Design for human and planetary health: a transdisciplinary approach to sustainability

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Abstract

This paper explores various integrative frameworks that are contributing to an emerging transdisciplinary meta-perspective on sustainable development. It proposes a holistic/integral strategy based on scale-linking design for human and planetary health: First, 'Integral Theory', 'Spiral Dynamics' and 'Integral Ecology' are briefly reviewed as dynamic mapping methodologies to structure, facilitate and mediate between diverse value systems and perspectives of multiple stakeholders and disciplines. Changes in worldview, value system, and intentionality are crucial to the emergence of a sustainable civilization. Second, design is described as a transdisciplinary integrator and facilitator of informed decision making in the face of uncertainty. Design for systemic health can catalyse the sustainability transition. Third, the paper outlines how complexity theory, combined with a holistic conception of health, informs a scale-linking approach to sustainable design. Systemic health is a scale-linking, emergent property of healthy interactions and relationships within complex dynamic systems. The health of human beings, societies, ecosystems and the planetary life support system is fundamentally interconnected and interdependent. Sustainability, as a process of community-based learning, is expressed through design that is informed by ecological principles and adapted to local, regional and global limits and opportunities. In general, sustainable design is synergetic, symbiotic, scale-linking, salutogenic and sacred. There is a need to integrate ecological, social, cultural, economic and psychological (spiritual) considerations into a flexible and responsive strategy to facilitate the sustainability transition. Design for human and planetary health requires a transdisciplinary dialogue aiming for appropriate solutions and community-based visions of sustainability.

Keywords: scale-linking design, complexity, integral ecology, salutogenic design, transdisciplinary integration, health, sustainable civilization, vision.

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1 Introduction

> "While design became a professional practice with the rise of the industrial culture, more fundamentally, as elemental to mind, it is and always has been, one of the designations of what it is to be human. In this frame, everyone is a designer" [1].

The complexity of interrelated psychological, social and ecological problems that dynamically interact to drive the growing crisis of an unsustainable human civilization cannot be understood or responded to appropriately by compartmentalised, specialized, piece meal thinking. There is a clear need for broadly integrative frameworks that help to create a meta-level synthesis which draws on insights from a diverse range of disciplines and worldviews, and bridges theory and practice. Analytical, reductionist, objectivist, and quantity-focussed perspectives have to be contextualised through integrative, holistic, participatory, and quality-focussed perspectives.

What will affect the transition towards a sustainable human civilization even more profoundly than the necessary changes in our energy and resource use, settlement patterns, production and transport systems, and the local and global economies, are the underlying changes in worldview, value systems, life styles, and intentionality. There is a material (biophysical and ecological) dimension as well as an immaterial (psychosocial and conscious) dimension to the fundamental changes that will steer us towards sustainability.

This paper can only provide the faintest of outlines of the transdisciplinary synthesis attempted in the author's doctoral research. It is but a short summary of a two-volume thesis, entitled *Design for Human and Planetary Health: A Holistic/Integral Approach to Complexity and Sustainability*. The paper introduces some of the central concepts and strategies reviewed, developed, and integrated by this research. It sketches out a tool and a map to promote and structure a transdisciplinary dialogue about sustainable development and the participatory creation of a collective vision of a sustainable human civilization.

2 Mapping and integrating diverse stakeholder perspectives

> "Briefly what I am proposing is that the psychology of the mature human being is an unfolding, emergent, oscillating, spiralling process marked by progressive subordination of older, lower order behavioural systems to newer, higher-order systems as an individual's existential problems change. Each successive stage, wave, or level of existence is a state through which people pass on their way to other stages of being. When the human is centralized in one state of existence, he or she has a psychology which is particular to that state. His or her feelings, motivations, ethics and values, biochemistry, degree of neurological activation, learning system, belief system, conception of mental health, ideas to what mental illness is and how it should be treated, conceptions of and preferences for management, education, economics, political theory and practice are all appropriate to that stage" [2, pp.5-6].

The psychologist Clare Graves first began in the 1950s to map the complexity of human perspectives, worldviews, or dynamics of psychological development. He proposed a rough, but extremely useful, map of different human 'biopsychosocial systems' [3]. The fundamental validity of Graves' cartography of human consciousness has been tested internationally, through countless independent studies involving more than 50,000 people [2, p.6].

Graves' map has been developed further by his students, Don Beck and Christopher Cowan [3] into a framework and methodology for mediation and conflict resolution among diverse stakeholders with often drastically different points of view and value systems. The 'Sprial Dynamics' approach has been used in a wide range of circumstances, including the South African post-Apartheid reconciliation process. It is a tested tool for the integration of and mediation between diverse stakeholders and perspectives. Beck and Cowan argue:

> "Spiral Dynamics apply to a single person, an organization, or an entire society. Since it describes human nature in a universal sense rather than through personality types or racial, gender, and ethnic traits, the model provides a common language for grappling with both local and global problems. It offers a unifying framework that makes genuinely holistic thinking and actions possible" (p.30).

The philosopher Ken Wilber has incorporated, and developed the spiral dynamics approach into an even more encompassing and detailed integrative framework under the name of "integral theory". According to Wilber, the integral approach aims to "include matter, body, mind, soul and spirit as they appear in self, culture, and nature" [2, p.xii].

Wilber's 'integral theory' is trying to make sense of the individual *and* collective, as well as, the exterior *and* interior, aspects of humanity's conscious and co-creative participation in a continuously transforming *kosmos*. Just like the reductionistic, dualistic, materialistic map that defines modernity's dominant scientific and mechanistic worldview, Wilber's integral "theory of everything" is only a *map* albeit much more encompassing and inclusive. Maps remain extremely useful as long as we do not confuse them with the territory [4]. Integral theory can be effectively employed to situate different worldviews, value systems, and disciplinary perspectives and to acknowledge their validity and respective contributions to the dialogue on sustainability.

> "Integral Ecology weaves together the myriad approaches to the natural world in an effort to respond as effectively and timely as possible to the complex ecological problems that face ourselves, our communities, and our world in an evolving universe. In effect, Integral Ecology unites consciousness, culture, and nature in service of sustainability. People who are utilizing the Integral ecology framework recognize that it is not enough to integrate ecosystems and social systems. Instead, what is needed is an integration of subjective (e.g. psychology, art, phenomenology), intersubjective (e.g. religion, ethics, philosophy), and objective" (e.g. behavior, science, systems analysis) realities" [5].

The transdisciplinary scholars Sean Esbjörn-Hargens and Michael E. Zimmermann [6] are among the initiators of this emerging transdisciplinary research initiative which applies integral theory to the sustainability transition. An Integral Institute and an Integral University have been established in Colorado. Integral theory and integral ecology are promising emerging research agendas that are complementary to, and significantly overlap with, the scale-linking, systemic health promoting, design, and metadesign framework described by the research summarized in this paper.

> "Integral Ecology takes a participatory approach to the environment by recognizing that ecological phenomena are the result of an interaction between the knower, what is known, and how it is known. By acknowledging and honoring the multivalent nature of ourselves, our communities, and our environment, we can as global citizens, embedded in local eco-social systems, work effectively together towards sustainable solutions. A premium is placed on solutions grounded in mutual understanding between divergent viewpoints and understandings. By cultivating the capacity to inhabit other perspectives and hold multiplicity, we will be able to respond more adequately than current, less comprehensive approaches to the complex problems that currently face our bioregions" [7].

From within the social and ecological sciences, as well as the arts and humanities there is an ever-stronger call for transdisciplinary integration. The severe challenges of climate change, resource depletion, environmental and social disintegration, and national and international inequality, are converging into a global crisis that confronts humanity as a whole. The common purpose of health, and well-being, in full awareness of global-local interdependence, will stimulate transdisciplinary and transnational cooperation in the creation of more inclusive, multi-perspective based, decision-making processes that steer us towards the vision of a sustainable human civilization.

3 Design as transdisciplinary integrator and facilitator

Design occurs at the nexus between theory and practice. It can be used to integrate divergent value-systems and worldviews. How to meet true human needs within the ecological limits of the planetary life support system is a question of appropriate design. Broadly defined, design is the expression of intentionality through interactions and relationships. Design, as transdisciplinary integrator and facilitator will take a leading role during the 21st century to structure cooperation within the context of envisioning sustainability at a local, regional and global scale. With such multifaceted, multi-scale visions of sustainable futures, we can collectively create the strategies working toward such futures.

The Nobel laureate Herbert Simon proposed in his seminal book *The Science of the Artificial* [8], first published in 1969, that "the proper study of [hu]mankind is the science of design, not only as a professional component of a technical education but as a core discipline for every liberally educated person" (p.138). Simon saw design as special kind of science that is informed by the

natural sciences and deals with the artefacts and processes created by humans. He made the important distinction that while the natural sciences "are concerned with how things are," (p.114) and try to make nature more intelligible, most "design solutions are sequences of actions that lead to possible worlds satisfying specific constraints" (p.124). Design is based on human intentions and goals and therefore "concerned with how things ought to be" (p.114). It is this visionary and creative character of design, which gives design its central role in envisioning and creating a healthier and more sustainable future.

Scale-linking design for systemic health offers a holistically informed response to changing circumstances in the complex dynamic system that unites nature and culture, as well as mind and matter. It can help to create the political, social and economic institutions that are relevant and appropriate to changing circumstances within the interconnected and interdependent complexity of the real world. Issues like climate change, poverty, resource depletion, terrorism, inequality, and global environmental degradation can only be tackled through such a concerted response. Richard Buchanan [9] writes:

> "There is no area of contemporary life where design – the plan, project or working hypothesis which constitutes the 'intention' in intentional operations – is not a significant factor in shaping human experience. Design even extends into the core of traditional scientific activities, where it is employed to cultivate the subject matters that are the focus of scientific curiosity" (p.6).

In the material dimension the intentionality behind design is expressed through the interactions and relationships formed by products, transport systems, economies, systems of governance, settlement patterns, and resource and energy use, with the complexity of social and ecological processes. In the immaterial dimension our organizing ideas, worldviews, and value systems affect how we make sense of our experience of reality through metadesign. Metadesign, the psychological, epistemological and ontological aspect of design affecting human experience, has to be recognized as a crucial catalyst in the transition towards a sustainable human civilization. Buchanan [10] argues:

> "Design is a discipline where the conception of the subject matter, method, and purpose is an integral part of the activity and the results. On the level of professional practice, the discipline of design must incorporate competing interests and values, alternative ideas, and different bodies of knowledge".

At the nexus between theory and practice, between worldviews, value systems, and diverse stakeholder interests, and faced with the need to maintain an effective planetary life support system, design can fully step into its crucial role as interdisciplinary integrator and facilitator. Sustainable decision-making and design processes have to be open to contributions from diverse disciplines and perspectives, and at the same time, conscious of the epistemological and ontological metadesign that defines the perspective of each discipline.

There is an important visionary element to design that affects how we experience and shape our environment. "Designers deal with possible worlds and with opinions about what the parts and the whole of the human environment should be" [10]. Creating an inclusive vision of a globally sustainable human civilization, expressed through a diversity of locally adapted communities,

requires the integration of multiple worldviews and value systems. This integration can be facilitated through a dialogue-based, transdisciplinary process that applies future state visioning methodologies to the collective design of a sustainable human civilization at local, regional, and global scale. John Todd, one of the pioneers of integrative design for sustainability believes that ecologically informed design can help us to create such a civilization:

> "…through ecological design, it is theoretically possible to have a high civilization using only one tenth of the world's resources that industrial societies use today. We can reduce the negative human footprint by ninety percent and thrive as a culture. We do not have to destroy the Earth. Ecological design allows us to link human life support systems in a symbiotic way to the rest of the biosphere" [11].

4 Scale-linking design for systemic health

We are participants in a fundamentally interconnected physical, chemical, biological, ecological, social, and psychological process. The complexity of interactions and relationships between diverse agents makes this process fundamentally unpredictable and controllable. The appropriate way to come to terms with this fundamental unpredictability and uncontrollability is to remain constantly flexible, and increase resilience, adaptability and health on all scales throughout the holistic hierarchy - or holarchy [12] - of holons within holons, or networks within networks. Through *appropriate design* the negative human impact on the planetary life support system could be drastically reduced, and ecological and social integrity, resilience and health can be restored.

The constitution of the 'World Health Organization' (WHO) defines the concept of health as "a state of complete, physical, mental and social well-being and not merely the absence of disease or infirmity." In 1986, the WHO's 'Ottawa Charter' added the following "fundamental conditions and resources for health: peace, shelter, education, food, income, a [dynamically] stable ecosystem, sustainable resources, social justice and equity." In 1991, the WHO's 'Sundsvall Statement' emphasized the "way forward lies in making the environment – the physical environment, the social and economic environment, and the political environment – supportive to health rather than damaging to it" [13]. This implies a salutogenic design approach that contextualises and promotes individual, community, societal, and ecosystems health.

Design for human and planetary health aims to explore strategies that sustainably integrate humanity into the health maintaining and life-supporting processes of the biosphere. It responds to the challenges and opportunities mentioned in the WHO Commission on Health and Environment report [14]:

> "There is a powerful synergy between health, environmental protection, and sustainable resource use. Individuals and societies who share the responsibility for achieving a healthy environment and managing their resources sustainably become partners in ensuring that global cycles and systems remain unimpaired" (p.*xxx*).

Broadly conceived, if there was a more salutogenic (health-generating) intention behind all acts of design, humanity could greatly improve community, societal, ecosystems and planetary health, thereby driving the sustainability transition. The report argues: "Health depends on our ability to understand and manage the interaction between human activities and the physical and biological environment." It concludes: "We have the knowledge for this but have failed to act on it, although we have the resources to meet current and future needs sustainably" (p.*xiv*).

Humanity's failure – up to now - to engage in globally and locally cooperative salutogenic (health-generating) design aimed at the creation of a sustainable civilization is predominantly due to inappropriate cultural metadesign. We are culturally trapped in a mindset focussed on the individual rather than the collective, competition rather than cooperation, quantitative rather than qualitative growth, and a reductionistic rather than holistic understanding of our participatory and co-creative involvement in the complex dynamic process that unites nature and culture into a global community engaged in what Alfred North Whitehead called 'life's continuous exploration of novelty'.

> "Complexity theory is becoming a science that recognizes and celebrates the creativity of nature. … it opens the door to a new way of seeing the world, recognizing that these complex dynamic systems are sensitive to initial conditions and have emergent properties. We have to learn to walk carefully in relation to these complex systems on which the quality of our lives depends, from microbial ecosystems to the biosphere, because we influence them although we cannot control them. This knowledge is new to our western scientific mentality…" [15].

Brian Goodwin explains: "Emergent properties are unexpected types of order that arise from interactions between components whose separate behaviour is understood. Something new emerges from the collective – another source of unpredictability in nature." He continues: "The complex systems on which our lives depend – ecological systems, communities, economic systems, our bodies – all have emergent properties, a primary one being health and well-being"(p.27).

Most broadly, sustainable design can be defined as appropriate (salutogenic) participation in social and ecological process. Appropriateness should be judged by the extent to which a certain design maintains the overall dynamic stability, resilience, flexibility, adaptability, or health of the system as a whole. In order to create sustainable designs we will have to learn to reintegrate social and ecological processes. This will require us to consider insights from many different disciplines through trans-disciplinary co-operation and dialogue. Designers will also have to become more conscious of the way that a particular design may participate in various, interconnected scales of natural process at one and the same time. Furthermore, the role of conceptual metadesign (epistemological and ontological assumptions) has to be considered explicitly.

Complexity theory, health, symbiosis, synergy, appropriate participation, and integrative design are related scale-linking concepts and frameworks. They can help to structure an integrated strategy to maintain human and planetary health

and achieve sustainability. Bryan Norton offers a definition of sustainability within the context of human, community, ecosystems and planetary health:

> "Sustainability is a relationship between dynamic human economic systems and larger, dynamic, but normally slower-changing ecological systems, such that human life can continue indefinitely, human individuals can flourish, and human cultures can develop – but also a relationship in which the effects of human activities remain within bounds so as not to destroy the health and integrity of self-organizing systems that provide the environmental context for these activities" [16].

From this perspective that aims to integrate social and economic realities into their wider ecological context, the notion of sustainability and the notion of maintaining and restoring a healthy and therefore resilient environment – at the community, ecosystem, and the planetary scale – are inextricably linked. Ecological and societal health, as a system-wide emergent property, facilitates healthy human development, and allows for healthy and diverse cultural expressions. Systemic health emerges as locally adapted communities learn to co-create sustainable modes of interaction and relationships within the limits and opportunities set by the ecological and social conditions of their local bioregion within a global context. In a continuously changing, complex system, the promotion of health and sustainability requires constant learning in order to adapt appropriately to such change.

Haskell *et al.* [17] emphasize that ecosystem health "cannot be defined or understood simply in biological or ethical or aesthetic or historical terms. Many approaches must be used in clarifying the goals of environmental protection." The concept of ecosystem health is best understood from a "pluralistic, multidisciplinary collection of perspectives … covering a broad spectrum of ideas from philosophy, science, and management" (p.3). The concept of "protecting and restoring health to ecological process at all levels" may help us in maintaining "the autonomous, self-integrative processes of nature as an essential element in a new ethic of sustainability" (p.4). Haskell and his co-authors understand ecosystem health as a characteristic of complex natural systems. They explain: "Since fast-changing human cultures are embedded in larger scale, slow-changing ecological systems, we must develop policies that allow human cultures to thrive without changing the life support functions, diversity, and complexity of ecological systems" (p.4).

Robert Costanza [18] reviewed a number of conceptual definitions of 'ecosystem health' based on health as: homeostasis, absence of disease, diversity or complexity, stability or resilience, vigour or scope of growth, and as balance between systems components (p.239). All of these conceptualisations of health have a valid perspective and can be informative, but they also have their limitations. Costanza calls them "pieces of the puzzle." He proposes that ecosystem health should be understood "as a comprehensive, multiscale, dynamic, hierarchical measure of system resilience, organization and vigour," and argues: "These concepts are embodied in the term 'sustainability', which implies the system's ability to maintain its structure (organization) and function (vigour) over time in the face of external stresses (resilience)." Costanza

emphasizes the important holarchical, scale-linking aspect of health: "A healthy system must also be defined in the light of both its context (the larger system of which it is part) and its components (the smaller systems that make it up)" (p.240).

David Brunckhorst [19], head of the UNESCO Institute for Bioregional Resource Management, emphasized that "resilience, like sustainability, has multi-faceted elements effecting it through scales of space and time – it does not simply occur at a local or global scale." He explains: "To sustain and restore resilience in ecological and social systems for long term sustainability, we must begin to integrate our planning and operate our management across multiple scales…". According to Brunckhorst, we may be able to do so by "nesting functional requirements of ecological systems and social systems for an enduring future" (p.16). He writes:

> "Sustainability implies not challenging ecological thresholds on temporal and spatial scales that will negatively affect the resilience or adaptive capacities of social and ecological systems. … Resilience within and across systems operates at multiple temporal and spatial scales. Loss of resilience undermines the ecosystem's capacity to continue to deliver life-support and other ecological services to humanity under a wide range of environmental conditions" (p.15).

Just as design can serve as an integrative concept for trans-disciplinary cooperation in the creation of more sustainable solutions, health can provide the integrating concept that unites social, ecological and economic needs across all scales (*and cultures!*). Such integrative concepts are crucially important in motivating individuals, societies, cultures and humanity collectively to collaborate in the creation of more holistically considered, sustainable solutions.

The emerging transdisciplinary strategy to integrate sustainable development through ecologically informed, salutogenic, and scale-linking approach to design has been heralded over the past century by the work of such pioneers like, Patrick Geddes, Lewis Mumford, Ian McHarg, John and Nancy Todd, Bill McLarney, Bill Mollison, John Tillman Lyle, Gregory Bateson, Victor Papanek, Seaton Baxter, Sim van der Ryn, Stuart Cowan, David Wann, Daniel Chiras, Robert Costanza, Janis Birkeland, Paul Hawken, Hunter and Amory Lovins, William McDonough, Michael Braungart, and David Orr [20].

Many, but not all, of the approaches promoted through the important work of these people, are explicitly stating the improvement of individual, community, ecosystem, and planetary health as their central aim. Their lowest common denominator is the intention to contribute to the creation of a more sustainable human civilization through design and metadesign that leads to appropriate participation in social, economic, and ecological process. Professor Orr writes:

> "The etymology of the word 'health' reveals its connection to other words such as healing, wholeness and holy. Ecological design is an art by which we aim to restore and maintain the wholeness of the entire fabric of life increasingly fragmented by specialization, scientific reductionism and bureaucratic division. …The standard for ecological design is neither efficiency, nor productivity, but health, beginning with that of the soil and

> extending upward through plants, animals, and people. …It is impossible to impair health at any level without affecting it at other levels" [21].

This perspective recognizes the complexity of health as a scale-linking emergent property of the complex dynamic system that unites ecological and social processes into a continuously co-evolving and transforming whole. It contextualises an approach to sustainable design that is synergistic, symbiotic, scale-linking, salutogenic, and sacred.

Within the context of a fundamentally interconnected complex whole, design is a co-creative act that affects all life. As human beings we both shape, and are shaped by life's evolutionary process. In this frame, the evolution of life and consciousness is the sacred ground of our being. As such, all acts of sustainable design that preserve the health and integrity of the community of life and the planetary life support system are also sacred acts of appropriate participation in the wider process that gives us identity and meaning.

5 A holistic/integral approach to sustainability

> "The new science keeps reminding us that in this participative universe, nothing lives alone. Everything comes into form because of relationship. We are constantly called into relationship – to information, people, events, ideas, and life. Even reality is created through our participation in relationships. We chose what we notice; we relate to certain things and ignore others. Through these chosen relationships we co-create our world. If we are interested in affecting change, it is crucial to remember that we are working within webs of relations, not with machines" [22].

Ultimately, the shift towards a sustainable human civilization and increased human and planetary health will require a majority of global citizens to assume full responsibility for their co-creative involvement in shaping humanity's and the planet's future. To a greater or lesser extent, we are all designers of this future. The author's doctoral research concluded that if the basic intention behind all human design was salutogenesis - the improvement of health throughout the wider system that contains us - we would be able to facilitate a drastic shift towards more sustainable practices at the local, regional, national and international scale.

Salutogenic design aims to facilitate the emergence of health at *and* across all scales of the whole. It recognizes the inextricable link between human, ecosystem, and planetary health. Rather than primarily focussing on the relief of symptoms of disease or ill-health, this approach tries to promote positive health and a flourishing of the whole by altering underlying relationships and interactions in such a way that health can emerge as a systemic property on all scales of the whole. In other words, the aim of salutogenic design is to create healthy individuals in healthy communities that act as responsible participants in healthy societies [23], ecosystems, bioregions, and ultimately a healthy biosphere *and* noosphere.

Valerie Brown and her colleagues list two criteria that should guide human behaviour if we hope to avoid serious damage to the biosphere and the natural

processes that maintain its health. The first strategy is "to consume nature's flows while conserving the stocks (that is, live off the 'interest' while conserving natural capital." The second strategy is "to increase society's stocks (human resources, civil institutions) and limit the flow of material and energy" [24].

Nature's processes are fundamentally scale linking and unite the nanometer scale of photosynthesis to the macro scale of atmospheric composition and climate change. Maintaining and improving systemic health across all scales of this dynamic whole requires an intentionally salutogenic attitude to be widespread throughout society. The global shift towards improved health and sustainability involves everyone, everywhere. To turn the vision of diverse, sustainable communities and cultures and a sustainable human civilization into reality, not only professional designers, everybody needs to act consciously and responsibly. Sustainability depends on the intention to collectively envision and create a sustainable future through the daily interactions and the relationships we form in our human and ecological communities.

This holistic and participatory perspective on sustainability proposes that the fundamental intentionality guiding us in the uncertain and uncontrollable journey towards a sustainable future should be to improve the overall health of the whole system. Through a deeper understanding of the relationship between eco-systemic, biospheric, and human health, an integrative framework for a holistic/integral approach to sustainability and complexity is emerging.

If all our actions are considered in the light of how they might affect the health of the local and the global environment as well as the health of human communities and individuals, both in the short- and in the long-term, appropriate participation, and thus sustainability, will cease to be an elusive concept and become a tangible strategy. Truly everybody is a designer, whether we are professionally engaged in the design industry, or whether we contribute to cultural, societal, and biological evolution through the way we relate to nature and culture and express these attitudes through our actions and lifestyles. Salutogenic, symbiotic, synergistic, scale linking, and sacred design can promote sustainable development, and help to structure transdisciplinary integration in a globally and locally cooperative effort to create a sustainable human civilization.

References

[1] Fry, T., *Remakings: Ecology, Design, Philosophy*, Envirobook: Sydney, p.113, 1994.

[2] Wilber, K. *A Theory of Everything: An Integral Vision for Business, Politics, Science and Spirituality*, Gill & Macmillan: London, 2001.

[3] Beck, D. & Cowan, C., *Spiral Dynamics: Mastering Values, Leadership and Change*, Blackwell Business Publishers, 1996.

[4] Bateson, G., *Steps to an Ecology of Mind: Collected essays in Anthropology, Psychiatry, Evolution, and Epistemology*, Jason Aron, 1972.

[5] Esbjörn-Hargens, S., 'Guest Editor's Introduction', *World Futures*, Vol.61, No.1-2, Special Issue on Integral Ecology, p.1, 2005.

[6] Zimmerman, M.E., 'Integral ecology: A Perspectival, developmental, and Coordinating Approach to Environmental Problems', in *World Futures: The Journal of General Evolution*, Vol.61, No.1-2, pp.50-62, 2005.
[7] Esbjörn-Hargens, S., 'Integral ecology: The *What, Who,* and *How* of Environmental Phenomena', *World Futures*, Vol.61, No.1-2, Special Issue on Integral Ecology, p.36, 2005.
[8] Simon, H., *The Science of the Artificial*, 3rd edition, The MIT Press, 1996.
[9] Buchanan, R., 'Wicked Problems in Design Thinking', in Margolin & Buchanan edits, *The Idea of Design*, The MIT Press. 1995.
[10] Buchanan, R. 'Rhetoric, Humanism and Design', in Buchanan & Margolin edits. *Discovering Design*, The University of Chicago Press, p.26, 1995.
[11] Todd, J. 'Ecological Design in the 21st Century', Annual Schumacher Lecture, Schumacher Society, UK, (see www.oceanarks.org), p.3, 2000.
[12] Koestler, A., *The Ghost in the Machine*, Arkana Books, 1967.
[13] Waltner-Toews, D. *Ecosystem Sustainability and Health: A Practical Approach*, Cambridge University Press, p.90, 2004.
[14] World Health Organization, *Our planet, our health: A Report of the WHO Commission on Health and Environment*, WHO, Geneva, 1992.
[15] Goodwin, B. *et al.*, 'Participation in a living World', in *Revision: A Journal of Consciousness and Transformation*, Vol.23, No.3, pp.27, 2001.
[16] Norton, B.G. 'A New Paradigm for Environmental Management', Costanza, Norton & Haskell edits. *Ecosystem Health*, Island Press, p.25, 1992.
[17] Haskell, B.D., *et al.* 'What is Ecosystem Health and Why should We Worry About It?' in Costanza *et al.* edits. *Ecosystem Health*, Island Press, 1992.
[18] Costanza, R., 'Towards an Operational Definition of Ecosystem Health', in Costanza *et al.* edits. *Ecosystem Health*, Island Press, pp.239-256, 1992.
[19] Brunckhorst, D.J., *Bioregional Planning: Resource Management beyond the New Millennium*, Routledge: London, 2002.
[20] Wahl, D.C., *Design for Human and Planetary Health: A Holistic/Integral Approach to Complexity and Sustainability*, Ph.D. thesis, School of Design, University of Dundee, Scotland, 2006.
[21] Orr, D.W. *The Nature of Design: Ecology, Culture, and Human Intention*, Oxford University Press, p.29, 2002.
[22] Wheatley, M.J., *Leadership and the New Sciences: Discovering Order in a Chaotic World*, Berrett-Koehler Publishers, p.145, 1999.
[23] Wilkinson, R.G., *The Impact of Inequality: How to make sick societies healthier*, Routledge: London, 2005.
[24] Brown, V.A., *et al.*, *Sustainability and Health: Supporting Global Ecological Integrity in Public Health*, Earthscan: London, p.45, 2005.