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Knowledge of Making Life: Design Patterns for Regenerative-Adaptive Design

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Abstract

An astonishing intense fascination is under way in the design sciences, where the words of 'living structures' and 'adaptive' are being linked with 'technology. In part fuelled by the emergence of the Anthropocene discourse, these words are inspiring authoritative new insights into the workings of wild nature, humanity's position and responsibility to planet Earth, and is being articulated through the rapidly increasing science of pattern theory. The new terminology is provoking the design sciences to seriously consider technologically-informed innovation in design and new possibilities including living technology, morphogenetic sequences, self-organisation, generative codes, biophilia, biomimetics and regenerative-adaptive design, opening the doors to a new era in ecology-informed design. The idea of design as an adaptive and transformation process, is at the core of the whole systems theory pioneered by Alexander in *A Pattern Language* (1977) and *The Nature of Order* (2001–2005). Alexander positioned this hypothesis in generative codes supported by morphogenetic sequences. Drawing upon Alexander's *The Nature of Order* (2001–2005), this paper advances a regenerative-adaptive design theory (Roös, 2016), towards a holistic integrated design method that incorporates the principles of regenerative design with an adaptive pattern language that re-establishes human wholeness with nature and offers relevant strategies towards resilience; in essence creating a living technology.

Keywords: Regenerative design, Coastal planning, Climate change adaptation, Design patterns

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1 Introduction

Fuelled in part by the emergence of the Anthropocene discourse, the words 'living structures' and 'adaptive' are inspiring authoritative new insights into the capacity of brining and or replicating nature's values and properties into our built environment fabric, aided by interest in pattern theory science. The language of 'living technology', 'biomimetics', 'morphogenetic sequences', 'self-organisation', 'generative codes', 'biophilia', and 'regenerative-adaptive design' has been introduced in the last 10 years into our inquiries of which regenerative-adaptive design is the most holistic and integrative in its perspective and application. This paper considers regenerative-adaptive design theory, as an applied design methodological approach, offering a plat-

form for its application in practice. The structure of this paper thus charts a methodology involving an investigation of relevant literature, and reviews of relevant theories together with the application of the 'notion of regenerative patterns' equation, concluding with findings, application to practice, before recommending further research inclusive of identifying a pedagogical strategy for teaching regenerative-adaptive design.

2 Methodology

2.1 A Pattern Language Approach

By linking the supportive theories of Alexander (1977; 2001–2005) and Roös (2016) to the idea that design can be an adaptive and transformation process, as argued in this paper, a step-by-step approach similar to a pattern language is applied (Alexander *et al.*, 1977), requiring that all aspects of a place in its context of 'wholeness' are considered.

2.2 Research Framework

The research framework for this paper includes: review of the literature of the science of pattern theory and living systems thinking, identifying the design methods for including the natural and the built environment as a whole; reviewing the principles of regenerative design and an adaptive pattern language to re-establish human wholeness with nature offering relevant strategies towards resilience; reviewing the application of regenerative patterns to practice, through the application of a 'regeneration patterns' equation; and, summarising findings and recommendations, to identify future considerations and possibilities.

3 Living Systems and Pattern Theory

3.1 Living Systems

Human beings are intrinsically connected and linked to visible and non-visible geometric forms and patterns in nature. Wilson argued in *Biophilia* (1986) that humans need to connect with living structures in the natural environment (Kellert *et al.*, 2008). The argument was not based upon the need for resources or attempting to link primary aesthetic preferences alone, but rather a deep connection to the geometric structures and patterns that occur in the form-making processes of the living systems of nature (Salingaros, 2012; 2015: 8). This biophilic effect, an important as part of our daily lives,

can be divided in two parallels; one source of biophilia instinct derives from inherited memory due to evolution, the second source of biophilia derives from the biological structure of nature itself (Downton, Jones & Zeunert, 2016). This structure comprises the geometrical rules of biological forms, a language of patterns; in essence the combination of geometrical properties and elements of landscapes embodied in the complex structures found within all living forms (Salingaros, 2012; 2015: 9).

3.2 Pattern Theory

Alexander introduced into the architecture discipline the notion that patterns influence place settings and provide formations for 'living structures' in *A Pattern Language* (1977), identifying the ordering of patterns in space, time, and human dimensions (Salingaros, 2012: 150). This structure of order with reoccurring outcomes based on empirical rules, encompass a list of 15 fundamental properties that link geomorphological sequences and patterns in nature with geometric living structures of the built environment (Alexander, 1977; 2001–2005).

The theory of *A Pattern Language* (1977) developed further from its initial structure, offering a generative process that defined the word 'generative' as a system where there is always a sequence, an order, and specific instructions that follow the rules of 'centres' that appear within the larger whole as distinct and noticeable parts (Roös, 2014b; Neis *et al.*, 2012; Alexander, 2001–2005a; Alexander *et al.*, 1977). These generative codes are capable of driving the organic unfolding of a place in such a way that the people who live and work in the place have a good chance to be resilient and flourish personally, economically and ecologically (Neis *et al.*, 2012; Alexander, 2001–2005a; 2003).

4 Regenerative Design and Adaptive Pattern Language

4.1 Regenerative Design

Regenerative design is a process-oriented systems theory approach to design. 'Regenerative' describes processes that restore, renew or revitalize their own sources of energy and materials, creating sustainable systems that integrate the needs of society with the integrity of nature (Lyle, 1984). Lyle argued that human's ability to evolve culture is the instrument for regeneration scaffolding an ability for adaptation to change (Jones, 2013; McHarg, 1992). It is recognised that for human settlements to be resilient against change, especially along Australia's coastlines, one must consider the natural environment with all of its processes included, and how we as humans engage with this environment (Roös & Jones, 2013). Critical to this relationship is our inherent connection and understanding of nature. Regenerative design principles inform our con-

nection to nature and acknowledge that we are an integral part of nature in its most natural adaptation processes. The fundamental principles of regenerative design, that links adaptive capacity with generative patterns in nature; considers the regenerative capacities of both natural and human systems (Roös, 2014a, p.449; Reed, 2007).

4.2 Adaptive Pattern Language

Regenerative design further develops approaches that support the co-evolution of human and natural systems to support both natural and social capital (Cole, 2012). In its native form, the concept of regenerative-adaptive design is a process oriented system that inherently includes a set of rules that adhere to an adaptive pattern language approach that mimics ecosystems whereby biotic and abiotic material is not just metabolized, but metamorphosed into viable materials that go through morphogenesis stages (Roös, 2014b: 38). This can be applied to the design and planning of the built environment to achieve 'deep sustainability', as argued by Alexander in his Schumacher Lecture: *Sustainability and Morphogenesis: The Birth of a Living World* (Alexander, 2003).

Regenerative systems are characteristically adaptive, and use principles of the pattern language and generative code advanced of Alexander (2003), further enhanced in regenerative-adaptive design theory that includes a list of 12 Regenerative Patterns to be applied to the design and planning of Australian coastal settlements for re-establishing human connections to nature, as well as proposing processes for sustainability and adaptation in response to the changing climate (Roös, 2016: 320–333). The 12 Regenerative Patterns are listed in Table 1.

5 Application of Regenerative Patterns

The application of regenerative patterns to a specific place in applied practice, is inherently complex. Application can be achieved by respecting the process of regeneration. In a generative system, unfolding steps are identified through design patterns that enable people in a community to create a healthy, sustainable living place. The generative system comprises codes (rules) that replicates natures' rules that are used to unfold an organism into a natural landscape, but the particular codes (rules) of a generative system in the context of settlement planning, unfold a specific place and its buildings, infrastructure, natural environments and functions (Alexander, 2005).

The consideration of a generative process, as the fundamentals of a design and planning solution to a specific place, includes the 'notion of patterns' as well as the consequences as a result from the design process (Stark, 2012; Borchers, 2008: 16). To be able to address the complex processes underpinned in the human-nature biophilia and adaptation discourse, Roös (2016) developed an extended version of Stark

#:	Regenerative Pattern Name:	Short Description:
[RP1]	Adaptive Built Environments	Includes the considerations of adaptive potential of buildings and infrastructure
[RP2]	Protect Nature's Adaptive Capacity	Considers the adaptive capacity of local natural systems, assist to the ability to adapt
[RP3]	Nature's Work as a Continues and Reciprocal Interaction	Allows life support functions to be processed through conversion, distribution, filtration, assimilation and storage with interaction throughputs
[RP4]	Optimisation and Multiple Functions	Inclusion of multiple functions and outcomes for systems to optimise resilience ability
[RP5]	Aggregate not Isolate, Integrate rather than Segregate	Integrate all parts to fix connections, aggregate to assist the inclusion of symbiotic relationships to promote regeneration
[RP6]	Self-Regulation and Feedback Loops	Include self-regulation of positive and negative feedback loop systems in processes
[RP7]	Produce no Waste, Recycle and Assimilate	Make use of all inputs and outputs for a closed loop or net positive system
[RP8]	Conversion of the Solar Income	Include passive solar systems for energy, heating and cooling, thermal storage and conversion
[RP9]	Scale Linking to Facilitate Flow	Shaping the medium to facilitate flow, scale linking for support of maximum function at smallest scale
[RP10]	Storage as a Key Resource	For Energy, Water and Materials - maintaining adequate storage with balancing the replenish rate with the rate of use
[RP11]	Valued Renewable Resources and Services	Use and value existing natural, renewable resources for energy and biological services
[RP12]	Human - Nature Connections for Healthy and Prosperous Environments	The application of Biophilia strategies and designs to create healthy environments for both humans and nature

Table 1: Regenerative Patterns (Source: Roös, 2016: 320)

& Borcher's formula into a 'notion of regenerative patterns' equation as follows:

$$rgp = \left\{nda, f_i \ldots f_i, std, tsp_{15}, e_i \ldots e_i, r1, pot\right\}$$

where each regenerative pattern (*rgp*) in this instance displays a function:

- a name of a typical design or adaptation challenge (*nda*);
- a set of forces which have an impact on (f_i);
- the specific place settings and time dynamics (*std*);
- the transformations specific to place (tsp_{15});
- one or various examples of the specific core pattern (e_i);
- regenerative attributes (*r1*); and
- the potential of the specific design or adaptation challenge (*pot*).

During the process of applying the 12 Regenerative Patterns to a specific place, the 'notion of regenerative patterns' equation was used to analyse each regenerative pattern with specific descriptions allocated to a specific geographic location (Roös, 2016: 322–333). For example the application of *Regenerative Pattern [1]: Adaptive Built Environments* includes and follows a structure where each element and its functions of the equation are analysed and applied to the *Regenerative Pattern* as follows:

- the name and number of the *Regenerative Pattern* listed in bold type;
- a short statement of what the *Regenerative Pattern* is to represent in italics;
- the description of what the *Regenerative Pattern* is to achieve or accomplish; and
- explanations of each element and its functions *nda*, $f_i \ldots f_i$, *std*, tsp_{15}, $e_i \ldots e_i$, *r1*, *pot* of the relevant *regenerative pattern* equation.

This review, analysis and application of Regenerative Patterns and the 'notion of regenerative patterns' equation demonstrates that using *A Pattern Language* (Alexander, 1977) and the generative approach of *Generative Codes* (Alexander, 2005) to the design and planning of our coastal built environments, offers a holistic integrated systems-based solution (Roös, 2016). Using patterns in a design narrative creates what Alexander calls the 'mathematical process of design', in which the process of inventing physical things which displays new physical order, organization, and form responds to function and the morphological sequences of nature (Alexander, 1964: 7). *Regenerative Patterns* (Roös, 2016) goes further embracing the processes of evolutionary adaptation, aiming to achieve resilience in the context of adaption to future scenarios of a changing climate.

6 Summary and Conclusion

Regenerative-Adaptive Design offers a holistic approach, informed by nature which is an integral player in all settlement planning and design processes, to better craft and strengthen resilient coastal communities. The knowledge of 'making life' is embedded in the fractal geometry and morphological sequences of nature, and if we can establish a process and method to reconnect the human-nature relationship and secure resilience through our actions, both in practice and teaching, we can be liberated as noted by Alexander (2001–2005b: 269):

> *Somehow, a person's own self is mobilised, liberated, made more strong by that person's success in making life in the world. It is as if the life in the world which is created, directly nourishes the person.*

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