousing) Communities & clusters Experimental housing (apartments) Senior Cohousing Mixed age-group eco-housing estate	Discussions, interviews, conducted tour with Finn Jensen. 1 full day. Information about Cohousing, development & management processes, experience of Housing Association in setting up EcoHousing and Cohousing for elderly.	Community Ecocycles	EcoHousing Project Odense Commune 1988: many plans jettisoned through funding cuts (19mKr → 15m Kr): including glasshouses on SE or SW (prepared for), solar cells, solar HWS (local power under-used and very cheap), house sizes (space under rooves constructed for future expansion and 1-2 rooms addition). Associations: can determine enthusiasm of community participation in programmes such as recycling (which is compulsory, and saves on rent, so most do it and maintenance, but may not do much else together. Composting and Walgaarst (separates urine out for fertiliser) toilets. See Table 129 on research with senior Co-housers. See Holluf Have.	Workings of Housing Associations. Priority given to social housing for all income groups in Denmark (subsidised by Municipality & Housing Association, user pays 2%, has no equity).. Importance of servant leadership by chairpersons of management committees in communities set up by Housing Even in Denmark, difficult to get people to care for each other: Individualism is having a very destructive impact on people who traditionally valued communal relationship.
Blommehaven	Near Odense	Tract (multi-development area).	Competition experiments in social & eco-housing (including competition designs)	Motor tour with Finn Jensen	Community Ecocycles Elements	Design comparisons between adjacent buildings (eg design for interaction on stairways, paths, at mailboxes, laundries, play areas, vs separate entrances, privacy-driven design). EcoCommunity in progress, built in circle, some facilities shared; notable for elderly one side, able to oversee children, have visitors, but own shared & private space to withdraw to. Tables 123, 129; Figure 59.	Elderly in Denmark don't seem to wait to be carted away to homes: they are organising well before this happens, and setting up the types of lives they want, actively supported in guarding their independence by local & national governments & housing associations. See Tables & Figures.
Holluf Have	Odense	Cluster, groups of 15 houses, 250 residents, built 1986. Low density.	Cohousing community	2 hours conducted tour with Finn Jensen.	Ecocycles Community Feedbacks	One ('best') of 35 small communities Set around central space. Recycling & compost making specialists: project set up by Morten Elle. Community activities: use common house for kids' & olds' clubs; meet there & go out together; monthly meetings, low level sharing, don't eat together. Activities response to superior leadership qualities of hand-picked management group chairman.	Need for appropriate community level leadership to get projects going. CoHousing may be very good at recycling but very low density. Most projects seen have one or two good features but not the integration needed for a full-featured EcoCommunity descriptor. Overdrevet scores well in many areas. Still low density, but they do produce food in quantity.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Ålborg							
University of Ålborg,	Ålborg		Department of Development & Planning Now funded as Key Centre for Urban Ecology	Discussions with staff, re projects, University buildings with solar design, issues of theory & principles. Guided tour of University College (solar design). 1 day.	All, Ecocycles Community Elements	Urban Ecology Theory development. Projects: 2 types of urban ecologists: those living the lifestyle and those in academia studying them. Not necessarily a clear distinction.	Government support of experimental attitude makes a huge difference in urban ecology.
CoHousing	Ålborg & surrounds	City Clusters	Cohousing communities	Guided tours Prof. Gitte Marling, over several days.	Community	Big array of types: low income, small, large, retrofit, academic group, suburban, rural (Vårst).	Every part of Denmark has a large scale Plan: rigidly adhered to. Also municipal Plans, but must conform to RP. Minister can approve changes, but then all scales below must write changes into their Plans. Strong community challenge rights & requirements for consultation processes. In collaborative housing, time saved by having help with tasks is balanced by time lost in meetings.
International Kollegium	Ålborg University	50 students	College	I hour conducted tour, research eco-building	Ecocycles Community Elements	Recyclable materials, compact, passive solar design (roof lights, thermal mass, windows S-E & S-W,), large solar panels (SPVs), solar thermal HWS & space heating, argon windows, double glazing, whole building is a greenhouse. Communal toilets, cooking, laundry, phones. Civil engineers stopped many innovative ideas: demonstrates importance of acceptance of concept of 'urban ecology experiments'.	Pleasant light character from glasshouse design.
Vårst ('Windmill')	10-14km out of Ålborg	Cluster	Cohousing community, 16 houses.	1 evening, Henrik Lund (civil engineer), wife Søsser	All	See Report Card, Figure 63.	Community 'Roles' individual, cf Muir Commons where roles are taken by committees. Significant resource savings from modest multiple strategies. Attractor survey of interest.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Sweden							
Uppsala							
Swedish University of Agriculture; Institute for Future Studies	Uppsala		Second generation EcoHamlets Social research.	2 days. Per Berg, Susan Livsey & colleagues; conducted foot tour.	Community Ecocycles Biotics Elements Connectivity	Cohousing apartments, common recycling system, local forest impacts from overuse (mainly children), common houses, EcoHamlet site & plans (Berg). Interface settlements for perimeter people (Livsey). Research on 'what is sustainability?' (different in different places (urban, rural, suburban). Garden experiments (genetics, eco, Permaculture, companion planting, compost trials). Arable land Ecology: fine root ecosystem studies. Quality loss with large monocultures; demise of small scale efforts due to diversion of funding to large scale: natural assets being sold out. 'Green Wedge', 'Finger Plan' green zoning in Scandinavia. Motorway rings & fragmentation control issues (cause massive traffic chaos, eg Paris). Waste water rethink due to infrastructure replacement due: identifying where can periphery be disconnected for smaller scale Ecocycling? Importance of green structures in city (research). Ecrat planning (Australian Batten) concern: basic freedoms to move, breathe clean air. Berg: "What about freedom to stay"? All children are firesouls. Island School 600 year spaceship exercise.	Wide variety of approaches to common house use in set of apartments where all else equal: importance of Community development for sustainable practices to work (common houses built into all blocks). Swedish research (Ostrom, Beijer Institute, 1993) shows local emergence of property rights systems protects natural resources better than state scale authority, but may collapse if not recognised by the latter. Tradable rights systems are sometimes much more efficient, but hard to implement in many cases. IPM is re delivering just the right dose pesticide at right time. Periphery as centre for ecological development (few choices in centre). Increasing biogas systems on farms (all Europe). EcoHamlets: energy, water & nutrient recycling, social. Series of historical landscape studies with an ecologist, from Roman Iron Age to future; mismatch between public ideal vision & large scale centralised decisions. Enormous expense (resources) of moving house. Challenge: how to keep people there. Basic need to move physically (walk, cycle): car produces 'speed blindness' & no personal movement.
Stockholm							
City of Stockholm	Stockholm	Local Government	Interview with planner Per Eric Siljestam	2-hour lunch meeting	All, Community Ecocycles	Plans for EcoVillage Experience with such planning, especially Community development & processes, decisions.	See Table 130 "Swedish EcoVillage: Adjustment of Strategies over Time".
Architect	School of Architecture, Tekniska Höjskolan	Building	EcoVillage design	1 hour interview Varis Bokalders		Design for EcoVillage discussed with Siljestam	Concept stage.
Svenska Dagbladet	Stockholm	City	Conservative newspaper	Translation by house host	Community Ecocycles	Frequent articles on recycling and other environmental matters in all aspects and very practically presented: in very conservative daily paper.	'Conservative' in Sweden is very different in attitude to environment than the business press expresses as conservative interests here (ie environment has traditionally been viewed as an 'either/or' problem: to be traded off against economics.
Global Action Plan - Sweden	Stockholm	National	Part of Global network of national nodes committed to teaching sustainable lifestyle.	1+ hour interview Alexander Mehlmann	Community all	Package being differenced for each participant nation (with local data & targetted exercises). Personal training in groups with local exercises & followup networking. Followup of UNCED & email contact. Further followed up in Istanbul (Marilyn Mehlmann) 1996.	Swedish Social Security allows people doing useful social work to be exempted from wasting time looking for work, for 6-months at a time. Progress of GAP.

Entity	Location	Scale (Space, Time, Population)	Type, Activity	Contact Time & Type	UHSE Criteria	Principal Features	Principal Learnings
Commuter system	Stockholm	City	Community Arts programme	During commutes over a week	Community Genius Loci Connectivity	Rail integration Well-known artist & Community involvement in arts through station decoration. Shotcrete surfaces left visible & decorated; superion floor treatments.	Commuter stations can be very pleasant promoting public ownership and reducing vandalism.
Henriksdals Reningsverk	Stockholm	City	Sewage & recycling works (underground)	External & local explanation: no detail	Ecocycles	Municipal waste, high temp incinerator, diverts sewage from sea (fish now returning). Huge treatment works for whole city with cogeneration district heating.	
Activist interview	Stockholm	Individual	Every known issue	2 hour visit	All	Papers on every available surface, on every possible issue.	Committed energy of solitary firesoul.
Seerenparken	Stockholm		Housing for elderly			Medium density, progressive, large. Woodland setting.	Well-heeled people seem to be plentiful in Sweden.
Finland							
Helsinki							
Retrofits				Total 8 bus & boat trips associated with IFHP Conference looking at developments.		Olympic Village 20 years on. Old buildings renewed/saved. Military fortress retrofit.	
Underground development						Sewage treatment works Underground sports & meeting place. Underground Church. Underground Olympic Pools complex. Underground university heavy engineering stress testing centre (serves all Europe).	Odourless open sewage treatment. Underwater rugby! Underground windsurfing using snow blowers! Finnish Tunnelling Association has perfected rock drilling at depth. Great fear of Russia in Finland: stimulated tunnelling behaviour (bunker mentality).
IFHP International Conference	Helsinki	1200	Housing & Planning conference	Sept-Oct 1993 7 days	EcoCycles Community All	See BP 5.1 MFP Helsinki Paper. Vast choice, poor proceedings (abstracts only). Underground building was a side issue I took an interest in: Japanese architect re earthquakes and underground conditions, and options to go underground when city ran out of space (some examples already); American experiments with underground psychology (confident all needed conditions can be provided); Finnish obsession with fear of Russian invasion, so developed expertise in rock tunnelling.	Huge multi-stream international conferences can be a lot more powerful if they have comprehensive Proceedings (such as Innovative Housing did).

4.2 SUSTAINABILITY STRATEGIES

The following Database is organised in separate tables under Criterial headings in the order already used above. The column headers follow the commonest emergent themes under these headings: issues constellations, as referred to elsewhere and as seen already in the concept constellations in JVNIC entries (Figure 60: JVNIC Theme Report). These are entered without judgment, as a record of strategies and principles argued for by different groups. Any strategy would always have to be considered in the context of local information, energy, materials, space & time conditions and connections.

<u>Source List:</u>

Agenda 21 (UNCED, Rio de Janeiro 1992), (United Nations 1992),

Aldinga Arts EcoVillage By-Laws (Geoffrey Adam & Co 2000)

Andreas Glanznig, President, Community Biodiversity Network (Australian) (Glanznig & Prideaux 1999: 13-20)

Andrew Euston (US Federal Dept. Housing) unpublished handout

Australian Conservation Foundation (Hare,Marlow,Rae,Gray,Humphries & Ledgar 1990)

Centre for Human Settlements, University of British Columbia (Rees 1989)

City of Manningham (Victoria Aust.) (Manningham City Council 1998: 1-2)

CoHousing Features (Petter 1993: 14)

Commonwealth of Australia (Commonwealth of Australia 1992: 8-9)

Deep Ecology (Naess & Sessions) (Devall & Sessions 1985: 70)

Dovers & Boyden (Boyden 1990)

Earth To Spirit (Pearson 1994: 72-3)

Findhorn Ecovillage Project (Building Biology) (Talbott 1993: 1-7, 1-12, 1-17)

Guidelines for Eco-Village Development (Gilman 1991: 60-61)

New Urbanism Charter (unpublished printout source MultiFunction Polis Australia)

OECD (Competitors' brief, Jerrabomberra Valley National Ideas Competition, 1994)
Oregon Experiment (Christopher Alexander) (Alexander,Silverstein,Angel,Ishikawa & Abrams 1975: 5-6, 15-187)
Places of the Soul (Day 1990:28, 108, 179)
Policy Strategies (Troy 1990: 21)
RAIA Environment Policy (Royal Australian Institute of Architects 1994)
Richard Register (originator of term 'ecocity') (Register 1993: 4-5)
Rocky Mountain Institute, (ecological site design guidelines) (Rocky Mountain Institute 1998: 129, 125-156)
Sainsbury Ecopatterns (Sainsbury 1994)
Sustainable Building Checklist {Environmental Building News:14}
Toronto Declaration on the Environment Preamble (from City of Toronto)
Town & Country Planning Association (UK) (Blowers 1994)
Transit Sensitive Urban Development (TSUD) (Kaufman & Morris 1994: 39-40)
Urban Ecology Australia (Ecopolis Development Principles) (Downton 1994)
Ventura County Citizen Planners (Citizen Planners of Ventura County 1991: 20

DATABASE 4.2 SUSTAINABILITY STRATEGIES

Table: Collated Lists x Scalar Themes

	Scalar Thinking	Connectivity Between Scales	International	Large Scale	Metro-Region	Local Scale	Temporal Scales
Community	Set sustainable time horizons	Integrate Government scales in policy	International legal instruments and mechanisms International institutional arrangements National mechanisms and international cooperation for capacity building in developing countries International cooperation to accelerate sustainable development in developing countries and domestic policies	The global dimension of environmental impacts of actions and policies should be recognised and considered 100 & 500-year Plans Global Impacts Policy	The metropolitan region is a fundamental unit of the contemporary world Governmental cooperation, public policy, physical planning, and economic strategies must reflect this new reality Cities for Climate Protection	Local authorities' initiatives in support of Agenda 21 Local sustainability initiatives - local government, business, community groups: increase Neighbourhood design wherever possible, for human contact & independence	Equity now & future Short term is not sacred
Landscape	Be aware of large scale patterns from small scale developments	Respect interconnection of regions & environments Respect matrix connectivity		Consider Landscape Ecology in building projects	Metropolitan regions are finite places with geographic boundaries derived from topography, watersheds, coastlines, farmlands, regional parks, and river basins The metropolis is made of multiple centres that are cities, towns, and villages, each with its own identifiable center and edges	Wildlife corridor integrity	
Elements					Define water landscape before planning Base planning on water landscape		
Genius Loci	Right scale						
Biotics						Indigenous plantings	
Organism		Pre-empt & confront impacts on wider community			WHO Healthy Cities	Meet human needs by building & planning: Piecemeal growth - construction in each budgetary period overwhelmingly small projects Neighbourhoods should be compact, pedestrian-friendly, and should follow the principles of neighbourhood design where possible Meet human needs by building & planning: Organic order - allows whole to emerge gradually from local acts. Guiding aim for freedom for all from want & political concern All daily needs accessed by walking 5-10 minutes for access, health & fitness	
Population					WHO Healthy Cities	Social systems: attractors (waterfronts, park, festivals etc)to keep people & money within the community	
Ecocycles		Urban/rural systems: urban/rural consortia: manage shared rural job-supporting resource bases - amenities (recreation, resources many types), ecocycle loops, ecological resource inventories, Geographical Information Systems		Work with large-scale processes		Support local agricultural & local business products & services Buy locally produced building materials Neighbourhood design → walking → saves energy	Design for future reuse
Connectivity		Corridors are regional connections of neighbourhoods and			Concentrations of civic, institutional and commercial activity should be embedded in neighbourhoods and	Neighbourhood design increases access to elderly & children, & → independence	

	Scalar Thinking	Connectivity Between Scales	International	Large Scale	Metro-Region	Local Scale	Temporal Scales
		districts; they range from boulevards and rail lines to rivers and parkways Connect to networks beyond site Neighbourhood, district & corridor are essential identifiable elements of development & redevelopment, and are thus available for citizen responsibility for maintenance & evolution Decentralise State Government administration			districts, not isolated in remote, single use complexes Schools should be sized and located to enable children to walk or bicycle to them		
Feedbacks	Scalar sensitivity: economic effects		The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised			Seek small local successes Critical: import replacement & economic capital retention - use citizens to identify & mobilise local resources for economic development	
Rheotics							Balance long term & short term
Indicators		Integrate Government levels in Indicators					
Scale	Scalar thinking (global/local) Scalar thinking (global/local) Scalar thinking Right scale	Evaluate solutions in terms of their larger context					

Table: Criteria x Community Themes

	Cosmology, Paradigms, Ideology	Governance: Any, International & National	Governance: Regional	Governance: Local Design Codes, Zoning, Planning	Community Partnership in Governance & Action, Community Projects & Networks	Institutions & Education, Knowledge, Training	Glue: Relation-ships & Contracts
Community	Equity for all Democracy Cooperative paradigm Revenues and resources can be shared more cooperatively among the municipalities and centres within regions to avoid destructive competition for tax base and to promote regional coordination of transportation, recreation, public services, housing, and community institutions Consensus of vision Create a sustainable society At least minimum social justice & equality Freedom of religion, speech & asembly	Decision making processes should effectively integrate both long and short-term economic, social and equity considerations Integrating environment & development in decision-making Qualitative development & public participation Conserve democratic political systems Sustainable governance Social justice infrastructure Glass bureaucracy Environmental Bill of Rights	The metropolitan region is a fundamental unit of the contemporary world Governmental cooperation, public policy, physical planning, and economic strategies must reflect this new reality Healthy public policy Transport Policy for social equity	Local authorities' initiatives in support of Agenda 21 Decisions affecting local environment: decrease number taken in absence of those affected Formally give the transit agency an opportunity to comment on proposed plans and request changes to them, and to participate in the consolidation & enforcement of the final changes recommended by the municipal planning department Consider environment in all decision making Improved EIA Preventive Planning Coordination with other levels of government	Local sustainability initiatives - local government, business, community groups: increase joint activities Community level consensus building (key): Understanding → planning → implementation Decisions and actions should provide for broad community involvement on issues which affect them Communities will be the testing grounds Meet human needs by building & planning: Participation - all decisions re what & how to build, by users Community participation CoHousing schemes Support community action in partnership with policymakers Increase public involvement in development Public participation in program development	Policy & practice informed by science Education Make sure everyone understands the issue User training systems Developer training systems Designer training systems Builder training systems Access to high quality education & information for all Educate the developers	
Landscape	Respect land		Fit the bioregion: respecting and conforming to the parameters provided by the bioregion within which the development is situated, fitting into the landscape with the patterns of development following the inherent form and limitations of the land Policy to focus development around public transport nodes Ban future high-rise buildings in CBDs	Zoning: allow a mix of housing types & densities in residential areas Zoning: amendment applications for redevelopment should be high density enough to support high level transit service Ban buildings above 4 storeys Transfer of development rights to achiieve desired urban form			Streets and squares should encourage walking, and enable neighbours to know each other and protect their communities
Elements		National pollution control standards to continually reduce heat, noise, air & water pollution		Mixed development policies to meet standards for sound, smell, air, noise, pollution, visual amenity Natural drainage for all major subdivisions Retain water on site as much as possible: absorptive paving, retention systems, tree planting, earth berms Protect underground water quality			

	Cosmology, Paradigms, Ideology	Governance: Any, International & National	Governance: Regional	Governance: Local Design Codes, Zoning, Planning	Community Partnership in Governance & Action, Community Projects & Networks	Institutions & Education, Knowledge, Training	Glue: Relation-ships & Contracts
Genius Loci	Democratic Architecture, buildings and public places Promote an ecological aesthetic						
Biotics	The well-being and flourishing of human and non-human Life on Earth have value in themselves (synonyms: intrinsic value, inherent value) These values are independent of the usefulness of the non-human world for human purposes Equal & fair distribution	Policies must be changed due to excessive interference of non-human world by humans These policies affect basic economic, technological, and ideological structures The resulting state of affairs will be deeply different from the present National planting policy/programmes		Join or start a 'friends of' group to help landholders and councils in their efforts to bring back the native grasses and woodlands to their properties, river frontages, roadsides, beachfronts and public areas Integrate ecology & social concerns in planning & development Act to reduce noxious emissions Tree planting policy/programmes Indigenous native planting policy Conserva & sustain natural areas Policy: heal past damage to vegetation/habitats 3-storey rehabilitation, not just trees-and-grass	Decontaminate toxic sites	Community education so better environmental choices are made	Recognise that humans and non-humans are entities sharing the biosphere Share biosphere
Organism	Personal Constraint conserves resources			Child care near public transport Encourage local food production, seed swapping, barter Policy: heal past functional damage in new development			Meeting places Sitting places People-watching places
Population	Social equity Social justice for all	Set limits to population	Policy: development should balance job availability with number of residents in area	Zoning: amendment applications for redevelopment should conform to the mix of uses foreseen for site or neighbourhood in the official plan or secondary plan Require parking facilities to be located in side or rear yards for most land use categories (maximise convenience for pedestrians walking between transit stops & building entrances) Official plans & zoning amendments should seek feedback from groups representing women, elderly, ambulatory disabled, to ensure their safety in accessing transit services Establish local produce markets			
Ecocycles	Reject consumption values The ideological change is primarily that of appreciating life quality (dwelling in situations of inherent value) rather than adhering to an increasingly higher standard of living There will be a profound awareness of the difference between big and	National packaging legislation Set limits to consumption Carbon Tax Energy parsimony Policy	Stop car parking requirements for planning approvals	Policy to improve composting Eliminate car parking requirements for planning housing Assist household recycling: separate collections for glass, paper, plastics, metals Ecosystem approach to all policy & programmes	Successful practical projects	National energy conservation & climate change programme National educational programme re fossil fuel parsimony reasons for action Community education to → better choices International fossil fuels education campaign	

	Cosmology, Paradigms, Ideology	Governance: Any, International & National	Governance: Regional	Governance: Local Design Codes, Zoning, Planning	Community Partnership in Governance & Action, Community Projects & Networks	Institutions & Education, Knowledge, Training	Glue: Relation-ships & Contracts
	great						
Connectivity		National infrastructure retrofit National car registration to reflect engine size		Pedestrian supportive streetscape design: policy documents should establish the basic principle that at least one major entrance to a major shopping centre building (or other large buildings in the shopping centre complex) should be located adjacent to the street Incorporate transit & transit needs into planning process Zoning: ensure standards for off-street loading facilities are adequate, to minimise conflict between buses & trucks Local government Development Plans should have transit service standards, to be met before route extension is considered Zoning: facilities generating large trip numbers should be located close to transit Zoning: amendment applications for redevelopment should require buildings located along activity nodes & corridors to be at or close to street line Official plans & secondary plans should have a general policy statement about role transit is to play in the community Subdivision design: applicants should document proposed locations of bus routes & stops Subdivision design: applicants should document walking distances as part of the background information accompanying draft plan & subdivision submissions Subdivision design: reverse lotting (back fencing) adjacent to arterials/collectors should be discouraged A significant majority (for example 90%) of residences, jobs & other activities located within 400meters walking distance of a transit stop	Local area business network Develop telecentres and telecottages Keep cars peripheral to property	Network of advisors and technicians	Within neighbourhoods, a broad range of housing types and price levels can bring people of diverse ages, races and incomes into daily interaction, strengthening the personal and civic bonds essential to an authentic community Keep balance between privacy & community
Feedbacks	Promote social equity employing economic and management structures which embody principles of social equity Balance social, economic, ecological Those who subscribe to the Deep Ecology Principles have an obligation directly or indirectly to try to implement the necessary changes	Control of the Economy	Policy: charge for services & resources at average cost of production, not marginal pricing	Zoning: avoid large area zones for a single use & density; generally allow a greater mix of uses (where appropriate) within each zone Local government Development Plans should have transit service standards Make polluters pay for environmental damage Full cost accounting for all municipal services	Future residents fully participate indesign process at all stages		
Rheotics	Equity now (2) Equity now & future Long-term stewardship	Policy & practice fulfil long-term goals		The economic health and harmonious evolution of neighbourhoods, districts, and corridors can be improved through graphic urban design codes that serve as predictable guides for change The neighbourhood, the district, and the corridor are the essential elements of development and redevelopment in the metropolis They form identifiable areas that encourage citizens to take responsibility for their maintenance and evolution	Create a participatory design process		

	Cosmology, Paradigms, Ideology	Governance: Any, International & National	Governance: Regional	Governance: Local Design Codes, Zoning, Planning	Community Partnership in Governance & Action, Community Projects & Networks	Institutions & Education, Knowledge, Training	Glue: Relation-ships & Contracts
Indicators							
Scale (Space, Time)	Intergenerational equity (2) Long-term stewardship						

Table: Criteria x Landscape Themes

	Patches: Vegetation Form, Indigenous Matrix, Wildlife Corridors, Urban Form	Design for Balance, Harmony Between Elements	Design or Regulation for Function & Integration
Community	Establishment of ultimate & interim boundaries to reduce sprawl & encourage compact development A range of parks, form tot-lots and village greens to ballfields and community gardens, should be distributed within neighbourhoods		Neighbourhoods should be compact, pedestrian-friendly, and should follow the principles of neighbourhood design where possible Development Plans: Avoid monocultures of all types; zone for mixed use, diversity; sustainable agriculture
Landscape	Halt urban sprawl: developing human habitation at relatively high density within inviolable green belts of natural or restored ecologically viable landscape with the overall development density constrained by ecological limits European-style low-rise, high density settlement patterns Increase green open space Spaces at the Centres Increase Densities No More New Subdivisions	Architecture and landscape design should grow from local climate, topography, history, and building practice	Variety of size, quality, forms, types and functions of buildings in every area
Elements	Use of Geographical Information Systems: eg inventories for planning; soils, aquifers, surface water, topography, infrastructure, agriculture, forest & energy resources		
Genius Loci	Conservation areas and open lands should be used to define and connect different neighbourhoods and districts	Paolo Soleri (Arcology – earth architecture) Individual architectural projects should be seamlessly linked to their surroundings This issue transcends style The development and redevelopment of towns and cities should respect historical patterns, precedents, and boundaries Development patterns should not blunt or eradicate the edges of the metropolis Identify patterns of the place	
Biotics	Preserve & enhance indigenous landscapes Reinforce natural infrastructure Adapt built environment components to landscape patterns (buildings, utilities, circulation)	Landscape "non-toxic, natural and earth-wise" Balance development: balancing the intensity of development against the ecological carrying capacity of the land whilst protecting all viable existing ecological features Streets and squares should be properly configured	Preserve and re-establish landscape patterns
Organism	Vary road width according to needs & site		In the contemporary metropolis, development must adequately accommodate automobiles It should do so in ways that respect the pedestrian and the form of public space
Population			Location of land uses frequented by transit-dependents or mobility-impaired people located adjacent to transit stops Pedestrian emphasis PSSD (Pedestrian Supportive Streetscape Design): pedestrian amenities such as canopies, arcades & landscaping for weather protection should be incorporated into the design of buildings located along major transit routes PSSD: buildings should be oriented to the street & to transit services (to minimise walking distances) PSSD: retail & pedestrian-oriented commercial uses should be developed at street level PSSD: where appropriate, transit waiting areas should be incorporated into the design of major buildings located adjacent to transit stops A primary task of all urban architecture and landscape design is the physical definition of streets and public spaces as places of shared use
Ecocycles	Infill development within existing urban areas conserves environmental resources, economic investment and social fabric, while reclaiming marginal and abandoned areas Metropolitan regions should develop strategies to encourage such infill development over peripheral expansion	Integrate Natural Ecologies with Urban Use Patterns	Land use systems: urban forest/upwind planting; high density/compact aggregation; truck farming/community gardening; biomass cultivation for fertilisers & fuels Landscape systems: shading; wind buffering; solar orientation of buildings; permeable paving; cooling ponds Develop clustered, mixed use, pedestrian oriented eco-communities
Connectivity			'Ped shed': Diagram comparison of radial distances with actual walking distances to demonstrate quality of network connectivity Avoid culs de sac; for disconnection, use bollards, to allow bicycles & pedestrians through; allow for possibility of opening up the network later Street system design for proximity & access: minimise travel Subdivision design: collector/arterial roads should be designed to be as direct as possible to prevent circuitous transit routes Walkable neighbourhood Every dwelling within 200m or 2-minute walk of public open space Subdivision design: local road patterns should provide direct pedestrian access to transit stops Pedestrian supportive streetscape design (PSSD): minimise barriers to pedestrian access PSSD: parking areas should be located in side or rear yards wherever possible

	Patches: Vegetation Form, Indigenous Matrix, Wildlife Corridors, Urban Form	Design for Balance, Harmony Between Elements	Design or Regulation for Function & Integration
Feedbacks	Densities above 25 dph cost for infrastructure less per dwelling than conventional suburban development		
Change	Rate of expansion of urbanised areas: reduce		
Indicators			Develop a monitored landscape management program
Scale			

Table: Criteria x Element Themes

	Earth	Water	Fire	Air	Climate
Community		Respect water Protection of the quality and supply of fresh water resources: Application of integrated approaches to the development, management and use of water resources		Protection of the atmosphere	
Landscape		Integrate water quality management into urban greenspace design: storm, sewage, natural purification systems Design water-efficient, low-maintenance landscaping			Locate buildings to minimise environmental impact Pay attention to solar orientation Site buildings to benefit from existing vegetation
Elements					
Genius Loci					
Biotics		Don't discharge contaminated water into sensitive natural ecosystems: design for reabsorption roughly where rain falls			
Organism		Keep roof water for drinking		Indoor air pollution: 5 main causes: biogenic particles (moulds, bacteria), combustion products (tobacco, gas ...), organics (benzene, formaldehyde ...), background hazards (lead, radon), fibres & airborne particles (asbestos, fibreglass, pollen)	
Population					
Ecocycles		Dispose of chemicals, paints, oils, detergents and plastics through your special local council services, not through the stormwater or sewerage system which will pollute your waterways Look into feasibility of graywater & roof-top water catchment systems		Avoid CFCs	
Connectivity		De-pipe street stormwater disposal			
Feedbacks		On-site absorption & treatment of stormwater saves infrastructure costs			
Rheotics					
Indicators					
Scale					

Table: Criteria x Genius Loci Themes

	History	(Present) Ambience & Sensory	Meaning (Interpretation, Culture)
Community	Respect history: maximising the retained or deployed value of previous worthwhile human endeavour in terms of both heritage and manufactured artefacts	Create a powerful & memorable work of art through development Responsibility to spirit of place whenever we build something new	Enrich the cultural landscape: supporting and promoting cultural diversity and incorporating ecological awareness into all aspects of the making and maintenance of human settlement Cultural Identity Vernacular Wisdom Ancestral archetypes: (especially geometric, ancient patterns, Feng Shui, Hindu Vedas, Maharishi Mahesh Yogi's cities for 1-200 families, Natural Law: "right direction, right proportions, right placement" Civic buildings and public gathering places require important sites to reinforce community identity and the culture of democracy They deserve distinctive form, because their role is different from that of other buildings and places that constitute the fabric of the city Frank Lloyd Wright, preceded by pre-Raphaelites, arts & crafts movement, Art Nouveau; symbolism & geometry of Gothic reinterpreted through vegetative, organic elements
Landscape		All buildings should provide their inhabitants with a clear sense of location Harmony with the Land Buildings should front onto public open spaces for surveillance, safety, local amenity & real estate value	
Elements		All buildings should provide their inhabitants with a clear sense of weather Most sense of place & life where elements meet: earth & sky, water & rock, able to immerse self in "rock-waterIness" Windows odd shapes & sizes; different for North, South, East & West	Wisdom related to traditional responses to climate
Genius Loci	Composite of sensory experiences reinforced by historical associations"	Every place has a spirit unless it has been destroyed by hard, unresponsive actions"	Create a Sense of Identity and Continuity
Biotics	Integrate historic preservation & ecological management	Water flowforms decrease pollution, oxygenate water, aesthetic	
Organism		Cubes make for cold, rational thought & action, logical materialist; construct from the heart → love in the users; build with love → an aura of healing, rejuvenation Streets and squares should be safe, comfortable, and interesting to the pedestrian Ensouling a building, urban environment includes health, peace Healing architecture: Baubiologie (Germany, Scandinavia), "healthy building with spiritual & ecological sensitivity" Organic designs Organic designs create well-being, creativity, individuality; Amsterdam ING Bank (Tom Alberts), diversity of angles, healing atmosphere; sun, water, air, space; trailing plants interior, harmony with land: colours, crouching	Different inside & outside a building: inside an idea function, the building's purpose (home, shop, office); outside a relationship/response to spirit of place function plus idea/purpose spaces (meditation garden, parking place, privacy courtyard)
Population			
Ecocycles			Sewerage Processing as a Work of Art
Connectivity			
Feedbacks		Dynamic equilibrium between opposites is like a dance: symmetry <-> asymmetry; expansive, warm colours <-> contracting, cool colours; tall, crowded buildings <-> low, scattered buildings; low, sheltered intimate spaces <-> high, open, communal spaces Rudolph Steiner: form influences behaviour & expression of feelings	
Rheotics	Preservation and renewal of historic buildings, districts, and landscapes affirm the continuity and evolution of urban society	All buildings should provide their inhabitants with a clear sense of time	
Indicators			
Scale		Right scale	

Table: Criteria x Biotic Themes

	Life Support, Habitat Integrity & Diversity, Land Use, Integration, Ecosystem Services	Life Supported: Biodiversity (Ecosystem),	Life Supported: Biodiversity (Population/ Species Diversity)	Life Supported: Biodiversity (Organism/ Genetic Diversity)	Damaging Processes	Healing Processes
Community	Nature Conservation Orders: increase area & number Sustainability covenants Richness and diversity of life forms contribute to the realisation of natural values and are also values in themselves Permaculture	Precautionary Principle (2)				
Landscape	Public open space & natural resource conservation linkages Preserve natural habitat in urban design Reuse redundant land Managing fragile ecosystems: sustainable mountain development Diversified mature forest: increase area				Environmental cost of land occupation Managing fragile ecosystems: Combating desertification & drought	Develop bioshelters for land regeneration Biodiversity and habitat preservation and recovery Restore degraded land: rehabilitating and maximising the ecological health and potential of land as a consequence of the development of human settlement (rural, city)
Elements					Dispose of chemicals, paints, oils, detergents and plastics through your special local council services, not through the stormwater or sewerage system which will pollute your waterways	
Genius Loci						
Biotics					Avoid use of pesticides and other chemicals that may leach into the groundwater Avoid walking on reefs Many species are very delicate and will die when crushed under human weight Pop on a 'mask and snorkel' and swim around instead	Harmony with nature
Organism	Protect biodiversity (4)		Protect species	Protect genetic biodiversity	Violation of biosphere is equivalent to violation of self	
Population	Make your garden or property wildlife friendly by leaving logs and rocks, and planting local native plants to provide food or shelter to birds, frogs, reptiles and other animals Diversified mature forest: increase area		Find out how to get local native plants by contacting your local council or branch of the Society for Growing Australian Plants		Reduce numbers of people suffering poor quality daily living environment Consider alternatives to chemical pest control in your garden or use it sparingly Birds, frogs and reptiles can become sick or die if they feed on insects sprayed with pesticides Useful insects, are killed by pesticides	Local native plantings Useful insects, like ladybirds and praying mantis, help control pests

	Life Support, Habitat Integrity & Diversity, Land Use, Integration, Ecosystem Services	Life Supported: Biodiversity (Ecosystem),	Life Supported: Biodiversity (Population/ Species Diversity)	Life Supported: Biodiversity (Organism/ Genetic Diversity)	Damaging Processes	Healing Processes
Ecocycles	Minimise use of old-growth timber Promoting sustainable agriculture & rural development Protect biological diversity and maintain essential ecological processes and life-support systems Development in a way that maintains the ecological processes on which life depends (sustainability)	Native plant communities	Support a rich species diversity	Increase number of urban trees	Minimise use of organic solvent-based floor finishes, paints, stains, adhesives Safe and environmentally sound management of radioactive wastes Environmentally sound management of biotechnology Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (Uncertainty Principle)	
Connectivity	Negotiation principles for removal of fences					
Feedbacks	Safeguard natural resources Conserve natural capital Conserve natural capital; sustainable income Land tenure mechanisms Sustainability covenants Protected biodiversity: increase area A Fair Share of the Biomass	Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas, and the protection, rational use and development of their living resources			Combating deforestation	Land tax as a transition Support resilience Protect, preserve & restore the natural environment Foster biodiversity Make a habit of restoration
Rheotics						
Indicators	Assess what is there already	Assess what is there already	Assess what is there already	Assess what is there already	Assess what is there already	Assess what is there already
Scale	Biospheric integrity Harmony with biosphere Conserve ecological capital for the future Protect biospheric integrity					

Table: Criteria x Organism Themes

	Function as a Whole	Needs: Physical, Health	Needs: Emotional & Sensory	Needs: Mental & Psychological	Needs: Social, Cultural & Spiritual	Needs: Biotic	Needs: Human & Eco-Community
Community	Balance economy, ecology, social; integrate Community wellbeing & health: priority Rebuild whole systems	Community Gardens					Meet human needs by building & planning: Participation - all decisions re what & how to build, by users Opportunity to Integrate overlapping interests & values with contemporary use & ecological management Meet human needs by building & planning: Patterns - all design & construction guided by "a collection of communally-adopted planning principles called patterns"
Landscape	Celebrate the place as an integrated whole Integrated approach to the planning and management of land resources The metropolis has a necessary and fragile relationship to its agrarian hinterland and natural landscapes The relationship is environmental, economic, and cultural Farmland and nature are as important to the metropolis as the garden is to the house	Baubiologie: Houses located away from centres of industry & main traffic routes Baubiologie: Houses located in spaciously planned developments with amplle 'green' areras Increasing density encourage walking Neighbourhood design encourages walking Design for exercise	Design for safety & security	Buildings define spaces Don't sacrifice access & openness to security			Where appropriate, new development contiguous to urban boundaries should be organized as neighbourhoods and districts, and be integrated with the existing urban pattern Noncontiguous development should be organized as towns and villages with their own urban edges, and planned for a jobs/housing balance, not as bedroom suburbs
Elements		Baubiologie: Use of wall, floor & ceiling materials that allow air diffusion Baubiologie: Use of building materials that are hygroscopic (can absoprb & release water to help moderate indoor air humidity) Baubiologie: Interior surface materials that allow air filtering & neutralisation of air pollutants (i.e. materials capable of 'sorption') Baubiologie: Balancing heat storage (thermal mass) and thermal insulation levels to provide a comfortable interior living temperature Baubiologie: adequate protection from noise & infrasound vibration Baubiologie: Maximum use of natural daylighting & colours in the interior Baubiologie: Minimise artificial electromagnetic fields while maintaining natural magnetic & electrical fields					

	Function as a Whole	Needs: Physical, Health	Needs: Emotional & Sensory	Needs: Mental & Psychological	Needs: Social, Cultural & Spiritual	Needs: Biotic	Needs: Human & Eco-Community
Genius Loci			Design for visual amenity				Metropolitan regions are finite places with geographic boundaries derived from topography, watersheds, coastlines, farmlands, regional parks, and river basins The metropolis is made of multiple centres that are cities, towns, and villages, each with its own identifiable center and edges
Biotics		Switch to slow combustion or natural gas heaters Firewood collection alters or removes the habitat of mammals and birds, and is contributing to the decline or disappearance After woodchipping, firewood harvesting, at 61 million tonnes per year, is Australia's second largest timber extractor Protect trees and topsoil during sitework Local agriculture Use of non-toxic & untreated natural building materials Baubiologie: Construction materials that do not contribute to environmental degradation in any aspect of extraction, manufacture, installation or use; do not exploit limited or endangered natural resources				Provide for all biota's needs to continue & multiply	
Organism		Service roads Opt for more natural materials Safe & healthy work environments	Opt for more natural materials	Opt for more natural materials	Opt for more natural materials	Provide access to all needed resources for existence for all people	Individual health & wellbeing
Population		The revitalisation of urban places depends on safety and security The design of streets and buildings should reinforce safe environments, but not at the expense of accessibility and openness Reduction of need for inter-urban commuting by incorporation of a full range of urban housing types & land uses On street parking buffers pedestrians, slows traffic Review design comfort criteria for buildings					Protecting & promoting human health Cities and towns should bring into proximity a broad spectrum of public and private uses to support a regional economy that benefits people of all incomes Affordable housing should be distributed throughout the region to match job opportunities and to avoid concentrations of poverty Provide health & security: employing appropriate materials and spatial organisation to create safe and healthy places for people to live, work and play in the context of an ecologically resilient environment
Ecocycles		Timber Supply as Urban Planting Baubiologie: deal with indoor air pollution Baubiologie: Use radiant heating & solar energy wherever possible Baubiologie: Use of construction materials that do not contribute to pollution in any aspect of extraction, manufacture, installation & use					

	Function as a Whole	Needs: Physical, Health	Needs: Emotional & Sensory	Needs: Mental & Psychological	Needs: Social, Cultural & Spiritual	Needs: Biotic	Needs: Human & Eco-Community
Connectivity	Designation of one or more mixed-use, high density "activity nodes" in the urban area, located at major intersection points in the transit system	Designation of major transit routes as medium density, mixed use "activity corridors" Concentrations of civic, institutional and commercial activity should be embedded in neighbourhoods and districts, not isolated in remote, single use complexes Schools should be sized and located to enable children to walk or bicycle to them The more intersections per area, the more permeable the urban fabric					Patterns: four neighbourhoods meet at crossroads to form town centre; neighbourhood centres locate at junctions with greatest circulation
Feedbacks	Well-designed back lanes: many advantages but may not be affordable on cheap land or density <20 dph Economic diversification Meet human needs by building & planning: Organic order - allows whole to emerge gradually from local acts	Create a sustainable physical infrastructure Meet human needs by building & planning: Coordination - slow emergence of organic order assured by funding process which regulates the stream of individual projects put forward by users On street parking drastically reduces the need for off-street car parks Safety from reducing speeds and traffic calming, not removal of obstacles					Promoting sustainable human settlement development Live on the interest, not the capital Economic sustainability
Rheotics	These guiding principles and core objectives need to be considered as a package <u>No objectives or principle should predominate</u> over the others A balanced approach is required that takes into account all these objectives and principles to pursue the goal of ESD						Heal the biosphere: contributing to the repair, replenishment and improvement of: water, soil, energy, biomass, food, biodiversity, habitat, ecolinks, waste recycling
Indicators	Meet human needs by building & planning: Diagnosis - well being of the whole protected by annual diagnosis of live & dead spaces						
Scale	Sustainable Development: improves the total quality of life, both now and in the future						Safeguard future health & wellbeing

Table: Criteria x Population Themes

	Attractor Landscape: Satisfiers	Attractor Landscape: Pseudosatisfiers, Destroyers	(Wanted) Population Counts & Movements: Indigenous Human, Animal, Vegetation, Microbial, Visitors	(Unwanted) Population Counts:Exotics: Humans, Weeds, Ferals, Visitors	Ecological Relations (Predator-Prey etc)
Community				Set Viable Population Limits	
Landscape		Appropriate building densities and land uses should be within walking distance of transit stops, permitting public transit to become a viable alternative to the automobile			
Elements	Transit stops: offer ample weather shelter: awnings, overhangs, trellises, lighting				
Genius Loci					
Biotics				Demographic dynamics & sustainability The flourishing of human life and culture is compatible with a substantial decrease of the human population The flourishing of non-human life requires such a decrease Reduce the impact of your cat or dog on native wildlife Keep them enclosed at sun up, sun down and at night when native animals do most of their feeding Present human interference with the non-human world is excessive, and the situation is rapidly worsening Stabilise human population (2)	
Organism	Make transit stops safe: position near people & surveillance; avoid large areas of bush, blank walls, empty land		Know your fish That orange roughy you're eating could well be 150 years old Find out where your fish are caught and if the methods used are ecologically sustainable If your fish vendor doesn't know ask them to find out For a guide to buying fish call the Vic National Parks Association Ph: (03) 9650 8296		Be conservative when you go fishing Only take what you can eat yourself and don't keep undersized fish
Population	Encourage community: incorporate provision for a wide diversity of social and community activities within a 3-dimensional urban structure		Some fish stocks are under greater threat from recreational fishers than from commercial fishing		Humans have no right to reduce this richness and diversity except to satisfy *vital* needs
Ecocycles					
Connectivity	Transit: access to disabled & prams *[and bicycles; meet service needs of passengers: trams in Freiburg im Breisgau will order cabs for passengers to meet tram]* Permit & encourage facilities (such as educational institutions, senior citizens' housing, places of worship, social services, medical facilities), which are likely to attract a large percentage of transit dependent people, to locate adjacent to transit stops and to be oriented toward those stops		Establishment of target urban densities (employment & residential) to support desired levels of transit service	Don't dump weeds, prunings or grass clippings in the bush or local parks as they new weeds and spread others	

	Attractor Landscape: Satisfiers	Attractor Landscape: Pseudosatisfiers, Destroyers	(Wanted) Population Counts & Movements: Indigenous Human, Animal, Vegetation, Microbial, Visitors	(Unwanted) Population Counts:Exotics: Humans, Weeds, Ferals, Visitors	Ecological Relations (Predator-Prey etc)
Feedbacks	Encourage community: include secure and attractive, physical and electromagnetic communication networks within a 3-dimensional urban structure Zoning: permit a wide range of multi-family residential, commercial, retail, entertainment, community facility, recreational, & light industrial uses at designated activity nodes & along designated activity corridors; permit pedestrian-oriented uses such as retail, restaurants, & entertainment facilities at grade			Set Viable Population Limits	
Rheotics					
Indicators	Biodiversity Gap Analysis Program (University of Idaho)				
Scale	Social systems: attractors (waterfronts, park, festivals etc) to keep people & money within the community				

Table: Criteria x Ecocycle Themes

	Information	Matter (Materials) & Energy: Resource Conservation & Efficiency, Consumption, Eco-Design	Matter (Materials) & Energy: Transformations, Technology, Industrial Processes, Eco-Design	Cycles, Loops & Ecoservices, Pollution
Community	Obtain quality information on ecologically based economic options from ongoing sources such as government, science, academia & public media Education Demonstration developments	Respect biomass Micro planning: Intensification of permitted uses; performance criteria to minimise nuisance; flexible zoning; zoning incentives to encourage retrofitting Keep the contents of your boat, car, bag in your boat, car, bag ... Don't throw rubbish, waste, oil or chemicals into the sea or into urban creeks or rivers - even if you believe them to be biodegradable Australia's marine and riverine ecosystems have naturally low nutrient levels and can't easily absorb human waste or rubbish Replace consumption model Reject consumption model	Ordinances to forbid buildings over 4 storeys	Report any new waste discharge to the sea or river It may be an accidental spillage or a new discharge point that is not yet regulated Councils and the EPA need to know what's going on and will appreciate your eyes and ears Urban/rural systems: urban/rural consortia: manage shared rural job-supporting resource bases - amenities (recreation, resources many types), ecocycle loops, ecological resource inventories, Geographical Information Systems Takeback legislation for packaging, cars, white goods, appliances, as in Germany, Austria
Landscape		Optimise use of interior space to keep overall building size & resource use minimum	Construction systems: district heating/cooling; clustered/mixed use development; optimal building shape & height Passive solar features where possible through orientation & window layout Minimum interior space	
Elements		Recycle materials for housing Local materials Low embodied energy materials Reusable materials Use natural ventilation & daylight Use low overall lighting + task lighting	SPV & wind energy sales Passive solar features where possible through orientation & window layout Local stone for skirting, patios & pathways (Scotland) Roofing with natural clay tiles & drainage with vitrified clay piping (check for environmental destruction at source & supplier's policy to restoration) Innovative 'breathing wall' construction (Findhorn), with controlled exchange of air & vapour Suspended timber floors for better air circulation to avoid buildup of radon gas Isolation of electrical circuits to reduce electromagnetic field stress Water conservation (showers, low-flush toilets, self-closing taps) Low maintenance water efficient landscape design Energy efficient building Grey & roof water use	Collection & recycling of rainwater for garden use Waste water treatment lagoons (cheaper, better environmentally) Hydrologic patterns: on-site stormwater management, infiltration (eg swales, absorptive surfaces, natural or artificial retention systems) for aquifer recharge Minimise greenhouse gas emissions in architectural design Minimise indoor pollution & external air pollution from buildings
Genius Loci				
Biotics		Minimise EcoCost of Buildings Try to buy organic produce It's better for you and better for the environment because it does not use chemical pesticides Maximise conservation & develop local renewable resources Integrate natural environment into buildings Use renewables sustainablt (below rate of regeneration) Use locally grown & harvested timbers from managed forests Minimise use of old-growth timbers (use recycled, not new) Locate buildings for minimum impact on habitats & biota Site buildings to benefit existing vegetation	Assumptions: perpetual land use; adaptable & resilient land use systems; no net degradation of natural resources or the culture using them Aquaculture; fertiliser substitutes; organically grown brands Environmentally sound management of hazardous wastes, stop illegal international traffic in hazardous wastes Environmentally sound use of toxic chemicals, stop illegal international traffic in toxic and dangerous products Natural wastewater treatment systems (eg constructed wetlands, composting toilets, biological wastewater treatments, sand filters) Non-toxic organic paints & wood preservatives throughout Composite boarding manufactured without the use of toxic glues or resins	Encourage endemic foods Full production/market cycle; waste management (ecocycling), consumables; water purification technologies Repair the damage

	Information	Matter (Materials) & Energy: Resource Conservation & Efficiency, Consumption, Eco-Design	Matter (Materials) & Energy: Transformations, Technology, Industrial Processes, Eco-Design	Cycles, Loops & Ecoservices, Pollution
Organism		Sustainable dying Localise food production Protect vegetation & waterways during building Provide users with maximum control of personal space in buildings	Baubiologie Avoid CFCs Avoid solvents & toxic glues	Appropriate housing full (human) life cycle
Population		Smaller Houses Reductions in consumption per capita, specified scarce resources, especially construction-related Changing consumption patterns Consumption: reduce average, reduce rich:poor differential		
Ecocycles	Demonstration models of technological innovations	Reduce energy use Energy efficient building Decrease rate of use of resources & energy Reduce waste & technometabolism Install high-efficiency heating & cooling equipment Use high efficiency products Install water-efficient equipment Install high-efficiency lights & appliances Optimise energy performance: operating at low levels of energy consumption, using renewable energy resources, local energy production and techniques of resource reuse Make Buildings Better Efficiency in development Shared facilities (laundry, kitchen, lounges) avoiding unnecessary duplication Use building products made from recycled materials (several) Use salvaged building materials when possible Renovate older buildings Retrofitting Reduce, Reuse, Recycle (2) Packaging reduction, design Reduce total waste volume Use durable products & materials Diversify and integrate resource procurement Design for increased waste storage Choose non-structural alternatives, including not to develop Avoid packaging Make recycling easy for occupants: design in recycling Minimise waste Avoid pressure-treated lumber Choose low embodied energy & Co2 materials Buy local materials	Natural methods of heating and cooling can be more resource-efficient than mechanical systems Production systems (energy): geothermal; methane from trash; photovoltaic; wind power; low head hydro; biomass Conservation systems (energy): co-generation heat recovery; peak load reduction; industrial process (savings); street lights/stop light economies Clean fuels, natural gas Solar-aquatic sewage treatment systems Minimise EcoCost of Buildings Choose building materials with low embodied energy Reduction in proportion of non-renewable energy embodied in buildings: primary production of materials, construction, maintenance Design buildings to use renewable energy Minimise use of pressure-treated lumber Solar panels for domestic water heating *(even in Denmark & Northern Scotland)* District heating system using a gas condensing boiler for highest fuel efficiency (1993) High levels of insulation (U-values of 0.2 watts/m2 C in roof, walls & floors) Low-energy light bulbs Triple glazing (U=1.65 watts/m^2 C) Use of cellulose insulation (made from recycled paper) Minimise waste by accurate quantity surveying Avoid disposables Support energy efficient products & processes Request best rated whitegoods Minimise packaging Retrofit old buildings Minimise waste Localise, integrate and diversify energy generation Rheoticsenergy use & generation to minimise peak loadings Energy competitive strategies through urban systems: material efficiency Minimise job-site waste Minimise packaging waste	Kerbside recycling Localise sewage treatment and recycling The city as a natural ecosystem Living machines One systems output is another systems input Protect ecosystems Waste management for future resource "mining Alternative waste water treatment (spatial limitations): cost savings from decentralised, modular, scalable, large diameter tanks in greenhouse, set up with biota to suit nutrients available (staged) Environmentally sound management of solid wastes and sewage-related issues Make it easy for occupants to recycle waste The most efficient use of resources is represented by natural patterns Reduce major air & water pollutant production Establish recycling programs & recycled materials industries

	Information	Matter (Materials) & Energy: Resource Conservation & Efficiency, Consumption, Eco-Design	Matter (Materials) & Energy: Transformations, Technology, Industrial Processes, Eco-Design	Cycles, Loops & Ecoservices, Pollution
Connectivity	Electronic bulletin board and trading: wide access Information superhighways	Eliminate super voltage grids Movement systems: pedestrian transit malls; mass vs private; bicycling; car pooling Decrease journey to work Increase transit passenger miles	Utilise advanced transport, communication & production systems	Conserve systems society depends on Maintain ecological processes Conserve resources Understand, preserve, repair Critical: import replacement & economic capital retention - use citizens to identify & mobilise local resources for economic development Meet human needs by building & planning: Piecemeal growth - construction in each budgetary period overwhelmingly small projects Work with large-scale processes Improve ratio usage rate: replacement rate for key renewables Increase recycling
Feedbacks		Develop an EcoCost Budget for Proposed Developments Stabilise resource use When shopping, choose the more environmentally friendly products and avoid excessive packaging Costs & benefits around resource use: greater equality (between rich & poor) Lifecycle costing of materials Design for future reuse	Simple timber frame construction & detailing suitable for self-build	Ecological balance of trade Reduce local export of money: increase urban-rural connection, reduce dependency on imports, energy, chemicals; localise the economy, (invigorate multiplier effects)
Rheotics		Use durable products & materials		
Indicators				
Scale		Safeguard future resources (2)		Reduce local export of money: increase urban-rural connection, reduce dependency on imports, energy, chemicals; localise the economy, (invigorate multiplier effects)

Table: Criteria x Connectivity Themes

	Physical Connection, Disconnection	Risk	Intangible: Linkage, Influence, Glue	Design
Community	YIMBY (Yes In My Back Yard!)		Communication (2)	Sociable, Accessible
Landscape	Reduce traffic path distances - more short cuts and no dead ends Fractal Index Corridors are regional connectors between neighbourhoods & districts The physical organisation of a region should be supported by a framework of transport alternatives to allow maximum access and mobility, and reduce car use	Avoid risk: QRA		Subdivision design: reverse lotting (back fencing) adjacent to arterials/collectors should be discouraged Designation of a comprehensive network of arterial roads, 'collector roads' & major transit routes Interconnected networks of streets should be designed to encourage walking, reduce the number and length of automobile trips, and conserve energy
Elements	Waterways are corridors Coastlines are corridors			Design for reabsorption roughly where rain falls
Genius Loci				
Biotics	Parkways are corridors			Don't discharge contaminated water into sensitive natural ecosystems
Organism	The physical organization of the region should be supported by a framework of transportation alternatives. Transit, pedestrian and bicycle systems should maximise access and mobility throughout the region while reducing dependence on the automobile	Don't fence out risk (it produces dangerous enclaves)	Improve the quality & service of public transport	
Population	Good public transport Pedestrian ways Many activities of daily living should occur within walking distance, allowing independence to those who should not drive, especially the elderly and the young Bike paths Appropriate public transport Low speed vehicle ways			Vertical mixed use: live above the shop A significant majority (for example 90%) of residences, jobs & other activities located within 400meters walking distance of a transit stop Subdivision design: applicants should document walking distances as part of the background information accompanying draft plan & subdivision submissions
Ecocycles				No supply lines in or pipelines out
Connectivity	Railways & boulevades are corridors		Transport The problem with cars is ... Motor corridors disconnect Public transport corridors connect	Subdivision design: applicants should document proposed locations of bus routes & stops Live over the shop
Feedbacks	Transit priority through traffic signal pre-emption systems Raise parking fees & eliminate 'free' parking Adequate spacing of arterial & collector roads to accommodate needs of transit operators (1km apart maximum) Transit corridors, when properly planned and coordinated, can help organise metropolitan structure and revitalise urban centres. In contrast, highway corridors should not displace investments from existing centres		Subsidise public transport	Zoning: amendment applications for redevelopment should require parking in side or rear if feasible; parking spaces minimised if near good transit Zoning: reduce or eliminate minimum parking requirements in all zones (especially in activity nodes & corridors supporting transit); establish maximum parking requirements; permit shared parking across sites Zoning: reduce minimum lot sizes & lot frontage requirements, to increase development densities, reduce or eliminate required setbacks for commercial buildings or employment centres along transit routes Zoning: increase maximum (+/or establish minimum) gross floor area (GFA) and floor space index (FSI) standards along transit routes, and at activity nodes Functional patterns
Rheotics				
Indicators				
Scale	Corridors are regional connections of neighbourhoods and districts; they range from boulevards and rail lines to rivers and parkways			Connect to networks beyond site Respect interconnection of regions & environments

Table: Criteria x Feedback Themes

	Negative Constraint (Limiting Factors)	Positive Constraint (Positive Feedback, Catalysis)	Philosophy (Cosmology) & Learning	Double Loop Issues
Community	Regulatory systems: building & zoning codes; assessments; tax incentives; rewards; utility rate structuring; rule making; revolving funds; energy conservation authorities	Financial resources and mechanisms: regional & subregional development banks and so on Science for sustainable development: better communication with decision makers & public Scientific & technological community: more input to decision making Strengthening the role of business and industry Strengthening the role of non-governmental organisations: partnerships for sustainable development Strengthening the role of workers and their trade unions Strengthening the role of farmers: farmer-centred approach; sustainable agriculture Graphic urban design codes promote economic stability	Replace growth model (2) Combating poverty Promoting education, public awareness and training Information for decision making More cooperative sharing of revenues & resources by local governments (otherwise competing, with negative outcomes)	Green accounting/valuation Create a Sustainable Economy Base the Monetary System on Sustainable Resource Base
Landscape	Address broad scale clearing and destruction of native plants and animals Speak out about new dykes, weirs or sea walls Most of Australia's coastline relies on a natural flow of water up and down our sandy beaches Any break in this flow disrupts and destroys local ecosystems	Expand our national reserve system		
Elements	2-part water charges: basic service/supply + consumption National pollution control standards, to progressively reduce pollution of/with water, air, noise, heat	Ensure that flows on our regulated rivers allow for environmental needs Encourage ecologically benign energy use, passive solar etc		
Genius Loci				
Biotics	Do not use native forest and woodland timber in home building, fencing or firewood Support conservation of coastal and wetland habitats Mangrove and coastal swamp systems provide breeding habitats for many fish, crabs and prawns and help maintain clean waterways Heavy penalty for breaking law about safe disposal of toxics/hazardous waste	Use plantation timber, in home building, fencing or firewood. Demand for plantation timber by consumers will put effective pressure on the suppliers Environmentally benign consumption patterns: positive & negative price levers Fund major replanting from carbon taxes Integrated national forest products industry Encourage tree planting on private land		Connected green spaces system
Population	TND (Traditional Neighbourhood Development) is consistent with socio-economic trends, efficient urban form, transport efficiency, energy conservation, infrastructure cost savings & environmental sustainability It is also likely to be a nice place to live!	Recognising & strengthening the role of indigenous people and their communities Children and youth in sustainable development Global action for women towards sustainable and equitable development National tree planting programme	Children and youth in sustainable development Global action for women towards sustainable and equitable development Recognising & strengthening the role of indigenous people and their communities	Children and youth in sustainable development Enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations
Organism	Heavy penalty for breaking hazardous waste laws	Mank small parks available	Design for permeability, variety & legibility at all scales from regional to local Make your business operations more environmentally responsible	Combating poverty
Ecocycles	Refund all containers Prevent industry dumping toxic wastes into sewage system Carbon fixing tax on fossil fuels National packaging legislation to reduce plastics & cardboard National motor reg. Fees x engine volume Energy parsimony policy for all products produced Import fees & quotas based on fossil fuel embodied in product with fossil fuels	Transfer of environmentally sound technology, cooperation and capacity building Investment & incentives for technologies: replace non-renewables, improve energy efficiency, reduce waste & pollution Decrease kerbside parking by half; increase charges; ban constructing any further off-street parking; capacity charges for all off-street parking Refundable charge all containers High quality sewage disposal making compost & fertiliser (income producing)	Nationa; educational programme re need for fossil fuel parsimony	Find out what happens to your city's effluent Each year 10000 tonnes of phosphorus and 100,000 tonnes of nitrogen are discharged into our seas from sewerage systems This kills many marine ecosystems, reducing the ability of the oceans to sustain life Domestic waste is the main culprit, so suggest to your state government representative that it be recycled back on land
Connectivity		Traditional Neighbourhood Development (TND) allows proximity to work, important for part time jobs National infrastructure modernisation & development programme	Public transport corridors enhance urban life; highway corridors impact on & displace investment	

	Negative Constraint (Limiting Factors)	Positive Constraint (Positive Feedback, Catalysis)	Philosophy (Cosmology) & Learning	Double Loop Issues
Feedbacks	Establish true-cost pricing economics Conserve investments	Shedding the second car and moving to a traditional neighbourhood translates into $70,000 extra home mortgage capacity (1994), that is $130,000 becomes $200,000 Contribute to the economy: supporting and promoting appropriate economic activity Avoid destructive competition for tax base by local governmenmt: promote regional cooperation & resource provision	Don't leave your environmental conscience at home when you go on holidays Recognise the 'no development' option	
Rheotics				
Indicators				
Scale		Seek small local successes Development profitability: emphasise long term relative to short		Contact your local elected representatives (MP or councillor) to get more areas protected for nature conservation Ask them to address the bigger-picture issues beyond your scope, such as broad scale clearing and destruction of native plants and animals, expansion of our national reserve system, and ensuring that flows on our regulated rivers allow for environmental needs

Table: Criteria x Rheotics Themes

	Past- Present – Future, Short Term – Long Term	Impacts	Healing Process	Incremental Change
Community	Balance long term & short term Evaluate solutions in terms of their larger context EcoCommunity building: Recognise it will be a journey – and enjoy it (great love, persistence & patience over years) Develop a Vision – and keep developing it (clear, shared, *"Yes!"* response from all concerned) Build relationships and bonding (heart, glue, solid interpersonal relationships) Make the whole-system challenge explicit (balance planning <u>and</u> experiment) Get help to become self-reliant (budget for all to learn group process & management skills) Develop clear procedures (written: decisions, disputes, finances, meta-procedures) Maintain balance – sustainably (important balances: group/private, hardware/software, heart/mind/will, talking/acting, time & money in current consumption/investment/sustainable service) Be open & honest (sensitive issues: sex, power, money; power gradients are universal, go for equal fairness, complete equality is a destructive fiction) Preserve architectural & cultural heritage Preserve natural heritage	Pre-empt & confront impacts on wider community Common choice: restore & reuse neglected lands vs. destroy the few remaining rural or natural areas.	Balance humans & environment in planning & development "Pioneering in reverse" Preserve & revitalise urban neighbourhoods	Manage change & complexity
Landscape	Development & redevelopment should respond to & respect historical patterns, precedents & boundaries		Regard site interventions as opportunities to heal & sustain the wider environment Retrofit derelict lands Create model solutions based on natural processes (Reflect the elegance and efficiency of natural processes) Long-term goal: sustainable landscape	Regard site interventions as opportunities to heal & sustain the wider environment Retrofit cities for transit over time, with interim and long-term boundaries designed to mould urban form towards compact, TSUD. Allow changing uses over time: where demand is for low density, large blocks, organise for easy increase in density later; interconnected streets allow incremental change.
Elements				
Genius Loci	Attractive urban design			
Biotics				
Organism			Safe & healthy work environments	Increasing density encourage walking
Population		Rehabilitate community facilities		
Ecocycles		Rehabilitate housing		Help re-establish natural functions (support complexity)
Connectivity			Protect & maintain urban infrastructure	
Feedbacks	Safeguard future economic development	Protect neighbourhoods from physical & economic disruption	Job creation	
Rheotics				
Indicators	New performance indicators	New performance indicators	New performance indicators	New performance indicators
Scale	Short term is not sacred			

Table: Criteria x Indicator Themes

	Use of Indicators & EMS	SoER (Condition, Snapshot)	Compass & Benchmarks (Dynamic Process)	Optional Operating Space & Threshold
Community	Ecological Evaluation Systems			
Landscape				
Elements				
Genius Loci				
Biotics				
Organism				
Population				
Ecocycles				
Connectivity				
Feedbacks	Use Real Indicators			
Rheotics	Use Real Indicators EMS			
Indicators	New performance Indicators			
Scale				

5 APPENDIX E: BACKGROUND PAPERS

5.1 HELSINKI PAPER ON MFP-AUSTRALIA

Presentation to International Federation of Housing & Planning International Congress
'Cities For Tomorrow: Directions for Change'
HELSINKI FINLAND 26/9-2/10/93

"MFP-Australia: The Urban Development"
(Re-named by Conference Committee: 'Urban Development in Australia')
Dr. Vanda Rounsefell

ABSTRACT

Early in 1987 the Japanese Ministry of International Trade & Industry (MITI) proposed a business venture to the Australian Government: a privately-funded, new space-age city adjacent to one of the existing State capitals, a multi-purpose urban technopolis which became known as the MultiFunction Polis (MFP). The MFP was seen as an opportunity to create wealth and employment. There was a predictable storm of objection, largely on anti-capitalist grounds from people who were concerned about lack of information and consultation and large-scale foreign ownership of Australian assets. The press and academe had a "field day" with public xenophobia, amid fanciful concepts projecting business ideas into the future, and the MFP is still having to address perceptions born at that time, despite substantial evolution of the concept and changes in focus since translation to an Adelaide setting was initiated.

The MFP is now demonstrably an Australian project, promoting local site-specific, social and environmental problem-solving with a firm focus on economic development. There is support and future investment potential from the Japanese, especially the MACAJ group (MFP Australia Cooperative Association of Japan), but the MFP is seeking project partners world wide.

The site was chosen by the Australian Government from five competing State submissions. The Japanese apparently preferred a site in Queensland for recreation reasons, and a site near the Gold Coast was chosen first, subject to conditions which were rejected. Adelaide was then recommended and eagerly grasped by the Bannon Government in 1990.

Feasibility studies had recommended a single, self-contained city of 100,000 people. This was eventually rejected for a concept of a central "hub" (core site) with "spokes" extending to many areas of the city and beyond, and Adelaide site characteristics later dictated a much smaller population of some 50,000, to be developed over 20 years in several stages.

The MFP has two essential components, a network of business initiatives and a physical site. Opportunities for economic development in Australia were identified as adding value - development & marketing (presently weak) to basic research projects (presently strong), pre-emption of technologies for the 21st. century based on state-of-the art communications, particularly information technology and telecommunications (IT&T), and environmental management. Major changes in education with increased IT&T input and lifelong duration were seen as niches.

The MFP intends to establish a World University, connecting existing universities electronically through the MFP precinct, and is already trialling tele-medicine between major city and country hospitals. Software development, tele-cottages, a media production centre for the Asia-Pacific Region and signal processing are other high-tech MFP efforts envisaged or initiated. The MFP has legally incorporated Adelaide's two Science Parks which have global expertise in biotechnology and electronics.

These activities are expected to achieve a high degree of international cultural and intellectual exchange. Their location at the MFP, (now a State tax exemption zone for 10 years), is expected to generate 1500 skilled jobs per MFP village of 4500. Skilled jobs create a flow-on of service infrastructure employment. This is relevant to high unemployment levels, and to an Australian demonstration of mixed land use, with village residents having 10-minute walking access to workplaces and amenities.

The Adelaide proposal was centred around a challenging core site of 2343 hectares at Gillman near Port Adelaide, set in degraded and partly contaminated industrial swamp land adjacent to Adelaide's most socio-economically and enviromentally unhealthy suburbs.

12% of Adelaide's stormwater crosses this site, killing mangroves and sea grasses. This, nearby world conservation areas, the river, the swamp, the fishing industry and land contamination make water management a key issue. Strategies include total catchment management, canal, pond and lake systems, and the site from which soil for building rafts will be obtained, will provide artificial wetlands for biological cleansing of stormwater before recycling. Some regeneration of mangroves will be possible. Houses will have dual water supplies.

Other key concepts for the urban development include "a paradigm shift" in ecologically sustainable urban planning: stringent energy policy (50% reduction overall, 70% fossil fuel reduction), solar access site design, energy efficient housing, mixed development, higher density, pedestrianised localities, advanced transport (long-term) and "environmental management" including local industrial cleanup and site decontamination. A social planning team has identified social imperatives for design of the built environment, especially in the "parochial realm", and integration of the proposed development with surrounding communities is a core priority.

Planning problems have been formally minimal, most objection grounds being political (anti-capitalist), social (perceived hijacking of funding & early stage public consultation issues), information-related (misunderstanding, confusion, dearth) and environmental (site -related & EIS criticism). The MFP argues that the site is crucial to the MFP concept, and on balance its restorative effects will be major and almost immediate, whereas the present long-term government discounting of the importance of local social, environmental and environmental health issues is no longer tenable. A vigorous research effort has identified over 50 opportunities for energy and materials-saving refuse-resource coupling of industries and innovative environmental projects around the MFP site. Saleable spinoffs include bricks, pavers and agricultural products from initially contaminated sewage.

By 1993 a step-up project of 70 dwellings near the MFP site (NEW HAVEN VILLAGE) will prepare sceptical local developers and builders for the even more radical stage I, which should, politics willing, be completed in 1996.

ADDENDUM: PRESENTATION NOTES.

HISTORY

The MFP was first suggested by the Japanese Ministry for International Trade and Industry (MITI) in 1987.

The initial concept development was funded by Australian & Japanese companies under the umbrella of their Governments in association.

Many political twists and turns later, it is very different from the self-contained, multi-function technopolis first mooted by the Japanese.

The MFP is now clearly an Australian project. It is hoped that it will contribute to the improvement of Australia's overseas equity and the local job market. We presently have 12% unemployment nationally and for young people in Adelaide the figure was recently 47%.

The MFP's interest in collaborative ventures is not limited to Japan, and it has an International Advisory Board from 10 countries.

Its goal is the provide leadership in a balance of three areas:

BASIC VISION

This is the basic vision:

- An international centre of innovation and excellence in the use of advanced technology.
- A social model for the 21st. Century based on equitable social and economic development.
- A model of conservation and management of resources and the natural environment.

TWO ELEMENTS

The MFP intertwines two basic manifestations:

- An extensive, centrally-coordinated economic effort
- An urban expression as 21st. Century city: a physical development based around a core site.

CORE SITE

The official planned core site is located on the LeFevre Peninsula. While this site is integral to the environmental management side of the MFP, there are political issues which may interfere with its location here, and even with the establishment of an urban development at all, however at the time I left Adelaide (June 1993), this was the accepted arrangement, and the details I will present will be the generics for the urban development as conceptualised at that stage.

The core site is 2,343 hectares. It is handy to the port and the airport, and 15-20km from the CBD.

This is a long-term project: over 20-30 years, and will house some 50,000 people.

It will reduce the sprawl on Adelaide's fringe areas by about 30%.

ECONOMIC BASE

The economic base is crucial to the survival of a project like this, especially in a recession, and this is the chief present focus of the new CEO who was head-hunted from Honeywell a few months ago.

The State Government has announced a 10-year tax holiday for MFP businesses and has designated it an enterprise zone.

The project will be funded from Commonwealth, State, Local and private sources.

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From CEO Kennan: Better Cities $40m (rehab.); $130m remediation; $160m State Govt.; outgoing $350m, receipts $220m; expected shortfall at Phase I $70m ($A).

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THE KEY CONCLUSIONS OF MANAGEMENT

The key conclusions of management as to the appropriate 21st century industries for targetting by the MFP were as follows:

- Information Technology & telecommunications (IT&T), especially software development
- A media production centre for the Asia-Pacific
- Building up the two Science Parks which are already part of the MFP.
- Research & Development in a variety of high-tech areas
- Environmental remediation & management
- Education (including a world university linking existing universities through the MFP, and electronic-based education systems) and
- Employment

PRESENT SITUATION

Telecommuting through an extensive fibreoptic system (MFP telemedicine is already on trial, linking country hospitals with big city hospital expertise)

These industries would support the sustainable urban development principle of access by proximity - shifting information rather than people.

The MFP is aiming to generate 1500 skilled jobs per village of 4500 people plus infrastructure (get right term) flow-ons at the locally-established rate of about 1:1.9. Local schools would be involved in providing courses which ensure local young people will have access to appropriate training to compete in the MFP job market.

It has been said that overseas skilled workers will want to live in the more fashionable Eastern suburbs near high quality education and International Baccalauréat access; if so their commuting would be a problem for sustainability. The provision of proper public transport options to the city in advance of occupation would make sense while awaiting the critical mass for advanced transit.

R&D

At this stage the MFP is involved in a lot of R&D.

Feasibility studies for its Service Company are proceeding.

This company will provide integrated waste management and energy services to the site, including service reticulation, for which the use of an umbilical cord system as used in oil rigs is being assessed for suitability.

The efficiencies derived from this coordination of service provision will substantially reduce development costs.

Some of the most interesting of the MFP's activities so far have been the creative combination of waste products from local factories, and about 50 such opportunities have been identified.

A favourite is the use of contaminated sewage and alkaline grits from the soda-ash factory to make saleable items like agricultural products and bricks ("shit-a-bricks" so-called), which are already selling well.

This avoids the present practice of dumping waste products in the river or sea, or stockpiling them.

There are many examples of presently wasted resources the MFP hopes to use better:

The Torrens Island power station outputs 40°C water, interfering with local marine ecology. It is hoped that computer modelling will assist in understanding the management of the Barker Inlet which is affected by a number of adverse urban consequences.

This methane from the Wingfield rubbish dump could go directly to a factory. It is presently being bottled and will be available for about 30 years. The Garden Island dump will likewise be a source.

SITE ISSUES: MODELLING TOTAL CATCHMENT MANAGEMENT

The core site is damaged land; better than building on the little quality agricultural land we have left (a source of economic benefit from intellectual capital around site cleanup).

There is a high, salty water table.

It's low and swampy - that's MFP land there: contaminated in parts from industrial use throughout its history (about 10%), a rifle range with mineable lead pellets: knowledge derived from remediation of this site would be relevant to similar situations world-wide.

Red tides in the Port River from algal response to sewage outfalls, have caused occasional mass poisonings of fish, and temporary measures will no longer suffice.

The mangroves are under threat for many reasons.

12% of Adelaide's storm waters cross this site.

This has severely damaged mangrove and samphire swamp communities which provide nurseries for the local fishing industry.

Heavy metals have built up along the creeks.

Total catchment management and estuarine management are now in progress.

The Gillman site is fundamental to the environmental management side of the MFP, but the MFP is anxious to be seen as function-oriented rather than fixed to a particular site or form at this stage.

3 GOALS

The MFP says it is trying to integrate and balance the three goals of

- People
- Technology
- Environment

COMMENTARY ON SLIDES

- Environmental management rather than mere cleanup, will enable sale of the expertise so developed.
- MFP plans to build an Environmental Management Centre, which will house the Australian Commonwealth and South Australian State Environmental Protection Agencies.
- An early concept sketch had a strong canal focus - not necessarily valid today.
- Here we have villages surrounded by fields, forests and water features - canals and lakes.
- Soil quality and water flow are issues, and building rafts would have to be established well above the current land surface to avoid salt and heavy metals.
- Stagnant water must be avoided as there could be a local mosquito problem.
- Material for these platforms could come from a large uncontaminated sand area, leaving a possible site for the proposed artificial wetlands for storm-water treatment.
- The engineering side of the MFP will be similar to this development with an artificial lake built 20 years ago at West Lakes. This won the prestigious Prix d'Excellence (FIABCI) last year. *[Note 29/12/00: this development was, like the MFP current proposal, done at the expense of extensive natural wetlands. There has been a major upset in 2000 due to the discovery that contaminated materials were used in the pre-development phase, to build up soil in what is now a residential area].*
- Energy issues are of primary importance, and an energy management performance statement will demand domestic and commercial criteria of the highest standards technically available.
- Designs must follow the principles of "less waste, less harm to people & environment, and less use of non-renewable resources".
- Costs must be built into long-term funding, not perceived as optional add-ons.
- The target for energy consumption is 50% decrease on Adelaide average overall, and 70% decreased fossil fuels.

This translates into such strategies as:

- Resource conservation & recycling
- Service coordination
- Living near work
- Discrimination against cars
- Renewable energy (later)
- Site design for solar access
- Passive solar housing design
- Demand management
- Efficient appliances
- Peak load stripping
- Education (including direct feedback metering)
- Further R&D (ongoing)

Urban design features favoured include:

- Multiple land use
- Higher density housing: 50 residential units per ha.
- Pedestrian domination
- Social integration with surrounding areas
- Community development strategies
- Water management: recycling storm & grey water,
- Dual household reticulation, aquifer recharge
- Waste management: industrial & domestic recycling
- Local sewage management
- Technological enhancement: fibreoptics throughout
- Leading edge transport.

OTHER POINTS IF TIME

All of this is currently extra-ordinary for Australian housing developments. Even the Olympic eco-village is not so ambitious.

The MFP Board recently decided to ensure control of the first stage by NOT handing the project over to developers.

Being established by its own Act of Parliament, it has the advantage of not being beholden to Local Government controls and obstructions.

In fact it is working cooperatively with the Councils of the surrounding areas in the so-called North-West crescent.

Surrounding areas in Port Adelaide and the North-West crescent are the most socio-economically deprived and the most industrially polluted in Adelaide.

Yet the gentrification process is starting too: this is a lively area by the sea & river with many lifestyle options.

Considerable effort is going into integrating the MFP with surrounding communities.

A Community Services Strategy Plan is being developed abd work should by now be under way with surrounding households, special needs groups, special interest groups, service providers and key local people to establish how to strengthen the North-West crescent service facilities in preparation for integrating use by MFP residents.

It is expected that up to 60% of residents will come from surrounding areas.

The survey will also identify special wild places and other features of local social value so that they may be preserved: such as the local fish market.

There will be direct consultation of local people about their needs.

A statutory South Australian Community Advisory Committee is also being set up.

Answering criticism, the MFP argues that it provides desperately needed leadership.

While it may cause minimal environmental damage locally, its restorative effects will be major and will have region-wide benefits.

Furthermore, they say the do-nothing approach to date is no longer tenable, and funding for straight cleanup will not be forthcoming from a Government in recession.

The MFP appears to have out-waited environmentalist objectors, having been quiet during the phase of search for the "right" CEO and permanent Board of Management.

It is now entering a new phase of activity.

A design competition for a "step-up" project of 70-80 houses near the MFP site will shortly announce winners and a very high standard of entries.

This will be built next year and is designed to provide a learning experience for sceptical local builders and developers, to prepare them for the even more radical stage I.

It will also provide vital information about processes, materials and technologies.

It was hoped that the first people would move into villages in 1996, but a lot of economic consolidation, social development prioritising and other preparations will precede the call for design concepts for Stage I.

This had been planned for late 1993 when I left Adelaide 4 months ago, but I am unable to give the latest news on this.

5.2 TRANSACTIONAL ANALYSIS AS A MULTI-SCALE MODEL FOR THE SOCIAL SCIENCES

TRANSACTIONAL ANALYSIS: AN ESTABLISHED, POST-FREUDIAN, INDIVIDUAL/SOCIAL PSYCHIATRY MODEL, ALREADY USED IN ORGANISATIONAL DEVELOPMENT, AND CONFLICT RESOLUTION, POTENTIALLY APPLICABLE TO SOCIOLOGY AND FORMAL SOCIO-CULTURAL ANALYSIS ACROSS MUILTIPLE SCALES

INTRODUCTION

Transactional Analysis (TA) is a well-tested, unified system of Social Psychiatry, a "relational system of behavioural analysis" (Abraham & Shaw 1992;Forman & Ramsburg 1978: 23), which is capable of working at several scales, and of bridging and explaining micro-meso-macro relationships. It is a window on dynamic social ordering principles which through its application to an issue immediately defines the direction of healing work. The model has easily comprehended, generic explanations for structures and processes and underlying human psychological needs, (see Criterion Organism) behaviours, and interactions, and for the complex constraint set that socialises and individualises behaviour.[18] One of its great virtues is the flexibility with which it eclectically accommodates an array of change strategies, and explains their mechanisms in easily comprehended terms. Its roots go back to Eric Berne's observations of Army conscripts during World War II.

Two of Berne's early books were well known publically: *"A Layman's Guide to Psychiatry and Psychoanalysis"* (1947) and *" Games People Play"* (1964). The latter was thought by some to be frivolous, but a closer look would elicit the term 'ingenious'.

TA's commitments to mutual respect, contractual business and therapeutic relations, personal emancipation, continuous learning and enjoyable yet candid, cooperative participation, 'on the side of the Child', make it well suited to 21st. Century issues. Its Game Theory is not that of Economics, but has much to teach conflict resolvers and human resource managers. Its initial conditions consisted in a reaction to the limitations and inefficiency of Psychoanalysis[19], which led Eric Berne (c.1956) to intuitively observe actual behaviour of clients instead of mechanistically applying psychiatric labels to them (Steiner 1974: 9-12).

LINKS WITH OTHER THERAPIES & THEORIES

TA already contains a number of recently-announced 'new' ideas, emanating from psychiatrists (for example grief or trauma work by scenario completion, narrative therapy as a strategy to honour the individual and defuse a destructive social Parent and other trauma, certain types of dream work and Art Therapy, and post-traumatic stress disorder work involving internal conversations. It dovetails nicely with the anthropologically-initiated Social Bias Theory or Group/Grid Analysis developed by Professor Mary Douglas (Douglas 1982a;1982b;1985;Douglas & Wildavsky 1982), links with Neuro-Linguistic Programming (NLP) (see Paper below) and Ericksonian Hypnotherapy, and transfers comfortable across cultures (especially the work of Western Australian group in Asia and the European Association for Transactional Analysis EATA). It also dovetails well with Process Oriented Psychotherapy, a Neo-Jungian system emerging from Zürich, and now based in Portland Oregon. 'POP' or 'Process Work' has tended to specialise in psycho-spiritual matters, the (archetypical) world-scale ('world channel') issues of the Collective Unconscious, issues of serious illness (AIDS, cancer), race, conflict and oppression, large-scale work (thousands), town meetings and 'Deep Democracy'. It actively embraces Chaos and Complexity Theories. Having worked with both, I can see many ways in which these two modalities overlap and complement each other. Theoretical discussions in the TAJ are tending to increasingly emphasise communications, conversation and narrative theories, as would be expected in a Postmodern setting.

SCHOOLS AND APPROACHES

As a model developed initially to explain inter- and intra-personal communication, in a context of individual and group Psychotherapy, Transactional Analysis Theory is less intensively worked out

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[18] Transactional Analysis does not have an explicit Complexity Theory basis, although the structure is compatible with this theory, and early works did refer to it as based on Systems Theory (Childs-Gowell 1979).

[19] Postmodern analysis appears to be inclined to quote Freud. Although Transactional Analysis is neo-Freudian, it is distinguishable from this theory on many grounds, and is far more comprehensive conceptually.

at society and nation scales, yet is already a rich, working conceptual system, and many of its terms have passed into the vernacular (for instance 'script', 'strokes', 'warm fuzzy', 'inner child', 'games people play').

The full suite of professional options includes Structural, Transactional, Game, Racket, Systems (especially family) and Script Analyses as starting points, but there are also a number of specialist Schools and strategies of TA, which have been developed for application in personal growth and individual and group psychotherapy of normal 'neurotics' (Redecision School, McNeel Parent Interview, TA-Gestalt, English/Erskine/Trautmann Racket Analysis, Kahler Mini Script), psychotics (Cathexis School), gaol populations (Asklepion School), alcoholics & power relations (Radical Psychiatry, Steiner), organisations (Jongeward & James, Ernst OK Corral, Jongeward), the Church (James, Harris), parenting (Hallett, James, Ernst, Steiner), education (Jongeward & James, Chapman, Steiner) (Family Therapy (Bader,), Developmental Psychology (Levin), conflict resolution (Jacobs), self therapy ... the list is very long, and the Transactional Analysis Journal (TAJ) and other publications produce more every month, mostly in the Psychotherapy, Ethics, Organisational Development and Education realms.

There has always been a smaller branch of Theory and Practice in TA that concerned itself with bigger pictures. One of Berne's earliest books was *"The Structure and Dynamics of Organizations and Groups"* (Berne 1975), and his *"What Do You Say After You Say Hello?"* extends psychological Basic Position theory from individual interactions to wider social dynamics (Berne 1972: 85-9). Social psychiatrist Dr Claude Steiner's early work in 'Radical Psychiatry', the therapy of alcoholism and concerns of power and society, did much to develop the theory in these areas, and his Stroke Economy theory has powerful explanatory relevance beyond psycho-social health to the whole area of Social Psychology and Marketing (See Criterion Organism under Unified Human Settlement Ecology)(Marcus,Steiner & Wyckoff 1974;Steiner 1971;1974;1977;1981). Social and Cultural Scripting are ongoing subjects discussed frequently in Transactional Analysis journals (for instance see Jacobs 1990;Jacobs 1991)[20], and the Transactional Analysis listserver. Transactional Analysis theory is also currently under specific review under the guidance of Steiner, for the purpose of better addressing the negative larger scale communications issues which are escalating worldwide[21]. **Link: Structural Analysis (below).**

BASIC NEEDS: 3 PSYCHOLOGICAL 'HUNGERS'

At the centre of the model is a concept of Basic Needs (see Criterion Organism) for psychological health and well-being. There are also 'hungers' for having a Position on self, others and life; Stimulus, which may be physical, verbal, nonverbal, conditional, unconditional, positive or negative, and mediated by 'strokes', the 'unit of social intercourse'; and Structure: one of six activity classes – something to do with your time - that provide meaning in terms of your own Script.

LIFE SCRIPTS

Transactional Analysis has a Theory of Life Scripts, which describes developmentally how a personal Script (a set of individual organising principles) comes to be structured (as an integrated and evolving set of Decisions). Redecision or rewriting of parts of the Script is the personal goal of Psychotherapy or personal growth, whether or not explicitly stated. Similar goals apply on larger scales, as in Ireland or East Timor. In organisations, the Script tends to remain that of the founders unless a period of Creative Destruction results from the appointment of new management structures (see Berne 1961;1972;Erskine 1997;Erskine & Trautmann 1997;Goulding,Goulding & McCormick 1978;Schiff 1975;Steiner 1971;1974;1981).

The personal Life Script[22] is an emergent entity that reflects the collection of perceptions and individual life experiences, interpretations and immature Decisions that result in this feedback looped, complex dynamic situation (a personal 'construction of reality' as postmodernists would say). Script is both a reference system for personal, organisational or cultural orientation, and a constraint or ordering system. Script structure, which includes a constellation of generic organising principles such as Drivers, Injunctions, Permissions, Decisions, Racket Systems, parent

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[20] Jacobs has written a number of papers which analyse the dynamics of the WW2 Holocaust, nationalism and power relations in society (for instance see Jacobs 1990).

[21] Personal Communication 9 March 1999. "I agree that therapies that deal actively with conflict and oppression will become more and more necessary. You may or may not be aware of the fact that I have become very involved in helping ITAA 'go upscale' as you say. What I am doing is to work out a set of core concepts which has a large majority of support within our community so that we can present ourselves to the rest of the healing communities as a coherent, understandable, sensible point of view from which to go upscale." The International Transactional Analysis Association is a global body with many thousands of members.

[22] Proposed by Berne and theory extensively developed particularly by Steiner, Bob & Mary Goulding.

figure modelling, Basic Position, Time Structure, transpersonal, intra- and inter-personal systems, and Stroke Economy, is applied in the individual case through processes that depend on the client Contract. Structural and Functional Analyses are both used. Script is referred to in the text above as a personal Metaphor: a personal life plan, usually carried pre-consciously, not unlike a play script, from which the term is derived. Its effect is similar to having adopted a set of policies, the most important made under five years of age, which then go on to organise one's life out of awareness unless brought to consciousness and Redecided. Transactional Analysis is widely used in organisations, where reference is made to 'Organisational Scripts' (Jongeward 1973;Villeré 1981). **Links: Feedbacks Criterion; Organising Principles.**

The Script forms a banal, hamartic (tragic) or healthily integrated frame of reference for perception and interpretation of the world, decision-making and behaviour. The existence of a negative filter (I'm/you're not OK: pessimistic or negative outlook; refusal to see the positive), a negative conclusion as to the character of the world, and especially a tragic Decision complex (for example 'if things get bad enough I'll kill myself') will ensure the building of a recursively driven negative memory bank, which may eventually be 'cashed in' on what is felt to be a justified negative outcome, constantly reinforced to breaking point by repetition[23], such as suicide, homicide, divorce or psycho-somatic disease. This type of approach has been developed to a high level by Richard Erskine with the assistance of others including Trautmann, under the terms 'Racket Systems' or 'Integrative Transactional Analysis' Theory (Erskine 1997).

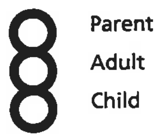
'POST-FREUDIAN'

TA is 'Neo-Freudian' in the sense that it understands personality to emerge from the interplay between personal givens and past personal environment, mainly before the age of five. Its message of hope for individuals lies in the concept that immature Decisions are made by the growing child, about the meaning of life and the way one must 'be' in order to survive psychologically or actually. Such Decisions can be 'Redecided', and therapeutic interventions based on this theory have proved to be highly efficient and effective in practice.

While TA recognises three 'Ego States', 'Parent', 'Adult' and 'Child' (PAC), represented by three circles, which bear superficial resemblance to the Freudian 'SuperEgo', 'Ego' and 'Id', and were derived from the work of Federn in the 1950s, such entities are not regarded as lurking in an unfathomable 'Unconscious', but rather, are easily accessible and physically visible in the body language under the many therapeutic strategies available.

EGO STATES (STRUCTURAL ANALYSIS)

Formally named 'Exteropsyche', 'Neopsyche' and 'Archaeopsyche', the Ego States represent respectively, the parts of the personality that are borrowed or transmitted from parent figures and other external people and sources (for example television), which may be nurturing or controlling; concept structures and responses arising internally from reality-testing, perception interpreting and information processing (person as computer); and layered personality structures arising from internal responses to external introjects, conclusions and behaviours related to the types of closure of Gestalts such as basic needs, in the formative years, and the broad sweep of emotional drives, responses and experiences ('behaving like the child you once were,' at different ages).



Structural Analysis is based on Berne's three pragmatic absolutes and three general hypotheses. **'Pragmatic absolute'**: a condition with no exceptions so far:

- Every grown-up was once a child.
- Reality testing is theoretically possible for every human being with adequate brain tissue.
- Every survivor of childhood has had someone in loco parentis or actual parents.

Hypotheses:
- Archaeopsychic relics survive into adulthood as complete Egostates (Child).
- Neopsychic functioning is not an isolated capacity but the reality testing of a discrete Ego State (Adult).
- Exteropsychic functioning involves executive takeover by introjects of perceived external Ego States (Parent) (Berne 1961: 35-6).

[23] 'Repetition compulsion': it is thought that the repetition is primarily driven at an attempt to resolve the archaic situation. This is unsuccessful as long as responses and solutions are reiterated unchanged.

'Ego States' are 'states of mind and their related patterns of behaviour', as the 'phenomenological and operational manifestations' of three corresponding psychic 'organs' (Berne 1961: 34-6, 30, 31). Like the axioms and assumptions of Science, the Parent Ego State (Exteropsyche) is the personal repository of assumptions and rules, which is first constructed through observation, imitation, parental teaching and experiment, to a large extent internalising the individual introjection derived from the combination of the behaviours observed and experienced at the hand of caregivers (usually at first the parents, but later extending to wider family, teachers, friends, shopkeepers, TV entities, ministers, movies, media, wider society etc.) This is the channel linking the individual & collective.

By automating behaviour, the Parent saves time and releases energy for use in other activities. A preconscious process of perception, with internal processing leads to a temporal lobe screening of the perceived situation for familiarity (déjà vu? jamais vu?), and if familiar, the option of automated behaviour or response exists; if unfamiliar, a newly constructed response occurs (Rounsefell 1993). This theory overlaps with another psychotherapeutic modality known as Neuro-Linguistic Programming (NLP), which was derived originally from a combination of computer science and the hypnotic techniques of Milton Erickson (Bandler & Grinder 1975a;1977).

An ongoing process of updating potentially continues through life, which adapts the personal function to current context, while rigidity in the Parent adaptations results in positions of prejudice, inappropriate response, conflict or displacement psychopathology. Process Oriented Psychology deals with the role of psychopathology of the collective being expressed through such as psychiatric patients who lack a personal 'metacommunicator', thus being vulnerable to projection themselves and to picking up those of others (Mindell 1988: 23-43). Part of the healing process for such people therefore involves working with the patient on the role he or she is playing on behalf of society (such as holding up a mirror to it), and includes setting the patient to work in society in conscious and constructive ways.

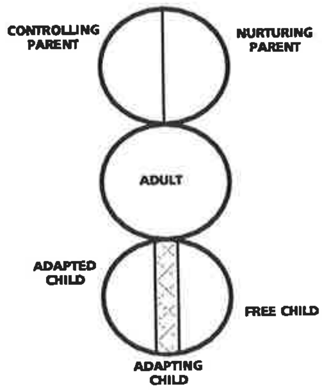
The emergent entity of the collective, the 'Social Parent' or 'Cultural Parent' (or 'Organisational Parent' in organisations) will reflect the mechanism for reciprocity between individual and society. Updating is a combined effort of the external- and internal-perceptive, creative, data gathering and assessing, and personal historic aspects of the personality, and in situations of psychopathology may need therapeutic assistance. Perception is constrained both by physical characteristics of perceptual organs and the set of Script constraints (which govern interpretation) relevant to the situation. All these potentially dissonant voices are held in intuitive interface until 'subdivided off' through other constraints (the Script Decisions), or a new structure emerges. This may be through dreaming processes, behavioural repetition (as when learning to ride a bicycle), a tension-relieving psychological Decision, which may be conscious or preconscious, or through a formal TA technique of Decision-making which is based on this theory. Unresolvable dissonance may trouble the subject in the form of indecisiveness, alternating inconsistent behaviours, mental preoccupation (rumination) or nightmares.

Reality testing is a function of the Neopsyche (Adult Ego State), which is more or less brought to bear depending on the relativities of the Parent-Child relationship and the situation.

The Archaeopsyche (Child Ego State) represents the young, feeling and sensing, creative and child-like aspects of the person; unlike the Freudian Id, this is an observable state of being, in the case of adults taking the form of behaving like the child he or she once was. The Child is actually the chief controller of psychic energy, its wellbeing determining how the other Ego States are cathected, and usually driving the choices and decisions which are later explained 'rationally'. It is often justified through appealing to social acceptability through the other Ego States.

FUNCTIONAL ANALYSIS

The three circles representing Ego States may be used in two ways: for Structural Analysis, which may be of various orders of nestedness, usually no more than three, and for Functional Analysis, where the Parent and Child Ego States are divided vertically to produce Nurturing/Controlling divisions for the Parent and Free/Adapted for the Child. A distinction may be made between'Adapted' and 'Adapting', the former representing the limitation from Script decisions in the former, and the flexibility of the free state in the latter. Each functional type has an optimal operating range, and they should all have expression in a well-harmonised psyche.



5.3 WORKING WITH VAGUE INFORMATION: Q-ANALYSIS & FUZZY LOGIC

Q-ANALYSIS & FUZZY LOGIC

INTRODUCTION

With attenuation of the stranglehold on Mathematics and Physics of the Newtonian School it was predictable that non-mechanistic approaches to these subjects would emerge. Weyl's Intuitive Set Theory is one such.[24] Both Fuzzy Logic and q-Analysis are based on Set Theory and work with pattern recognition and matrices. They are also both concerned with working with ordinary language and avoiding statistical data compression. More importantly, they consciously build bridges between the two lenses of Complementarity (see Subatomic Theory) and have unique approaches to connectivity which may offer useful strategies at a number of philosophical levels.

Q-ANALYSIS

> The whole point of classification is to make something complicated simpler and more readily understandable. The longing to understand something seems to be an inherent part of our humanity ... To categorise is to differentiate, and even in the old Latin root – *dif-ferre*, to carry apart – we hear the sound of division and separation. We also sense the tension of splitting and partitioning things in an even older root – the Greek *ταξιζ* or *taxis* – from which we get our modern word *taxonomy* ... ordering by division seems to be deeply embedded in our Western languages – and therefore in pour thinking in those languages.
>
> A place for each thing, and everything in its place – this seems to be the motto, implying that our boxes or categories exhaust the possibilities, and every possibility fits into one, and only one, box. It all seems so natural ... Many scientists still assume *[a purely natural order]* ... -getting closer to *the* Truth – unaware of the deep theological basis upon which their thinking rests. The partitions and taxonomies of the physical and biological worlds are not natural in the sense given by God (the paternalistic view), or of Mother Nature (the maternalistic view), but are impositions of ordering constructs created by us ... *[therefore]* they must always be subject to revision ... *[and]* this openness to the possib8ility of revision ... always characterises the best Science (Gould,Johnson & Chapman 1984: S38).

Q-Analysis was introduced in 1974 by RH Atkin as a mathematically based language of structure for application through computers in the Social Sciences, and Urban Design in particular (Traffic Engineering). In attempting a wholistic description, it invokes hierarchical systems of carefully-defined finite sets and cover sets which form the dynamic but relatively static 'Backcloth' on which any action or 'traffic' may take place and the relationships between them may be analysed (explained in Atkin 1974). This methodology was taken up, extended and applied by a group of enthusiasts, including Gould (UK → USA), Johnson (UK) and Casti[25] (USA, Vienna).

Gould[26] (Gould 1981: 98-9), a long standing proponent of q-Analysis, while stating that laws of human behaviour do not exist, considered Atkins' claim to the possibility of the description of 'meta-laws' or 'regularities'.[27] He compared the devastating constraints imposed on Social Science data by most forms of clustering and partitioning in multivariate procedures, which see their objects against a static background, with the ability of q-Analysis to "let the data speak for themselves" by avoiding Ideology while exploring structure, and at the same time retaining access to detail. It derives its ability to do this from its hierarchical structure, which is conceived in a Gestalt way (figure : ground: also used in Process-Oriented Psychology, using the terms 'primary process' and 'secondary process': the former representing the focus of current awareness).

Entities at a level are described geometrically through analysis of their connectivity, and a hierarchy of richness of connections ('q-connectance') is symbolised by the sharing of points, lines or surfaces of complex polyhedra. **Link: HST: A Nonlinear Approach to Qualitative Risk Analysis; Figure: Connective Structure for p-Surprises.**

Matrices are assembled to assist the Connectance Analysis (illustrated below). At any level of the hierarchy (N+1) "the Newtonian view" relates to "the Einsteinian view" through the interface between the geometrically or algebraically-described structure of the Backcloth or context

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[24] Hermann Weyl (1885-1955) wrote on the philosophies of maths and science and made "distinguished contributions" to many areas of theory including quantum mechanics and relativity (Prather 1986: 1).

[25] Casti has taken on the task of interpretation to the public (Casti 1993;1994).

[26] Author and geographer from Pennsylvania State University, recently deceased.

[27] See Transactional Analysis Script Theory this volume.

(Newtonian description), and its impact (through structurally derived, variably-intense t-forces such as social forces or pressures, organisational pressures, ambitions etc.[28]) on the traffic (N) in question, which translates (Einstein view) into emergent patterns experienced by an entity at that level. While this is regarded as an "Einsteinian" view due to its taking account of the social relativities involved, this translates more accurately to a Complementarity interpretation, taking care of the rate-independent realm of meaning and social interpretation.

Incidence Matrix for Relation λ*PRD* in a 15-Species Predator-Prey Network

λPRD	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}
x_1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0
x_2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
x_3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
x_4	0	1	0	0	1	1	0	1	0	1	1	0	0	0	0
x_5	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
x_6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
x_7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
x_8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
x_9	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
x_{10}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
x_{11}	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
x_{12}	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
x_{13}	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
x_{14}	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
x_{15}	0	0	1	0	0	0	0	1	0	1	0	1	0	0	0

(Transcribed from Casti 1994: 189).

A problem is first approached technically by extremely careful definition of structure in terms of cover sets (conceptual hierarchies; can theoretically use any hierarchy type) and subsets at many levels (N-x, N-1, N, N+1, N+2, N+x and so on: illustrated below), then interpreted, recursively questioned, and constantly refined and redefined as required. Variables in a complex constellation are first sorted into different hierarchical levels. Changes in the Backcloth, the extent of which will have to do with local meaning of the structure and T-forces, may generate the phenomena of attraction or repulsion towards a particular location in the traffic pattern (Atkin 1974: 51, 56-7, 65-6;Casti 1993; also Johnson 1981a;Johnson 1981b;1982;1990: 291-4). While interpretation and mathematical manipulation in q-Analysis are an esoteric skill, the basic concept of asking what Backcloth is likely or required to support a particular traffic is valuable in itself.[29]
Link: Unified Ecology: Scale: General Review.

Mixture of terms at different hierarchical levels creates conceptual, geometric & logical problems. Complex systems tend to be hierarchically organised, with complexity generated by interactions between and across levels (see diagrams on following page). If, for example, a 'Clifford Algebra' perspective is taken, the other perspectives are still present but discounted.

Understanding this, in q-Analysis, defined entities are 'drawn' from a hierarchical 'soup', and the system is defined through a language of cover sets and connectivity. Thus q-analysis demands extreme care in defining sets and hierarchical levels in both Backcloth and Traffic, from the outset (Gould *et al.* 1984: S35).

This approach allows users to choose and define conceptsin any problem area they choose, but the set definition must be relevant to the problem, and a need for refining is expected. Multivariate methodologies such as cluster analysis and numerical taxonomy rely on numerical information and use the new power of computers in old-fashioned, partitioning ways. Gould *et al* believe we should be seeking new ways to use computers, and demonstrate through a study of television policy and programming, how this may be done with q-Analysis (Gould *et al.* 1984: S57, S58, S39-S123). Other examples include Regional Planning (Gaspar & Gould 1981), and Traffic Management (Johnson 1981a). Q-Analysis seeks to include both numerical and other types of data, using a conceptual hierarchy of ordered cover sets moving from top-down.

Cover sets are often represented as cones, of which each represents all the elements meeting the defined criteria of membership at that hierarchical level. For instance the base of a 'Target Sport' cone may contain target shooting, archery, darts, guns, competitors. A hospital system may cover various departments including surgery, which in turn may cover intradepartmental work areas such as theatres, casualty, recovery ward; which may cover instruments, beds, surgeons, patients, some of which may be subject to overlapping covers (for example patient may be attached to

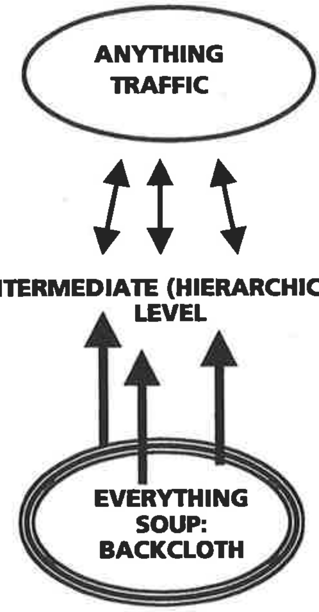
[28] **Link: Hierarchy Theory: Constraints.**

[29] Peter Gould personal communication 2/1996.

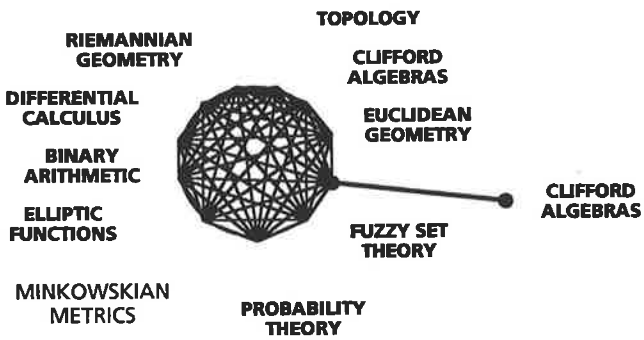
several of those areas, as may surgeons). Covering implies nesting, but elements may be members of more than one cover set (the cones overlap). Philosophical Paradoxes and humour may be solved through understanding that they depend on shifting between different hierarchical levels or from one cover set to another (Casti 1994: 182-5;Gould *et al.* 1984: S62).

The application of this Theory to frequency hierarchies, has not to my knowledge been pursued.

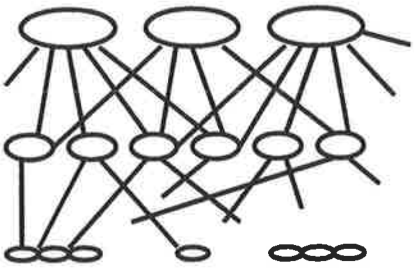
These two Illustrations are adapted from Gould *et al* 1984: S35, S57 respectively.



Hierarchy Based on Cover Sets



'Everything Soup'
Problematique derived from mixing hierarchical levels



Hierarchy of Set Elements

(Figures adapted from Casti, 1994: 182, 183).

APPLICATIONS OF Q-ANALYSIS

Q-chain risk analysis was described under Complex Dynamic Systems (Hypercyclic Systems Theory). An epidemiological example follows. Without an understanding of the mathematics involved, the main application for human settlement design lies in the Backcloth/traffic distinction.

Gould describes the difference between differential calculus, which gives a straight line graph because it assumes linearity in change rates, and the actual patterns seen frequently in natural systems, where a logistic or exponential system emerges due to feedback loops between components of the system (Gould 1993:155-167). He points out that while classical Epidemiology specialises in expensive, spatially blind computer models which average out infection rates, these are useless in predicting future rates and say nothing about where the next cases will be. In other words, while acknowledging that social traffics are arranged on a rate-related hierarchical Backcloth, not only must rate-related information be considered (time hierarchy), but spatial mapping (space hierarchy) is crucial to predicting location and conceptual hierarchy is needed for meaningful intervention such as targeted education, health facilities and so on.

Using a q-Analysis framework, Gould has been able to trace and predict the pattern of spread of AIDS by studying the q-connectance of the virus at several hierarchical levels (subcellular, cellular, organism, interpersonal, local contiguous and hierarchical transport-connected) (Gould 1993: 178-200). The constant question in his mind is "what Backcloth best supports this type of traffic *[AIDS transmission]* at this scale?"

FUZZY LOGIC

The things of the universe are not sliced off from one another with a hatchet, neither the hot from the cold, nor the cold from the hot." (Anaxagoras). "There are no whole truths; all truths are half-truths. It is trying to treat them as whole truths that plays the devil." (Alfred North Whitehead).

Thus McNeill and Freiberger begin their chapter on the story of the precise Lotfi Zadeh's conclusion from his examination of Complexity, that the real world is inherently inexact and contradictory (McNeill & Freiberger 1993: 14-23).

Fuzzy Logic allows human vagueness to interface with Computer Science, recognising a grey world where the black and white of Probability is a limiting case (McNeill & Freiberger 1993: 200-205).

> Draw a circle or oval (it will be inherently inexact):
>
> Now consider two competing views of the inexact oval. *Probability view* The oval is probably a circle. *Fuzzy view:* The oval is a fuzzy circle ... The Probability view commits to a property hard to find in the oval. Where is the "randomness"? The figure is fixed and static ... Probability has become our cultural default for uncertainty ...It casts a "random" mood over our verbs and descriptions and thoughts. It takes us from a simple state of being in "That is so" to a new world of quivering chance in "That is probably so ... The fuzzy view ... means that the figure is to some degree a circle and to some degree not a circle., but more a circle than not ... we can not draw a hard line between circle things and noncircle things. They overlap ... circles shade into noncircles ... the fuzzy view sees a, ambiguity or vagueness between thing and non-thing ...If trained in probability and statistics, we conduct a coin-tossing "random" experiment in our head and believe the inexact oval results as an outcome .(Kosko 1993: 46).

Johnson provides a clear exposition of the equivalence between Fuzzy (Possibilistic) Logic and Boolean (Probabilistic) Logic, which are equivalent mathematically as long as the truth values are either 0 (false) or 1 (true) (Johnson & Picton 1995: 175-206).

A territory battle between fuzzy and Probability proponents continues (theoretically apparently unnecessary, since fuzziness can include Probability as a limiting case). This is demonstrated throughout the IEEE Transactions on Fuzzy Systems special issue on Fuzziness versus Probability (vol.2, no.1,1994) where again, as noted under Section II 2.(i), one is reminded of the Lakoff & Johnson's *"Metaphors We Live By"* contention that symbolically, "argument is war", or of the Pastime described by Eric Berne in *"Games People Play"* known as *"Mine's Bigger Than Yours"*. There is also a Mythology of struggle set out in recent fuzzy literature and comment (Coveney & Highfield 1995: 73-6;Kosko 1993: 40-43, 48-54;McNeill & Freiberger 1993: 58-60, 243-83)[30].

Klir takes this argument to a new plane in his explication of the relationship between Probability Theory and Possibility Theory through Dempster-Schafer Theory which subsumes them both. By defining information as uncertainty reduction, and generalising Classical (probabilistic) Information Theory, it becomes apparent that there are two types of uncertainty co-existing within Dempster-Schafer concepts, which measure dissonance (non-linear function E, associated inter alia with Probability Theory) and nonspecificity (linear function V). Klir demonstrates that nonspecificity is not encompassed by Probability Theory, as often claimed in Classical Information Theory, and that the U-uncertainty of Possibility Theory does do so, and is a special case of (linear) function V, while Possibility Theory also extends to compatibility with Fuzzy Set Theory. The nested focal elements of Possibility Theory (defined by set membership) are not dissonant, and so are referred to as "consonant bodies of evidence". Because at the extremes of its normalised range (0,1), the values of a finite set of possible alternatives are the same as for the equivalent uniform Probability distribution, it is often mis-perceived that Probability and Possibility can be based on similar assumptions[31]. These are in fact quite different (Klir 1991: 133-141, 131, 135, 138).

The key difference is that Probability is like a betting system, designed to find the odds that a particular black or white event will occur. It seeks to 'tidy up' the real world in a way that loses a lot of information by such strategies as conflation, subsumption, aggregation or subdivision. It operates from an either/or, yes/no perspective. Possibility(fuzzy logic) operates from a both/and

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[30] **Link: Subatomic Scale: Quantum Theory: Uncertainty Principles.**

[31] If an event is 80% probable, then each time the opportunity occurs for its expression, there is an 80/100 chance it will and a 20/100 chance that it won't happen; if it does happen, it will be 100% true. This is like a betting system. Probability is about whether an event will happen. Possibility is about whether it can happen and to what extent. A fuzzy value of ·8 indicates a ·8/1·0 (8/10; 80/100) extent of membership of the set which represents the event in question: the situation is true to ·8 extent. Values of 0·0 or 1·0 represent the positive and negative poles of Probability, which at those points become congruent with the extreme states of Possibility (McNeill & Freiberger 1993: 70, 202).

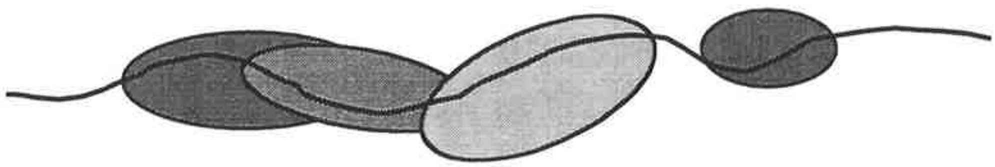
basis; and fuzzy sets represent Possibility, ranging from non-membership to membership smoothly, not abruptly.

Because it works with partial membership of sets, fuzzy functions can more closely imitate the real world; this provides an opportunity to work with natural language and situations of imprecise definition (for example the use of such terms as 'a lot', 'somewhat', 'many', 'often', 'a bit'). It has been found that the economically and computer memory-expensive outputs of precise, Bayesian Probability-based control systems[32] perform no better (and often less well) than fuzzy systems which work inexactly but take the grey zones into account, especially in situations with multiple parameters and many uncertain values (such as environmental problems)(Burrough & McDonnell 1998: 291).

Fuzzy control approaches deal with Chaos and Complexity by operating through a vague, language-triggered, rule-based system, initially expert-driven, which could be related to designing attractor and repellor regions on complex surfaces. This does not even attempt to represent faithfully all the elements of a complex system as does Probability[33], but works happily in areas with uncertain truth values (defining on a baseline, partially overlapping triangular zones of operation, one for each rule), and at a functional outcome level, confining system behaviour to an acceptable region by sensor and feedback mechanisms, which is similar to the mode of operation of natural systems (and probability-driven systems also).

A fuzzy system is just a big bunch of fuzzy if-then rules – so it is just a big bunch of patches. All the rules define patches that try to cover some wiggly curve. The better the patches cover the curve, the smarter the system. More rules means more patches and a better covering. The more uncertain the rules, the bigger the patches. The less fuzzy the rules, the smaller the patches. If the rules are so precise they are not fuzzy, then the patches collapse to points and they don't cover much of anything (Kosko 1993: 158).

Fuzzy products have microprocessors that run fuzzy inference algorithms and sensors that measure input conditions. The rule patches partially overlap and partially respond when triggered. Tradeoff levels between manageability and precision can be specified, and any continuous mathematical function can be approximated. Such a system is illustrated below. The best systems are hybrids between fuzzy processors and neural networks ('Fuzzy Adaptive Networks' – FANs), as they rapidly tune the network, using the best of both worlds: unsupervised networks create rules best and supervised ones tune best (Kosko & Isaka 1993: 64-7).



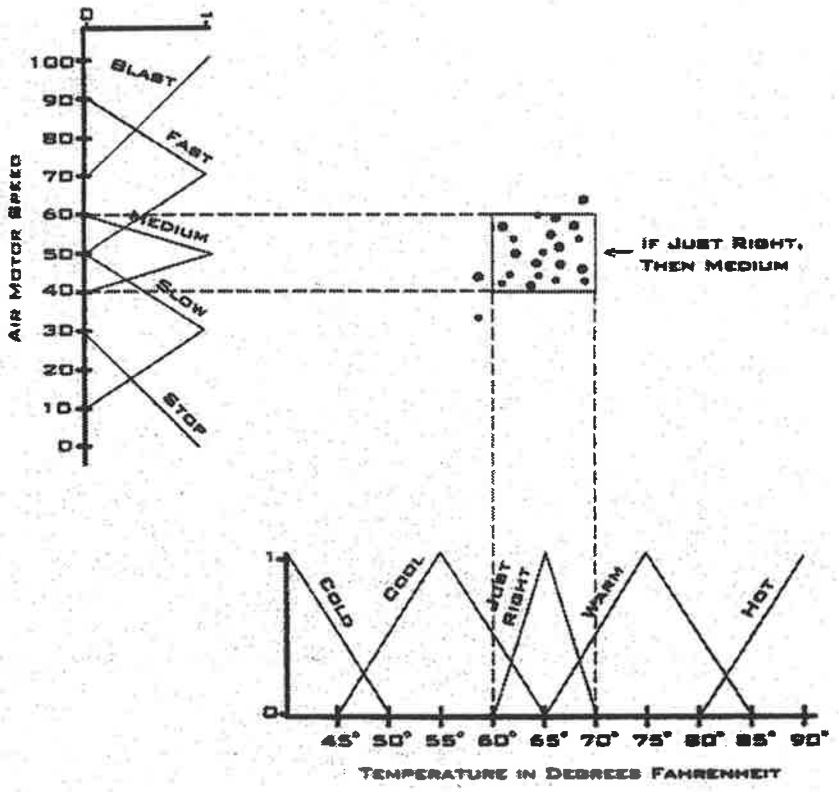
(From Kosko 1993: 158). See also Fuzzy Air Conditioner below (technical graph of control system).

[32] For industrial processes but also military purposes, such as control of helicopters, self-piloted aircraft and robotics: *"Proc. Flamoc"* '96 (Dimitrov & Dimitrov 1996b).

[33] Using vastly more computer memory and time in the process.

FUZZY AIR CONDITIONER CONTROL SYSTEM
(Scanned from Kosko 1993: 218).

Fuzzy Logic is well proven in industry and has many applications in industrial and transport control systems, pattern recognition, military remotely-guided systems, optics and smart technology such as Camcorders®, camera autofocus, fuzzy washing machines, and fuzzy vacuum cleaners, elevator and motor vehicle controls, (McNeill & Freiberger 1993: 162-9), medical equipment: insulin



pumps, infant incubators, anaesthetic delivery systems, pacemakers (Hooper,Járos,Hu & Baker 1995;McNeill & Freiberger 1993: 282) spatial database development (Hunter & Goodchild 1993); modelling complex dynamics (Kosko 1991); Dynamic GIS (Burrough & McDonnell 1998: 265-91), Economics (Macmillan 1978); decision making (Sun & Eklund 1994;Xiang,Gross,Fabos & MacDougall 1992;Zimmermann 1996;Zimmermann,Zadeh & Gaines 1984); complexity management (McNeill & Thro 1994); Artificial Intelligence (Johnson & Picton 1995;Kosko 1991;Kosko & Isaka 1993); computing with words (Zadeh 1995); Agriculture (Eklund,Sun & Thomas 1994); Land Use and Transport Planning (Bantayan & Bishop 1993;Smith 1992); data/image fusion for OTHR (Over The Horizon Radar) and MR (Microwave Radar) (Deer & Eklund 1995;Johnson & Kewley 1995); decision making/ Fuzzy Cognitive Maps (FCMs) and matrices (Hooper,Járos,Xiheng & Baker 1996;Whalen & Schott 1983); knowledge processing Taber (Taber 1991); Plant Physiology (Chapin,Bloom,Field & Waring 1987); Philosophy (Járos 1995); and myriad other applications (Dimitrov & Dimitrov 1996a;1996b;1996c).

On top of all this, a small number of people have apparently taken on the challenge of interpreting Quantum Theory through Fuzzy Logic (Koshelev & Kreinovich 1995).

Group decision making with weighted choices and social research can be done in new ways[34], and adaptive fuzzy expert systems can be linked to a GIS (Bantayan & Bishop 1993;Hunter & Goodchild 1993). Fuzzy expert information can easily be added on because it is a network not a decision tree, and in Artificial Intelligence, Fuzzy Adaptive Networks can define their own operational rules. Fuzzy decision making does not replace small scale collaborative decision making, but has

[34] Ordinary semantic differential questionnaires are in effect fuzzy information.

real potential for large group, regional scale or future large scale computer-based referendum-level decision-making. Nor does it command any particular system of values. As with so many powerful tools, it may be used in the service of benefit or manipulation of eco-social systems. An example from military sources gives an idea of this potential in the wrong hands:

Zadeh, its originator,[35] is working on fuzzy graphs and computing with words (Zadeh 1995 & pers. comm.). FCMs are one way to do complex 'what-if scenarios' and offer a different approach which does not attempt to exactly model the variables at all, thereby again saving on computer memory. This tool is currently under evaluation and needs development.§ Fuzzy Logic is finding its way into a wide range of research-based appplications, especially in Natural Resource Management and software programmes related to soil and water resource management (Ward,Ward,McBratney & de Gruijter 1989: 1).§

FUZZY LOGIC APPLICATIONS: OVER THE HORIZON RADAR

Clearly, the fusion of OTHR & MR data is a complicated problem involving complex sensors and human interaction. It is proposed to solve this problem and manage the complexity by using Fuzzy Logic. In fact the goal is to emulate a human *combining* and *reasoning* with tracks from multiple sensors of different source types. Conventional trackers can combine, but cannot reason about the behaviour of the entities being tracked, with respect to each other; humans do both. Therefore rather than physically modelling the problem, a *systems approach* is used and the *human reasoning chain* is modelled by using a *fuzzy rule based system.*

The generalisations available by using a fuzzy rule based system are due to the wide scope of the rules, including coping with non-numeric information. For example the additional information from a visual sighting 'they were both small grey planes' does not fit well into a tracker statespace vector, but by contrast is easily incorporated as a fuzzy rule. Thus the overall goal can be clearly seen; the attempt is to enhance the system performance of a suite of sensors, of different source types, by *adding a higher level stage.* Additional fuzzy rules could be developed in cooperation with the Australian Defence Force (ADF), to allow them to contribute their experience and knowledge directly.

ALICE: Always Logical in Connecting Events

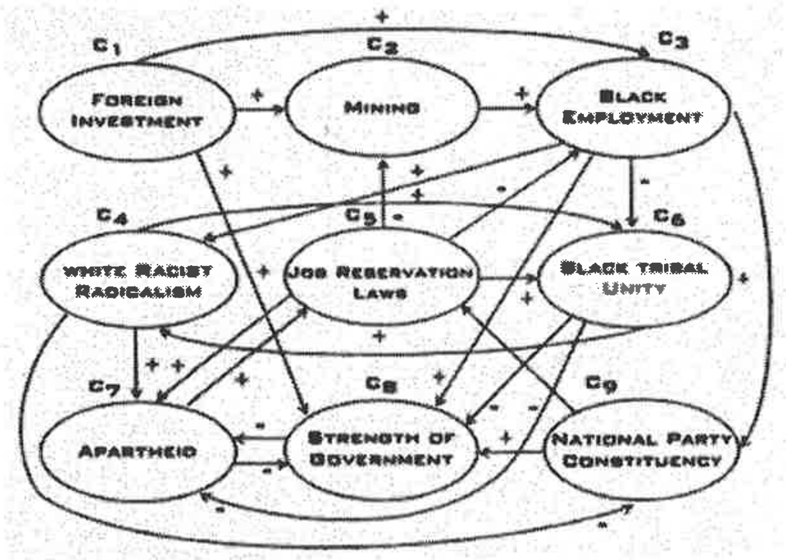
OTHR: Over The Horizon Radar   MR: Microwave Radar

(Based on Deer & Eklund 1995: 283-7).

[35] Originator of Fuzzy Logic, Prof. Emeritus of Electrical Engineering and Computer Sciences at University of California, Berkeley, & Director of BISC (Berkeley Initiative in Soft Computing). Keynote Address, Flamoc 1995.

FUZZY COGNITIVE MAPS (FCMS)

Taber discovered and Kosko took further, the concept of analysing a social or economic situation as a weighted matrix. The information source could be a series of experts or analytic papers written by one or more experts, each node being set to trigger at an arbitrary, experimentally derived or intuited level, and the system 'run' through a computer. Such a system settles after a few circuits into an attractor pattern, which gives an emergent system prediction according to the information used (Kosko 1991;Taber 1991). This behaviour can easily be demonstrated even by manual calculation and for simple plus or minus triggering rules.§ FCMs have potential in scenario, constraint and attractor research.



FUZZY COGNITIVE MAP

This FCM, on South African apartheid politics (from Kosko, 1993: 227) uses a simple +/- (causal increase/decrease) system to indicate direction (values can be expressed in the range 0,1 or –1, +1 or use words such as 'more', 'less'), and each arrow represents a Fuzzy Rule. The nodes (concepts) are also fuzzy, firing to a degree between)% and 100%. This FCM's nodes are derived from an economist's paper about the issues and relationships relevant to the situation in 1986. More can easily be added, and nodes can be turned on and off, as well as being modulated by weighting rules. 'Running' the programme leads to a dynamic equilibrium which indicates the presence of an *attractor basin*. This is a hidden pattern, that emerges over multiple iterations of the system.

FUZZY IF-THEN

Ordinary CMs work with long chains of If-Then rules. FCMs run like neural nets, and respond to feedback loops. Kosko learned to look for hidden patterns and 'edges', where turning off or on key nodes makes a difference to the outcome. FCMs behave as described under Chaos Theory in Volume 1: they settle into fixed point, limit cycle or chaotic attractor patterns, and stay there until the structure of the FCM is changed. Link: Chaos Theory.

The above FCM with all nodes on, to question high foreign investment, settled into a fixed point with nodes C1, C2, C3, C4, C8, and C9 on. When C1 was turned off after the system settled, indicating foreign disinvestment, the system settled into a limit cycle of two states. It alternated between [white racist radicalism + job reservation laws] and [black tribal unity + apartheid], the government having fallen, appearing to indicate social chaos and a race war (Kosko, 1993 222-235).

To update the FCM, one might go back and add other nodes called 'Mandela influence', 'meeting basic needs', 'ecological restoration' and other concepts such as 'Truth & Reconciliation'.

Link: Criteria: Feedbacks, Indicators: Fuzzy Sustainability Space.

OTHER POSSIBILITIES FOR COMPUTER ASSISTED PATTERN RECOGNITION

These include CNN chips and ever more clever GIS layer methods, computerised Environmental Threshold (UET – University of Queensland Depart of Planning§).

The CNN (Cellular Non-linear Network) chip and the CNN Universal Machine which enables its programming.

This is a multi-connected analog processor array which closely mimics natural visual function and operates at the edge of chaos. It has superior, direct discrimination ability well beyond the capacity of digital processors, which operate in a linear way. Machine vision will be enabled once the 1:1 mapping/size problem is solved, at present being limited to 64x64 pixels, with 128x128 in progress (The Economist 1999). I would speculate that nanotechnology may eventually solve this problem.

Mathematical approaches to complexity have been considerably assisted by the development of digital (and new uses for analogue) computers, which in most cases use an adapted general systems approach, increasingly often hybridised with expert systems and neural networks (Allen & Starr 1982;Bantayan & Bishop 1993;Barrow 1991;Hunter & Goodchild 1993;Lewin 1993;Shaw,Gallopin,Weaver & Oberg 1992). A cheap fuzzy computer chip was developed some years ago (McNeill & Freiberger 1993: 151-4, 262-7).

ANALOG-DIGITAL TECHNOLOGY LINKAGES

It has been found by Dr Helen Payne and her London team, that rich applications in biotechnology may be found by judicious use of the Complementary characteristics of analog and digital technologies in 'biologically inspired signal processing'. Digital technology has until recently been allowed to 'supersede' analog, but it is not recognised that analog has many functional similarities to natural systems, and is far superior in pattern, speech and image recognition. Whereas digital operates on an either/or process, excluding 'noise' brilliantly in such contexts as IT&T, where clarity of transmission is imperative, analog is a fuzzy, both/and system, using the full range of signals. Analogue is required for the actual transmission of digital signals in IT&T, so clever interfaces are crucial. Where a digital approach needs a separate transmitter (neurons are the biological equivalent) for every signal type, analog uses a single transmitter for all functions, using significantly less power and fewer resources. It is less accurate, but where many work in parallel, as in parallel processing or the brain, lack of accuracy is compensated for by superior overall function.

Current digital speech recognition is a clumsy, rigid affair, easily outclassed by even a human infant. Analog technology will revolutionise this. It is also being reviewed for use in speech recognition in Medicine, and Dr Payne's group is developing a finger-nail sized cochlear implant for subcutaneous insertion behind the ear, which exploits this new knowledge.[36]

[36] 5RN ABC Radio interview with Science Show, Robin Williams, 28/9/2000.

5.4 THE PROBLEM OF CAUSE

CAUSE: REVISITING AN OLD PROBLEM FROM A COMPLEX SYSTEMS PERSPECTIVE

INTRODUCTION

> Two broad perspectives permeate all branches of ecology ... first ... in a feedback loop, or system, one component affects a second component that in turn affects the first component; such loops underlie most ecological processes ... *[and]* ... may be positive or negative ... both may oscillate within a relatively predictable range through time ... a regulating or control mechanism to produce a relatively stable equilibrium ... second ... ecologists look for both proximate and ultimate factors in determining organism-environment interactions (Forman & Godron 1986: 33-4).

It is perhaps surprising that some 90 years have passed since Einstein's Relativity and some 30-40 years since Systems Theory emerged in earnest this century. Yet mainstream thought still aligns itself with mechanistic metaphors. Cause-and-effect thinking is kept well alive by politicians, with the comfortable machine language of snap-in/snap-out modular thinking, putting policy modules and various 'packages' 'in place': the techno-fix in full flight.[37] The mass media and politicians constantly feed community Stimulus Hunger by reinforcing our self concepts as Rescuers, Persecutors and Victims in the grand drama of life, and win elections or sell newspapers by indulging in targeted Rescues and Victimisation of Persecutors. Bemused by double-bound choices[38], witch hunts and Blaming Games, confused about what to do about apparently causeless, 'irrational' behaviours we see around the world, we look with naïve hope towards those who can give us certainty by claiming a moratorium on explanation, prediction and control.

Placing such high value on prediction in this society has demanded clear answers where none exist, and actual predictions are not routinely followed up, so their inaccuracy is rarely noticed. On the other hand there has probably never been a more litigious society than that of contemporary America, an unfortunate, witch-hunting approach that is now spreading across the Western world as we seek to blame each other for causing us pain and anxiety. While all due care may be taken, the requirement for this system is never to make an error of judgment, and for 'accountability' to presage financial ruin. Mistakes are hushed up and become unavailable for learning (the 'commercial in confidence' game). This, combined with the reduction of inputs from History and Geography in the school system, is creating a brittle, ignorant, consumption-driven community, timidly relying on experts, and vengefully enraged and litigious when its unrealistic demands, based on misleading claims to knowledge and control, are not met. The necessary experimental, learning approach to sustainable strategies becomes impossible. This is ecologically and socially unsustainable. An argument for a wholistic approach to causation follows.

SCALE AND CAUSE

Gibson *et al* remind us that Science consists in the discovery of patterns, and that patterns may appear and disappear as the resolution of investigation changes (Gibson,Ostrom & Anh 1998: 7). Geographers, ecologists, sociologists and others are familiar with mappings done in their areas of interest, that vary dramatically with scale, for example patch structure on landscapes. Gibson *et al's* warning about fallacies of scale in ascribing causation, should be repeated here, as they emphasise the risks of linear attribution of Cause.

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[37] This situation has been confronted almost to obsession over the last decade by Paul Downton, one of Australia's leading proponents of the ecological city, who when the MultiFunction Polis was alive, never lost a public-speaking opportunity to denounce the techno-fixing MFP and all its works[5].

[38] A favourite recent political game has been the neo-carrot-and-stick method of getting unpopular legislation passed. This is presented to the public as cause-and-effect: "your failure to vote for the sale of Telstra will 'cause' the environment to lose out". But the strategy in fact displays a high level of systems thinking ability, with adeptly selected leverage strategies. The unpopular legislation (privatisation of a highly profitable government monopoly) is linked to an offer that is difficult to refuse. For example one might remove most recurrent funding from environmental protection, and offer to bring it back after the sale only, in a form that favours somebody else (your own supporters), such as farmers, loggers, uranium miners, cotton growers, developers and other resource-exploiters. Simultaneously, voices of protest such as conservation bodies and environment-defending lawyers are constraining by de-funding, and told that there is now a funding squeeze and we must all share in the discomfort. 200,000 government-sponsored environment workers lose their funding linked to work-for-slightly-more-than-the-dole programmes. These are replaced by 2500 over 3 years, rebadged but similar jobs for youth only, which are promoted widely to sound like a new idea generous to youth, but very few benefit. This scheme is presented to the public with the help of a far-from-independent, monopolised media, as the most generous environmental scheme ever devised, and few members of the public have access to information that may indicate otherwise.

Explanatory Fallacies

SCALE & EXPLANATION		
DOWNWARD CAUSATION Key variables from a higher scale said to cause a pattern (dependent variables) at lower scale		**UPWARD CAUSATION** Key variables from a lower scale said to cause a pattern (dependent variables) at higher scale
FALLACIES TO AVOID		
Individualistic	Imputation of macro patterns to same cause as that causing micro patterns	
Ecological	Improper imputation of lower level operators as cause of macro patterns	
Cross-Level (intra-level)	Generalisation from one subpopulation to another at same level, without establishing equivalence of initial conditions	

(Gibson *et al.* 1998: 9).

PROXIMAL AND ULTIMATE CAUSE

Forman & Godron explain this philosophical issue in the context of Ecology. Proximate factors have, on the surface, direct impact, and ask the questions 'what?' and 'how?'. Ultimate factors answer the 'why?', questions (Forman & Godron 1986: 34-5): they explore the supportive Backcloth that allowed the emergence of the entity in the first place, the 'conditions for emergence', which may refer to many processes and conditions such as evolution, thermodynamics, climate and environment.

Peat gives a nice illustration of a game of tennis. While the causal aspects of tennis dynamics appear to be quite distinct, and classically explicable, a very different story is revealed by a wholistic approach. The degrees of freedom underlying the emergent velocity and position of the ball include gravity (affecting the whole trajectory through spacetime curvature due to the Earth's mass, but influenced by local geomorphology, lunar phases, distant celestial bodies and masses of players); air resistance (whole trajectory effects, but influenced by ball velocity and air density variations due to temperature, humidity, and nearby vegetation); and air currents and winds (related ultimately to Coriolis forces, global weather cycles and currents, terrain-induced modifications, regional perturbations, local urban microclimate effects) (Peat 1987: 43-4).

With perfect knowledge of the initial conditions for each element and for the system as a whole, 'cause and effect' could perhaps be spelt out, but in reality is inherently meaningless. Even Einstein's famous relativity equation has had its complex elements excised. Where the outcome is trivial, as in tennis, one can afford to relate to deterministic aspects, or to wager on a probability system. But intuitive 'tips' on the winner arise not from a probability calculation, but from an internal consultation with the ('right') brain, which uses a wholistic, possibilistic patterning system. If the issue is the safety of a nuclear power plant, however, Possibility Theory is the key to the optimum.

This leaves us with Classical measurement and prediction for limited, convergent problems, and the other side of the Complement, pattern recognition and field connectedness, to explore context. At least we are in a better position to explain what happened in the past. Chaos Theory, Fuzzy Logic and q-Analysis all allow for pattern recognition, and patterns may well be recognisable, but as a tendency for divergent issues, not a prediction. With deterministic chaotic conditions apparently applicable to the full spectrum from the subatom to the universe, questions arise as to the roles and meaning of causality, randomness and free choice.

A WHOLISTIC THEORY OF CAUSATION: COMPLEMENTING 'CONDITIONS FOR EMERGENCE' WITH 'CAUSE AND EFFECT' AS PROXIMATE CAUSE

Many disciplines appear to agree that causality should be regarded as a wholistic matter, requiring a systems view. The existence of chaotic conditions at all scales demands a new, scale and field-driven concept of Causality (and thus prediction). Kosko offers partial set membership and the Fuzzy Logic understanding of nonlinearity as a more accurate approach to the real world (Kosko 1993: 44-64).[39] The concept that multiple degrees of freedom may best be regarded as an

[39] I have suggested the possible usefulness of a fuzzy interpretation of Quantum Theory to three different people with knowledge of subatomic physics: in each case the instant response was to glaze the eyes and move onto another topic without any satisfactory or reflective response to the suggestion at all. My interpretation of this is that mathematical physicists are so steeped in the absolutism of Probability that they are unable to consider the mathematics of Possibility (possibly not being familiar with the mathematics involved). I have the same response from orthodox medical

interference field, where the elements each have needs thresholds and optimal rate ranges for participation, and the field outcome is seen as an emergent entity dependent on the attractor-repellor topology relative to each component. This begins to express the ecological approach to Complexity (or the complex approach to Ecology). While the logic of such a system is 'multi-valued' or 'non-deterministic', each element actually has its own little field of determinisms, Constraints and thresholds, which can be partly comprehended in Classical ways through reductionist research.

Ascription of Cause is dependent on the functional loop leading from perception to interpretation via a metaphoric or Script Frame-of-Reference filter. The brain does not 'pick up information from the environment as such, ' but rather specifies what will be received as a perturbation pattern and what changes will ensue if such a pattern be discerned (Maturana, 1988: 169). Stimuli for which the brain (and ears and eyes) are not tuned are thus not detected, and are effectively invisible. This is labelled 'Structural Determinism', and so has implications for a concept of Cause. A similar situation pertains in ecosystems which operate at specific frequency ranges and ignore data coming at frequencies outside this range, short of physical disruption (**Link Hierarchy Theory**)[40]. The perception is very unlikely to encompass the whole picture. The postmodern concept of a plurality of 'constructions of reality' is well-founded in Science.

Lakoff & Johnson's type of analysis of linguistic metaphor also supports a systems interpretation, experiential gestalts rather than concrete entities that create something in a simple way. Concepts of cause are core organising principles for physical and cultural interpretations of reality (Lakoff & Johnson 1980: 69-76).

Philosophically, by ignoring meaning or by rejecting mechanistic thinking in the name of rejecting Dualistic Ideology, we discount half the Complement: the ecological paradigm needs to transcend and integrate both. Causal chains have been the principle of unity and order in Classical description, however in *"The Paradox of Cause"* Miller demonstrates the abstract nature of the property being researched, since all but this property is excluded, so that scientific experimentation can never explain the whole world or object of study (Miller 1978: 14-15), but is inherently restricted and looks outward to an inherently teleological larger ideal. This accords with Schumacher's description of convergence and divergence (Schumacher 1977: 144-7).

Another model[41] promoted by Altman and others, regards time, continuity and change as intrinsic to psychological phenomena, inseparable from their contexts, both physical and social. Altman claims to understand phenomena through a *formal cause* approach rather than the Aristotelian efficient (antecedent/consequent), *material cause* (self-characterising substantial agent) or (ultimate objective) *final cause* (Altman 1992: 268-9;Blackburn 1996). Altman agrees with Rogoff that time and change are not psychologically separate considerations: every event is unique.

Maruyama, originator of *'the second cybernetics'* (recognition of the deviation-amplifying function and creative essence of positive feedback in dynamic systems, 1963), recognises a number of different *'mindscapes'*, ways of thinking or logical approaches (**Link: Criterion Community: Clues to the Convivial Society**). They have bearing on interpretation of reality, selection of Metaphors, ascription of Cause and interpersonal and intercultural fit, in situations requiring good communication, innovation, productivity or delegation, such as within organisations or in international business. These tend to be present in all cultures, but four types are most common, and cultural differences are often profoundly related to general espousal of particular logical styles (Maruyama 1994: 1-3, 75-87). Thus, subcultures are not homogeneous in their approach to Cause.

McNeill & Freiberger explain the relevance of paradox to the conceptualisation of causation. Cantor Set Theory describes the four mathematical operations which can be applied to ordinary sets: *containment, complement, intersection* and *union*. However these operations are affected by the sorites paradox ('the paradox of the heap'). When does a heap of sand stop being a heap as one removes grains one by one? This is a classification problem and many named examples exist. They are usually solved by 'drawing a line' (McNeill & Freiberger 1993: 26-7). This paradox illustrates the tendency we all have to round things off for convenience, but unconscious

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practitioners to the mention of Chiropractic, and from Christians when I mention witchcraft. I subsequently discovered an article on Fuzzy Quantum Theory **(Link: Background Paper: Working with Vague Information: Fuzzy Logic)**.

[40] There is clearly an intuitive understanding of these principles in social realms, as English at least is rich in allegoric or metaphoric reference to sensitivity to frequencies: for example 'being on someone's wavelength', 'in sync', 'in harmony', 'social discord', 'dissonance', 'too speedy'.

[41] Transactional Psychology, not to be confused with Transactional Analysis.

interpretive issues intrude (two observers may describe the same glass as half full and half empty). Russell's barber's paradox strongly challenges our rounding-off proclivities:

> The barber shaves all men and only those men in town who don't shave themselves. Who shaves the barber? If he shaves himself, he can't; if he doesn't, he must. (McNeill & Freiberger 1993: 62)

Fuzzy Logic offers a way to work with issues that are partly true. In the barber's case, the answers are equally true and false (fuzzy notation falls between the extremes of 0 and 1; these statements fall on 0.5) . Q-analysis (Background Paper) explains the paradox as a confusion of hierarchical levels. The dualist system of Classical Logic underlies most modern Western explanation (McNeill & Freiberger 1993: 62-4). In is contended here that a shift to an Ecological Paradigm, where Complex Dynamic Systems ensure a fuzzy, hierarchical situation, could be greatly assisted if all its concepts were rethought in light of Complex Dynamic Systems qualities. That in complex, divergent situations, a 'Conditions for Emergence' approach be pursued instead of one of 'Cause-and-Effect'. **Links: Hypercyclic Systems Theory: q-Chain Analysis; Background Papers: Working with Vague Information, What Mathematics for the Divergent Sciences?**

Great violence can potentially be done locally by centralised or globalised forces in positive feedback, which are asked to justify themselves only in narrow (Reductionist) scientific or economic, causal terms at their own scale, and do not have negative loop components built in to balance them. It seems that modern decision makers have mastered systems thinking at the expense of their 'customers' (see footnote on double-binding above). If this is true, and to make appropriate decisions in an increasingly systems-savvy world, this knowledge is urgently needed by civil society in general, a point mentioned elsewhere in relation to Forrester and his educational work.

> Cause must be a principle universally valid, and at the same time applicable only to finite and specific actuality", presuming rather than being inconsistent with teleology, with its "locus in the finite world where attention to specific facts demands scrutiny of their connections, but found only through a process of discovery through a context of relative disorder, incompleteness and restriction (Miller 1978: 15-16).

5.5 APPLICATIONS OF QUANTUM THEORY COMPLEMENTARITY

APPLICATIONS OF QUANTUM THEORY & COMPLEMENTARITY

The question may be asked 'How would we begin to approach our world if we accepted some of these subatomic ideas into our conceptualisation of reality at higher scales?' This essay looks at some of the literature emerging from such thought processes.

EDUCATION

In Education, fashion in the teaching of reading, and developmental dyslexia have recently been recognised to be associated with different functional areas, probably related to left and right sides of the brain.[42] Reading skills in children are taken care of first by establishing a small sight vocabulary (an 'organic' function which relates to words as a whole as patterns), and one or two years later by expansion through phonics, the 'building blocks' of reading mechanism. This again suggests in a different way that the Complementarity distinction may reflect the structure and function of the brain itself, similar evidence emerging from the field of art and creative expression (*"The New Drawing on the right Side of the Brain"*) explores these ideas in the area of artistic expression (Edwards 1999).

Certainly both mechanistic analysis and audio-visual pattern recognition are important components of reading skill, and over-emphasis of either will tend to prevent automatic functioning. The refusal to teach sounding (phonics) by an educational fashion that demands whole word recognition, disadvantages extension both of normals and of vulnerable groups of children: those who have a probably genetic difficulty in forming the appropriate mental images (pattern recognition).

Knowledge in this area also comes from Ericksonian hypnosis training, which builds its highly effective techniques on an understanding that functionally speaking, thinking may proceed according to three different styles: vertical (logical, 'left brain', linear, convergent), lateral (associative, 'right brain', divergent) and 'mosaic' (integrative). These thinking styles are easily discernible in tertiary students, the mosaic having a particular problem with presentation of complex subjects in a linear way as usually required in essays and other writings, but possibly representing an unappreciated resource in the new world of complex systems.[§]

THE PSYCHONEUROPHYSIOLOGY OF CHANGE AT INDIVIDUAL SCALE

In an early but relevant dissertation, Bohm describes the development and mode of functioning of human perceptual systems, emphasising the fact that the act of perception itself is only a very small proportion of the total situation, which is the outcome of the interfacing of interest in the subject, experience drawn from personal history, actions both mental and physical of the percipient to attune to the environment, hypothesis-building and checking of the "internal show" with externally derived signals, and high level abstraction of the general structure of past and present experience. This ongoing process continues largely outside of direct consciousness, and appears to involve a type of hypothesis-development which continually and rapidly seeks the best fit between internal and external fields, continually updating until there is a generally good fit, which explains the consensual reality experienced by humans in society, which is in general agreement, but subject to distortions of personal perception.[43] Bohm goes on to draw the similarities between individual and societal (through Science) levels of perception: both involved in scanning for patterns of invariance in complex fields, both involved in abstraction and relativity judgments, both making provisional maps of the territory, to be continually updated. He challenges the concept of Science as a body of absolute truth, once again pointing to a more dialectical and multi-faceted process which continually evolves, and needs to (Bohm 1965: 185-230).

By remaining alert to contradictions and sensitive to new relationships, thus permitting the growth of a fresh understanding, we can keep up with our contact with the world, and in some ways we can anticipate what is coming later. In Science this process takes place at a very high level of abstraction, on a scale of time involving years. Immediate perception occurs on a lower level of

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[42] Prof. Max Coltheart, Macquarie University: 5RN Open Mind Series, 21/5/96.

[43] This both argues for the existence of an objective reality independent of observation, and explains the difficulties experienced in Courts of Law in the elicitation of reliable evidence.

abstraction and is very rapid. In Science the process depends strongly on collective work, involving contributions of many people, and in immediate perception it is largely individual. But fundamentally both can be regarded as limiting cases of one over-all process, of a generalised kind of perception, in which no absolute knowledge is to be encountered (Bohm 1965: 230).

Ramachandran et al, approaching brain function from the orthodox medical discipline of Clinical Neuroscience and Neurophysiology, find support in brain damaged patients for a physical explanation of Freudian defence mechanisms and also suggest a systemic explanation for laughter[44]. Their experiments affirm the thesis of hemispheric specialisation. The left constantly monitors perceptual input and compares this with the existing frame of reference. The need for "consistency, coherence and continuity" is promoted by acting as a filter for a complex "script".[45] Where dissonance exists, denial, selective filtering, distortion and confabulation are initiated to conserve mental comfort and decisiveness: "create a model and defend it at all costs". Only major and irrefutable evidence of model failure results in re-evaluation (and sometimes not even that)(Ramachandran *et al.* 1995: 40-43, 49-55).

[This is of some concern to the ideal of proper conduct and interpretation of scientific investigation. It is also of some satisfaction to females who have long suffered discrimination from males on the grounds of their preference for the right brain functions. Actually, both sides represent survival approaches, with different objectives appropriate to different situations].

Balancing these tendencies, the right brain operates like a 'devil's advocate', an anomaly detector. The full range of possible interpretations is coldly scanned. Beyond a particular low-set dissonance threshold, it "forces a Kuhnian paradigm shift in response to anomalies", with complete rebuilding of the model to fit the 'facts' of subjective experience (Ramachandran *et al.* 1995: 43). This process also continues during Rapid Eye Movement (REM) sleep, resulting in an increasingly coherent frame of reference for personal orientation (:52).

While this description simplifies the situation by ignoring the many other ways of approaching cognitive function, the exaggeration of these effects when one hemisphere or other is disabled, supports the general theme. The conversation between the two tendencies and the emergent integrative balance display the classical characteristics of the edge of chaos phenomenon. The stability engendered by the left emerges from its resistance to change. The creativity of the right emerges from its sensitivity to the perturbation of anomaly (interpreting patterns). Complex behaviours emerge at the boundary (Ramachandran *et al.* 1995: 55) (as described by Prigogine).

There is an area of theory on bistable oscillators which is relevant to this structure. Prof. Jack Pettigrew[46] (Department of Physiology, University of Queensland), is researching the cathexis of left or right hemispheres (achievable by caloric stimulation on the contralateral side), and the rates and characteristics of switching between them. Gender-related hemisphere preference, rapidity of switching and 'sticky' switching appear to be natural phenomena, with genetic implications[47], and may also be linked to artistic temperament, cyclothymic personality and bipolar mood disorders. Preditor-prey and prey-preditor strategies, which differ substantially, may also align with this framework, another point of potential interest to human psychologists!

Tests which present different patterns (eg horizontal lines, vertical lines) to right and left eyes separately, demonstrate switching styles (average approx. rate 1-2 seconds), alternate overriding between sides, and unilateral bias (from various causes including genetic, habit, learning). The presented patterns will be perceived alternately, switching being very fast anteriorly (1-2 sec) and slower posteriorly (4-5 sec), while some subjects demonstrate rapid synthesis as mosaics, which seems to be a transcendent pattern representing creativity, and having a wave-like nature. In this context it seems that the orthogonal[48] (particle) relationship (script) is the left/ right

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[44] Humour is "a response to an inconsequential anomaly." If hemispheric specialisation is accepted, then the mechanism is a paradigm shift (left focus shifts to right) with trivial consequences, which harmlessly releases pent-up psychic energy, and has survival value in providing a false alarm signalling mechanism. Joking is also used as a defence mechanism in "an attempt to trivialize what would otherwise be genuinely disturbing.." (Ramachandran,Levi,Stone,Rogers-Ramachandran,McKinney,Stalcup,Arcilla,Zweifler,Schatz & Flippin 1995: 33). Jokes are followed with mild anticipation, expecting the frame of reference to be radically switched at the end. Sometimes the joke is that it doesn't.

[45] The parallels between this and the Script of TA are obvious.

[46] Personal communication 08/1997.

[47] Males appear to favour left hemisphere, females right, remembering that this will be an oversimplification. This needs more work and sensitive enunciation. Since right brain, devil's advocate, mediates cool assessment of all options (multi-dimensional matching of perceptions to interpretations) and left brain promotes clarity, singlemindedness and emotional, defensive strategies in defence of a rigid system, this calls into question many of the assumptions behind presentation of the logical, masculine way as necessary superior in problem solving, and of the description of the female approach as 'irrational' and 'emotional'.

[48] See Subatomic Theory.

character, with the oscillating output the wave form (and pathology is generated by extreme imbalances).

The Structural Analysis and Script Theory aspects of Transactional Analysis also offer a helpful model which bears upon development and change of personal Frames of Reference. In essence, the Exteropsyche or Parent Ego State[49] (that part of the personality wherein messages received from the exterior reside), scans events for familiarity (déjà vu/jamais vu) and responds either automatically to the familiar (programmed from past experience), or consciously, if that response is triggered by interpretation of sensory messages. This requires investment of time and creative energy, so the structure described is an efficiency measure, keeping the behaviour relatively constant and predictable, so long as it remains appropriate to the context.

Again, Process Oriented psychotherapists doing conflict resolution in large groups (eg 50-1000) may use the modality of 'World Work',[50] one technique of which uses a form of sociodrama. This involves supporting as many positions on the issue on hand as can emerge from the group, which walks about in a large, roughly circular space. As position statements are made, group members place themselves at distances from each speaker in turn, which indicate their degree of agreement with the statement enunciated, a thoroughly 'fuzzy' technique (see Fuzzy Logic above). With the leader's assistance, new or transcendent solutions usually emerge after a period of polarisation during which the group as a whole allows (not necessarily without passion) a number of conflicting concepts to be present simultaneously[51]. It is consistently found that the dissonant voice has great potential to lead to new levels of understanding, and this knowledge can most profitably be used to assist group evolution. This is a crucial point for application in public consultation contexts.

BRAIN FUNCTION FROM A SUBATOMIC PERSPECTIVE

As introduced in the text proper, Zohar, who is qualified in Physics and Philosophy, and was a student of David Bohm[52], is assisted by her husband Ian Marshall, a psychiatrist and psychotherapist. She takes these and related concepts, describing them in detail. She links them analogically (at least analogic: she also postulates a real similarity)[53] to the brain function/consciousness question by proposing that groups of neurones act as a unified whole in the manner of 'Bose-Einstein condensates' with characteristics similar to lasers and superconductors, the same equations representing the parts and the whole, and exhibiting behaviour analogous to particle and wave functions, at macro scale, the latter representing the entity unified with its context. This phenomenon is known as 'quantum coherence', based on the oscillatory nature of the waveform, but translated into a larger scale entity which is protected by an energy gap from environmental intrusion (Penrose 1994: 351).

Penrose, seeking concepts of mind in theorising Artificial Intelligence and the non-computable, has looked closely at the quantum level of the human brain. He supports Zohar and Marshall's predictions about the non-local collective quantum effects in nervous tissue cytoskeleton (Bose-Einstein condensation), which may underlie the emergent entity, 'mind'. He describes a structure of amino acid microtubules made of subcellular 'tubulin dimers', filled with water in an unusual ordered state ('vicinal water'). Evidence from Anaesthetics supports the hypothesis that consciousness is associated with cytoskeletal 'wave' function, while 'high' temperature superconductivity[54] in biological tissues has now been shown to be related to microwave 1011Hz EMR based on high metabolic energy (Penrose 1994: 201-8, 357-69, 369-71). What is emerging here is thus a quantum coherence translated to macro scale.

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[49] This is an operational linkage thought by some to be better separated into the psychic organ and the phenomenon it supports. Discussed in more detail in Erskine & Trautmann (Erskine & Trautmann 1997: 99-100).

[50] In this context best demonstrated in the work of Dr. Max Schuepbach of the Lava Rock Clinic, Oregon, USA and Dr. Arnold Mindell.

[51] A common pattern is as follows: The process will often start with vigorous Child-Victim statements, polarised with either high level Critical Parent Persecutor or Parent flipping to competing Victim. Furious Parent-Rescuers will often intervene here, demanding that the oppressed be heard. Respectful and guilty silence follows as the Victim is finally heard. Much emotion is released. Often erstwhile Persecutors will then compete to have their pain acknowledged. If this is indulged, the Victim will be competitively oppressed, all over again. After this, sympathetic feedback (Adult information about the effects of Persecutor statements and behaviours) is often offered to Persecutors, Nurture to Victims, uncritical sharing starts. A feeling of Intimacy supervenes. Feelings of resolution are often reinforced by positive feedback to the courageous (who risked participating). World Work Workshop, Noosa Queensland 1998.

[52] Late Emeritus Professor of Theoretical Physics, Birkbeck College, died 1993.

[53] Recently experimentally confirmed: New Scientist, April, 1996.

[54] It was previously believed that superconductivity was only possible at extremely low temperatures. High metabolic energy levels apparently overcome this requirement, thus opening a large new area of biological functional understanding. This is a good example of analogy leading to scientific confirmation in the new field. Penrose is keen to develop computable theories of the brain as it will lead to applications in artificial intelligence.

SOCIOLOGY

In Sociology, the struggle for dominance in social explanation between proponents of structure and agency, and the potential resolution through Giddens' Structuration Theory, could fit into a Complementarity interpretation. Structuration Theory gives essential attention to the integration of the subject-object dualism: the 'double hermeneutic' (consisting of the interface of frames of meaning of agents and sociologists), and the 'duality of structure'. This latter refers to the linkage of structure and agent through a recursive process, which Giddens emphasises, is a dualism, not a duality. By this he appears to mean a unified whole, viewed from two aspects (Giddens 1984: xx-xxi, 284, 289, 297, 374)[55]. In this case, the unitary social entity under study is approached from both structural and hermeneutic perspectives, as required in applying the Complementarity Principle.

URBAN STUDIES & POLITICO-ECONOMIC THEORY

In *"A Copenhagen Interpretation of Gentrification"*, Clark points out that Complementarity is not synonymous with wholism, integration or synthesis, but explains the change as epistemological - a shifting of the position of the line separating observer and observed (Clark 1994: 1037-8). 'Rent Gap' and 'Value Gap' are not Complementary explanations, but are of the same logical type, but Clark suggests that economic-cultural, production-consumption and demand-supply oriented explanations, form Complementary pairs (:1039-40). While culture may provide an explanatory context for Economics (or vice versa for economic fundamentalists), the Complementary lenses should be looking at the Economics-and-its culture complex, not seeing them as two global concepts to be somehow partnered: a point of agreement between Clark and Bohr.

Conceptual conflict may indicate the presence of Complementarity, but does not necessarily. For example, while the above Clarkian pairs can not be brought into the same plane of focus, these would not all be regarded as valid complements by Pattee and Allen, since the last two are not distinguished by rate dependence/independence and do not necessarily fall into mechanism/meaning distinctions as sorted by other Social Science authors.

Nor are they Heisenberg-type or Koskovian uncertainty pairs. It is reiterated that Complementarity refers to two uncommensurable aspects of a unified whole, not two separate entities which may be linked. Far from succumbing to pejorative assessments (such as Schrödinger's "Bohr wants to complement away all difficulties" and Einstein's .."soothing philosophy - or religion?- of Heisenberg-Bohr"..) (Pais 1991: 320, 425), Complementarity does assist in resolving a number of inter- and intra-disciplinary conflicts, and even if 'disproven' in the course of sorting out the many QT interpretations, is an extremely important Metaphor for an ecological approach in its unifying mechanism-meaning interpretation.

ARCHITECTURE & URBAN DESIGN

In Architecture and Urban Design, Wright, discussing the application of self-organising, dynamic approaches to cultural or urban systems, points out that in defining sustainability, "because the new organizations which emerge must be compatible with human interests", normative aspects must be added to the systemic, so that human goals and attributes may be encapsulated in a notion of 'purpose' (Wright 1995: 408). Leaving aside the anthropocentric aspect of this statement as such, the above conclusion in fact expresses the same general philosophy on human values as relevant to a human habitat, as does Complementarity Theory: each analysand has two important aspects, the scientifically described and the values-laden.

INTEGRATED WHOLISTIC RESEARCH

In the Integrated Wholistic Research devised for the Man in Biosphere Program (Boyden 1979;1984;Yanitsky 1984), apart from the necessity to work at different scales, the importance of both the intangible and the measurable is underlined. This is further differentiated into three rate-coupled 'qualitative levels': spatio-temporal, historico- cultural and socio-functional (Yanitsky 1984: 32-5), which have epistemological relationship to the Criteria of Unified Human Settlement Ecology (Landscape, Community, Population respectively), and Habermas' 'troika', mentioned elsewhere (Gould 1982).

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[55] The duality of structure is explained in recursive terms common to those of Complexity (self-organising systems) Theory literature, "where the structure is the medium of the outcome of the action it influences".

HEALTH

In the health area, at least two authors (a Western-trained Ayurvedic physician and a physicist respectively) have presented models based on Quantum Theory (Chopra 1989;Wolf 1986), both of which seek better to comprehend Molecular Biology and the mind-body interface, especially as if affects catastrophic illness (Chopra) and ordinary Molecular Physiology and the psyche (Wolf). Wolf links his theory into Freudian and Jungian concepts and aligns Complementarity with the *Dreambody Model*[56] promoted and put into clinical practice by the neo-Jungian Arnold Mindell Goodbread 1987;Mindell 1984;1989;1992).

ECOFEMINISM

Historically, the distinction between facts and values has served to drive an artificial wedge into what are at least academically, well-known to be organically whole systems. It is convenient and 'efficient' to separate them, especially politically. The Plotinian division between the realms of mind and matter, spirit and body, reinforced by the Scientism of the Industrial Revolution, has created a metaphoric template for social and personal alienation and ecological harm. This is, of course, the realm of discourse of EcoFeminism. **Link: Theory of Scale: Dominance Hierarchy.**

[56] This proposes two processes: a *Primary Process*, which in Gestalt theory would be referred to as 'foreground' - this is the 'reality' of which a person is subjectively aware from moment to moment. The *Primary Process* tends to alter as the subject tracks her perceptive channels. Processes which are not in conscious awareness remain in the shadow, undealt with, and are often visible to others through body language, but rarely to the subject. The *Secondary Process* is the *'Shadow'*, or *'Dreambody'*, similar in many ways to the *Unconscious* of Freudian Psychology (also sometimes called the 'primary process' by psychoanalysts), or the *'Psychological Level'*, the *Transactions*, and the *Scripts* of TA. The collective version of this is an emergent entity called the *'Collective (Un)conscious'* by Jungians, and transactions with it are through the *'World Channel'* (Process Psychology) of perception, often through the medium of synchronicities and archetypal experiences such as the curious global public response to the death of Diana, Princess of Wales, and similar events which emerge in a large-scale therapeutic setting such as large scale conflict resolution (n=1000s).

5.6 PREDICTABILITY IN COMPLEX DYNAMIC SYSTEMS (CDS)

PREDICTABILITY IN COMPLEX DYNAMIC SYSTEMS

INTRODUCTION

Casti, in *"Searching For Certainty"* graded (F-A)(0-high) five applications of Complexity Theory from the point of view of prediction and explanation. Medians for both were in B-C areas, with explanation tending to score higher (Casti 1993: 407). Prediction is essentially qualitative in such systems, which is not without value.

In modelling fractal systems, predictability is related to resolution. Chaotic unpredictability at one scale may reappear as a predictable system when viewed from a higher scale. Scale, resolution and hierarchical arrangement are seen to be important research considerations when attempting to apply fractals and chaos concepts to complex systems, especially in moving from theory to application. Costanza *et al* have established a method for defining optimal resolution for a given problem in modelling ecological economic systems which may generalise to all resolution types (space, time, component number). The log of resolution is in strong linear relationship to the log of predictability, and they propose that chaos may be a high resolution phenomenon (seeing from too close) resulting in low model predictability. They support this claim by reference to the work of May & Sugihara who found different dynamics for measles epidemics at different scales: chaotic dynamics (with a chaotic attractor evidenced) at city scale, but only periodic dynamics at national scale (Costanza,Wainger,Folke & Maler 1993: 549-550).

Simple formulae rapidly develop great output complexity, as has been found repeatedly by weather modellers. An early realisation of complexity theorists was that complex outcomes may and usually do have simple causes (antecedents), not necessarily complex ones. But simple 'cause-effect' is not a good explanation for complex relationships (Capra 1982: 289), nor can predictions be made from forward projections of current trends in complex systems. Trend reading is not necessarily a useful activity, politician-speak notwithstanding.

Money spent in forward-projecting complex behaviours in social systems often results in rate-focused, aspatial and strategically limited information which is rarely checked for accuracy retrospectively, yet continues to be recommended for (such as) Planning and Epidemiology (Gould 1993: 178-186). The Social Sciences in particular periods have attempted to force research into linear moulds. Postmodern Pluralism, the concept of different 'constructions of reality' and the emergence of the 'political correctness' ethic[57] have seen a reversion to consideration of the diverse particular, but have not indicated a particularly helpful way forward in dealing with this chaotic diversity of selves, nor of a helpful approach to values, nor of pattern seeking for the purpose of decision making or managing community services.

So what approaches are available in the midst of all this uncertainty?

FLOWING WITH PATTERNS: EMBRACE UNPREDICTABILITY!

It is suggested here that the key to sustainability and to the handling of complexity does not lie with prediction and control at all, but with the appreciation of <u>pattern</u> and learning to 'flow with', constrain and manipulate patterns. Fuzzy Logic and q-Analysis have both demonstrated high level functionality in pattern recognition, but the best source for design is usually intuitive, as the human brain is unsurpassed in pattern recognition and manipulation, and is an essential partner to clever data and expensive equipment. This ability, along with systems thinking, should explicitly be developed by specific education, especially at primary school level (see remarks in text about Harvard work with YK-12 systems training with STELLA software).

Design of devices to exploit chaos and nonlinearity rather than try to avoid them, has led to new ways of approaching the stabilisation of electrocardiographs, lasers and electronic circuits (Ditto & Pecora 1993: 62, 64, 68). Similar work in weather forecasting has found that working from the stable patterns can be predictive, while trying to compute the chaotic side becomes unmanageable after 3-4 days.

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[57] Some would say 'scourge' (as extreme forms oppress, persecute and prevent important social dialogue).

CONSTRAINTS, STRATEGIC RESTRUCTURING AND ENTRAINMENT

Allen and Hoekstra explain that predictability depends on the characteristics of the constraint system, and that scale is implicit in any such question: if constraint is stable, as in small number systems (for example planets) or large number systems (for example gases) where the average of large numbers of component parts is reliable, the system is predictable. Where constraint is unpredictable, as in middle number systems, (too many parts to model separately, too few to average), prediction is difficult or impossible unless the system can be structured in a hierarchical manner. Constraints in such systems may switch from one to another for local, not general reasons (Allen & Hoekstra 1992: 62-5).

> Scaling is rate-dependent in that the constraints constituted by the parts, relationships, materials and life processes of an organism persist only for the duration of the organism's life (Allen & Hoekstra 1992: 63).

As also indicated by Synergetics, which speaks of entrainment, if a system can be described as a small number entity, it may become predictable, hence the scientific interest in rate-based hierarchies (Allen & Starr 1982: xii-xiv), and the social interest in leadership and 'firesouls'.

> Central to the theory is the concept that organization results from differences in process rates.[58] ... Medium number systems, like ecosystems, operate over a wide spectrum of rates. Behaviours can be grouped into classes with similar rates, and if the classes are sufficiently distinct, then the system can be considered as hierarchical and dealt with as a small number system. The structure imposed by differences in rates is sufficient to decompose a complex system into organizational levels and into discrete components within each level (Overton) (O'Neill,De Angelis,Waide & Allen 1986: 75-6).

SUPPORTIVE BACKCLOTHS: CONDITIONS FOR EMERGENCE INSTEAD OF FORWARD ESTIMATES

Using q-Analysis, Gould has demonstrated a time series mapping approach to the AIDS epidemic expressed through a logistic spatial adaptive filter device. This tracks and predicts local incidence and timing quite accurately through identifying the location of Supporting Backcloth for AIDS, thus allowing rational and timely intervention (Gould 1993: 184-5). Definition of associations or conditions for the emergence of an entity is often a more accurate procedure than prediction per se, and the q-Analysis concept of a Supporting Backcloth is crucial, even in the absence of the complex mathematics available.[59] **Link: q-Chain Analysis.**

It is interesting that the unpredictability of complex systems means that they have thereby resisted scientistic manipulation and thus control. The best advice according to Waldrop is "total Taoist":

> to "quietly observe the flow, realising that you're part of it ... then every so often you can stick an oar into the river and punt yourself from one eddy to another" (Waldrop 1992: 330-331).

The crucial influence of local conditions in determining systemic outcomes leads to a tension (for example in social systems) between those who would control a system from above, with Strategic Plans and the like, from where aggregate effects can appear misleadingly simple, and those who would focus on lower scale variables, whose peculiar interference field yields the emergent local realities, which have such potential for unique expression and demand local consideration in all interventions.

The EPP case demands a balance of both, as unconstrained systems are sensitive to runaway positive feedback (instability and collapse), and if the core Attractor is fear of change, fear of discomfort or greed, a pattern of eco-social disaster is clearly predictable. This is as true internationally as it is locally.

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[58] Fundamental insight of Simon (1962, 1969, 1973) and refined by Allen & Starr (1982).

[59] Indeed for the non-academic practitioner, who will probably not have such access, the concept may be crucial and useful, while the Mathematics may be of exaggerated importance (Peter Gould, personal communication, 2/'96).

5.7 ELEMENTARY CATASTROPHE THEORY (ECT): APPLICATIONS

ELEMENTARY CATASTROPHE THEORY IN URBAN & OTHER STUDIES

In the broader field of Bifurcation Theory, non-gradient systems[60] tend to have small numbers of separate stable equilibrium points (attractors) and unstable points (repellors) which influence system behaviours as mapped onto trajectories in State Space. The general ECT theory does not apply, but the bifurcation and attractor approaches do (Wilson 1981: 33).[61]

The table below presents a summary of the types of area in Urban Planning in which the use of Catastrophe Theory approach was found to be useful in the 1970s, at the height of its popularity.

Catastrophe Theory and q-Analysis appeared at approximately the same time, and both appeared to put off potential users by the level of mathematical mastery required for their manipulation. The advent of computers has provided the potential for a review of their usefulness, as both are concerned to explore and affirm the native characteristics of complex, multi-parameter systems, and in particular, try to account for divergent, human and other living elements.

Chaotic (stochastic) behaviour has no regular periodicity, no equilibrium points, stable or unstable, although apparently random behaviour may be either superimposed dissimilar frequencies or like Brownian motion, be represented by manifestly deterministic equations (Haken 1983: 333). Complex systems have different solutions for different initial conditions, with different characteristics for different parameters and a mix of trajectories depending on different types of equilibrium values. Non-linearities in the $\underline{f}$ function result in folded surfaces and bifurcations, divergence and convergence and hysteresis similar to those in ECT, attractors and repellors may appear and disappear at critical parameter values, and separatrices separate completely different system states with different attractors (Wilson 1981: 42-43). In addition, since state variables are 'fast' and control variables (parameters) 'slow', Wilson proposed hierarchical catastrophes/bifurcations systems with constants above control variables above state variables for a (somewhat arbitrarily defined) three-layer system, or extensions of this with similar relationships between any number of levels, that is, a rate-based nested hierarchy (Wilson 1981: 58-60).

[60] Gradient systems take some objective function and both minimise it and its associated dynamics, and maximise it's negative. Possible equilibrium points of the system are found through the equation Min (x, u) = f(x,u) for some function f where x is a set of state variables and u a set of independent variables describing the system. Process dynamics are given by $\dot{x} = -\frac{df}{dx} = -\text{grad}\,\underline{f}$ and min f is at grad $\underline{f}$ =0 (Wilson 1981: 33).

[61] (From Wilson, 1981: 34-56). Graphic presentations represent 1-2 variables of a system in a higher dimensional space (thus diagrams are slices of higher dimensional ones), and include: Cartesian plotting of State Variables x as functions of other x (shows trajectory in State Space for given initial conditions), as functions of Control Variables u (displays presence of fold catastrophe), as function of an intermediate variable (studies mechanisms of change such as bifurcation behaviour); or one equilibrium value of x against one control variable u (demonstrates bifurcation branching), or a state variable x against time t (demonstrates oscillatory behaviour), or a time derivative of a state variable x against x (shows position of equilibrium points and indicates their stability). More variables may be dealt with using sets of differential equations solved together, but these are usually non-linear and need a computer or geometrical methods to map. For some fields such as urban & regional studies models may be developed for (static) equilibrium points embedded in a dynamic framework.

Table: Urban Applications of ECT

Problem Modelled	Catastrophe Used	Control Variables	Behaviour (State) Variables	Authors	Descriptive Notes	Technical
City Macro Scale	Cusp Fold	• Housing rental. • City opulence (all kinds urban wealth).	• Population density.	Amson 1974	• Hysteresis (time-lag) discontinuous jumping behaviours. • Ghost town phenomenon.	C: Surrogates used for control variables. Simultaneous transformations to each other & original axis demonstrated catastrophe. Scales replaced with percentages above basic datum.
Economic: Urban Property-Price Macro Scale	Cusp	• Demands of consumers. • Demands of speculators.	• Rate of price increase.	Casti & Swain 1974		
Economic: Urban Property-Price Macro Scale	Butterfly	• Time. • Interest rate. • Demands of consumers. • Demands of speculators.	• Rate of price increases.	Casti & Swain 1974	Intermediate behaviour pocket between two catastrophic price jumps.	Character suggested butterfly. Wilson (:77) questions use of time; existence of intermediate surface not clear.
Central Place Systems Macro Scale	Cusp Alternative description could be fold (Wilson :75)	• Disposable income per capita. • Market area population. • Alternative single c: spending power.	• Order of central place (no. of goods/ functions provided there).	Casti & Swain 1974	Illustrates jumps, hysteresis, divergence. Wilson identifies different effects of control variables c: splitting & normal, seen on control manifold.	C: Empirical data with jump & hysteresis behaviours suggest underlying catastrophe mechanism (inductive approach).
Urban & Regional Facilities eg Shopping Centre (Macro): Size-Distance Optimising	Fold	• Benefits of facility size. • Disbenefits of travel.	• Size of centre. • Av. distance travel to reach centre.	Poston & Wilson 1976	Jumps from large no. of small centres to small no. of large centres.	(M): Logistic relation between size & disbenefit; distance & disbenefit linear. Plot distance as dependent variable (since co-variants) against neg. slope of transport disbenefit line.

Problem Modelled	Catast-rophe Used	Control Variables	Behaviour (State) Variables	Authors	Descriptive Notes	Technical
Macro Scale: City Revival Medieval Europe	Butterfly	• Population in manu-facturing towns.	• Difficulty of transport. • Average productivity. • Productivity difference bet. town & country. • Crowding factor (population ÷ land).	Mees 1975	Traces revival of cities.	C: Av. productivity = butterfly factor. Town-country productivity difference = bias factor. Then can plot other c variables for different combinations of values of the above.
Macro Scale: Strategic Elements Of Catastrop he Theory to a Theory Of Major Urban Structural Change	Cusp	• Population.	• Increase in productivity of each unit of population (splitting factor). • Direct contribution of a marginal unit of population to total welfare (normal factor).	Isard 1977	Function to be maximised taken as welfare.	C: Interprets potential function directly. Delay convention for real cases.
Slums in Urban Settings: Macro Scale	Mush-room (para-bolic umbilic)	• Quality of housing stock. • Utility level of residents.	• Per capita income. • Internal rate of return (willingness of private investors to invest). • Social discount rate (probability of investment by public sector). • Population : capital stock density.	Dendrinos 1977	Starts by identifying macro scale slum-causing variables. Then goes to manifolds. Attempts interpretation of potential function in terms of minimisation of social costs.	C: Suggests without evidence unstable states may be achievable in slum case. Useful to explore density of system paths. Geometry & analysis very complex.
Macro Scale: Sudden Urban Growth	Cusp			Papa-georgiou 1980		M

(Based on Amson, 1975: 217; Wilson, 1981: 69-92).
Key:
M = seek manifold directly, interpret via CT
C = define variables carefully, use canonical surface form.

Wilson slightly modified a six-level approach to modelling CDS with CT by Zeeman in 1977, which provides a hierarchy of complexity in research processes.

Table: Levels of Approach to Catastrophe Theory after Zeeman

Level	Comment
1. Study of equilibrium surface & singularities.	Approach to non-smooth behaviour (jumps, divergence, hysteresis); "comparative static" approach useful; can incorporate constraints within CT.
2. Identification of sets of variables with different relative rates of change and associated nesting of corresponding mechanisms of change; if only two sets, specification of state variables (fast dynamic) and specification of control variables (slow dynamic), otherwise rate-based hierarchy.	By nesting variables, excessive nos of parameters may be conflated into the hierarchy; differential equations need to be specified, sometimes embedded in relative static model. Causes of bifurcation: folded surface; critical parameter values change solutions to one or both sets of equations; crossing of separatrix after perturbation. General shape of model evident at this stage.
3. Representation of feedback between fast & slow variables ie slow as functions of fast (fast as function of slow already established).	Adds further complexity: new non-linearities provide new bifurcation opportunities.
4. Recognition of noise (may generate fluctuations).	Adds realistic complexity: refers to Prigogine's order through fluctuation theory.
5. Modelling of diffusion processes (useful to mimic SpaceTime, with 4 control variables).	Links to Geography.

(Source: Wilson, 1981: 60-62).

There have been two approaches to Catastrophe Theory by workers, one where the variables are assembled according to the situation, and an equilibrium manifold is constructed directly, then interpreted using Catastrophe Theory principles. This is called 'Catastrophe Analysis': a less commonly used, inductive approach, extending Dynamic Systems Analysis, with ground-up development of a specific model (example: utility model in Microeconomics). The other, more commonly used deductive approach, 'Catastrophe Modelling', which defines the variables, then selects an Elementary Catastrophe to structure the State Space according to the numbers of inputs and outputs. This may be adjusted, extended, conflated or otherwise manipulated to get a better result (example: urban, physiological and morphological modelling by Zeeman) (Oliva,Desarbo,Day & Jedidi 1987: 123-4;Wilson 1981: 92;Zeeman 1977).

There appears to be an inherent difficulty in selecting the appropriate number and scale of variables, yet the explanations of system behaviour, especially in the simpler fold and cusp catastrophe cases, make good intuitive sense. Again, the greatest disadvantage is the need to master a form of mathematics which may take several years. This does not exclude collaborative effort, of course.

From the literature it appears that there was an initial burst of activity following the introduction of the theory, followed by a loss of confidence in its usefulness for prediction, followed again by a renewed interest due to the recognition of the essentially useful and possibly crucial concept of S in ecological systems. Since methodologies for empirical testing and improved mathematical competence have emerged, there has been a slow renewal of interest in CT. It is still seen as suitable for analysing state-determined systems where future states are determined by the influence of future inputs on the existing system state, and in particular is seen by Oliva et al as "a parsimonious description of many situations which can be characterised as having both elements of revolution and evaluation" (for instance negotiations, political conflict, business competition, technological development) (Oliva *et al.* 1987: 136).

This is deterministic process modelling, where global aggregate system behaviour is 'macro-deterministic', but behaviours of individual units (for example voters, shoppers) are be regarded as stochastic but state-determined Olivia (Oliva *et al.* 1987: 122), The deterministic concreteness of physical systems enables easier application of CT in the 'hard' Sciences, with the stochastic approaches involving social systems taking a Probabilistic Mathematics to the dependent variable, speaking of a 'Probability Density Function'. This is "in some sense an 'average' value" which represents 'leakages' within the bimodal area, where shifts occur with greater frequency as the edge is approached, rather than suddenly and uniquely at the edge. It is interesting that the probability density is usually normalised to have a unitary integral, as in a fuzzy description.[62] This characteristic is regarded by Oliva et al as beneficial, with the concept of persistence replacing that of Determinism, allowing flexibility around responses and inter- and intra-subjective error. This in turn allows the examination of stochastic processes which are fundamentally nonlinear (Oliva *et al.* 1987: 125-6).

Olivia *et al* also detail the history of CT. They present 'GEMCAT', a multivariate methodology for the assessment of univariate or multivariate catastrophe models, evaluating individual models, testing their reliability, and also comparing their performances. It is designed especially for the Social and Behavioural Sciences (such as Psychology, Sociology, Marketing, Economics) (Oliva *et al.* 1987: 121-3). This approach recognises the dangers of conflating multivariate data into composite factors, and addresses the problems of dealing with non-observable constructs.

[62] I wonder again, without exploring the concept further, whether the express use of fuzzy functions instead of Probability in Complexity Theory equations and applications would allow more realistic modelling outcomes.

5.8 REPRESENTATION OF SPACE AND TIME USING GIS

SCALE & REPRESENTATION ISSUES IN GEOGRAPHICAL INFORMATION SYSTEMS

Spatial Hierarchy was discussed in Volume I. Geography has, of course, always been concerned with the interpretation and recording of space, and in its behavioural versions, with the perception of space. The means of studying those hierarchies has been traditionally static, and more recently, dynamic and relative. Relative space as a concept emerged more or less in parallel with the relativity revolution from the mid 1900s (Gibson *et al.* 1998: 4-5). Time Geography has been mentioned elsewhere.

Static spatial representation by Geographical Information Systems (GIS) is error-prone for technical reasons. For instance it was found by Buzer 1995[63] that she could trace information from macro to micro down the full hierarchy of images, but an ascending error emerged after about two levels.

Lee indicated in 1990 that automation of the type of complex spatial information required for urban applications was particularly difficult, due to linear, sequential processing of complex, multi-dimensional dynamic information (a problem of digital computation) and the fact that a fundamental set of operators for spatial work had not yet been devised. The stretching of scale required by users to focus in on an area, created difficulties and distortions in feature representation in data-dense, multi-layered representations, which created problems for three-dimensional representation and put limits on the extent to which zooming was useful (Lee 1990: 464-5). This was resolved in this instance by a cartographic strategy, using the CARIS vertically continuous database which links layers through point features (Lee 1990: 469). Geographical Information Systems applications in 1999 are still constrained by exponential growth in file sizes with each operation, which has been ameliorated by increase in computer capacity rather than by solving the problem.

Another Geographical Information Systems concern lies in the possibility of hidden, orders-of-magnitude errors derived from later applications of data collected under different assumptions of end-purpose. In particular, the tag approach (site specific characterisation of dominant features, discounting small or irregular features), and the count approach (quantity or spatial extent of something within an area specified using point sampling strategies), are often layered electronically for planning purposes (for instance soil type + ownership patterns respectively). Tag questions are not properly answered by count data, funding often does not extend to ground truthing, and the data collection method is not always specified or enquired about by Geographical Information Systems software vendors and users (Gersmehl & Brown 1992: 89-91).

Exploratory Data Analysis (EDA: a technique from the 1970s) allows the extraction of information from raw non-spatial data, which through graphic display, can reveal patterns and processes not readily apparent in the raw. A spatial version of EDA, ESA (Exploratory Spatial Analysis) was emerging in the early 1990s, which enabled real-time integration of spatial and temporal series (Goodchild 1992: 156). The ability to zoom and pan, aggregate and disaggregate has been greatly enhanced by the introduction of expert systems, Fuzzy Logic and chaos modelling as options to 'hang off' Geographical Information Systems packages, much of this now being available to desktop PCs (Burrough & McDonnell 1998: 4-16, 278-9). What can be done is very much constrained by finances and the limitations of digital technology. The issues mentioned above are still pertinent, and while there is much present effort towards better integration and the iteration of rules and rationales for analysis and interpretation of data, there still tends to be a lot of uncritical Geographical Information Systems use (naïve as to assumptions and rationales). The need for ground-truthing is ever-present, and often not followed through, through ignorance or scarcity of funding.[64]

For assessing land for land use planning, development or management, a hierarchical system of 'land units' or 'landscape units' has been developed, which is a top-down process that avoids several common errors attributable to Geographical Information Systems alone (but may well use Geographical Information Systems to develop final maps), and is relatively low cost. It integrates

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[63] (Personal communication), PhD University of Queensland related to ground-truthing problem with GI Studies of Fraser Island.

[64] Information derived from interviews of two professionals using Geographical Information Systems, one a consultant and academic, the other a Geographical Information Systems-related PhD candidate, environmental manager at different times in local government and Catchment Board projects.

Geomorphology, vegetation and Soil Sciences[65], defining its units in terms of relative ecological homogeneity at the scale in question, and accepts a holonic, CDS hypothesis of Landscape (Zonneveld c1990: 67, 83-5).

In dynamic applications of GIS (Geocomputation), which combine Topology with many extra parameters, regular, grid fields of appropriately scaled space and time units, have been found to deal easily with zooming (different resolutions), and updating. They are based on Burrough's GeoAlgebra, (a combination of Cartographic Algebra, cellular automata and Fuzzy Logic – a rule-based system as seen above). This system uses finite difference equations, much easier to handle than the traditional partial differentials, and succeeds in providing a simply-learned and managed, inexpensive system, accessible at several levels of sophistication, and available low cost for the study of emergent phenomena in CDS/SOS (Burrough 2000).[66]

[65] Providing that specialist scientists are present together at certain crucial points in the process: preliminary photo-interpretation map, data collection from exactly the same point, and final map preparation (Zonneveld c1990: 67).
[66] Available as software known as 'PCRaster': http://www.geog.uu.nl/pcraster/.

5.9 THE NLP META-MODEL

NEURO-LINGUISTIC PROGRAMMING

Neuro-Linguistic Programming (NLP) is a theory of Psychotherapy first developed in the 1970s by computer scientists working to explain the remarkable hypnotherapeutic skills of Milton Erickson, arguably the most skilled worker with altered states ever known to Therapy. The 'Meta-Model' of NLP is based on Transformational Linguistics (after Noam Chomsky). This develops a set of rules, a grammar of well-formed patterns in native language, that describe the relationship between superficial and deep linguistic structures – a hierarchical concept - and their modes of transformation. This meta-structure functionally overlies all communications, and reflects neurological structure. It can be used to represent and communicate all models of experience including thinking, visual, kinetic and verbal, and as a guide for meta-explanation of the various approaches to the business of behavioural change which Psychotherapies represent.

All Psychotherapies work with meta-model concepts (often unconsciously), and NLP therapists (and Process Oriented Psychology and Transactional Analysis therapists also), work directly but differently with conflicts and incongruence between the five common sensory modalities or channels, and recognise the characteristic linguistic predicates and behavioural attributes (body language) present as therapy proceeds (Bandler & Grinder 1975b: 23, 36-8;1975c: 195-6;Bateson 1975 ix-xi). Individuals vary in the representational systems ('Rep Systems') most valued and in their ability to 'occupy' different channels (Goodbread 1987: 20-25, 79). All the techniques of every form of therapy are techniques that affect the process of representation, the creation and organization of a client's model of the world. To the degree that techniques induce change in a client's modelling of the world is the degree to which therapists will be effective in assisting a client to change. As a client's model of the world changes, his perceptions change and so, too, do his behaviors. The processes by which a person's model of the world becomes impoverished are the same processes by which it can be enriched – the processes of Deletion, Distortion, and Generalization. All forms of therapy, all the techniques of the different forms of therapy - in fact, all learning - can be understood in terms of the process of representation. (Bandler & Grinder 1975c: 195)

> We have always found it uncanny that the techniques of therapy mirror so precisely the disorders of the mind found in ... mental hospitals ... we ... therapists ... use the formal patterns present in psychotic and schizophrenic behaviour [highly repetitious, stuck behaviour seeking resolution to incomplete patterns] to assist our clients in growing and changing in ways that enrich their lives ... [we therapists act] as a guide using natural processes already at work in people all of the time ... In some sense, this was the purpose of the human potential movement – to make psychology available to everyone, so that all of us could live happier and more creative lives (Bandler & Grinder 1975c: 196).

Relative valuation of sensory channels seems to be influenced by environmental conditions, especially those related to available mass media. Differences have emerged between the (audio-visual) generation which grew up with wireless and reading (books, newspapers) as the primary news media, and the (visuo-kinaesthetic) modern generation which has grown up with television and the marketing of visual over-stimulus (including ever-increasing vicarious experience of speed, violence, suspense, sex and self-gratification).¥ Modern marketing is used in attempts to create behavioural change by changing the customer's model of the world (or pre-empting this by conditioning: by instilling a consumer model into young children.

This Theory is relevant to the guided processes of societal change, marketing and community building, as the behaviour of families, groups and collectives is based on individual mechanisms that are transformed to (and included in) the larger scale. The larger group consists in a system with similar organising principles but different patterns, emergent from individual components. We need a clear exposition of such transformations, the grammar that structures them and the Metaphors and Semiotics that give them meaning. Clearly, different groups in society have different ways of coding their experience, as seen under Metaphors & Mindscapes. Examples different organising principles, are seen under UHSE (Criterion Community) in the work of

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[67] In authoring a chapter in a first year Architectural Design textbook recently, I was required by the editor to write at junior high school level for what she described as the "attention deficit generation".§

Maruyama and of Douglas (Douglas 1982b;Maruyama 1994). While all can use all subsystems, favouritism, exclusion and distortion patterns become embedded in personal style and Scripting. People with different preferred representation systems often have communication and co-working problems, particularly if the frame of reference is competitive. Such interactions and differences can be predicted to become increasingly important as the world becomes more crowded and populations are increasingly tightly connected to diminishing resource bases.

5.10 WHAT MATHEMATICS FOR THE DIVERGENT SCIENCES?

MODIFIED SYSTEMS THEORY, DIFFERENTIAL EQUATIONS AND STATISTICAL APPROACHES: GENERAL REQUEST FOR A DEDICATED MATHEMATIQUE

CONVERGENCE & DIVERGENCE

The concepts of divergence and convergence in research questions were highlighted by Schumacher in *"Guide for the Perplexed"* (Schumacher 1977: 142-47). For convergent questions, (:144) "the answers tend to converge, become increasingly precise; they can be finalised and written down in the form of an instruction." Such questions relate to the 'dead' aspects of the universe, such as Physics, Astronomy, Chemistry, Mathematics, which can be 'mastered' or possessed. Divergence is a characteristic of higher levels of being, involving consciousness, inner experience, life and self-awareness. It has an elusive quality such that focus on an element leads to ever more detail, more qualification of the answer and the emergence of opposites (a yin/yang situation). Such opposites are taken by reductionists as either/or, right/wrong issues. Studies are constructed by the 'laboratory approach' to eliminate anything that can not be strictly controlled, providing proofs from within that isolated system, unrelated to external relations.
Link: HST: Thermodynamics: Entropy & Negentropy; Figure: System Types.

> ... to solve a problem is to kill it. There is nothing wrong with 'killing' a convergent problem, for it relates to what remains after life, consciousness and self-awareness have been eliminated. But can - or should - divergent problems be killed? ... Divergent problems cannot be killed ... in the sense of establishing the 'correct formula'. They can however be transcended (Schumacher 1977: 145-46).

> How can opposites cease to be opposites when a 'higher force' is present? How is it that liberty and equality cease to be mutually antagonistic and become 'reconciled' when brotherliness is present? These are not logical but *existential* questions ... It is important for us to become fully aware of these pairs of opposites. Our logical mind does not like them: it generally operates on the either-or or yes-no principle, like a computer. So ... it wishes to give its exclusive allegiance to ... one ... of the pair (Schumacher 1977: 146).

Unipolar thinking, says Schumacher, leads to loss of truth and realism, to rigid adherence to half the truth as the final answer, or to sudden switching between polarities, each time with the delusion of moving on to a new world order or a fresh 'truth'.

The basic divergent pairs are *freedom - order* and *growth - decay*. Very common in Education and Politics are *freedom - equality* (solved in the French case by transcendence to love: *liberté v. egalité* → fraternité); and *freedom v. discipline/obedience* (also transcended by love, understanding and compassion).

The way to comprehend such pairings is not to come down on one side or the other, but by transcendence to a higher level where a flow of brotherliness, love, empathy, understanding and compassion is available as a reliable resource.

> Divergent problems ... provoke, stimulate and sharpen the higher human faculties without which man is nothing but a clever animal. A refusal to accept the divergence of divergent problems causes these higher faculties to remain dormant and to wither away, and when this happens the 'clever animal' is more likely than not to destroy itself (Schumacher 1977: 147).

PROBLEMS WITH MODIFIED SYSTEMS THEORY AND STATISTICS AS MATHEMATICAL BASES FOR DIVERGENT PROBLEMS

Modified Systems Theory with its modelling tool of differential equations, has been challenged as a sole strategy in practice by Gould and by P.M.Allen. Gould objects to the model's aspatiality, and Allen is concerned because a probabilistic definition of system behaviour automatically discounts microscopic diversity, the very source of creativity and adaptive capacity in far from equilibrium adaptive systems (Allen 1989: 82-3;Gould 1993:136).

Gould offers a cartographic, q-Analysis -based improvement to statistical epidemiological trend prediction. He protests that while orthodox epidemiological research corners a substantial proportion of the huge AIDS budget (USA), funding ever more complex and practically useless computer models based on differential equations, research which would pinpoint future locations and populations of new cases and thus potentially save thousands of young lives, is consistently refused funding (Gould 1993: 136-144, 164-6).

The common statistical practice of averaging, as used by the media in conveying 'scientific' information to the public is also often highly misleading. For example reporting of medians would in many cases be more conducive to understanding and allowing a better 'feel' for a situation. Knowing that 'the average income of South Australians is $44,000' ($846/week) is very different from knowing that the median weekly income per household is $553 (Australian Bureau of Statistics 1999: 7-11), and percentages relative to the 'poverty line' would be similarly enlightening but are rarely reported. Anyone who has conducted a open-response social survey would be aware of the degree of category conflation required for statistical significance in small sample sizes, immediately imbuing the results with less relevance at the scale of collection, or alternatively, requiring huge sample sizes to really tease out the local dynamic elements.[68].

Batty emphasises the need in urban modelling both to adopt a biological (rather than mechanistic) model, by attending to spatial and temporal boundaries which define systems, and to change the approach from working at aggregation level, to modelling the rich dynamic interactions at the disaggregated, micro level and allowing macro order to emerge (Batty 1996: 479-81). This latter was also the essence of argument in the work of Jane Jacobs, when she took to task the habit in both Economics and Urban Planning of discounting the local and being guided in decision making by insensitive, large scale, aggregate information such as in Macroeconomics (Jacobs 1961;1984).

Atkin's criticism of statistical approaches to *Risk Analysis* and his *Backcloth Analysis* remedy were discussed under CDS. Bohm (Ordering Principles) also has a problem with statistical averaging at quantum level, in that explanations based on statistics or randomness as orthodox Quantum Theory is, exclude the operation of fundamental Ordering Principles. Bohm feels that wherever randomness is proposed as an explanation (as in orthodox Quantum Mechanics and Prigogine's order-through-random-fluctuations work), it should alert thinkers to the possibility that hidden variables of as yet poorly understood or experimentally elusive entities are affecting the system (Bohm 1980: 77;Bohm & Peat 1987: 104-150).

The acceptance that the wave function may be an objectively real field as distinct from a mere mathematical symbol, and that electrons have more properties than the observable, leads to an unorthodox interpretation of Quantum Theory which nevertheless makes no difference to the experimental results obtained from statistical methods. In Bohm's view, fluctuations, bifurcations and nonlinear functions of particle coordinates reveal a sensitivity to context subject to Chaos and Thermodynamics Theories, and occur through a hierarchy of levels below the atom, at present hidden, each of which answers to its own qualitatively specific laws (Bohm 1980: 68, 77-84;Bohm & Hiley 1993: 40-42, 78)[69]. This is interesting, as Quantum Theory in its orthodox form is inherently linear, but the foundations of nonlinear *Quantum Field Theory* are being laid at present through theoretical developments such as these. Kosko points out that Einstein's famous mass-energy equation is also linear, but that Einstein linearised the mathematics for simplicity, excluding fourth and higher-order terms from an initially complex formulation (Kosko 1993: 107).[70] This practice is another reason for the acknowledgment that Classical Laws can only be regarded as approximations.

The concept of the emergence of new rules and conditions at higher (different) scales means that conclusions drawn from aggregates are unlikely to be sufficient for taking care of the needs of the system's lower level entities, even as they appear to solve problems or answer questions at the level of interest. Thus linear approaches must be accepted as incomplete, and statistical approaches remembered to be scale-related and say nothing about the local particular. Although still useful where approximations and linearisation suffice, new theory for complex systems in all domains must accommodate this and in some way lead to a framework that allows us to retain the richness of local detail in order to discriminate at that level. We need assistance in choosing appropriate Methodologies, in the evolution of Theory that embraces nonlinearity. Likewise, we need to question the connections between aggregated interpretations (statistical emergents) and the unaggregated scales of empirical measurement from which they are derived.

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[68] An experiment conducted by University of Adelaide Geography students in 1991 as part of a population survey, where the same topic was explored by open and closed questioning, demonstrated very clearly the extent to which respondents can be lead by the selection of aspects for comment.

[69] Bohm gives examples: in Medicine, the existence of statistics (for example in Epidemiology) has never stopped research into individual laws (mechanisms); in Physics, Brownian movement expects molecular action at a lower level according to other laws, later shown to depend on individual atomic characteristics. "*... lawlessness of individual behaviour in the context of a given statistical law is, in general, consistent with the notion of more detailed individual laws applying in a broader context*" (Bohm 1980: 68).

[70] "The real equation reads $E=MC^2$ + *infinitely many terms.*" (Kosko 1993: 107).

Conversely, when working with aggregates, the uniqueness of interpretation at that scale should be remembered, not only through reflexive linkages with other scales, but as an entity in its own right. Therefore, when dealing with something as complex as a human settlement, and especially when intending either to intervene or change the system constraints in any way, then at the very least the outcomes at many scales should be considered. With high impact intentions, all imaginable scales of relevance and their connections should be included conceptually, even though the Mathematics is far from settled.

A PLEA FROM WHOLISTS

"The apparently paradoxical, contradictory accounts should not divert our attention from the essential wholeness" (Holton 1988: 1018). Outliers in graphs are there for a reason. Arguments as to 'the correct' explanation of any phenomenon are manifestly inappropriate and inadequate within a paradigm which acknowledges complexity, context and Complementarity. Casti concludes his "Complexification" with a quote from Yourcenar (in part):

> ... When two texts, or two assertions, or perhaps two ideas, are in contradiction, be ready to reconcile them rather than cancel one by the other, regard them as two different facets, or two successive stages, of the same reality ...
>
> Marguerite Yourcenar, "Memoirs of Hardrian", 1980.

Gould pleads for avoidance of mechanistic (statistical) crushing or conflation of human information, letting the data speak for themselves (Gould 1981), and promotes Habermas' *'troika'* of intertwined perspectives on enquiry: *Technical* (mechanistic, structural, [rate-dependent], Newtonian or Cartesian); *Hermeneutic* (meaning-related, interpretive, linguistic, [rate-independent]) and *Emancipatory* (meta-inquiry, critique of Ideology, assumption-testing, emancipating from law-seeking), which is similar in conception to the Complementarity model with the addition of cosmological context. He offers *q-Analysis* as a non-binary form of Mathematics suited to this task:

> In the human world we need to move beyond this simplistic dichotomy [deterministic or probabilistic - mechanistic- descriptions] that arises from the descriptive requirements of the physical and biological worlds (where they have been perfectly adequate), to the fundamental facts of consciousness, reflection and informed choice - not simply conditioned behaviour - in the human world. The mathematics must enable non-mechanical interpretation in allowing, forbidding but not requiring geometries ... The frontier question - whether the tyranny of the conventional binary operation forces mathematics and, therefore, the parts of our world described by mathematics, to be mechanical - this question leads us to reflect upon the meaning of mathematics itself (Gould 1986: 4).

Gould then goes on to quote Heidegger [comparing " .... the exactitude of physics"... "the self-contained system of motion of units of mass related spatio-temporally ..."] to the Humanistic Sciences, which by contrast

> ... indeed all the Sciences concerned with life, must necessarily be inexact just in order to remain rigorous ... The inexactitude of the historical sciences is not a deficiency, but is only the fulfilment of a demand essential to this type of research (Gould 1986: 5).

Gould summarises:

> In brief, we cannot employ conventional, physically inspired forms of mathematics in the human sciences, not if we wish to pay reverent heed to that world of conscious, sentient beings, with the capacity to reflect upon any statement or description we make of them (Gould 1986: 5).

I can not claim any functional level of mathematical skill, and in one way it would seem presumptuous to pass judgment on the highly esteemed work of others in the orthodox mathematical arena. However I would make some observations. When I began this dissertation I made approaches to both the *Departments of Mathematics* and *Mathematical Physics* at the University of Adelaide, seeking an academic who could advise me of the appropriate type of Mathematics to learn to enable me with intelligence to read the literature I was struggling with. These were mainly the literatures of Ecology, Fuzzy Logic, q-Analysis, Topology and Complex Dynamics. This proved to be a fruitless exercise for a number of reasons (mainly economic and time structure), but it left me in a position which I am sure has proved a barrier to others seeking ordinary world answers to questions arising in the ivory towers.

Having decided to struggle for general comprehension rather than unravel explicit formulae, I learned a new skill: to skim over the proofs, and concentrate on the findings and meanings. This meant that there was no way for me to evaluate the quality of the Mathematics, which had to be taken on trust. It did appear that the complacency of orthodox statistical and differential treatments of data needed to be challenged in order to come to terms with the uncertain world of complex dynamic systems with multiple degrees of freedom. q-Analysis appeared to be understood by very few (Jeff Johnson – fluent in both Fuzzy Logic and q-Analysis - of the UL Open University at Milton Keynes, and Peter Gould, were unaware of anybody in Australia who could help me). Fuzzy Logic is certainly widely used, in engineering, defence and natural resource management, but not widely taught to undergraduates as far as I can tell. The latter are extremely heavily saturated in Probability concepts and Mathematiques. From my exposure to conferences and seminars on Fuzzy Logic in particular, it appears to be a rapidly growing field, and a whole new world could become available for mathematical exploration if the territory battles could give way to collaboration.

PLEASE MAY WE HAVE AN INTEGRATED MATHEMATICS FOR DIVERGENCE, INCORPORATING CONCEPTS FROM POSSIBILITY THEORY, FUZZY LOGIC, q-ANALYSIS, SYNERGETICS AND NONLINEAR DYNAMICS?

6 APPENDIX F: DECLARATIONS & CHARTERS

6.1 THE ISTANBUL DECLARATION ON HUMAN SETTLEMENTS

ISTANBUL DECLARATION

We, the Heads of State, Government and official delegations of countries assembled at the Second United Nations Conference on Human Settlements (Habitat II) held in Istanbul, Turkey, from 3 to 14 June, 1996, take this opportunity to endorse the universal goals of ensuring adequate shelter for all and making human settlements safer, healthier, more livable, equitable, sustainable and more productive. Our deliberations on the two major themes of the Conference, adequate shelter for all and sustainable human settlements development in an urbanising world, have been inspired by the Charter of the United Nations and are aimed at reaffirming existing and forging new partnerships for action at the international, national and local levels to improve our living environment. We commit ourselves to the objectives, principles and recommendations contained in the *Habitat Agenda* and pledge our mutual support for its implementation.

We have considered, with a sense of urgency, the continuing deterioration of conditions of shelter and human settlements. At the same time, we recognise cities and towns as centres of civilisation, generating economic development and social, cultural, spiritual and scientific advancement. We must take advantage of the opportunities presented by our settlements and preserve their diversity to promote solidarity amongst all our peoples.

We reaffirm our commitment to better standards of living in larger freedom for all humankind. We recall the United Nations Conference on Human Settlements held in Vancouver, Canada, the celebration on the International Year of Shelter for the Homeless and the Global Strategy for Shelter, all of which contributed to increasing global awareness of the problems of human settlements and called for action to achieve adequate shelter for all. Recent United Nations world conferences, including, particularly, the United Nations Conference on Environment and Development, have given us a comprehensive agenda for the equitable attainment of peace, justice and democracy built on economic development, social development and environmental protection as independent and mutually reinforcing components of sustainable development. We have sought to integrate the outcomes of these conferences into the *Habitat Agenda*.

To improve the quality of life within human settlements, we must combat the deterioration of conditions that in most cases, particularly in developing countries, have reached crisis proportions. To this end, we must address comprehensively, *inter alia*, unsustainable consumption and production patterns, particularly in industrialised countries: unsustainable population changes, including structure and distribution, giving priority consideration to the tendency towards excessive population concentration; homelessness; increasing poverty; unemployment; social exclusion; family instability; inadequate resources; lack of basic infrastructure and services; lack of adequate planning; growing insecurity and violence; environmental degradation and increased vulnerability to disasters.

The challenges of human settlements are global, but countries and regions also face specific problems which need specific solutions. We recognise the need to intensify our efforts and cooperation to improve living conditions in the cities, towns and villages throughout the world, particularly in developing countries where the situation is especially grave and in countries with economies in transition. In this connection, we acknowledge that globalisation of the world economy presents opportunities and challenges for the development process, as well as risks and uncertainties, and that achievement of the goals of the *Habitat Agenda* would be facilitated by, *inter alia*, positive actions on the issues of financing of development, external debt, international trade and transfer of technology. Our cities must be places where human beings lead fulfilling lives in dignity, good health, safety, happiness and hope.

Rural and urban development are interdependent. In addition to improving the urban habitat, we must also work to extend adequate infrastructure, public services and employment opportunities to rural areas in order to enhance their attractiveness, develop an integrated network of settlements and minimise rural-to-urban migration. Medium- and small-sized towns need special focus.

We reaffirm our commitment to the full and progressive realisation of the right to adequate housing as provided for in the international instruments. To that end. we shall seek the active participation of our public, private and non-governmental partners at all levels to ensure legal security of tenure, protection from discrimination and equal access to affordable adequate housing for all persons and their families.

As human beings are at the centre of our concern for sustainable development, they are the basis for our action in implementing the *Habitat Agenda*. We recognise the particular needs of women, children, and youth for safe, healthy and secure living conditions. We shall intensify our efforts to eradicate poverty and discrimination, to promote and protect all human rights and fundamental freedoms for all and to provide for basic needs, such as education, nutrition and life-span health care services, and, especially, adequate shelter for all. To this end we commit ourselves to improving the living conditions in human settlements in ways that are consonant with local needs and realities and we acknowledge the need to address the global, economic, social, and environmental trends to ensure the creation of better living environments for all people. We shall also ensure the full and equal participation of all women and men, and the effective participation of youth, in political, economic and social life. We shall promote full accessibility for people with disabilities, as well as gender equality in policies, programmes and projects for shelter and sustainable human settlements development. We make these commitments with particular reference to the more than one billion people living in absolute poverty and to the members of vulnerable and disadvantaged groups identified in the *Habitat Agenda.*

We shall work to expand the supply of affordable housing by enabling markets to perform efficiently and in a socially and environmentally responsible manner, enhancing access to land and credit and assisting those who are unable to participate in housing markets.

In order to sustain our global environment and improve the quality of living in our human settlements, we commit ourselves to sustainable patterns of production, consumption, transportation and settlement development; pollution prevention; respect for the carrying capacity of ecosystems and the preservation of opportunities for future generations. In this connection, we shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of different contributions to global environmental degradation, we reaffirm the principle that countries have common but differentiated responsibilities. We also recognise that we must take these actions in a manner consistent with the precautionary principle approach which shall widely be applied according to the capabilities of countries. We shall also promote healthy living environments, especially through the provision of adequate quantities of safe water and effective management of waste.

We shall promote the conservation, rehabilitation and maintenance of buildings, monuments, open spaces, landscapes and settlement patterns of historical, cultural, architectural, natural, religious and spiritual value.

We adopt the enabling strategy and the principles of partnership and participation as the most democratic and effective approach for the realisation of our commitments. Recognising local authorities as our closest and essential partners in the implementation of the *Habitat Agenda*, we must promote, within the legal framework of each country, decentralisation through democratic local authorities and work to strengthen their financial and institutional capacities in accordance with the conditions of the countries, while ensuring their transparency, accountability and responsiveness to the needs of people, which are key requirements for governments at all levels. We shall also increase our cooperation with parliamentarians, the private sector, labour unions and non-governmental and other civil society organisations with due respect for their autonomy. We shall also enhance the role of women and encourage socially and environmentally responsible corporate investment by the private sector. Local action should be guided and stimulated through local programmes based on *Agenda 21*, the *Habitat Agenda,* or any other equivalent programme, as well as drawing on the experience of worldwide cooperation initiated in Istanbul by the World Assembly of Cities and Local Authorities without prejudice to national policies, objectives, priorities and programmes. The enabling strategy includes a responsibility for governments to implement special measures for members of disadvantaged and vulnerable groups when appropriate.

As the implementation of the *Habitat Agenda* will require adequate funding, we must mobilise financial resources at the national and international levels including new and additional resources from all sources - multilateral and bilateral, public and private. In this connection, we must facilitate capacity building and promote the transfer of appropriate technology and know-how. Furthermore, we reiterate the commitments set out in recent United Nations conferences, especially those in *Agenda 21* on funding and technology transfer.

We believe that the full and effective implementation of the *Habitat Agenda* will require the strengthening of the role and functions of the United Nations Centre for Human Settlements (Habitat), taking into account the necessity for the Centre to focus on well-defined and thoroughly-developed objectives and strategic issues. To this end, we pledge our support for the successful implementation of the *Habitat Agenda* and its Plan of Action. We also recognise the need to strengthen the role and functions of the United Nations Centre for Human Settlements as a major requirement for the successful implementation of the Habitat Agenda *and its Global Plan of Action.*

This conference in Istanbul marks a new era of cooperation, an era of a culture of solidarity. As we move into the twenty-first century, we offer a positive vision of sustainable human settlements, a sense of hope for our common future and an exhortation to join a truly worthwhile and engaging challenge, that of building together a world where everyone can live in a safe home with a promise of a decent life of dignity, good health, safety, happiness and hope.

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6.2 THE NEWCASTLE DECLARATION

The Newcastle Declaration

Endorsed at the International Conference
Pathways to Sustainability: Local Initiatives for Cities and Towns
1-5 June 1997 Newcastle Australia

Gathered at Newcastle, Australia on World Environment Day, 5 June 1997 we acknowledge that in the five years since the Rio Earth Summit much has been learnt about implementing the concept of sustainable development. There is growing evidence, however, that the future of all life on Earth is still in peril. There is an urgent need to accelerate and assist action at all levels, particularly locally, if the global sustainable development objectives of Agenda 21 are to be realised.

WE, AS REPRESENTATIVES OF THE GLOBAL COMMUNITY AND LOCAL GOVERNMENT ACKNOWLEDGE:

- That sustainability is a global necessity and that Local Agenda 21 is a fundamental framework for enhancing local and global sustainability.
- That based on growing population trends, there is an urgent need for the developed world to drastically reduce our per capita impacts in the short term if we are to achieve global sustainability in the long term.
- That actions need to be taken to mitigate the adverse effects on local communities of continued trends towards economic globalisation and free trade.

WE DECLARE OUR COMMITMENT, AS LOCAL GOVERNMENTS AND COMMUNITIES, TO ENHANCING GLOBAL SUSTAINABILITY, BY DEVELOPING PROCESSES AT THE LOCAL LEVEL BASED ON:

- Assisting our own and other communities to progress toward local sustainability by sharing and learning from each other.
- Ensuring that all sectors, groups and citizens in our local communities, including adults, youth and children are given equal opportunity for active participation and partnership in the process of developing Local Agenda 21 action plans.
- Simultaneously achieving economic, social, cultural and ecological goals by integrating them in the design and implementation of all local policies, programs and projects.
- Recognising the rights of indigenous peoples and the special contributions which they can make.
- Acknowledging the importance of difference and diversity in formulating and implementing Local Agenda 21 plans.
- Adopting a strategic and long-term approach to setting priorities and targets in order to achieve community-determined visions and goals.
- Establishing realistic short-term action plans with participatory mechanisms for monitoring, feedback and accountability.
- Celebrating the diversity within and between local communities and respecting and learning from minority voices and the aspirations of different cultural groups.

WE CALL UPON ALL LOCAL GOVERNMENTS AROUND THE EARTH:

- To embrace the goal of global sustainability by implementing Local Agenda 21action plans by the year 2000 which fulfil the goals of Agenda 21 and the Habitat Agenda.
- To monitor and review on an annual basis and report on progress at the Rio+10 review in 2002.

TO ASSIST US IN THIS PROCESS WE CALL UPON:

- The United Nations and national governments to recognise the progress made by local governments and their communities in enhancing the implementation of Agenda 21 and the Habitat Agenda
- National governments to provide a policy framework and the necessary resources to support national Local Agenda 21 programs.

All governments to increase their proportion of annual expenditure on demonstration projects which enhance sustainability.

WE AFFIRM THE NEED FOR INTERNATIONAL AND NATIONAL LOCAL GOVERNMENT ORGANISATIONS TO:

- Facilitate the exchange of examples of information on best practice in implementation of Local Agenda 21.
- Recognise the importance of research, community education, capacity-building and monitoring in local action for sustainability.
- Report on the progress of Local Agenda 21 on behalf of all local governments and communities.

(Signed by) Peter Woods, World Executive Committee, IULA Jeb Brugmann, Secretary General, ICLEI

Councillor John Campbell, President, ALGA Councillor Greg Hayes Lord Mayor, Newcastle

5 June 1997

6.3 THE EARTH CHARTER

The Earth Charter

(draft abbreviated version 1999)

I Preamble:

At this unprecedented time of opportunity and danger, when life on Earth is at risk, it is imperative that we, the Peoples of Earth, declare our interdependence with and responsibility to one another, the greater community of life, and future generations. An inclusive vision of shared values is urgently needed to provide an ethical foundation for the emerging world community. Therefore, in a spirit of human solidarity and kinship with all life, we affirm the following inter-related principles and commit ourselves as individuals, organizations, business enterprises, and nations to build a global alliance in support of their fulfilment. Together in hope, we pledge to:

II General Principles:

1. Respect Earth and all life.

2. Care for the community of life in all its diversity.

3. Secure freedom, justice, peace, and Earth's abundance and beauty for present and future generations

III Fundamental Ecological, Economic, and Social Principles

4.Protect and restore the integrity of Earth's ecological systems, with special concern for biological diversity and the natural processes that sustain and renew life.

5. Prevent harm to the environment as the best method of ecological protection and, when knowledge is limited, take the path of caution.

6. Treat all living beings with compassion, and protect them from cruelty and wanton destruction.

7. Adopt patterns of consumption, production, and reproduction that respect and safeguard Earth's regenerative capacities, human rights, and community well-being.

8. Ensure that economic activities support and promote human development in an equitable and sustainable manner.

9. Eradicate poverty, as an ethical, social, economic, and ecological imperative

10. Honour and defend the right of all persons, without discrimination, to an environment supportive of their dignity, bodily health, and spiritual well-being.

11. Advance worldwide the cooperative study of ecological systems, the dissemination and application of knowledge, and the development, adoption, and transfer of clean technologies.

12. Establish access to information, inclusive democratic participation in decision making, and transparency, truthfulness, and accountability in governance.

13. Affirm and promote gender equality as a prerequisite to sustainable development.

14. Make the knowledge, values, and skills needed to build just and sustainable communities an integral part of formal education and lifelong learning for all.

15. Create a culture of peace and cooperation.

As never before in human history, common destiny beckons us to seek a new beginning. Such renewal is the promise of these Earth Charter principles. Fulfilment of this promise requires an inner change--a change of mind and heart. It requires that we take decisive action to adopt, apply, and develop the vision of the Earth Charter. Every individual, family, organization, and government has a critical role to play. Youth are fundamental actors for change. We can, if we will, take advantage of the creative possibilities before us and inaugurate an era of fresh hope.

www.earthcharter.org

6.4 CHARTER OF THE NEW URBANISM

We assert the following principles to guide public policy, development practice, urban planning, and design:

The Region: Metropolis, city, and town

1. Metropolitan regions are finite places with geographic boundaries derived from topography, watersheds, coastlines, farmlands, regional parks, and river basins. The metropolis is made of multiple centres that are cities, towns, and villages, each with its own identifiable center and edges.

2. The metropolitan region is a fundamental unit of the contemporary world. Governmental cooperation, public policy, physical planning, and economic strategies must reflect this new reality.

3. The metropolis has a necessary and fragile relationship to its agrarian hinterland and natural landscapes. The relationship is environmental, economic, and cultural. Farmland and nature are as important to the metropolis as the garden is to the house.

4. Development patterns should not blunt or eradicate the edges of the metropolis. Infill development within existing urban areas conserves environmental resources, economic investment and social fabric, while reclaiming marginal and abandoned areas. Metropolitan regions should develop strategies to encourage such infill development over peripheral expansion.

5. Where appropriate, new development contiguous to urban boundaries should be organized as neighbourhoods and districts, and be integrated with the existing urban pattern. Noncontiguous development should be organized as towns and villages with their own urban edges, and planned for a jobs/housing balance, not as bedroom suburbs.

6. The development and redevelopment of towns and cities should respect historical patterns, precedents, and boundaries.

7. Cities and towns should bring into proximity a broad spectrum of public and private uses to support a regional economy that benefits people of all incomes. Affordable housing should be distributed throughout the region to match job opportunities and to avoid concentrations of poverty.

8. The physical organization of the region should be supported by a framework of transportation alternatives. Transit, pedestrian and bicycle systems should maximise access and mobility throughout the region while reducing dependence on the automobile.

9. Revenues and resources can be shared more cooperatively among the municipalities and centres within regions to avoid destructive competition for tax base and to promote regional coordination of transportation, recreation, public services, housing, and community institutions.

The neighbourhood, the district, and the corridor

1. The neighbourhood, the district, and the corridor are the essential elements of development and redevelopment in the metropolis. They form identifiable areas that encourage citizens to take responsibility for their maintenance and evolution.

2. Neighbourhoods should be compact, pedestrian-friendly, and should follow the principles of neighbourhood design where possible. Corridors are regional connections of neighbourhoods and districts; they range from boulevards and rail lines to rivers and parkways.

3. Many activities of daily living should occur within walking distance, allowing independence to those who should not drive, especially the elderly and the young. Interconnected networks of streets should be designed to encourage walking, reduce the number and length of automobile trips, and conserve energy.

4. Within neighbourhoods, a broad range of housing types and price levels can bring people of diverse ages, races and incomes into daily interaction, strengthening the personal and civic bonds essential to an authentic community.

5. Transit corridors, when properly planned and coordinated, can help organize metropolitan structure and revitalize urban centers. In contrast, highway corridors should not displace investments from existing centers.

6. Appropriate building densities and land uses should be within walking distance of transit stops, permitting public transit to become a viable alternative to the automobile.

7. Concentrations of civic, institutional and commercial activity should be embedded in neighbourhoods and districts, not isolated in remote, single use complexes. Schools should be sized and located to enable children to walk or bicycle to them.

8. The economic health and harmonious evolution of neighbourhoods, districts, and corridors can be improved thought graphic urban design codes that serve as predictable guides for change.

9. A range of parks, form tot-lots and village greens to ballfields and community gardens, should be distributed within neighbourhoods. Conservation areas and open lands should be used to define and connect different neighbourhoods and districts.

The block, the street, and the building

1. A primary task of all urban architecture and landscape design is the physical definition of streets and public spaces as places of shared use.

2. Individual architectural projects should be seamlessly linked to their surroundings. This issue transcends style.

3. The revitalization of urban places depends on safety and security. The design of streets and buildings should reinforce safe environments, but not at the expense of accessibility and openness.

4. In the contemporary metropolis, development must adequately accommodate automobiles. It should do so in ways that respect the pedestrian and the form of public space.

5. Streets and squares should be safe, comfortable, and interesting to the pedestrian. Properly configured, they encourage walking, and enable neighbours to know each other and protect their communities.

6. Architecture and landscape design should grow from local climate , topography, history, and building practice.

7. Civic buildings and public gathering places require important sites to reinforce community identity and the culture of democracy. They deserve distinctive form, because their role is different from that of other buildings and places that constitute the fabric of the city.

8. All buildings should provide their inhabitants with a clear sense of location, weather and time. Natural methods of heating and cooling can be more resource-efficient than mechanical systems.

9. Preservation and renewal of historic buildings, districts, and landscapes affirm the continuity and evolution of urban society.

(N/D: Supplied by MFP-Australia c.1994).

6.5 ISTANBUL DECLARATION OF CITIES & LOCAL AUTHORITIES

DECLARATION (PART)
WORLD ASSEMBLY OF CITIES AND LOCAL AUTHORITIES

We, the delegates to the World Assembly of Cities and Local Authorities, commit ourselves:

1) to take an active role in responding to the challenges facing humanity; to fight strongly at our level against poverty, ignorance, intolerance, discrimination, exclusion, insecurity, environmental degradation, and cultural levelling; and to promote and strengthen our action for the rights and well-being of children, which should be seen as the ultimate indicator of a healthy society and good governance;

2) to promote within our regions, metropolises, towns and villages participatory development policies rooted in an active partnership with all vital local forces (community-based organisations, neighbourhood or village associations, non-governmental organisations, the private sector, professional groupings, trade unions etc);

3) to devise methods of administration adapted to the complexity and specificity of the local level, as well as appropriate methods of financing and management of human settlements, including regional planning measures;

4) to improve the transparency and efficiency of the management of our regions, metropolises, towns and villages, with the primary aim of providing people with services to meet their needs, and thereby to encourage the development of a sense of civic engagement;

5) to accord every opportunity for full access and participation by women in municipal decision-making, by making the necessary provisions for an equitable distribution of power and authority;

6) to strengthen direct cooperation between our local authorities, with the support of the national, regional and international associations of local authorities, in order to encourage meetings between peoples, exchanges of experience and the development of partnerships between local actors. Such cooperation will also help us to build a local vision of the challenges of the future and to draw up appropriate strategies of action, in a constructive dialogue with the States, the international community, the private sector, non-governmental organisations and the other partners of civil society;

7) to draw full advantage from the transformation potential of new technological developments in setting up better targetted forms of decentralised cooperation by means of technical assistance, transfers of technology and know-how, and collaboration between practitioners;

8) to develop a constructive dialogue with the States, the international community and all partners, about activities and practices at the local level, especially by disseminating information and by producing specific local indicators to facilitate decision-making;

9) to work towards concerting our respective activities more closely, in particular through the global coordination of cities and local authorities established at this Assembly. This coordination will be our voice vis-à-vis the international community, with which it will in particular negotiate the ways and means of implementing at local level the global plan of action in the Habitat agenda;

10) to play our full part in achieving the fulfilment of the United Nations resolution calling for at least 0.7% of the GNP of the developed countries to be allocated to cooperation programmes with the developing countries;

11) to implement the recommendations of the Conference within our realm of responsibility through involvement in the national committees for HABITAT II, and to evaluate their impact with regard to our respective local authorities;

12) to collaborate with UNESCO in the institution of an international Mayors' Prize for Peace to be awarded to outstanding initiatives taken by local authorities in the implementation of a culture of peace in everyday living.

(World Assembly of Cities and Local Authorities 1996: 5-6).

7 GLOSSARY

4 Rs
Of resource conservation: Reduce,(do more with less); Reuse (use again the same or another way, keeping the same form); Recycle (break down and use again in same or another product: note timber referred to as recycled is usually Reused); Repair (rather than replace).

8 STRATEGIES
Of Habitat Healing: regeneration, restoration, enhancement, reinstatement, preservation, modification, protection and maintenance.

20:80 SOCIETY
A society where 20% of the population consumes 80% of the resources (a Western pattern).

AAAS Australasian Association for the Advancement of Science

ABC Australian Broadcasting Corporation

ABS Australian Bureau of Statistics

ABSOLUTE SCALE
The distance, time, or quantity measured on an objectively calibrated measurement device.

ACNEM Australian College of Nutritional & Environmental Medicine

ACF Australian Conservation Foundation

ACT Australian Capital Territory

ACTEW Australian Capital Territory Electricity and Water (Authority)

AI Artificial Intelligence

AIDAB Australian International Development Assistance Bureau

AIDS Acquired Immune Deficiency Syndrome

ALLOPATHIC (IN)STABILITY
Hypersensitivity to environmental stressors, set up be stress in pre- & peri-natal period: adults vulnerable to lack of control, reduced resilience to social & environmental flux in later life; especially likely to cause 'essential' hypertension.

AMCORD
"A national source document for the planning, design, assessment and implementation of residential development, other than high-rise housing (ie housing requiring lifts). It provides guidelines ... which can be adapted to the needs of State and local authorities and the industry and be used for the development of local codes and regulations" (from intro. Overview AMCORD '95).

AMOCO American Oil Company

AMOEBA Bottom-up, quality-of-life indicator

ANCA Australian National Conservation Agency

ANOP Australian National Opinion Polls

ANU Australian National University

ANZAAS Australian and New Zealand Association for the Advancement of Science

ASEAN Association of South-East Asian Nations

AT Appropriate Technology

AURISA Australian Urban Research Institute - SA

AUSAID Australian Aid Agency

BC Before Christ

BC British Columbia (Canada)

BCE Before the Common Era (≡ BC, but avoids mentioning Christ)

BEABLES
Real elements that exist independent of observation (including the observer). After Bell (1987).

BEABLES
Real elements that exist independently of observation (including the observer) (Bell, 1987).

BHP Broken Hill Proprietary (Limited)

BIFURCATION
Periodic doubling in chaotic system: behaviour underlying Deterministic Chaos; "our most important source of models for the dynamical processes of nature" (Abraham & Shaw).

BIOCENTRIC Ethic grounded in life.

BIONEERS
Biological Pioneers: multi-disciplinary group including leading scientists & thinkers, who

perceive us to be moving beyond the Information Age to a new Biological Age, and seek to discover new ways such as Biomimicry and Green Capitalism to deal with this reality and heal the planet. See www.bioneers.org/,

BOOLEAN ALGEBRA
A propositional calculus for analysis of Logic developed by George Boole (1815-65) (ODP).

BOOLEAN LOGIC
Boole's algebraic operators turn out to explain digital on/off (0/1) hardware structure in computers: determines choice points in circuit iterations: either/or (OR), neither/nor (NOT), both/and (AND); used as a Metaphor expressing the difference between Substance Pluralism (either/or) and Substance Monism (Quantum consciousness, both/and).

BOSE-EINSTEIN CONDENSATE
Special condition of matter, found in states of high temperature or high energy, where equations for all components also represent those for the whole; found in lasers (and possibly the brain) .

BREEAM Building Research Establishment Environmental Assessment Model

CA California

CA California

CALM Conservation And Land Management (Department of, WA)

CAPITAL Vehicle of trade against which an economic surrogate is standardised

CARIS Software

CAS Complex Adaptive System

CATASTROPHE THEORY (ECT)
Specialises in explaining surprising or unpredictable system behaviour arising from those unstable regions described by Chaos Theory.

CATWOE
Client (Victim), Actor, Transformation, World View (Weltanschauung), Owner, Environment: Checkland 'soft systems methodology' for environmental management (Allen & Hoekstra, 1992: 308-316).

CBO Community Based Organisation

CBT Classical Bifurcation Theory

CDS Complex Dynamic System

CEA Cumulative Effects Assessment

CEO Chief Executive Officer

CEPA Commonwealth Environmental Protection Agency

CHAORD
1. Any self-organising, self-governing, adaptive, nonlinear, complex organism, organisation, community or system, whether physical, biological or social, the behaviour of which harmoniously blends characteristics of chaos and order.
2. An entity whose behaviour exhibits observable patterns and probabilities not governed or explained by the rules that govern or explain its constituent parts. From *chaos* (formless, primordial matter; utter confusion, utterly without order or arrangement (L, GR); + *ordre* (Fr, ME, L) line, row, regular arrangement in accordance with rules. Hoch, 1999.

CHAORDIC
1. The behaviour of any self-governing organism, organisation or system which harmoniously blends characteristics of order and chaos.
2. Patterned in a way dominated by neither chaos or order.
3. Characteristic of the fundamental organising principles of evolution and nature.

CHAOS THEORY
Deals with the 'magnetic' infrastructure of complex systems, including 'unstable manifolds', Strange Attractors, Repellors and saddle points in the medium number realm of Complex Dynamic Far-From-Equilibrium Systems.

CHILD-FRIENDLY
Word used in Environmental Planning & Interior Design; also 'FAMILY-FRIENDLY.

CLASSICAL REALM
Scale above subatomic realm; includes human scale; appears with emergence of Spacetime at 10^{-33}cm; 4-dimensional; Newtonian /Classical mathematics can be applied to linear aspects.

CLT Community Land Trust

CNN Cellular Nonlinear Network (computer chip used for dynamic GIS and other applications requiring pattern recognition.

COD Concise Oxford Dictionary

COHOUSING® Housing together: intentional community developed for balance between privacy and sharing of expensive resources.

COMLE Community Oriented Model of Lived Environment

COMPLEMENTARISM (BOHR)
Bohr's Complementarity Principle applied across disciplines beyond the subatomic realm (including into Classical).

COMPLEMENTARITY PRINCIPLE (BOHR)
A system has Complementary aspects needing two incompatible descriptive modes, both of which are required for full description. These represent the observer and the observer-observed complex, and can be distinguished as rate-dependent and rate-independent, where rate refers to sensitivity to change due to change of frequency.

COMPLEXITY
Specific term describing a system with nonlinear characteristics

CONNECTANCE
(Gardner & Ashby 1970, quantitative approach with range ±1) is defined as 'the number of interconnections through competition, predation or parasitism as a proportion (percentage) of the maximum number of interconnections.

CONNECTEDNESS
(Allen & Starr 1982) 'take[s] account of mean connectivity, percentage connectance, and the strength of the connections or interaction terms'.

CONSTITUTIVE HIERARCHY
Groups of objects or processes are combined into new units that are combined into still new units with their own functions and emergent properties.

CORRESPONDENCE PRINCIPLE
Refers to overlap between subatomic and Classical realms for certain large atoms; spacetime 'barrier' better understood in terms of energy differentials rather than size of element.

CPR Condition – Pressure – Response (environmental indicator system)

VOLUTION
From the Latin, meaning 'rolled up' (Macquarie Dictionary). E-, in-, re-, de- volution are common words that intuitively indicate a Metaphor similar to Bohm's *Explicate Order.*

CRA Conzinc Riotinto of Australia (Consolidated Zinc - Rio Tinto)

CRES Centre for Resource and Environmental Studies

CSIRO Commonwealth Scientific and Industrial Research Organisation

CT Catastrophe Theory, Complexity Theory

CW Crystal Waters (Permaculture® community, Maleny, Queensland)

CWMB Catchment Water Management Boards

DBT Dynamical Bifurcation Theory

DCWashington DC (USA capital)

DEVELOPMENT
Complexification, enrichment, revelation: 'velopment', 'en-velopment', 're-velopment', 're-de-velopment'; from voluper (Fr) to unwrap (Macquarie & CODs).

DNA Deoxyribonucleic Acid

DPZ Duany Plater Zyberk (US developer)

DST Dynamic Systems Theory

EARTHCRETE Earth-concrete compound developed for Halifax Project cold-set bricks.

ECD EcoCommunity Development, Ecological Community Development

ECOCENTRIC Ethic grounded in cosmos

ECOCO Network of Ecological Consultants (Ecoco Global Limited)

ECOCYCLE
Ecological Cycle: a connected system in which the waste from one stage is the substrate for another; in Nature usually a web of interconnected subcycles; in human imitations (Industrial Ecology), usually less complex, but relying on natural processes to manage human waste and resource streams.

ECOLOGICAL FOOTPRINT
The ecological footprint of a designated population is the area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever on the Earth the land and water is located (Wackernagel & Rees 1996).

ECOLOGICAL RUCKSACK
When analysing the ecological significance of economic efforts, all resource and energy inputs - from the cradle to the grave - as well as the respective land use must be taken into consideration. We refer to these as the 'ecological rucksacks'
Every emission-avoiding provision, energy recycling effort, every solar collector and every disposal has its ecological cost ... renewable resources are by no means exempt from

ecological extraction costs, as they must usually be grown on plowed fields, irrigated, transported and processed (Hinterberger *et al.* 1997).

ECOLOGY vs ENVIRONMENT
Ecology: recognises interdependence of all living systems with each other & their environments; Environment = context.

ECOTECH
Exhibition of Green Technology associated with Earth Summit, Rio de Janeiro, 1992; loci in Rio and São Paulo.

ECOTONE Boundary or transition zone between communities or biomes

ECT Elementary Catastrophe Theory

EDA Economic Development Authority

EDGE OF CHAOS
Creative realm at any scale, where order emerges from a complex Interference Field; which lies between Stochastic (random) Chaos and Deterministic (structured) Chaos. Named by Santa Fe Institute (USA) in the 1980s.

EFT Ecological Field Theory

EGOCENTRIC Ethic grounded in self (individual).

EIA Environment Impact Assessment, Environment Institute of Australia

EIS Environmental Impact Statement

EM ElectroMagnetic

EMF Electro-Magnetic Field, ElectroMagnetic Force

EMF ElectroMagnetic Force

EMR Electro-Magnetic Radiation

EMS Environmental Management System

ENTRAIN Draw into Attractor Field, pull into the flow; refers to Synergetics: under unstable conditions of transition from one state to another, the field of more stable variables is entrained by the least stable, setting off a web of changes; enables the 'butterfly's wing' phenomenon. Also known as 'enslave'; see Medium Number Systems.

EPA Environmental Protection Authority

EPP Ecological Paradigm Proponent

ESD Ecologically Sustainable Development

ESP Extra-Sensory Perception; Electro-Static Precipitator(-ion)

ESQUISSE
Sketch, outline, beginning, suggestion: from French: first form of a design/architectural work (Dictionnaire Micro Robert en Poche).

ESS Evolutionarily Stable Strategies

ET EcoTourism

ETSA Electricity Trust of South Australia

EUHEMERUS Bible writer/ explainer of Myths; used be Eric Berne to refer to those who wrote the texts to which modern people refer; now used by Transactional Analysts to describe Berne himself.

EXCLUSIVE HIERARCHY
Groups or processes that are ranked as lower in a hierarchy are not contained in or subdivisions of groups that are ranked as higher in the system (eg military ranking systems – general, captain, lieutenant, sergeant, corporal, private).

EXTENT The size of the spatial, temporal, quantitative or analytical dimensions of a scale.

EXTREME WHOLISM
The network of relationships is all that we have (modified from Blackburn 1996: 177). *['W' added to holism].*

FAN Fuzzy Associative Network

FCM Fuzzy Cognitive Map

FDES Framework for the Development of Environmental Statistics

FFE Far From (thermodynamic) Equilibrium (negentropic)

FIRESOUL A fervent for something: visionary leader

FLAMOC Fuzzy Logic And Management Of Complexity (International Conference)

FLOCKING
Population strategy for mutual protection, interaction, response to scarcity or danger.

FQ Fundamental Questions Project (Centre for Resource & Environmental Studies, ANU)

FQP Fundamental Questions Program

FSS Fuzzy Sustainability Space

GATT General Agreement on Tariffs and Trade
GCM General Climate Model
GDP Gross Domestic Product
GEMCAT Software for Catastrophe Theory model assessment
GENERAL THEORY OF RELATIVITY (Einstein)
See Special Theory of Relativity
GESTALT
Theory of Perception. From *'Gestalt(en)'* : an emergent structure or form, creation, design, unified whole. Includes figure-ground switching. Gestalt School of Psychology founded 1910 by Weretheimer, Koffka & Köhler (Blackburn 1996;Terrell,Calderwood-Schnoor,Morris & Breitsprecher 1980).
GeV Giga Electron Volts
GHG Greenhouse Gas(es)
GIGO Garbage In Garbage Out (of computing)
GIS Geographical Information System
GNP Gross National Product
GPI Genuine Progress Indicator
GRAIN The finest unit of resolution possible using a particular scale.
GUT Grand Unified Theory
GWP Gross World Product
HEE Human Energy Equivalent
HEISENBERG'S UNCERTAINTY PRINCIPLE
Indeterminacy relations in subatomic particles; unresolvable duality of paired observables in orthogonal relationship.
HIERARCHY
A conceptually or causally linked system of grouping objects or processes along an analytical scale.
HOLOGRAPHIC UNIVERSE
Each cell contains <u>information about</u> the whole (Pribram); (<u>not contains</u> the whole).
HOLOMOVEMENT
Fundamental ground of reality: an atemporal, universal energy field with a boundary at 10^{-33}cm where Explicate Order emerges from Implicate Order.
HSD Human Scale Development
HSE Human Settlement Ecology
HST Hypercyclic Systems Theory (theory of complex, dynamic far-from-equilibrium dissipative systems poised at the Edge of Chaos).
HT Hierarchy Theory
HUP Heisenberg's Uncertainty Principle
HWS Hot water system
HYPERCYCLIC SYSTEMS
Systems with hierarchical structure, multiple feedback loops and embedded subsystems (Mesarovic & Macko 1969).
HYPERSPACE Space of over 4 dimensions at any scale.
IBRA Interim Biogeographic Regionalisation for Australia
ICE Institute of Community Economics (USA)
ICLEI International Council for Local Environmental Initiatives
IDGC Institutional Dimensions of Global Change
IEEE International Ecological Economics
IFC International Facilitating Committee (UNCED)
IFHP International Federation of Housing & Planning
IHDP International Human Dimensions Programme (of Global Environmental Change)
IHR Integrated Holistic Research
IHR Integrated Holistic Research (IWR)
IIASA International Institute of Applied Systems Analysis
IISD International Institute for Sustainable Development
INCIPIT Announcement of what is to come (L. In + cipere, initiate, begin, take, start)
INCLUSIVE HIERARCHY
Groups or processes that are ranked as lower in a hierarchy are contained in or subdivisions of groups that are ranked as higher in the system (eg modern taxonomic classifications – kingdom, phylum, subphylum, class, family, genus, species).

inter alia among other things (Latin)

INTROJECTS

Psychological complexes sourced from significant others; unintegrated, complex behaviours taken in by the developing organism and incorporated lonto own structure.

IR Interaction Ritual (chains): sociological concept (after Collins) explaining connections between micro and macro scales.

ISEE International Society for Ecological Economics

IT&T Information Technology & Telecommunications

ITAA International Transactional Analysis Association

ITDG Intermediate Technology Development Group

IUCN International Union for the Conservation of Nature

JVNIC Jerrabomberra Valley National Ideas Competition

KOSIS-Verbund

Communal (municipal) Statistics Information System

KRATOCENTRIC

Operating on a power Attractor (as distinct from Egocentric, Ecocentric, Anthropocentric, Biocentric; author's neologism; from Gk *kratos:* power.

LA21 Local Agenda 21 (Local government component of A21 – Chapter 28)

LAMARCKIAN EVOLUTION Inheritance of acquired characteristics

LAP Local Action Plan; Local Area Plan

LDC Less Developed Country

LETS Local Economic Transfer Scheme (aliter: Exchange/ Trading/ System)

LEVELS

The units of analysis that are located on the same position on a scale. Many conceptual scales contqin levels that are ordered hierarchically, but not all levels are linked to one another in a hierarchical system.

LG Local Government

LGA Local Government Association, Local Government Area

LGC Local Government Council

LTI Linear Time Invariant systems in signal processing

MAB Man And Biosphere (Program)

MAI Multilateral Agreement on Investment

MARC Marketing And Research Centre (Adelaide)

MDC More Developed Country

MEAN CONNECTIVITY

(Levins, 1974, qualitative approach) of components is defined as 'the mean number of direct interconnections between one component and the rest of the system'.

MEDIUM NUMBERS

The Ecological Paradigm is described by a region of Mathematics known as 'medium number systems'. These are complex and non-linear, and lie between small number simple systems and large number simple systems.

Molecular biologists and ecologists have found that in the medium number range, large numbers of variables can be organised into smaller modules subsumed to a small number of 'keystone' or 'ordering parameters' (or system inputs experimentally), that 'enslave' or 'entrain' the system, making it a lot easier to study if this structure can be identified. Such a structure confers stability and resilience to such systems as biological tissues, organisms, food webs, economies and ecosystems depending on the structural pattern, but in general it has relatively discrete, hierarchically arranged subsystems (frequency hierarchy).

MEME

"A unit of cultural inheritance, hypothesised as analogous to the particulate gene, and as naturally selected by virtue of its 'phenotypic' consequences on its own survivaland replication in the cultural environment" (Dawkins 1982: 290).

METAPHYSICS

Any enquiry that raises questions about reality that lie beyond or behind those capable of being tackled by the methods of science (Blackburn 1996: 240).

MFP MultiFunction Polis (Australia, Adelaide)

MIPS Materials Flows per Unit of Service

MIT Massachusetts Institute of Technology

MNC Multi-National Corporation

Moderate Wholism Other things beside these relationships also count.

Mosaic
One of three mental styles recognised and acted on by Ericksonian hypnotherapists (disciples of the late Milton Erickson). The other two are left/logical and right/lateral (refer Background Paper: Applications of Quantum Complementarity: brain function from a subatomic perspective (work of Ramachandran *et al*).

MOSS Metropolitan Open Space System

MP Member of Parliament

MQ Masters Qualifying

NAFTA North Atlantic Free Trade Agreement

NASH EQUILIBRIA
Local points of local fitness on *Rugged Fitness :Landscape* relative to available genotypes and stable population densities (see Kauffman 1993;Kauffman & Johnsen 1991).

NatHERS National House Energy Rating System

NATURAL CAPITALISM
Capitalism based on relative shortage of ecological services.

NCA National Capital Authority (Canberra, formerly NCPA, qv)

NCA National Capital Authority (planning)

NCP National Capital Plan

NCPA National Capital Planning Authority (now NCA)

NDP Natural Resource Depletion Product

NGO Non Government Organisation

NHT Natural Heritage Trust, derived from sale of IT&T carrier Telstra

NIMBY Not In My Back Yard!!

NKC
Kauffman's model (N = no of traits or genes; K = no of other genes or traits with impact on fitness contribution of each gene or trait (epistatic linkages); C = traits in other species with which each species interacts) enables study of the qualities of different levels of connectedness. The work of Kauffman and Johnsen in modelling and tuning 'rugged fitness landscapes' (after Wright) has indicated the importance of coevolutionary dynamics where abiotic environment and other organisms, all changing together, form the context for evolution, especially in molecular systems.

NLP Neuro-Linguistic Programming

NOÖSPHERE
Sphere of human influence on Earth. F. noösphere, f. Gr. mind + sphere n. :the world of mind (OED: selected quotes from full entry below).
In Ecology, term has come to mean zone of influence of human activity: presently somewhat pejorative due to technolgically driven, destructive character of human presence (note source of word as implying human dominance over Biosphere: see underlining).
The name given by Pierre Teilhard de Chardin in his theory of evolution to the stage or sphere characterized by the emergence of consciousness and mind which follows the stage of the establishment of human life.
J. S. Huxley (1953): Much more coherent and just as extensive as any preceding layer, it is really a new layer, the 'thinking layer', which has spread over and above the world of plants and animals. In other words, outside and <u>above the biosphere</u> there is the noosphere.
Externalization of our senses creates what de Chardin calls the 'noosphere' or a technological brain for the world (McLuhan 1962).
Verdansky (1945): 'I think that we undergo not only a historical, but a planetary change as well. We live in a transition to the noosphere.' By noosphere Vernadsky meant the envelope of mind that was to <u>supersede the biosphere</u> (Sci.Am. 1970).
Linguistic anthropologists pull language: "down from its <u>cold noosphere</u> back into the warm current of social living" (Times Lit.Supp.1965).
In practice we all act as if the mental aspect of Chardin's noösphere really is a guiding and determining factor in human existence (New Scientist 1967).

NRD Net Residential Density (now usually in dwellings per hectare)

NRSCP National Reserves System Cooperative Program

NSW New South Wales

OCW Opposing City West: studio project for final year architecture students University of SA, 1997.

OD Organisational Development

ODP Oxford Dictionary of Philosophy

OECD Organisation for Economic Cooperation and Development

OED Oxford English Dictionary

OH&S Occupational Health and Safety

Ontology

Derived from the Greek word for being, but a 17th-Century coinage for the branch of metaphysics that concerns itself with what exists. Apart from the ontological argument itself there have existed many à priori arguments that the world must contain things of one kind or another... (Blackburn 1996: 269-70).

OOR Optimal Operating Range

ORBoolean Term for an either/or choice in a pathway, which acts like a gate, controlling signal

OVER/UNDERCONNECTEDNESS

Outside optimal range of connectedness; of entity to other entities or to resource supplies. Of individuals, populations; for example scarcity → overconnection to food supply.

PAC Parent – Adult – Child (Ego States, TA)

PALM Planning & Land Management (Department of), ACT

PCRaster Dynamic GIS software programme

PERMACULTURE®

'Permanent agriculture': wholistic system of sustainable food production & lifestyle.

PIRSA Department of Primary Industries & Resources, SA

PNN Parliamentary & News Network

PO

Technique devised by Edward de Bono to assist creative thinking by acting as an intermediate impossible between two apparently unrelated concepts.

POP Process Oriented Psychotherapy/ Psychology

PPK Large private environmental consultancy

PR Public Relations

PRECAUTIONARY PRINCIPLE

"Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation" (Heads of Government in Australia 1992).

PSR Pressure-State-Response

PVC PolyVinyl Chloride

QA Quality Assurance, Q-analysis

QCD Quantum ChromoDynamics

QRA Qualitative Risk Assessment

QTQuantum Theory

QUANTUM SCALE

QUT Queensland University of Technology

qv Quod vide: which see (see below); from Latin

R2000 System of insulation standards (Canada)

RAIA Royal Australian Institute of Architects

RAPI Royal Australian Planning Institute

RCD Resource Conserving Development

REALISM

A realist about a subject-matter S may hold (i) that the kinds of things described by S exist; (ii) that their existence is independent of us, and not an artefact of our minds, or our language or conceptual scheme; (iii) that the statements we make in S are not reducible to other kinds of statement, revealing them to be about some different subject-matter; (iv) that the statements we make in S have truth-conditions, being straightforward descriptions of aspects of the world and made true or false by facts in the world; (v) that we are able to attain truths about S, and that it appropriate fully to believe things we claim in S.

Subdivisions of Realism include *Empirical Realism* (Kant): phenomenologically apparent things really exist, independently of our mental states; *Transcendental Idealism*: the phenomenological world reflects our interpretive minds; we perceive through conceptual and linguistic filters to an impressive extent (modern Philosophy, Goodman) (Blackburn 1996: 320).

Eliminativists think the S discourse should be rejected. Sceptics either deny (I) or deny our right to affirm it. Idealists and conceptualists deny (ii), reductionists deny (iii), while instrumentalists and projectivists deny (iv). Constructive empiricists deny (v). Other combinations. There is little consensus on exact construction of realist/antirealist dispute (Blackburn 1996: 320).

RED Resource Exploitative Development

RELATIVE SCALE
A transformation of an absolute scale to one that describes the functional relationship of one object or process to another (eg the relative distance between two locations based on the time required for an organism to move between them).

REM Rapid Eye Movement

RESOLUTION The precision used in measurement.

RHEOMODE Action language proposed by late Professor David Bohm

RNA Ribosenucleic Acid

ROI Registration of Interest

RQRed Queen

RSD Resource Sustaining Development

RUGGED FITNESS LANDSCAPE
A rugged plain with fitness peaks of different height and steepness, needing a transient decrease in fitnes to move from one to another: analogy for any major change to sustainability Attractors. Coevolving entities congregate at different local fitness peaks in dynamic inter-relationship. S = total no of species which interact. Si = no of species affected when any species i interacts. Increasing epistatic linkages increases landscape ruggedness by increasing the number of peaks, increasing the steepness of the sides and decreasing the height (by introducing conflicting constraints). Altering C for one species skews the landscape for other species. Two versions of the model exist, one including Lokta-Volterra logistics for evolution of competition or mutualism (Kauffman, Stuart A. & Johnsen 1991: 468-9).

RUST BELT
Area under decline (cities, regions, indicates predominance of obsolete industries or occupations, especially shift from industrial to post-industrial)

SA South Australia

SACHA SA Cooperative Housing Association

SAHT SA Housing Trust

SCALE
The spatial, temporal, quantitative or analytical dimensions used to measure and study any phenomenon.

SEA Strategic Environmental Assessment

sine qua none
Without which nothing (Latin): necessary for some outcome

SMB/SME Small-Medium Business/ Enterprise

SNF Electro-Strong Force (Strong Nuclear Force)

SO Self Organisation/Organising

SOD Shorter Oxford Dictionary

SOE State Of Environment

SoER, SOER State of Environment Report

SOS Self Organising System

SPACETIME
An emergent phenomenon (above 10^{-33}cm): a continuum of four dimensions (three of space, one of time), to which humans are attuned; location of matter as we understand it; used at macro scales to locate 'lumpy' ecological phenomena on a 'Spacetime Diagram'.

SPECIAL THEORY OF RELATIVITY (Einstein)
Relational frames under uniform motion, concerns time as a fourth dimension, related to 3D space ('spacetime'); General Theory of Relativity refers to all frames, including those under acceleration, and concerns gravity. Constant speed of light as a relational frame, so Laws of Physics now uniform across all frames of reference. (Baggott 1992: 35;Bohm 1965: 71-3, 110;Einstein & Infeld 1938: 59-65, 156-7).

SPRC Social Policy Research Centre (University of NSW)

SPRC Social Policy Research Centre (University of NSW)

SPV Solar photovoltaic (solar collector/ collector system)

ST Solar thermal (solar collector)

STELLA Training software package for systems thinking, Harvard Business School

STRAWBALE Method of alternative housing construction using bales of straw

SUBSTANCE MONISM
Ontological statement of ultimate universal connectivity. See Boolean Logic.

SUBSTANCE PLURALISM
Ontological statement of ultimate universal Atomism or disconnection. See Boolean Logic

SUSTAINABLE Able to continue in approximately the same state indefinitely

SUSTAINABLE DEVELOPMENT
"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1990: 87 – source of term).

SWOT Strengths – Weaknesses – Opportunities – Threats (business/project appraisal)

SYNERGETICS Energy coming together; the Science of Phase Transition (>1970s); has goal of describing the self-organising behaviour of macroscopic far-from-equilibrium systems through a generic mathematical model that enables inter-disciplinary communication (such as Physics, Chemistry, Biology, Ecology, Sociology and Economics) (Haken & others). Has three approaches: micro (Chemistry, Biology: follows order parameters and writes evolution equations for the parts); macro (studies for example Brownian movement, entropy); and phenomenological (studies order parameters near their instability points). Areas of interest include language, organising rituals, democratic laws, civil societies becoming nations, fashion and paradigms.

SYSTEM
A network of functionally linked entities with a unified, emergent purpose; essence of systemic function is intangible & best appreciated as functional patterns & processes (refer Capra).

TA Transactional Analysis
TAJ Transactional Analysis Journal
TBT Topological Bootstrap Theory
TCM Total Catchment Management
TMD The Macquarie Dictionary
TNS The Natural Step (environmental sustainability training)
TOD Transit-Oriented Development
TOE Theory of Everything
TSP Time-Space Prism (used in Time Geography to study behaviour)
UBC University of British Columbia
UCB University of California at Berkeley
UEA Urban Ecology Australia
UEQ Urban Environmental Quality
UET Ultimate Environmental Threshold
UHSE Unified Human Settlement Ecology
UICD University of California at Davis
UK United Kingdom
UN United Nations
UNCED United Nations Conference on Environment and Development
UNCHS United Nations Centre for Human Settlements (Nairobi)
UNEP United Nations Environment Program
UNSO United Nations Statistical Office
USA United States of America
USC University of Southern California
USDA United States Department of Agriculture
VHS Very High Speed (video tape format)
WA Western Australia
WASD Weighted Average Source Distance
WASP Weighted Average Source Point
WCU World Conservation Union (IUCN)
WHO World Health Organisation

WHOLISM
Any doctrine emphasizing the priority of a whole over its parts

WMC Western Mining Company
WNF Electro-Weak Force (Weak Nuclear Force)
WRI World Resource Institute
WTO World Trade Organisation
WW2 World War 2
WZB Wissenschaftzentrum Berlin für Sozialforschung (WZB), Science Centre Berlin

Y2K Year 2000 or millennium 'bug' (computer issue with PC and Cobol-using industrial hardware, (non-Macintosh platform), caused by economising on memory by using 2-digit year dates: inability to accommodate '2000' due to resetting of clock to '00' or 1900 at turn of millennium) with potentially disastrous consequences for computer function.

YIMBY Yes! In My Back Yard!!

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