ECOLOGICAL WORLDVIEW AND REGENERATIVE SUSTAINABILITY PARADIGM

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Abstract- There is an emergence of research on the potential of Ecological Worldview,Regenerative Sustainability paradigm and related design theories. This paper presents key findings from a review of key literature to date, discussing opportunities and challenges available to the contemporary design practitionerinterested in this approach.

Keywords- Architecturaldesign And Theory, Built Environment, Ecological Worldview, Regenerative Sustainability.

I. INTRODUCTION

The findings of a literature review suggest that, two worldviews are evident in current sustainability trends – the Mechanistic and the Ecological. Two paradigms have emerged within these worldviews – the Technological and the Regenerative. Separate meanings of 'sustainability' can be defined under these paradigms. Technological Sustainability (TS) refers to the Mechanistic worldview (MW) and Regenerative Sustainability (RS) refers to the Ecological worldview (EW). These two types of sustainability differ from each other and their differences are stark.

Conventional design of built environment (DBE) cannot counter the problem of pollution and resource inefficiency endemic in contemporary society. TS in DBE, though gaining popularity, can only mildly reduce the problem. RS in DBE can play a stronger role in protecting microclimates and reducing emissions whilst increasing economic and social capital [1].

The aim of this literature review is to explore the influence of RS in emerging design theories (DT's) such as, Biophilia, Biomimicry, Lyle's Regenerative Design, Yeang'sEcodesign, Regenesis's Regenerative Design and Development and Living Building Challenge. These DT's have found application in several recent architectural and landscape projects.
The outcome of this review is the identification of the range of opportunities that these DT's offer to the contemporary design practitioner. Several challenges that patrons of the RS approach face in practiceare also identified.

The significant finding of the review isthe exploration of a framework that can comprehensively communicate the value of RS. The framework is a philosophical model that can capture the inherent value of RS across its entire spectrum.

II. LITERATURE REVIEW

1.1 Overview

Current literature on the subject of RS was collected through keyword searches on online databases such as Google Scholar, Web of Science and Scopus. The material included peer-reviewed articles, books and online sources.
The literature was manually analyzed.The identified themes arediscussed in detail in the following sections.

2.2. Worldview, Paradigm and Sustainability

Hes and du Plessis [2]describe 'worldview' as"the stories we tell ourselves about how the world is created, what it is made of, how it is structured and how it functions. These stories in turn allow us to construct a value system that informs our ideas of what is good and true, what constitutes ethical action, and how we define concepts such as happiness and success. It also defines the paradigms we use to discover and structure knowledge." A 'paradigm' is the specific set of tools used to study a phenomena of this world from the perspective of the worldview[3].

du Plessis and Brandon [3], Benne and Mang [4], Dias [5], and du Plessis [6],have highlighted the difference between the prevailing MW and the emerging EW, the paradigms that operate therein, and corresponding influence on the meaning, definition and development of the term 'sustainability' (see). In documenting this phenomenon, they pay homage to Kuhn [7]who asserted that when one worldview cannot completely describe the complexity of the world, it is replaced by another. The prevalent worldview's limitations towards the understanding of the world have become evident and new knowledge has been discovered that demands the creation of a new perspective to properly explain this new knowledge.

Table 1: MW vs. EW

Worldview	Mechanistic	Ecological
Paradigm	Technological	Regenerative
Key people and historical development	Over past 500 years: Copernicus and Galileo (reality is constructed on what can be observed), Rene Descartes (mind is separate from matter and subjective from objective. True knowledge = what can be objectively observed and measured), Isaac newton (mechanics), Francis bacon (invent useful things to relieve mankind's misery). Over past 200 years: led to Modernisation and development, urbanization, industrialisation.	Amalgamation of ancient worldviews, findings from classical and new sciences such as theoretical physics, cosmology, ecology, transpersonal psychology, indigenous knowledge systems, religion and spirituality. More accurate in understanding how living systems and existence functions at the foundational level.
Central metaphor	Machine	Ecosystem
Core beliefs	Reductionism	Integration, relationship, interdependence
	Determinism	Unpredictability, emergence, evolution, change
	Dualism	Wholeness, co-creation, co-evolution
	Anthropocentrism	Biocentrism
Definition of sustainability	Is based on building performance, optimising efficiency, achieving and maintaining a triple bottom line, a steady state. Conservation strategies. Net zero practices.	Is the positive impact on the health of the ecosystem and biosphere. The capacity of the living system, to maintain its core purpose and integrity, in a continuously changing environment, in a reciprocal relationship to the larger system in which it is nested. Sustainability is an emergent property arising from the interaction of social economic and ecological situation.
Socio-economic challenges	Are technical problems.	Are Wicked problems, that is, ill-formulated social system problems with confusing and conflicting information, clients, decision-makers and uncertain ramifications on the whole system [8].
Solutions	Are derived from the unlimited power of science and technology. Limited impacts on resilience and vitality of the whole.	Seek to create conditions that enable all life in a place, including humans to flourish and evolve over time. Accept 'wholeness', 'relationship' and 'change' as key drivers and consequences of all phenomena.
Role of humans	Is to become good stewards.	Is to provide ecosystem services for other species. Be positive and contribute to whole communities. Be eco-effective, not merely, eco-efficient [9]
Site	Is limited to legal boundaries.	Is the interrelationship and interdependence of all things
Building	Is a static endpoint. A final outcome of the design process.	Is a beginning. A source and catalyst of ongoing positive change within the hierarchy it inhabits. Plays a role in enhancing human and natural capital.
Predominant narrative	Scarcity, negative impacts and disruptive technological change. Uncertainty, sacrifice. Fear.	Hope. Disruptive philosophical change.

The TS movement has not achieved enough. DeKay [10]asserts that TShas no transformative power and believesRS (or Integral) can have a positive effect on nature and people. Brown [11]has highlighted that RScanidentify the full-range of needs and capabilities of individuals and groups and cantailor unique andspecific developmental responses. Fox [12]has commented that a sustainable way of living on the planet can be provided by ethics nottechnology. RS rather than TScan address theissue of ethics.Meadows, Randers [13] insist that technology cannot stop humanity from overshooting the limits of the Earth's support capacity.

Hes and du Plessis [2], and Benne and Mang [4]insist the world must escape from 'traps' of the MW to the EW. The EW is more relevant to the complex and living systems of which we form part and can provide robust and resilient solutions to the problems the world faces today.

These world–problems - a consequence of the mechanistic way of thinking - have been succinctly described using the concept of 'planetary boundaries' by Rockström, Steffen [14]. They suggest that nine conceptual 'planetary boundaries' -climate change (CC), ocean acidification, stratospheric ozone depletion, atmospheric aerosol loading, biogeochemical flows – interference with P and N cycles (NP), global freshwater use (FW), land-system change, rate of biodiversity loss (BL), chemical pollution (CP) - exist and that anthropogenic pressure on three of these -CC, BL & NP- have already been transgressed.

Pope Francis [15]refers to CC, FW, BL& CP in his most recent encyclical letter and draws attention to the fact that a strong and unified response is required.du Plessis and Brandon [3] suggest that reducing the negative impacts of our actions under the TS paradigm, cannot stop humans from

transgressing these boundaries. Under the RS paradigm, the transgression can hopefully be reversed. They do caution however that EW does not negate or replace the MW, but adds to the knowledge base.

RS still has to be tested at scale and as a fully integrated system of physical, cultural and visionary interventions [16]. To this Cole [17]adds that although it is clear that regenerative design and development are emerging notions, currently very few proponents and very few built projects exist to illustrate their consequence and transformative capability. To an extent Hes and du Plessis [2], and Brown [11]have identified some contemporary examples where the principles of RS are evident in design but more evidence can be collected to support the assumption that RS in DBEcan perform better than TS in improving quality of life for sentient and insentient beings.

2.3. DB Easan Agent of Positive Change

Fox [12]identified that 'normative ethics' for design disciplines need to be developed so that it can align with the vision of RS and become an agent of positive change. Normative ethics are those dutiful norms, goals and standards that the designdiscipline 'should' cultivate. One such normative ethic was cultivated by McHarg [18]who suggested that better human habitats could be created, if nature was viewed as a partner. Many design theories have stemmed from this ethic and are available to the designdisciplines, albeit in embryonic form [2, 3]. These are presentedbelow:

- **Biophilia**

Biophilia can be defined as the innate human inclination to affiliate with the natural world instrumental in people's health, fitness, and well-being [19, 20]. Biophilic values, their benefits,Biophilic design elements and their attributes have been well described [19].Medical and psychological evidence documenting their positive health benefits.When incorporated, Biophilic design elements have fostered an appreciation of nature within its inhabitants. This appreciation has fostered a greater interest in the connection and protection of natural areas [2, 21]. Biophilic design can positively impact on quality of life.

The challenge, however lies in determining:-

1) Howand in what manner, can the use of Biophilic design elements stop the transgression of planetary boundaries?
2) How can the inclusion of Biophilic elements within DBE become mandatory, if indeed they contribute in stopping the transgression of planetary boundaries?

- **Biomimicry**

The term has been coined from the Greek bios, meaning life, and mimesis meaning imitation [22]. To resolve the human-nature relationship Benyus [22], suggests that humans can view nature as mentor, measure and model. Nature emerges as a teacher; it offers ecological standards; and it inspires designs. Interesting innovations in materials have emerged from interest in this field[23]. Biomimicry is becoming popular in the design of urban environments, infrastructure, and buildings [24-26].

TheEastgate Centre in Harare is a famous example. As a building inspired by termites it has demonstrated remarkable achievements in thermal comfort [25, 27-29].

Biomimicry as a design theory may allow buildings to achieve the objectives of RS[26, 28-30]. Zari has explored the concept of ecosystem services and ecosystem processes and commented on how buildings may mimic nature in this sense to adapt to and mitigate CC. He points out however that the following challenges confront the design professional interested in integrating Biomimicry into the design process:-

1) The adoption of new mindsets and goalsfor how built environments can and should function [28].
2) Efforts to apply biomimetic principles in design may remain at a shallow or metaphorical level[26].

A challenge identified by Goldstein and Johnson [31] is that the mechanistic way of thinking may perpetuate in individuals claiming to use biomimicry principles. A danger remains that methods of inquiry remain embedded in reductionist, deterministic, dualist, anthropocentric habits and nature's exploitation continues in order to innovate technological systems. Even though Biomimicry advocates creating conditions conducive to all life, all of nature may be put under the microscope. The core beliefs of RS (refer Table 1) may be lost as humanity pursues new avenues of knowledge creation within the natural realm.

The challenge remains – how can design professionals who employ biomimicry within DBE, maintain the vision of RS (such as, co-creation and co-evolution)? How can normative ethics be prescribed to aid the correct application of biomimicry principles? Howmuch impact can biomimetic buildingshave on planetary boundaries?

- **Lyle's Regenerative Design**

A landscape architect, Lyle [32]introduces the term 'regenerative design' whilst advocating that highly technical infrastructure systems characterized by linear throughput models have a degenerative effect on energy, materials and other services. Energy

conversion, water treatment, cycling nutrients, and waste assimilation are basic life supporting services that nature has perfected. Landscapes within built environments, therefore can be unifying & integrating networks of urban form that provide services such as energy conversion, water treatment, cycling nutrients, and waste assimilation. For Lyle technological systems are inferior in complexity, order, evolution and adaptability than ecosystems.

- **Yeang'sEcodesign**

Yeang [33]advances the idea of incorporating ecology into architectural design. He advocates that a symbiotic integration of the built and natural environment is possible and extends this idea into the design of skyscrapers [34, 35]. He translates the idea of pattern language to green design [36]. His pragmatic use of passive design methods (orientation, spirallingskycourts, permeable exterior façade, naturally ventilated lift lobbies, overhangs) is a convincing narrative on how a biophysical symbiosis between the built environment and the natural environment can operate.

- **Birkeland's Positive Development**

Positive Developmentis design **for** nature [37]. Positive development offers the opportunity for

1) Increasing the ecological base (the intrinsic and instrumental value of nature, whole natural life support system and includes biodiversity, natural capital, carrying capacity and eco [system]-services) And increasing the public estate (the equitable access to the ecological base); In order to create surplus, the following provisions can be made:
2) Eco-services - essential services that benefit humans and nature, such as air and water decontamination, pollination, flood control, climate stabilization, fertile soil, storm water retention, food and medical resources;
   And public amenity.

- **Regenesis's Regenerative Design And Development**

Similar in intent to PD, Regenesis, Santa Fe have developed a design and development methodology that aims for far broader outcomes within the entire socio-ecological system. It goes beyond metabolic flows of the biophysical. Their theory is grounded in organization and human development theory, bioregionalism, permaculture[2], Living Systems Thinking, and whole systems thinking [38]. They test and refine this methodology by using it in their actual projects. Their methodology has inspired the development of a number of tools, such as REGEN, a regenerative design framework developed by architectural firm Berkebile Nelson Immenschuh McDowell (BNIM) for the US Green Building Council; and LENSES, a facilitation tool developed by the Institute for the Built Environment at Colorado State University [2].

- **Living Building Challenge**

Living Building Challenge is inspired by BNIM's work on the EpiCenter in Bozeman, Montana. It is a philosophy, advocacy tool and certification program conceived by Jason F. McLennan, CEO of International Living Future Institute worked, Bob Berkebile and Kath Williams. It is a bridge between the old and new worldviews. It encourages clients and projects to develop a deeper understanding of a project's relationships with its Place [2].

Lyle, Yeang,Birkeland, Regenesis' and BNIM's work has provided a precedent for the use of RS within architectural and landscape design. A variety of tools (REGEN, LENSES, Living Building Challenge) that aid RS within architectural design are available.
These practitioners implore more design professionals to shift from a MW to an EW and integrate the living systems principles into practice [3, 4, 39, 40]. Robinson and Cole [38] have observed that, while shifting the prevailing worldview is central to a hopeful future, it is still unclear, how, or what circumstances will create this societal-wide shift. The challenge is that design professionals and their clients, fail to grasp the positive benefits of the RS approach. Its inherent value escapes clear communication since itrejects the familiarity of the technological paradigm.
Clearly a framework to articulate the full spectrum of benefits that the RS approach offers is required. This is a complex task since the framework needs to be one that can encapture the value and benefits of RS and communicate the essential message of hope.

2.4. Framework of Value: From Hope To Happiness

The literature review reveals that change in mindset is a dominant theme amongst RS practitioners[2, 28, 30, 39-44].

Pope Francis [15]links change of mindset to a change of heart and initiates a dialogue based around the concepts of care, gratitude and dignity to counter the scarcity, negative impacts, disruptivechange,uncertainty, sacrifice and fear fostered under the mechanistic worldview (
). He attacks consumerism and reflects on the hopeful benefits of integral ecology and spirituality.

2500 years ago Gautam Buddharesponds to the consumerism of his age in a similar way. This propels him to search for a true philosophy that elucidates the meaning of life for all people. His search reveals that humans fall into the habit of self centred-ness, greed and destructive egotism. This blinds them to the sanctity of their life. Once awakened to an awareness

of the dignity of their life, however, they awakento the dignity and value of the lives of others [45].

Such ideas may be key to solving the challenges being faced in the EW, RS and DT'sspace.Buddha's ideas were inherited and developed by a long line of scholars such as Vasubandhu, Nagararjuna, T'ienT'ai, Miao-lo, Dengyo and Nichiren [46, 47] and Ikeda[48]. Nichiren'swork can supply practitioners of RS and DT's with ideas on how to initiate the necessary change in heart/mindset.Nichiren was aJapanese Buddhist prophet [49]who lived in a time of great hopelessness [50]. Nichiren was skilled at initiating and maintaining dialogues with his contemporaries. He led people around him to awaken to the truth suggested by the Buddha - that their life and the life of others around them were all equally precious.

For Nichiren any theory has to stand up to the test and provide three proofs to establish its credibility [50-52]:

1) Documentary proof – written proof,
2) Theoretical proof – compatible with reason and logic,
3) Actual proof – the proof of reality; borne out by actual result when put into practice. This is the most important proof of all.

For a theory to be valid, it must be reported in literature, be compatible with reason and logic. Its theoretical constructs must be validated by the actual reality of daily life.

Nichiren's idea of three proofs can be a useful way to enquire into the benefits of RS. The system of three proofs can provide a framework within which to communicatethese benefits.

The literature review discovers another powerful concept introduced by Nichiren. This is the idea of the 'three treasures' [53, 54].

Nichiren proposes that three kinds of treasure exist in this world:-

1) Treasures of the storehouse – these refer to material possessions and financial wealth;
2) Treasures of the body – these refer to health, physical appearance;
3) Treasures of the heart – these refer to spiritual qualities and attributes that enhance our actions in daily life. These constitute the foundation of happiness.

Treasures of the storehouse and the body are important, cannot be neglected but are impermanent and ultimately relative. A legacy of hope cannot be built on them, as they cannot perpetuate through time. Treasures of the heart, in contrast, are neither transient nor circumstantial and give us courage, confidence and wisdom to win over any (unhopeful) situation (Hochswender, et al., 2012).

Nichiren advises that the least valuable treasures are those of the storehouse and the most valuable, those of the heart. Cultivating treasures of the heart, however, endows one with the ability to accumulate treasures of the storehouse and the body in a manner that can contribute to the happiness of oneself and others. Happiness of oneself and others is the only true measure of success.

This idea of 'treasures' can become a valuable framework to consider the contributions buildings make to their environment. It can become a philosophical model within which the inherent value of EW, RS and DT's can be clearly articulated and communicated.

III. RESULTS AND DISCUSSION

The predominant narrative of RS is hope. This makes it an attractive new field of study and challenging one,since it seeks to be holistic and integrative. The philosophical models identified in this review, measures success in terms of the contribution made towards the creation of treasures of the storehouse, the body and the heart. This allows for the inclusion of abstract spiritual qualities alongside material considerations. This philosophical model transcends reductionism, determinism, and dualism and embraces holism and integration. It finds a middle way between anthropocentrism and biocentrism and supplies significant new arguments in favour of EW, RS and DT's.

CONCLUSIONS

EW, RS and related DT's offer a new era of hope to humanity. However, many opportunities and challenges are offered by this approach. Future investigations need to consider the exact nature an impact of this work on the environment. Benefits and values, limitations and concerns need further exploration.

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