

Configuring Patterns and Pattern Languages for Systemic Inquiry and Design

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This paper builds on work relating to pattern languages for social change, such as in the papers titled *Fourth generation pattern languages - patterns as epistemic threads for systemic orientation*, and *Pattern Literacy in support of Systems Literacy* presented to the Systems Science and Pattern Language communities between 2015 and 2017.

It is part of an endeavor to bring pattern thinking and systems thinking, or pattern science and systems science, closer to each other, in order to further introduce pattern thinking and pattern language in the design, assessment and orientation of our socio-technological and socio-environmental systems, large or small, to better address the societal issues of our time. It complements several initiatives to put pattern languages at the service of sustainability and societal change, and to introduce pattern thinking and pattern language into systems thinking and systemic design.

My broader aim is to enhance the innate patterning capability of human beings and thus an overall pattern literacy in support of systems literacy. Pattern literacy manifests our ability to grasp, learn, assemble, represent and mobilize patterns to make-sense of, converse about and shape our world(s). Systems literacy manifests our ability to interrogate and attempt to understand the relationships among systems wholes and parts, and the mechanisms that affect and shape our world(s), in part or as a whole.

In this paper, I explore how a systemic approach to patterns and pattern language could support systemic inquiry and systemic design, and more generally the advancement of pattern language.

In particular, I discuss the extension of the act of design to encompass the systemic inquiry that motivates a design and the on-going monitoring of the fitness of a design to its intended purpose. I examine the multiple facets and understandings of the concept of pattern and show how they can be reconciled to include both the inquiry or observational/informational aspects and the design aspects of patterns in a larger systems framework. In this light, I reexamine the appropriateness of the pattern expressed in problem-solution form in the context of complex systems, and the notion of generativity, and I propose ways forward for extended definitions and pattern forms.

Categories and Subject Descriptors: • **Human-centered computing~Collaborative and social computing** • **Human-centered computing~Visualization** • Human-centered computing~Human computer interaction (HCI) • **Theory of computation~Semantics and reasoning** • **Computing methodologies~Knowledge representation and reasoning** • **Computing methodologies~Philosophical/theoretical foundations of artificial intelligence** • **Computing methodologies~Modeling and simulation**

General Terms: Human Factors, Design, Languages, Theory, Experimentation

Additional Key Words and Phrases: pattern literacy, semiotics, complex systems, pattern language, complex adaptive modeling, boundary objects, participatory inquiry, action research

ACM Reference Format:

Finidori, H. 2018. Configuring patterns & pattern languages for systemic design. HILLSIDE Proc. of Conf. on Pattern Lang. of Prog. 25 (October 2018), 32 pages.

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1. INTRODUCTION

This paper builds upon the work on *Fourth Generation Pattern Languages*¹ and *Pattern Literacy in support of Systems Literacy*² presented to the Systems Science and Pattern Language communities between 2015 and 2017. It complements several initiatives to put pattern languages at the service of sustainability and societal change³, and to introduce pattern thinking and pattern language into systems thinking and systemic design⁴.

For several years, I have been working at the intersection of the pattern language and systems communities trying to build bridges between them, convinced that the development of pattern thinking and pattern literacy was key to our understanding and orienting, if not designing, complex systems. I believe, indeed, that if we could better detect and/or monitor the mechanisms that underlie our socio-environmental and socio-technological systems and our various ways of understanding, representing, and affecting them, we could design better solutions for people and planet. The collective intelligence acquired through such literacies, would help us better design healthy regenerative systems, and re-orient systemic current trajectories, which, according to recent studies⁵, are leading us to environmental and social disaster faster than expected.

Developing pattern thinking and pattern literacy⁶ in support of systems literacy⁷ and systemic design involves taking a pattern approach to systems, and a systemic approach to design patterns and pattern languages.

In this paper, intended for the pattern language and design communities, I explore ways in which a systemic approach⁸ to patterns and pattern language within a larger systems framework could help develop more effective and adaptive pattern forms and practices in order to support systemic inquiry and design.

I first examine pattern language in the context of systemic design, starting with state-of-the-art pattern languages and pattern language evolution, seen through the framework of Takashi Iba's pattern language generations, and I introduce the next generation pattern languages that would help address complex issues systemically. I then explore the multiple facets of the concept of pattern. In particular I discuss the cognitive and semiotic properties of patterns, and their role in the processes of meaning-making and construction of our worlds, as encoding and decoding media, and I show how these properties are essential to systemic design. Subsequently, in the light of Christopher Alexander's work, I challenge how well the multifaceted nature of patterns is currently leveraged in pattern language form and practice. I critically discuss the current definition of the pattern and the notions of context, problem, solution, and their association, and I explore generative processes and their connection to patterns and pattern languages. I finally propose some directions for configuring and using patterns and pattern languages for systemic design for the pattern language community to follow-up on. The paper asks more questions than it provides final answers, and is intended to start a conversation.

2. PATTERN LANGUAGE AND SYSTEMIC DESIGN

In this section, I review different generations or types of pattern languages, and introduce the notion of systemic pattern language as next generation pattern languages. I build here on the initial concept of fourth generation pattern language presented at the 2015 Purplsoc conference, in extension of Takashi Iba's inquiry⁹ into the

¹ Finidori, Borghini, & Henfrey (2015)

² Finidori & Tuddenham (2017)

³ I am thinking here in general of the work presented at Purplsoc (Pursuit of pattern languages for Social Change) and PUARL (Portland Urban Architecture Research Lab) conferences and in particular the overall work of Mehaffy, West & Quillien, Iba, Schuler, Atlee, etc

⁴ I am thinking here of the work of Ing (2017b), Henshaw (2018), Ulrich (2006), Mobus & Kalton (2015), Troncale, Palmer, Tuddenham, McNamara, Silverstein and a few others.

⁵ For example IPCC Special Report on Global Warming of 1.5°C (SR15), Oct. 2018, <https://www.ipcc.ch/report/sr15/>.

⁶ I define Pattern literacy as the ability to grasp, learn, assemble, represent and mobilize patterns to make-sense of, converse about and shape our world(s).

⁷ I define systems literacy as the ability to interrogate and attempt to understand the relationships among systems parts and causes and effects, and the mechanisms that shape our world(s), in part or as a whole.

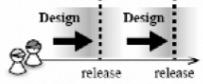
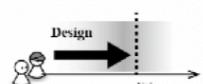
⁸ By systemic approach, here, I mean encompassing the study of repercussions of a design on the systems it is intended to effect or affect, focusing therefore not only on the design being built as a system itself, and the relationships and interactions within its boundaries, but also on the various systems the designed system is embedded within or in relation with. By systemic design, I mean a systemic approach to design, where a design is understood not only in relation to its outputs, but in context, and in interaction with its environment and other systems it may affect. In this context, a pattern is a manifestation of a system or part of a system in action. It can be a static or dynamic manifestation.

⁹ Iba (2013)

evolution of pattern languages, and I explore in more details the systemic constraints and the novelty of the approach.

2.1 The Evolution of Pattern Languages

Iba identified three generations of Patterns Languages since Christopher Alexander’s introduction of the concept in the mid 60’s. These three generations are not hierarchical. Rather, they embrace distinct dimensions of design differentiated along three criteria: the types of forms designed (object of design), the nature of the design process over time (act of design), and the type of connections generated among stakeholders throughout the design process (purpose). To expand on this framework, Finidori et al¹⁰ introduced a fourth generation pattern language, with an additional criterion of differentiation: the broader systemic aim of the design (orientation). In this evolutionary model illustrated in Figure 1 below, each generation adds more types of relational and adaptive components. The fourth generation, systemic in nature, integrates multidimensionality and multimodality by construction, for more effective problem identification and solutions design in complex situations. Mehaffy suggested his own interpretation of what he calls the ‘sliced pie’¹¹, that I will share along the way.

	Object of Design	Act of Design	Purpose	Orientation
Pattern Language 4.0	Dynamic Systemic Forms (Structures & Systemic behaviors, Relationships & Effects)	Design is Generative, Emergent, Stigmergetic and self-organizing over time	Connecting different types of Agencies across Domains of Praxis	Collective Interpretation and Navigation of System Directionality
Pattern Language 3.0	Forms of Human Action (Innovation, Education, Learning, Presentation, Collaboration) 	Design Act is Embedded in Actions over Time 	Connecting People who have Different Experiences 	Continuous Design of Interactions as Generative Forms
Pattern Language 2.0	Non-Physical Forms (Software, Interface, Organization) 	Design Act is Iterated over Time 	Bridging the Gap between Expert and Non-Expert Designers 	Collective Problem-Solving while Dealing with Technical Performance & Efficiency
Pattern Language 1.0	Physical Forms (Architecture) 	Design Act is Basically Carried out in a Period 	Bridging the Gap between Designers and Users 	Practice of Design as a System of meaning with a Purpose

Adapted from Takashi Iba – Comparison among generations of Pattern Language

Figure 1: The Four Generations of Pattern Languages

Iba’s first generation of pattern languages starts with Alexander’s initial pattern language. With this first generation, the object of design is a physical tangible form related to its environment or place: a building or a town. The act of design is carried out in a single time period, with an identifiable start and end. The purpose is to bridge the gap between designers and communities of dwellers or users. First generation patterns languages are meant to generate event and space piecemeal, through single acts of design, with the whole in mind, enabling ‘structure preserving transformations’¹², where each additional part strengthens the whole. The orientation added here is

¹⁰ Finidori, H., Borghini, S., & Henfrey, T. (2015).

¹¹ in a private conversation, all italics in the following paragraphs when referring to Michael are Michael words.

¹² In the Nature of Order, Alexander (2001-2005)

that of a practice with a meaning and a purpose, working towards a Gestalt. Mehaffy describes the design produced as *largely static configurations of design forces that are resolved in the most preferred way for designers and users.*

With Iba's second generation, the object of design is a non-physical intangible form: a software, a human computer interface, an organization, a process. The purpose of the design is to bridge the gap between expert and non-expert designers. The act of design is iterated over time, in the intention to adapt the design to changes in the context. The orientation added here is collective problem solving while dealing with technical performance and efficiency of the objects transformed. For Mehaffy, the design produced is a *process-oriented collection of code that also generates preferred results without crashing or producing unpreferred results.*

With the third generation, the object of design is human action. The purpose is to connect people with different experiences around a shared goal or practice. Group participatory processes such as collaborative discovery and sense-making, pattern languages of learning or creativity, pattern languages for dealing with organizational change, earthquakes or dementia, or pattern languages for democracy, fall under this category. With this third generation, the act of design, built from the mining of human experience, is embedded in action over time¹³. The orientation of the design is the continuous design of human action and interactions as generative forms. For Mehaffy such patterns allow, in the world of community action, *the sharing of knowledge about preferred practices and their likely outcomes.* He sees this third generation as *an extension of the first generation of patterns beyond the built environment, and incorporating some of the process aspects of the software patterns.*

2.2 Toward systemic pattern languages

Beyond the construction of meaningful or efficient wholes, or of human actions or interactions towards shared goals, the prospective idea of 'systemic' pattern languages, or fourth generation patterns languages, as proposed by Finidori & al, arises from the need to better understand and orient socio-technological and socio-environmental systems and the underlying mechanisms and behaviors, which emerge from many different types of wholes and human behaviors in interaction. These underlying mechanisms and behaviors manifest and can be identified in the form of patterns.

Typically, fourth generation pattern languages are intended to help deal with complex challenges or situations where natural, technological, social and psychological factors are entangled to create emergent phenomena that cannot clearly be related to determined causes, where conditions are in constant change, and where single goals cannot clearly be established. In particular, they are meant to help deal with issues for which adopted solutions could generate unintended consequences in areas¹⁴ beyond the environment or context for which the design was initially created.

Such "systemic" (i.e. systemically complex) issues and challenges cannot be solved by a device, material or immaterial, or by change of behavior only¹⁵. They involve systems of solutions of multiple types that operate synergistically on multiple leverage points¹⁶ in more or less controlled or self-organized ways, to change existing patterns of systems behavior or generate new ones.

With fourth generation pattern languages, as far as Iba's matrix is concerned, the object of design is a dynamic systemic form which results of many systems and processes in interaction. The purpose is to connect different forms of agency¹⁷ and constructs across domains of practice. The act of design is generative, emergent, and self-organizing over time. The orientation or broader aim is the collective interpretation and navigation of systems directionality as an 'enactment' of collective agency. Mehaffy sees fourth generation patterns as relationships in the wider world, *between elements in a system that generate specific kinds of forms, whether designed or natural, which combine process and structure, united within a systems perspective.*

¹³ Much of the development of this category of pattern languages and associated methodologies have been developed by Iba and the Iba Lab.

¹⁴ One can think, at the societal level, of health or addiction issues, criminality or conflicts, financial volatility, urban development, climate change and its consequences such as migration¹⁴ and droughts, or risks inherent to the development of artificial intelligence, cyber criminality or the development of big data exploitation, to name a few. In concrete terms, a fourth generation pattern language would consist in networks of patterns that could describe criminality, financial, urban, climate or power mechanisms, interaction of causes and their possible effects, variations and transformations in relation to the evolution of contexts. They would describe existing configurations and mechanisms as well as new transformative ones.

¹⁵ I argue in Finidori (2016) that this involves looking at more 'orders' than first or second from a cybernetic perspective

¹⁶ Meadows (1997)

¹⁷ Agency is to be understood here as capacity for action.

To take a simple example around the car and transportation: the first generation pattern language would help design the car, the object itself, in its material form, the infrastructures to support it (roads, energy supply, servicing) and the quality of the driving experience; the second generation would take care of the software and all the services the car could be connected to, as an extension of the driving experience; the third generation would cater to the lifestyle that the car would enable, such as mobility and connectivity, and all the social implications of driving; and finally the fourth generation would help tackle larger societal issues of collective mobility and transportation, its effect on the environment, the ethical implications of technology such as driverless cars, and how the different aspects of the 'car experience' from the perspective of the driver, the community, the infrastructure, the social system, the environment can work together.

2.3 Constraints and novelty

Systemic design and systemic pattern languages cater to complex challenges that require, to be solved, an aggregation of emergent solutions involving different types of agencies and generative processes. These aggregated emergent solutions cannot be proactively orchestrated, because there is no common or encompassing viewpoint, nor common vision and goal around which to devise common action, but only disparate action at multiple local levels. In many cases things cannot be directly designed, but the conditions for generative or regenerative forces to develop can be identified and fostered, for vectors of actions to be oriented in convergent directions. The intention is to work using participatory heuristic methods¹⁸, towards systemic health and [re]generative processes that synergistically work together to produce 'whole' outcomes that are greater than the sum of the parts, tending towards QWAN¹⁹ at multiple levels and scales.

Of course, this is exactly what Christopher Alexander was after with QWAN, keeping wholes whole and alive, at the different levels and scales of patterns. But I contend and argue in the following sections that current patterns and pattern languages and their practice are not currently defined and configured to achieve this optimally, especially in the context of socio-technological and socio-environmental systems. A major constraint is that the notion of 'good design', 'fit', quality or QWAN is more difficult to identify and capture given the variety of generative processes in interaction.

One probably hears and knows more about how systemic approaches and expertise can be deployed towards nefarious goals, and fourth generation pattern languages could serve these too. Nefarious approaches are often applied top down, or 'inside out' by a few who know how to manipulate systems to their advantage and diffuse memes to create aggregated effects that serve or preserve specific interests²⁰. One can think of various forms of propaganda, the fabrication of culture wars or addictions, or the externalization of certain categories of risks and cost to the broader system in which a designed system is embedded. It is far more difficult to unite so called 'forces for good' that are diffuse and distributed, than it is to deceive²¹ and divide²², hence the need to find ways to aggregate different expressions of 'good willing' agency towards systemic health. To a certain extent, pattern languages for systemic design address the notions of purpose or directionality of a system, and of power, i.e. the capacity to assess, influence or control the mechanisms or forces at play over time²³.

This systemic form of pattern language we are seeking to develop is to be seen not only as a medium for design, but also as a medium for inquiry, a heuristic, that enables at the same time and in the same act of design, the development of new understandings of systemic mechanisms and interacting forces, and the anticipation or envisioning of new desired ones, thus applying Christopher Alexander's aspiration with Pattern Language to the socio-technological and socio-environmental systemic scale. In this sense it is more a tool for collective intelligence,

¹⁸ See here Finidori (2016) and Finidori & Tuddenham (2017)

¹⁹ Alexander's "Quality without a name", that could be equated to regenerative systems. See Finidori (2015)

²⁰ The manipulation of social media for interference in elections worldwide is an illustration.

²¹ Jack Harich (2015) showed in a systems dynamics analysis how a dollar invested in deceit was more productive than a dollar invested in truth. One can also think of Jean Louis Dessalles Simplicity Theory, where simplicity is described as information out-of-the ordinary that stands out and is easy to describe.

²² I particularly like this quote of "finance hacker" Brett Scott: *"The large part of the complexity and opacity we are faced with is that it neutralizes political action. There is ... a large diffuse body of people who can't really articulate what they don't like about the [financial] system and how to change it..."*

²³ Issues of purpose and power, and appreciation, influence and control (AIC) are discussed in Smith (2015)

for the empowerment of the multitude and emancipation²⁴, than it is one for coercion. A tool for ‘hacking’ the ‘System’ in the good sense, i.e. taking it apart to understand its hidden mechanisms (decoding) to rebuild it anew or transform it with new mechanisms (encoding). It includes sense-making components that guide both participatory inquiry and design, with ways to explore and interconnect various epistemological perspectives so that solutions can be coherent and converge in self-organized ways, without a need to explicitly share goals²⁵.

Through pattern languages up to generation 3.0, the act of design moves from a single finished act with a beginning and an end, that completes a whole; to an act iterated over time, geared toward perpetually efficient constructs and processes; alternatively, it is an act embedded in and driven by action, nudging behavior toward a shared goal. With the fourth generation, the act of design encompasses causal relationships and the life that our designs take themselves in interaction with their environment, transforming contexts, in a continuously recursive and emergent process, that self-reorganizes over time as a result of decisions and applied solutions which transform the existing structures and forces at play. In particular, fourth generation pattern languages are about understanding how parts in a system differentiate themselves and change their structure and relationship to one another, as the whole goes through each phase of a process of transformation²⁶.

This extended act of design does not stop once the construction or adaptation of a design is achieved. It is broader than the conception-to-delivery of a designed object, project, or system, and even than the generative process that produces it. It involves a constant monitoring of the forces and underlying mechanisms that drive or influence a system and its transformations in parts and whole, and a constant adjustment through monitoring of successive states of both the design and the ideal state towards which it seeks to tend, which may itself be adjusted in time. In this context, the notions of problem and solution may be difficult to capture or circumscribe, and may be variable in time²⁷. The fit between problem and solution may rapidly become obsolete, therefore ‘hardcoding’ them in an interlocked way may make little sense. Considering them as current and desired configurations and mechanism, producing current or desired systems behavior, which may be evaluated and adjusted over time, may be preferable.

From this perspective, design patterns are not only to be seen as ideal configurations, guides for design, captures of best- or good-practices, or proven solutions to problems, prejudging of quality or ‘fit’, as they currently are in pattern language practice. They must be configured in more granular and modular ways to keep track of the configurations and forces discovered and captured in the design pattern. These configurations and forces may change over time, as the design itself, in interaction with other designs may generate processes and effects which recursively affect and modify, as they unfold, the initial contexts they arise from. These evolving configurations and forces are patterns themselves, under the definition of patterns as recurrent observable forms, and signs that can be recognized in the contexts which motivate a design, as well as in the processes and effects a design may generate in interaction with other designs and with the environment in which the design operates.

Such patterns can be understood as manifestations of systemic activity, at various levels, which can be assessed and monitored on an ongoing basis to ensure the systemic validity and fitness to purpose of a design, as well as its sustainability and evolution in time, and help make necessary adjustments or transformations. In the extended act of design, which interweaves systemic inquiry and design, patterns are involved as recognizable signs upstream in the context and forces that motivate or trigger a design, and downstream in the behaviors generated by the design in interaction with other designs, as well as the effects the design may produce on initial contexts and behaviors. This raises not only the question of the definition, form and role of the pattern in an act of design extended over time and space, but also the role and responsibilities of the designer and his margin of maneuver to affect positive societal change.

3. THE MULTIFACETED NATURE OF PATTERNS, LARGELY UNTAPPED

Much of Alexander’s work sought to capture the ‘systemic’ order and directionality of things -towards QWAN- into pattern language and design. The novelty of the approach I suggest here lies more in the extension of the application

²⁴ One can think here of Ulrich’s Critical Systems Heuristics (CSH) oriented towards *supporting critical and emancipatory practice*, to free users from those in control of knowledge. Ulrich (2006)

²⁵ See here Finidori (2016) and Finidori & Tuddenham (2017)

²⁶ This process was described in Mehaffy (2017) in the learning from the nature of order chapter.

²⁷ As I describe in *The pattern and the problem/solution association* section of the paper.

of pattern language to complexity that manifests in other domains than the built environment, where ‘place’ is more difficult to locate, and in the way patterns and pattern languages are configured and operationalized to do so effectively. I will discuss in the following sections why, although the systemic intention is there and well stated in current pattern language epistemology, practice does not follow. One of the main reasons I see is that current pattern language form and practice do not leverage the full properties and potential of patterns²⁸, although these properties were implicitly acknowledged by Alexander. In particular, pattern language practice has not taken the full measure of the potential of patterns as manifestation of systemic activity. And it has not leveraged the role of patterns in cognitive processes, in the way meaning and perception of the world are decoded and encoded, and in the way form and meaning are recursively transferred from the world, to our minds, to the traces we leave in the world through our actions and productions. Developing systemic pattern languages requires a reflection on pattern definitions, and on the different functions and qualities of patterns and how they can work together in practice.

3.1 Pattern definitions

Pattern definitions, however varied they may be, can be grouped in two intrinsically different functional categories:

(1) recurring signs or forms, arrangements in space and/or time, that are observed [or observable] - these are observational²⁹ patterns, descriptive, that reveal structure, behavior and direction/function, and therefore the result of a design of some sort, natural or created.

(2) captured experience or best practices, formalized processes or standards intended to guide design - these are design patterns, normative, that describe or show how to generate a design and to what end.

The first category of patterns are renderings of perceptions of reality, how things are configured and unfold, that can serve for comparison and evaluation. They imply some form of objectivity, even if they are subject to bias. The second category implies a value or quality judgment.

The two overlap in the case of mimicry³⁰, when an observational pattern becomes a model to be reproduced proactively. In this case, the documented observational pattern describes structures, behaviors, functions or mechanisms observed, which themselves may be designed by ‘natural forces’³¹ and/or the activity of agents³². It may also describe why such arrangement in space or time is effective, and must be reproduced. The design pattern describes the structures, processes and sequences of steps, necessary to bring about the observed or sought out structure, behavior, function or mechanism. In some cases, the observed pattern may serve as a model to build the design and therefore may also be the design pattern. One must beware however not to conflate an observed generative process with the process necessary to generate it³³. This is a key point that I will get back to later in the paper.

With “Alexandrian” patterns³⁴, we are typically in the overlap or mimicry case. Christopher Alexander referred³⁵ to the pattern as, at the same time, a “thing” (category 1), and the steps required to build the thing (category 2). I will argue however in the following sections of this paper that most in the pattern language community tend to privilege the second category of patterns, and neglect the first as means for systemic inquiry, used to identify and assess structure, behavior, function and direction. The first category is assumed ‘contained’, implicitly, in the second. This may make intuitive sense from a design pattern perspective, but I will argue further along that such integration is not systematic and explicit enough. Especially when the forces and contexts are complex, some signs may be left out. And when the integration exists, it does not leverage the full potential of the pattern as an observable, recognizable, or anticipable, and assessable sign of systemic activity.

²⁸ See my previous work for a more detailed description of properties: Finidori (2016)

²⁹ In observational, I include not only what is recognized, but also what is cognized, imagined, intuited, invented, anticipated...

³⁰ Biomimicry is the example that comes to mind

³¹ The forces of physics, biology etc

³² The two are often confused

³³ For example, the generative process to design a GMO is not to be confused with the generative processes that the new designed genes will enable.

³⁴ As determined by the work of Christopher Alexander and his followers

³⁵ Alexander (1979)

3.2. The pattern as sign and the construction of our world(s)

In the systemic design context, I propose that patterns and pattern languages not be confined to the process of design itself, as rules or proven ways combined into steps to reach a specific goal or quality. They are more than this. They play a critical role in our cognitive processes. Not only in our ability to create, but also in our ability to discover and to understand, to create meaning, and to confront interpretations and representations. These cognitive and semiotic properties of patterns are not currently leveraged to their full potential.

Patterns exist at the same time in the world, in our minds, and as representations, artifacts or other traces in our environment resulting from the interacting and co-evolving behaviors of many agents. The essence of pattern literacy and patterning, or pattern thinking, in the broad sense I intend here, can be understood as our ability to grasp, assemble, represent and mobilize patterns in both our cognitive and material activities, in order to make sense of, converse about and shape our world(s). It is this essence that Alexander has captured, and the reason why probably, despite the many shortcomings in application of his work which regularly are highlighted in the literature or at conferences, and by Alexander himself, the concepts and theories he developed are still popular and gaining traction.

We humans are an ‘agent’ species. We have evolved as designers who constantly build things, first for survival in hostile environments, then to thrive in an environment we managed to ‘master’ (or so we think), embarked, as we are, in a quest for understanding the world and extending our capabilities with tools. Patterns, as I understand them, are key to construction processes, whether cognitive, social, or material. They are the matter for constructing meaning, the building blocks of the meaning we create through our communication, actions and productions, and the connectors of the meaning we construct and/or make sense of in recursive ways. Alexander calls them the atoms of our man-made universe³⁶.

It starts with our embodied minds perceiving sensorial forms (shapes, sounds, textures, tastes, smell), and assembling them to give them meaning. These components and the assembled forms we cognize and re-cognize are patterns. A piece of an image of a house glanced by our left eye, another one by our right eye, the sound of a bird and we recognize our house in the dark. A strand of hair, an eye, a voice and we recognize a friend. A few notes of music and we hear a whole symphony. Patterns as recognition or anticipation of repetitive form are at the basis of our making-sense of objects as we piece perceptions together³⁷. But not only objects. According to promising recent work with infants in developmental psychology, we humans are born with five core innate pre-linguistic knowledge systems, that give us an ability to recognize and process percepts: forms and their relations of length and angles; quantity, numbers, and their arithmetic relations; objects and their motions; agents and their goal directed actions; places, and their relations of distance and direction, and we make inferences from them³⁸. Lakoff also identified similar innate schemas that we build both our physical motions and our metaphors upon³⁹. These can be seen as systemic operators, that help us make sense of organization in space and time, and its associated outcomes, and help us orient ourselves within it. Other mammals also have all or part of these knowledge systems, but what we humans have that other animals don’t is a unique capacity to recognize, assemble, and envision representations from across these independent systems into increasingly complex structures, as our mind / body develops⁴⁰. This pre-linguistic associative capacity may have been what Chomsky called ‘universal grammar’⁴¹, found at the basis not only of natural languages, but of all types of our cognitive encoding and decoding systems, or the languages or codes we may use, such as mathematics or music⁴². Pattern language as intuited by Alexander is one of these also.

It seems we have a form of pattern language hard-wired in our minds, with systemic operators at its core, and therefore systemic in nature, which enables us to recognize and differentiate structures, relationships, dynamics, flows, feedback, recursions, which are characteristic of working systems⁴³. This is a natural ability that humans

³⁶ Alexander (1979) p. 99

³⁷ Hawkins & Blakeslee (2004)

³⁸ Spelke & Kinzler (2007)

³⁹ Lakoff (2014)

⁴⁰ Dehaene (2014)

⁴¹ So one could argue to Chomsky’s detractors that he was not fully wrong, only ‘half wrong’, as suggested by Dehaene (ibid)

⁴² Ibid.

⁴³ I explain how this works and the ‘symetry’ in the next subsection.

have demonstrated since immemorial times, more or less consciously, that we could valuably reconnect with and further develop into a pattern literacy⁴⁴. How to develop such pattern literacy in support of systems literacy and effectiveness in systemic design is the object of my PhD research.

The process of cognitive construction operates recursively at multiple levels and on multiple dimensions, starting with our inner worlds and expanding to our social worlds, and the broader socio-technological and environmental contexts we evolve in, which include the material things we construct.

First, the assemblage of percepts helps us detect and infer arrangements in space and time, forms, movements, magnitudes, directions and outcomes, systemic in nature, that help us orient ourselves. We further organize these patterns in mind and build concepts around them to create increasingly more complex structures as we develop and learn, creating our inner worlds, identities, and ways of expressing them. This process of parsing reality as we observe and interact with it and with each other doing so, is what forms our identity. In this function, it is called individuation⁴⁵.

The process of Individuation constructs the frames of reference that we use to further parse and make sense of the new phenomena we encounter, the patterns in the world we perceive⁴⁶. Then expressed through language and other means, these frames contribute to shape our external social worlds as we reflect and exchange with others and co-individuate in recursive interactions. The resulting virtual and material transactions, generate recurrent habits, patterns of understanding and behavior characteristic of cultures at social scales.

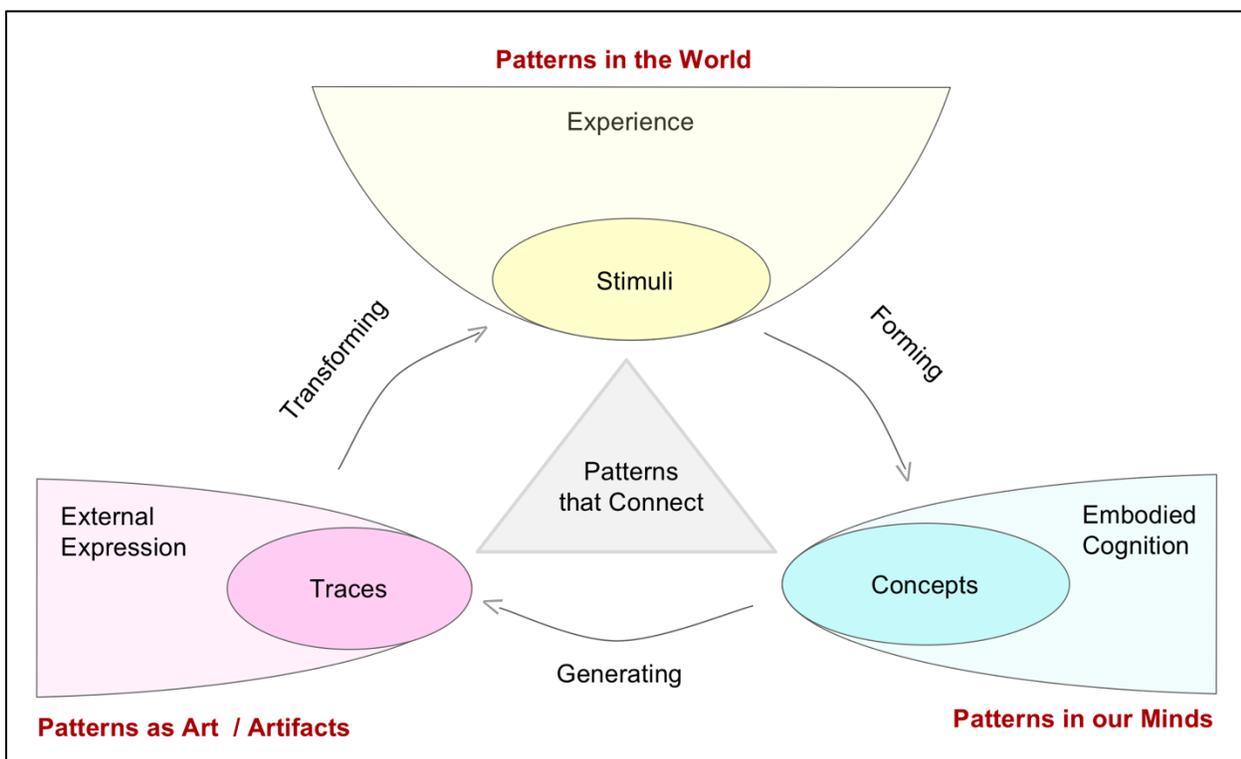


Figure 2: Patterns are at the center of the processes of semiosis and construction of our worlds. They enable the transfer of form from the world, to our minds and to the traces we leave in the world through our actions, communications and productions.

The frames of mind and logics of action we develop in such processes determine the form and direction of our designs and action, and the material things we produce. They in turn shape our social worlds and influence the

⁴⁴ Finidori & Tuddenham (2017)

⁴⁵ Jung (1976), Simondon (1989)

⁴⁶ Husserl (1982)

socio-technological and socio-environmental systems that emerge in the process. These socio-technological and socio-environmental systems that we participate in designing may take a life of their own, inspiring or constraining us, and designing us back⁴⁷. Any agent is both a designer and designed, because of feedback; as much as observation changes both the observer and the thing observed. At wider scales, the thing being designed is a partner in its own design, and leads the other designers along, which is, according to Gabriel, what Alexander was getting at with the objectivity of QWAN or Wholeness⁴⁸. For Alexander, “All acts of building are governed by a pattern language of some sort, and the patterns in the world are there, entirely because they are created by the pattern languages which people use.”

Through the assembling and enactments of more or less complex, and more or less conscious patterns, meaning and direction are generated in the world at various levels of recursion, influencing natural phenomena as well. Never has it been so considerable and visible. Welcome to the Anthropocene.

Patterns are involved in our perception of the world and our experience of reality. At the same time, they contribute not only to shape the material things we create, but also to the construction of our multiple social worlds, and of our world as a whole. They therefore play an active role in the recursive interactions between our inner and outer worlds, between the subjective, the intersubjective and the objective, between the natural and the constructed, between the material and the conceptual. As such, they have an enormous untapped potential as connectors⁴⁹ of multiple components, dimensions, modalities, that characterize complex systems. And they can act as mediators across phenomenological experiences, forms of knowledge (epistemologies) and modes of perception of reality (ontologies), for people to be able to understand and design systems across domains of knowledge and practice, and worldviews and ways of understanding things.

3.3. Language, composability and symmetry: patterns as encoding and decoding media

The patterns I described here as units of construction of our reality, units through which meaning is ‘encoded’ in our worlds, are also the units through which we can make sense of and decode meaning from our worlds and our peers, as a natural, embodied, process. The patterns we recognize come to reinforce the frames through which we recognize other things of the same or different kind. The semiotic properties⁵⁰ of the pattern as object observed in the world, interpreted as percept or concept in the mind and represented or expressed, and enacted in our socio-technological and socio-environmental systems, supports this decoding / encoding process.

For Michael Mehaffy, the universe is compositional, and so is the structure of the brain. Both display structural relationships and isomorphic properties, irrespective of any epistemological or ontological assumption. Moreover, both are connected via partial symmetric relations and isomorphic correspondences. A similar symmetry can be found in the structure and processes of language: patterns “are consistently created by the interactive movements of other patterns — and made comprehensible by the symmetrical patterns of our own language and thinking.”⁵¹

Mehaffy sees language as “the architecture of possibility”, that enables us to mirror and model the parts of the world we are the most familiar with, and to generate new possibilities in the process.

As Mehaffy suggested⁵², “we are ourselves structures immersed in a world of structures, and our linguistic structures (and the brain structures in which they’re evidently rooted) are in a continuous process of mapping symmetries and transformations, some of which we can bring about with our chosen actions. (But the choices are limited by -- even created by -- the mapping of the structures. They have generative power, but also limitations and dangers.) PLs are simply formal extensions of this same process into another logical system.”

How pattern languages, seen as I alluded earlier as proto-languages, or ‘code’ to describe in adaptive ways the workings of our world(s), could help to further enhance and leverage the potential offered by patterns as

⁴⁷ a phenomenon also called immergence by Bourguine in David Chavalarias et al. (2009) or ontological design, Willis (2015).

⁴⁸ Gabriel in private conversation

⁴⁹ One can think of Bateson’s Pattern which connects here Bateson (1979)

⁵⁰ Peirce (1903), Finidori (2017)

⁵¹ Mehaffy (2017)

⁵² in a social network conversation.

signs/forms manifesting systems activity, to better understand and design our world, is the question I have here. Enhancing this capability could help bridge our constructed categories and concepts, and the representations thereof, and to see/sense in multiple dimensions into multiple logical systems, developing both understanding and creativity.

Alexander mentions in the introduction to the Nature of Order a “*slightly modified vision of science, which includes mechanisms as understood in the past, but also includes a powerful new kind of structure, coupled with a new form of observation, that transforms the range and extent of the experience that science can illuminate*”⁵³, wondering whether the “*order observed in science, and the order created in art might ultimately be treated as one phenomenon*”.

Clearly Alexander was onto something here. We could probably go much further now, combining recent advances in both patterns and systems research.

We see the encoding and decoding resulting from an iterative integration of inquiry and design at work in scientific inquiry where patterns⁵⁴ are units of observation probed and turned into laws after successful experimentation. This process occurs in psychology, where the pattern is altogether trigger, habit, archetype. It has also been well understood by computer scientists who emulate the patterning capability of humans into AI⁵⁵, for recognition as well as representation and learning. In the sense I use them here, patterns are also very close to schemata described in schema theory⁵⁶ used by linguists and cognitive scientists as units of knowledge and theories of reality.

3.4. Envisioning the multi-faceted pattern at work

We perpetually design our worlds and co-evolve with them. What we experience in the world is not a succession of events resulting from discrete acts of design or iterations, even if we do formulate events. They are rather continuous processes that we are participants in, consciously or not⁵⁷, emerging from our various designs in interaction. In this logic, action is an act of design.

Intervention for change in the context of complex systems and wicked problems require making sense of all these patterns in interaction through constant processes of observation, interpretation, orientation, design, action, monitoring and adaptation at various levels and scales. These cycles of inference and action which themselves participate in the construction of our worlds are captured in a variety of frameworks such as Charles Peirce’s cycle of pragmatism (observation, induction, abduction, deduction, testing, action)⁵⁸, John Boyd’s OODA loop for situational awareness (observe, orient, decide, act)⁵⁹ and more recently, Dave Snowden’s Cynefin approach to complex adaptive systems (probe, sense, respond)⁶⁰, as well as the human needs centered approach of design thinking (empathize, define, ideate, prototype, test)⁶¹. All include sense-making and adjustment. These constant iterative adaptive processes of sense-making and design can happen consciously or unconsciously, at various paces, levels and scales in fractal types of ways, and can apply to any type of activity. Making these processes and iterations more conscious through pattern thinking, i.e. actively seeking, revealing, and mobilizing different types of patterns at these various iterative stages, could help further develop and embody these capacities characteristic of pattern literacy in more ‘automatic’ and unselfconscious⁶² forms.

Pattern thinking can help make different types of inferences, and go through these cycles using heuristic, iterative and interpretative approaches, identifying structure, behavior, function and potentially hidden mechanisms at multiple levels, and designing to adjust, if necessary, along the way. It can help distinguish, during interventions,

⁵³ The Nature of order I, p.22, Alexander (2001-2005)

⁵⁴ Pattern is the first of seven cross-cutting concepts in science, National Research Council (2013), Finidori (2017)

⁵⁵ Hawkins & Blakeslee (2004), Kurzweil (2013), Goertzel (2006)

⁵⁶ Ref [https://en.wikipedia.org/wiki/Schema_\(psychology\)](https://en.wikipedia.org/wiki/Schema_(psychology))

⁵⁷ This was evoked with Gabriel in a private conversation. One can think of Husserl’s lifeworld here, evoked in David Seamon’s Keynote at PUARL2018.

⁵⁸ Peirce (1903)

⁵⁹ Boyd (1996)

⁶⁰ Kurtz & Snowden (2003)

⁶¹ Model proposed by the Hasso-Plattner Institute of Design at Stanford (d.school). Addition advised by Christiaan Weiler.

⁶² Such as Alexander (1964) liked to describe

the different levels of observation (standpoints) and construction (objects of focus) involved, in order to better cross different types of boundaries and tackle specific challenges when seeking to transform or design systems.

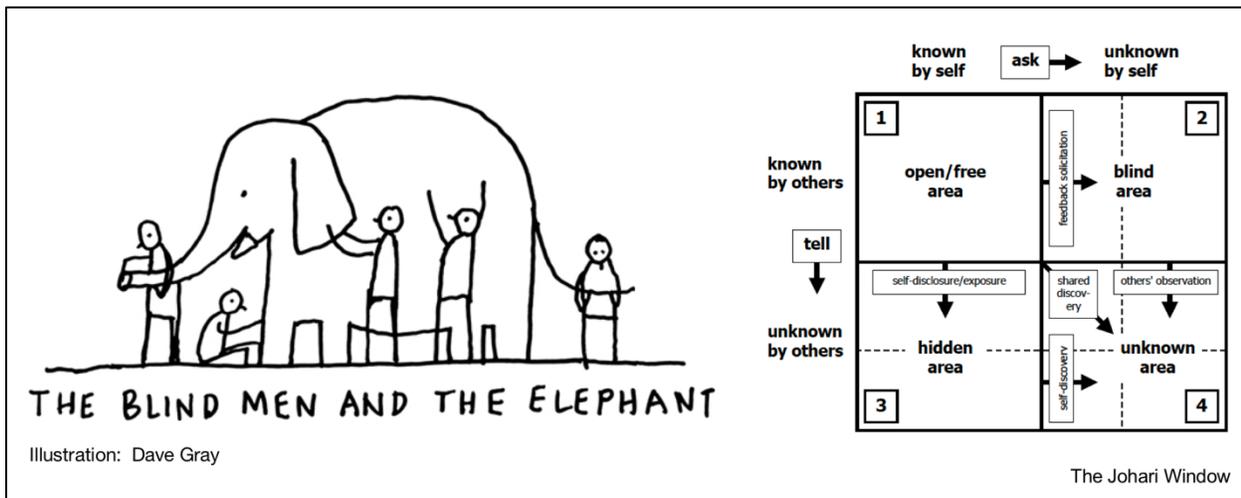


Figure 3: The blind men and the elephant fable, and the Johari window illustrate how patterns could be used as boundary objects, mediating and connecting multiple interpretations and representations in participatory inquiry. A way to explore, confront and record different views and interpretations, points of convergence and controversies jointly discovered in our shared phenomenological experiences. Getting a collective grasp of the elephant...

In this context, and because complex or wicked problems do not have clear boundaries, a systemic pattern language is not seen as a closed set of domain related patterns, but rather as a generative ability to compose and combine patterns as needed, in an open and probing way, just like in natural language, where what seems an infinite set of words is at our disposal -even if our vocabulary is arguably finite⁶³-. This potentially infinite composability enables new forms of literacy. In this sense, we can see such languages of patterns as much more open than maybe Christopher Alexander himself intended originally. They would indeed include an unbounded number of patterns, and possibilities of representing them, that together could be combined to “explain the universe”⁶⁴, and design it at the same time. Though seeking to explain and design the universe should be seen here as an ideal, and not as something attainable, a process which can help uncover unknowns, if not reveal some of the yet unknowable (see figure 3 above). In this sense, fourth generation pattern languages could be seen as a proto language, a systemic language, with more ‘performing’ or ‘systems behavior generating’ powers than natural spoken language, and with less assumed shared meaning. A sort of “perceptual code” used to describe, and simulate, if not enact, in adaptive ways, the systemic workings of the world, bringing the focus on processes and networks of complex systems interrelationships and their manifestations, rather than on categories, and how things are named by convention⁶⁵. Such approach would enable, as suggested by Henshaw⁶⁶, to focus attention more directly on individual subjects and organizational designs of nature, and their overlaps, cross-linkages, and ambiguities, rather than on *invented categories*. Such pattern languages become a medium for systemic conversation and mediation, with patterns used as boundary objects or object of research within and across different interpretation and representation worlds⁶⁷.

⁶³ In this respect I am nuancing Mehaffy’s statement “There is a corollary with languages, which have a limited set of words, and yet produce a vast set of complex meanings”. The finiteness of vocabulary is not set by construction, but by opportunity. New words can be created and appear anytime. Some languages also have rules to create new words. Alphabets that serves to construct words are finite.

⁶⁴ Mehaffy describes the universe as an *endless composable structure* that is partly comprehensible. One can think of mathematics here, as the language to explain the universe, and note that in the scientific approach, patterns are used to identify phenomena, and laws may be drawn from them. Pattern, moreover, is the first cross-cutting concept of the Next Generation Science Standards of the US National Science Teachers Association. General Systems Theory was developed to establish the universal principles that apply across sciences to systems in general irrespective of their kind.

⁶⁵ This is actually a very important ontological question that I would like to dig into: the limiting effects of natural language that ‘assumes’ what is, through conventional categories and naming, rather than describes and explains it, in ways that can always be reexamined and confronted. This is IMO related to the assimilation of the type of Chomsky’s that all is reducible to universal grammar and natural language composability. A theory I will be trying to nuance in my future work.

⁶⁶ Henshaw (2018) *Systems Thinking and systems making*.

⁶⁷ beyond what Cunningham & Mehaffy (2013) suggested.

I believe that this versatility of patterns is what makes the strength and the whole interest of using patterns as media for transferring form from the world, to the mind, to physical representations, through the inter-connection of their functional, conceptual, material and practical properties, to enable a decoding and an encoding of our world(s) at multiple levels⁶⁸, and the connection and mediation across multiple experiences of reality, forms of knowledge and ontological conceptions of the world⁶⁹.

Patterns are altogether the recurrent or anticipated signs and cues that we pick-up to 'grasp' something, the clues we look for, combine and follow to understand our world, our own selves, and our fellow humans in various situations; and the elements we assemble to express and share this understanding. They are also to be found in the habits we develop and in the ways we shape the world through our actions and the objects, organizations and experiences we design. Patterns of the latter type enable second order approaches, which, beyond the 'thing' and generative process observed or designed (first order), also focus on the observer and the designer as they observe and design. We can see patterns, in their broadest definitions, as units of 'meaning-making', which enable both the decoding (understanding), and the encoding (design or transformation) of systems characteristics, in a heuristic participative way.

This opens possibilities for pattern-based tools and methods that could leverage interpretative aspects in learning and action research type of interventions, such as I illustrated in my Plop 2017 paper⁷⁰, and Takashi Iba presented at his PUARL 2018 keynote on The Future of Pattern Language⁷¹

How pattern definitions, pattern language forms and the formulation of patterns could evolve to explicitly integrate the multiple facets of patterns, and how the practice of pattern language could tool an extended and continuous act of systemic inquiry and design is the question I have for both the pattern language and systems communities.

4. HOW WELL IS THE VERSATILITY OF PATTERNS LEVERAGED?

Earlier in the paper, I suggested that from an epistemological perspective, Alexander did capture the multiple facets of patterns, and their systemic implication. But I contended that the execution or practice did not follow, because in their current form, patterns and pattern languages do not leverage the properties and potential of patterns optimally. Indeed, patterns and pattern languages are not currently *configured* to be systemic. In other words, they are not fit methodologically for systemic design.

In particular the observational sign-quality of patterns as manifestations of current or aspired behaviors of systems at work (category 1) is neglected, as much of the focus is on patterns as guides for design (category 2). This slippage away from systemic fitness is accentuated among others by the widespread use of the problem-solution structure of the pattern, which locks the pattern in an instruction mode where it loses its recognizable 'performative' and 'evaluative' properties⁷². Practice is also hindered by a view of generativity which does not seem to support the multidimensionality and multimodality of generative processes of different nature in interaction, which characterize complex systems.

Developing systemic pattern languages requires a reflection on pattern definitions and on how problem, solution and generative processes are dealt with in an act of design which optimizes the integration the inquiry and design processes.

⁶⁸ This is something both Peirce (year) in his triadic semiotic relation and Rosen (year) in his modeling relation have highlighted.

⁶⁹ My ISSS 2018 paper Patterns as connectors of multiple realities addresses such epistemological and ontological issues.

⁷⁰ See Finidori & Tuddenham (2017)

⁷¹ Takashi Iba: The Future of Pattern Language (2018). https://www.slideshare.net/takashiiba/christopher-alexanders-thought-and-eastern-philosophy-zen-mindfulness-and-egoless-creation-with-a-pattern-language?fbclid=IwAR3yOO6lYQrL5wRRCElkvpSmYe_x3QDlmy29mF27JNCgMtl-zVZeR6tBeTo

⁷² I mean here the property to render what 'is' and unfolds, as observed or envisioned

4.1. Alexander's own versatility: getting the various definitions of patterns to work together?

In his work, Alexander considers and writes about both functions of patterns: patterns as signs or forms to be discovered (category 1: observational patterns / descriptive), and patterns as rules or guides for design to be followed (category 2: design patterns / prescriptive), both the thing 'in the world' or the thing designed, and the process to design it.

He switches among many understandings and perspectives of patterns, not only through time with his successive writings⁷³, but even within single units of writing, such as in the *Timeless Way of Building*⁷⁴, sometimes with inconsistencies⁷⁵.

In his earliest and latest work, he describes patterns more as signs/forms than rules or guides for design.

The pattern in the *Notes*⁷⁶ is an extension of the diagram: an "[a]bstract pattern of physical relationships which resolves a small system in interacting and conflicting forces", congruent with Herbert Simon's⁷⁷, *near decomposable complex system*. In his latest work⁷⁸ Alexander proposes fifteen fundamental properties of wholeness. Michael Mehaffy suggests⁷⁹ that the fifteen properties, which describe the basic structural results of the fundamental process of symmetry-breaking that occurs in any unfolding process, could be expressed as sign/form patterns as they describe the structure of any part-whole relations, which could be applied in principle to any phenomenon.

How, according to Alexander, do patterns in the world, and patterns in our minds inter-relate, and work together in the documented pattern and pattern language approach?

In the *Timeless Way* Alexander refers to a pattern as *something "in the world"* that we learn to see, belonging to the first category of patterns I mention above:

"a unitary pattern of activity and space, which repeats itself over and over again, in any given place, always appearing each time in a slightly different manifestation".⁸⁰

He goes on to relate patterns in the world and patterns in our minds:

"When we ask, now, just where these patterns come from, and also where the variation comes from, which allows each pattern to take on a slightly different form each time that it occurs, we have been led to the idea that these patterns "in the world" are created by us, because we have other, similar patterns in our minds from which we imagine, conceive, create, build, and live these actual patterns in the world. These patterns in our minds are, more or less, mental images of the patterns in the world: they are abstract representations of the very morphological rules which define the patterns in the world."⁸¹

This is the "symmetry" Mehaffy applies to reality and language, which mirror each other.

Alexander acknowledges here the constructed nature of the world, along with the existence of an external phenomenological order, and the recursive semiotic relationship between patterns in the world and their equivalent patterns in our minds.

How, then, does he shift from acknowledging patterns in the world which 'appear' in any given place, and referring to the 'very morphological rules which define both patterns in the world and their abstracted form in our minds',

⁷³ This has been highlighted in West & Quillien (2017), and by David Ing at Plop 2017

⁷⁴ The *Timeless Way of Building*, Alexander (1979)

⁷⁵ also highlighted by West & Quillien Ibid

⁷⁶ *Notes on the Synthesis of Form* (Alexander (1964)

⁷⁷ Simon (1962)

⁷⁸ *The Nature of Order* ibid.

⁷⁹ in a social network conversation and *Cities Alive* ref

⁸⁰ *The Timeless Way of building*, Alexander (1979), p181

⁸¹ Ibid.

to collapsing this idea altogether in the next paragraph, subsuming the representation or image of order to a know-how or even to an urge to build?

*"However, in one respect they are very different. The patterns in the world merely exist. But the same patterns in our minds are dynamic. They have force. They are generative. They tell us what to do; they tell us how we shall, or may, generate them; and they tell us too, that under certain circumstances, we must create them"*⁸²

... highlighting that we retain and nurture in our minds the forms that are the strongest and the most meaningful to us, and therefore recognizing the strength of the pattern in its cognitive dimension, and a drive to mimic in design the patterns in the world, but then immediately shifting the focus to a definition of a pattern as rule:

*"Each pattern is a rule which describes what you have to do to generate the entity which it defines"*⁸³

...the pattern in the world morphs into a guide for design, which Alexander announces as an 'extension of the definition of the pattern'. It seems the extension now prevails over the original intent.

This probably explains the narrowing of the pattern definition to the design functions that we see today. Many in the pattern language community currently tend to overlook the patterns we observe in the world. These patterns are signs or manifestations of systemic configurations or events, which can be used to identify and assess form and process, and their quality, and gave rise to design pattern in the first place. The concept of observational pattern, from which the design pattern originates, however, and quite paradoxically, seems to not fit the pattern community's definition of a pattern. I regularly receive comments that "my" patterns are not "patterns"... *"Could we name these differently, so as not create confusion?"* ... *"but then, everything is a pattern!"*, I hear regularly...

I understand that any random pattern in the world is not worthy to become a model for good design or action, for QWAN. But does this justify to ignore patterns 'in the world' altogether, and hold them unworthy to be called patterns, or to be discussed as part of a systemic inquiry and design? Turkish carpet patterns and patterns of embryogenesis, so dear to Christopher Alexander, before epitomizing beauty and the order of nature, or QWAN, are first and foremost patterns of the first category: recurrent forms and processes, which can be noticed and talked about before any value judgment is applied.

Most people understand patterns as repeated forms, of the first category, without introducing a value judgment a priori, using them as meaning-making and evaluating devices. How could we reconcile the two definitions, and leverage the full potential of patterns?

Patterns indeed are ubiquitous and multifaceted. They mean different things to different people, but these different meanings or functions of patterns are not random. They are connected through the semiotic relation between the form in the world, the form in the mind and the imprint of agency in the environment, and I believe that embracing and leveraging this multifaceted nature of patterns is exactly what could bring pattern languages to a next level as far as collectively addressing complex socio-technological and environmental issues is concerned.

Alexander offers the following four consecutive definitions statements on patterns in *The Timeless Way*, as an introduction to the properties living patterns must have in order to be documented and shared:

*"Each pattern is a three-part rule, which expresses a relation between a certain context, a problem, and a solution."*⁸⁴

As an element in the world, each pattern is a relationship between a certain context, a certain system of forces which occurs repeatedly in that context, and a certain spatial configuration which allows these forces to resolve themselves.

As an element of language, a pattern is an instruction, which shows how this spatial configuration can be used, over and over again, to resolve the given system of forces, wherever the context makes it relevant.

⁸² Ibid. p182

⁸³ Ibid.

⁸⁴ This is actually the title of the chapter and of the caption before the following. Statements.

The pattern is, in short, at the same time a thing, which happens in the world, and the rule which tells us how to create that thing, and when we must create it. It is both a process and a thing; both a description of a thing which is alive, and a description of the process which will generate that thing."⁸⁵

We do find here the multiple definitions or facets of patterns, and Alexander shows in the pages following these statements how patterns in the world can be 'discovered' from observing the context, revealing systems of forces, and inferring or inventing the configuration and processes that produce them, and from there deriving the instructions for building them, to ultimately produce the patterns in their documented form. What we are missing however is a reflection on how these facets of patterns may be complementary in their 'pattern-ness', and how they could 'work' together, while retaining their functional specificity, in an extended act of design. Or in other words, we are missing a reflection on how to better leverage all the properties and functions of patterns that Alexander has captured so well. In particular we are missing the reflection on how patterns in the world, and our various ways of interpreting them, and of enacting them, could be better 'recognized' as patterns themselves, in their observational, mediating and generative quality).

Kohls is probably the pattern language researcher who integrates the best the various properties of patterns, while addressing possible elements of confusion. He makes the semiotic distinction between patterns in the world, patterns in our minds, and patterns documented as description, and notes the frequent slippage between these semiotic aspects of a pattern, from the phenomenological aspect of the pattern to its representational one, both in mind and formalized. Acknowledging the constructed nature of our worlds and the epistemological aspects of patterns, Kohls underlines the need to distinguish the expression of patterns, which is just a tool for mediating patterns, from patterns themselves. For him, the documented form of the pattern is the projection (expressed) of the projection (in the mind) of the pattern in the world. It is an explicit description of a 'form' in the world together with practical knowledge about this form, which Gabriel refers to as a 'text genre' to document practical knowledge. Kohls suggests that documented patterns are a scientific endeavor that seeks to reveal hidden structures. This resonates with Cunningham and Mehaffy's suggestion of the pattern as research object⁸⁶, where quality can be evaluated and discussed in participatory settings, and convergences or divergences of interpretation recorded, just as they are, for example, in Wikipedia.

Alexander described the versatility of patterns, in their material, functional, conceptual and practical dimensions⁸⁷ quite effectively, but he did not really reconcile perspectives and show how they could work together and complement each other in practice, through an explicit pattern methodology⁸⁸ or framework. I believe we should embrace this versatility, rather than keep it vague or try taming it into strict limits. The work of Kohls, Mehaffy and other pattern and systems thinkers, and my own doctoral research are directed toward the creation of such pattern framework or methodology. I invite practitioners in the pattern language and the systems science and systems thinking communities to join the discussions and experiment on tools and methods that could help patterns and pattern languages support systemic design.

4.2. The inquiry/ design integration and the problem/solution association

Focusing now on the configuration of patterns and how they capture interacting generative forces and problématiques, if we look at the current prevalent structure of documented patterns, we see in majority a problem/solution structure, built from the definitions of the pattern that Alexander & al provided in APL: "*Each pattern describes a problem which occurs over and over again in our environment, and then describes the core solution to that problem, in such a way that you can use the solution a million times over, without ever doing it the same way twice.*"⁸⁹ and in a Timeless Way "*Each pattern is a three-part rule, which expresses a relation between a certain context, a problem, and a solution*"⁹⁰.

⁸⁵ Ibid. p.247

⁸⁶ Cunningham & Mehaffy (2013)

⁸⁷ I have developed these ideas in Finidori (2016)

⁸⁸ This term was used in a conversation with Michael Mehaffy

⁸⁹ Alexander et al. (1977)

⁹⁰ Alexander (1979)

Patterns and pattern languages are regarded as problem-solving tools par excellence. How well do they help accomplish this task?

One of the major issues pertaining to design and problem-solving in general is the difference in nature in the skills they require, which makes their integration difficult.

Considering problem-solving approaches in general, Ing⁹¹ refers to Peña and Parshall⁹² who mention the importance of the “*search for sufficient information to clarify, to understand, and to state the problem*”. They highlight the “*confusing duality of problem-solving methods*”, especially in “*finding out what the problem is and trying to solve it at the same time*”, suggesting that these are “*two distinct processes, requiring different attitudes, even different capabilities*”.

These different attitudes and capabilities map onto a historic dichotomy in distinctive drives, which we humans have built different types of skills around, that I have only indirectly alluded to with the categories of patterns I described earlier in this paper:

1. A critical drive: the quest for understanding the world around us and ‘how things work’; an epistemic quest that characterizes scientific inquiry and the drive for ‘truth’, aimed at identifying the order of things and the laws that govern it. This quest has for long been seen through the various epistemic lenses of siloed scientific disciplines. More recently it is opening up transversally with transdisciplinary studies, and with systems science⁹³ and systems thinking who aim to see things as more complete wholes, and to cut across disciplines and domains of practice.

2. A creative drive: the production of technologies, and derived objects, services or experiences, over which we collaborate or compete to attain some goal; an aesthetic and technical endeavor, which accompanies the drive for problem-solving, construction and action, meant to build new ‘orders’, and produce new outcomes. These were for long designed via master plans. More recently, more fluid and ‘need centered’ design methods are used, such as design thinking and pattern language, which support step by step adaptable designs.

The critical quest for understanding focuses on the questions, on the inquiry process, on the problem. The creative construction endeavor focuses on the response, on the design process, on the solution. The distinction of pattern as sign (observational pattern) versus pattern as guide (design pattern), which I highlighted earlier in this paper, can be related to this dichotomy as well. For Henshaw⁹⁴ however, and as I evoked in the section on constructed worlds, the two drives and competences evolved in connected ways. In her view, our systematic ways of thinking arose in the process of learning and teaching systematic ways of making things. As a general pattern for how humans work, she calls it “systems thinking for systems making”.

How well do systems thinking and design thinking perform in integrating both the critical and the creative drives? Comparing systems thinking and design as problem solving methods, Jones⁹⁵ and Ing⁹⁶ highlight the existence of a specialization either in the problem side of things or in the solution side. They point to the lack of consistency in the problem-seeking aspects of design⁹⁷, and the lack of practicality or accessibility of systems thinking, which prevent an integration of both endeavors. Neither systems thinking, nor design thinking, in their view, seem to have managed to integrate the two and the associated skills enough. The focus remains on one or the other.

How about pattern language? To answer this question, we must dissociate the idea of inquiry-design integration in the pattern language, from that of the problem solution association in the pattern itself.

⁹¹ Ing (2017b)

⁹² Peña & Parshall (2001).

⁹³ And in particular General Systems Theory

⁹⁴ Henshaw (2018)

⁹⁵ Jones (2014)

⁹⁶ Ing (2017b)

⁹⁷ Ing dedicates a whole chapter of the referenced book to problem-seeking vs problem-solving, which Schön calls ‘problem setting’ in Ormerod (1996)

By construction, pattern language seeks to achieve this integration, putting the accent on problem-seeking through the description of context and configuration of forces or problem, and on the 'solving' aspect through the configuration or solution that resolves them. Within the "architecture of possibility"⁹⁸ offered by pattern language, patterns can be composed and applied in granular, piecemeal ways at various levels and scales, enabling an adaptive approach to problem solving and design. Pattern language is thus relevant to systemic design, because its relational, nested, network like structure, and the focus on forces and configurations in specific contexts are congruent with and can mirror the structure and workings of systems, and can be applied in agile types of ways. The question in this context becomes whether the balance of competence or focus on inquiry and design is achieved and whether this integration is effective.

At the pattern level, the 'problem-solution' association may seem an effective way to achieve this integration from the ground up. The question here becomes to what extent such hard-coded association is relevant to solving complex problems.

First of all, how effective is the integration of problem and solution, inquiry and design, in terms of competence and methodology?

Pattern language can be described as an assessment of configurations or composition of steps that work, set as rules to guide design, allowing piecemeal or adaptive construction. Kohls suggests that "design patterns [which] document tested solutions, *reason*⁹⁹ about the problems solved and the contexts in which they can be applied". He takes the example of the 'path' to illustrate the pattern¹⁰⁰, which can also be seen as 'means to an end'. This metaphor is about ways to reach a solution, depending on the context: point of origin, type of environment and terrain, etc... A progression in space and time. This is an interesting heuristic approach, that could be made much more systematic and effective using observational patterns explicitly. Observational patterns have an inquiry or heuristic power themselves to inform this assessment and reasoning. They can help generate interpretations of a problem or system of problems at hand and the envisioning of emergent solution forms, and the sought living quality beyond the thing designed. Or in other words, patterns could be involved as much as components of the inquiry (as clues, forms to be reproduced, contextual forces to be transformed), and as outputs of the design process (as realized or ideal forms, performing in the world) in their observational form, as they are, in their instructional form, as pathways to bring the realized form into being.

The ambition of this integration is well perceived. In his 2006 review of Alexander's *Timeless Way of Building*, critical systems thinker Ulrich¹⁰¹ praises the powerful concept of combined observational and design quality embodied by patterns and pattern language, which he sees as an art of *seeing and sharing patterns that are alive*, with observers across all disciplinary and professional boundaries. He sees the timeless way of building as a call to re-create our observational languages, in order to address systemic issues. He highlights the potential of pattern languages for the continued development of action- and user-centered research approaches. Along similar lines, Henshaw discusses how the general pattern of how humans learn and make things she calls *Systems thinking for systems making* can be interpreted as a general language for all kinds of work, studied and refined as a universal form of "action research" applicable to any science or practice¹⁰². Manns & Yoder¹⁰³ argue, however, citing Jackson and Ungar, that patterns have not been looked at with a systems perspective. They suggest that the focus on the structure of the documented pattern as an object, rather than a process, over-focuses attention on the solution and neglects the systemicity of the problem. Pattern language seems not to escape the specialization dichotomy suggested above.

In the previous section, I suggested that observational patterns had been neglected to the benefit of design patterns, as they were not encompassed under the denomination of 'patterns' in current pattern language work, and exploited as such. It is likely as a result, that the observational quality embodied in observational patterns as seen

⁹⁸As coined by Mehaffy, see above.

⁹⁹my italic

¹⁰⁰Kohls (2014) chapter 2

¹⁰¹Ulrich (2006)

¹⁰²Henshaw (2018)

¹⁰³Manns & Yoder (2017)

by Ulrich has been overlooked in practice as well, possibly hindering the capacity to 'see', anticipate and evaluate the systemicity, and therefore the capacity to generate life or QWAN, in both systemic problems and solutions.

How then could the definition and form of the pattern be [re]extended¹⁰⁴ to better incorporate the observational property of patterns as signs of systemic activity, and thus help better assess and discuss the systemicity of problems, and of potential of solutions? How could the definition and form of the pattern, and the methodology of pattern language, embody more explicitly both the observational and design quality praised by Ulrich, establishing pattern language more assertively both as an observational and design language, to better integrate inquiry and design? Henshaw suggests this interweaving can be done through what she calls *a back and forth between conceptual thinking and practical thinking*, in an approach that *joins together systems of thought and action*¹⁰⁵. This can be operationalized by leveraging the cognitive and semiotic properties of patterns

Secondly, how effective is the problem solution association at the pattern level in the context of complexity?

Alexander himself¹⁰⁶ correlates the form to be designed to the context, and the fit of the solution to the problem, in a quite loose way: *"in the case of a real design problem, even our conviction that there is such a thing as fit to be achieved is curiously flimsy and insubstantial. We are searching for some kind of harmony between two intangibles: a form which we have not yet designed, and a context which we cannot properly describe."* As Wirfs-Brock suggests, patterns and pattern languages describe nuances of problems and possible approaches to solving them, they are tools for inquiry when things cannot be clearly and absolutely defined¹⁰⁷. They are heuristic tools.

Wirfs-Brocks defines heuristics as offering *plausible approaches to solving problems, not infallible ones*, with the following characteristics¹⁰⁸:

1. *A heuristic does not guarantee a solution*
2. *A heuristic may contradict other heuristics*
3. *A heuristic reduces the search time for solving a problem*
4. *The acceptance (or applicability) of a heuristic depends on the immediate context instead of an absolute standard*

The issue with a paired problem / solution in the context of complex systems is that the notion of problem and solution and their fit are not very stable. A problem can be a problem from one perspective but not another, to some people and not to others. This may involve trade-offs. Jones citing Latour¹⁰⁹ suggests that problems, and in particular complex ones, do not have clearly and unanimously (and therefore objectively) definable boundaries: they are social agreements on issues of concern. Ormerod¹¹⁰ quotes Schön describing *problem setting* as a way to select the *thing* that will be treated as the situation, and to *set boundaries of our attention to it*, so as to define a coherence and a direction to what needs to be changed. Kohls notes that a problem -i.e. the question to be answered- may be situated at different levels, such as the system of forces to resolve or systems behavior to transform vs the steps necessary to build the resolving configuration¹¹¹. Similarly, a solution could be a desired systems behavior or the steps to build it. Kohls notes, moreover, that there may exist many solutions to solve the same problem, and many different ways to build a particular solution. This involves specifying at which level we are situated, and which choices have been or are being made¹¹².

¹⁰⁴ I mentioned earlier that the pattern as rule for design was characterized an extension of the pattern definition by Alexander.

¹⁰⁵ Henshaw (2018)

¹⁰⁶ (Alexander (1964)

¹⁰⁷ Wirfs-Brock (2017)

¹⁰⁸ From Billy Vaughn Koen's philosophy of engineering heuristics, as explained in his Discussion of the Method: Conducting the Engineer's Approach to Problem Solving

¹⁰⁹ Jones (2014)

¹¹⁰ Ormerod (1996)

¹¹¹ We have here the distinction between the process generative of a design, and the generative process resulting from the design, as I alluded earlier.

¹¹² It may be relevant to mention the Function Behavior Structure framework which "represent the process of designing as transformations between function, behavior and structure, and subclasses thereof" and the 'situated' version of the framework which "explicitly captures the role of situated cognition in designing".

Additionally, not all solutions can be repeatedly applied as contexts shift as a result of applying solutions¹¹³. Any solution can become 'toxic' if over applied. How does a pattern account for unintended consequences, for aggregated effects resulting from disparate causes or cumulative effects of a repeated solution over time¹¹⁴?

Jones refers to problem systems, which he describes as co-occurring problem manifestations, akin to Ozbekan's *Problématiques*. How can problem/solution parts be integrated into a whole system solution that 'fits' a *problématique* in all its dimensions¹¹⁵? Or in other words can systems of co-occurring problems be solved by systems of problem/solutions? Would they not be better solved by systems of solutions applied to leverage points that do not necessarily directly relate, in terms of 'place', to identified problems? How does the pattern process and structure -mainly here the process of structuring the documented pattern- account for this type of questioning? Does it include a set of heuristics for making these types of inquiries, decisions and trade-offs, especially in view of the characteristics of wicked problems highlighted in figure 4?

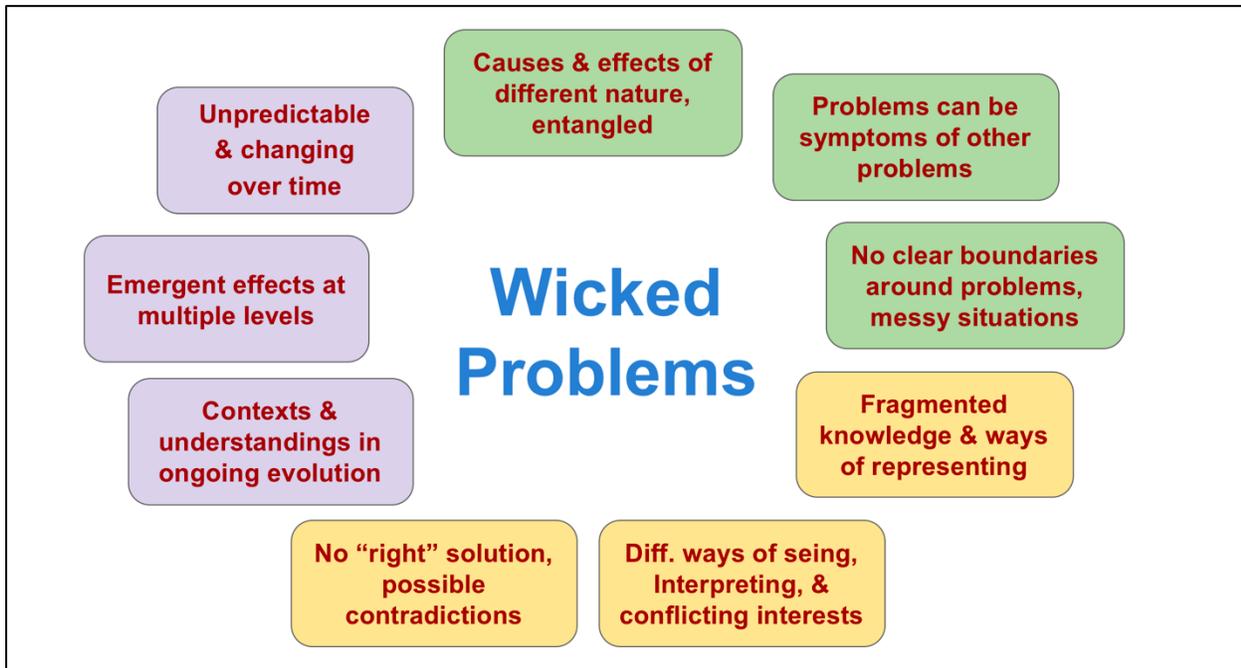


Figure 4 : Problems, solutions and knowledge in the context of wicked problems.

Systems thinking attempts to provide some responses, which may be usefully applied to pattern languages. These are exemplified in the work of Donella Meadows on *Leverage points to intervene in a system*, and systems archetypes, documented by Peter Senge, which simulate causalities and intervention on leverage points.

Systems archetypes can remind of the style of pattern languages. One expects to see a *therefore* in the adapted example below (Figure 5). The accompanying image works as a performed simulation cycle of nested feedback loops

¹¹³From a conversation with Rebecca Wirfs-Brock.

¹¹⁴ One can think here of a medicine that may kill patients if overdosed, or of an antibiotic that becomes ineffective over time on bacteria which have developed resistances to it, or of a parasite that thrives at the expense of its host. Similarly, over-targeting efficiency, and therefore reducing waste to zero, may eliminate all buffers and possibilities for resilience in case of breakdown: lean supply chains with no local inventory or capacity for production will not help local supply if transport systems are seriously disrupted. As far as human behavior is concerned, rewards to eradicate a behavior or a nuisance may lead to the fostering of the behavior in order to maximize potential for reward: a notorious example is a reward for killing cobras proposed in India, which led to an increase of cobra breeding, and the aggravation of the cobra issue. Some types of fines, such as for example highlighted in a recent research in Israel, for late pick-up in kindergarten, have been assimilated to the payment of a service and generated more late pick-ups. In the agriculture sector, a unintended consequence of the Aswan Dam in Egypt, built to control irrigation and provide electricity, was the capture of the Nile's fertilizing sediment in Lake Nasser, disrupting it's deposition along the river. This required the dedication of a large amount of the electricity produced by the dam to the production of artificial fertilizers in replacement. In agriculture again, the cumulative effect of extensive monoculture, use of chemical fertilizers and pesticides, with runoff along furrow lines causes both topsoil erosion and the pollution of groundwater tables.

¹¹⁵ Warfield & Christakis may have something to say here

that can be 'run', to model the execution of an envisioned solution.

The eight most common system archetypes are:

1. **Fixes that fail**—A solution is rapidly implemented to address the symptoms of an urgent problem. This quick fix sets into motion unintended consequences that are not evident at first but end up adding to the symptoms.
2. **Shifting the burden**—A problem symptom is addressed by a short-term and a fundamental solution. The short-term solution produces side effects affecting the fundamental solution. As this occurs, the system's attention shifts to the short-term solution or to the side effects.
3. **Limits to success**—A given effort initially generates positive performance. However, over time the effort reaches a constraint that slows down the overall performance no matter how much energy is applied.
4. **Drifting goals**—As a gap between goal and actual performance is realized, the conscious decision is to lower the goal. The effect of this decision is a gradual decline in the system performance.
5. **Growth and underinvestment**—Growth approaches a limit potentially avoidable with investments in capacity. However, a decision is made to not invest resulting in performance degradation, which results in the decline in demand validating the decision not to invest.
6. **Success to the successful**—Two or more efforts compete for the same finite resources. The more successful effort gets a disproportionately larger allocation of the resources to the detriment of the others.
7. **Escalation**—Parties take mutually threatening actions, which escalate their retaliation attempting to "one-up" each other.
8. **Tragedy of the commons**¹¹⁶—Multiple parties enjoying the benefits of a common resource do not pay attention to the effects they are having on the common resource. Eventually, this resource is exhausted resulting in the shutdown of the activities of all parties in the system.

Figure 5: Summarized Systems archetypes. Many are targeted to problem/solution issues. Saybrook University Blog¹¹⁷.

Ambiguity is latent in pattern language work, between the advertised fluidity and adaptability of patterns in their composability as pattern language, and the possibly rigid prescriptive 'proven' aspect of the problem/solution relationship in the pattern form, which might not be sufficient in practice to support probing and adjustments over time¹¹⁸.

Complex systems are in constant process of transformation, because agents constantly adapt to each other's behaviors and to changes in context. Contrary to enabling a monitoring of the co-evolution of context and solution, the problem/solution pattern risks 'freezing' the relationship into something that is not necessarily well adapted to uncertain contexts and continuous evolution. Indeed, the association can take a prescriptive / normative twist, preventing an actual inquiry in the definition of the problem and adjustment of a solution. Moreover, as noted by Rebecca Wirfs Brock¹¹⁹, it may impede the assessment of the validity of a solution over time. With such patterns, the slippery slope is to fall into an "unfreeze-change-refreeze" process¹²⁰, which is quite different from a piecemeal approach to produce a well-fitting form¹²¹ that ensures the plasticity of the whole.

The notion of plasticity, i.e the quality of being easily shaped or molded, is key, but can be tricky too, because it does not necessarily prejudice a capacity for resilience. The brain can reshape itself to a certain extent. In physics however, plasticity is an irreversible change of shape... Patterns are the 'matter' of plasticity, they can be extraordinarily malleable or they can 'crystallize' and remain 'stuck' in a shape just like some materials do, or like

¹¹⁶ The tragedy of the commons archetype has been proven false or trumped by Elinor Ostrom's work on managed commons.

¹¹⁷ <https://www.saybrook.edu/unbound/systems-archetypes/>

¹¹⁸ Pattern languages are however, because of their discrete and 'grammatical' nature, more adapted for such probing and adjustment approaches than systems dynamics models, as they enable to repurpose and probe compositions and connections in inquiry interventions, while systems dynamics archetypes are closed 'finished' models, which are difficult to 'enter' into to question the associations.

¹¹⁹ Wirfs-Brock (2017)

¹²⁰ Attributed to Kurt Lewin, a common model used in change management

¹²¹ Manns & Yoder (2017)

habits that can keep us locked into rigidly held worldviews and potential biases, or trapped in hard-to-get-rid-of behaviors. We want to avoid getting locked in by patterns, and rather use them to rewire, reconnect, repurpose when needed!

The question of the ‘aliveness’, and life cycle of patterns is one that is regularly brought up¹²² in the pattern language community. Alexander himself¹²³ questioned whether APL types of pattern languages in their context – problem/solution format didn’t actually reduce design to sequences of good ideas assembled into static forms rather than into generative entities, alive over time, able to effectively address complex societal challenges.

4.3. The pattern as thing and process, interweaving inquiry and design

Before examining the generative aspects of patterns, let us get back for a moment to the last paragraph of Alexander’s pattern definition set that I shared above:

The pattern is, in short, at the same time a thing, which happens in the world, and the rule which tells us how to create that thing, and when we must create it. It is both a process and a thing; both a description of a thing which is alive, and a description of the process which will generate that thing.”¹²⁴

A pattern is at the same time a thing and a process, generative of that thing. What does this entail?

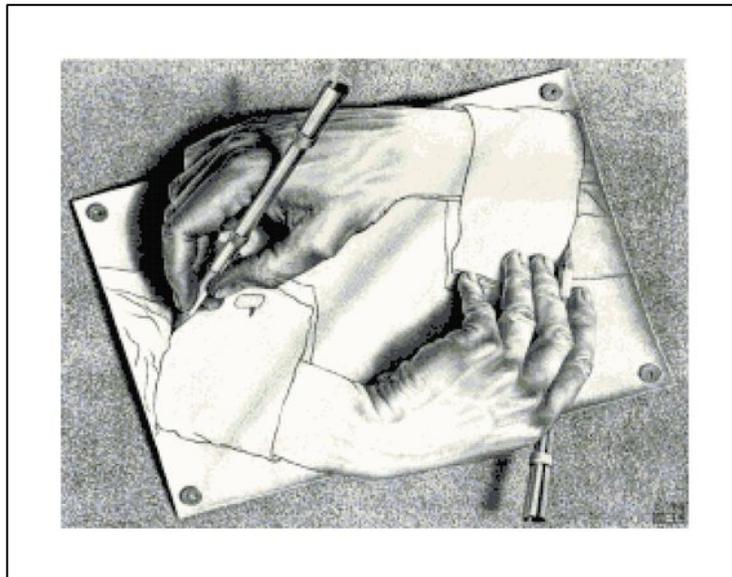


Figure 6: Are we in a strange loop?

When we consider this from a systemic perspective it seems there may be several levels of ‘things’, several ‘processes’, several levels of generativity involved, as illustrated in figure 7.

¹²² Such as Leitner, Salingaros, Reiner...

<https://www.metropolismag.com/uncategorized/living-patterns-as-tools-of-adaptive-design-2/> and <https://www.metropolismag.com/uncategorized/living-structures-should-come-from-living-patterns/>
<https://patterns.architexturez.net/doc/az-cf-172831>

¹²³ OOPSLA 1996. Mehaffy reported in private correspondence that Alexander also questioned whether APL effectively guided its readers in the creation of form.

¹²⁴ The timeless way, Alexander (1979) p.247

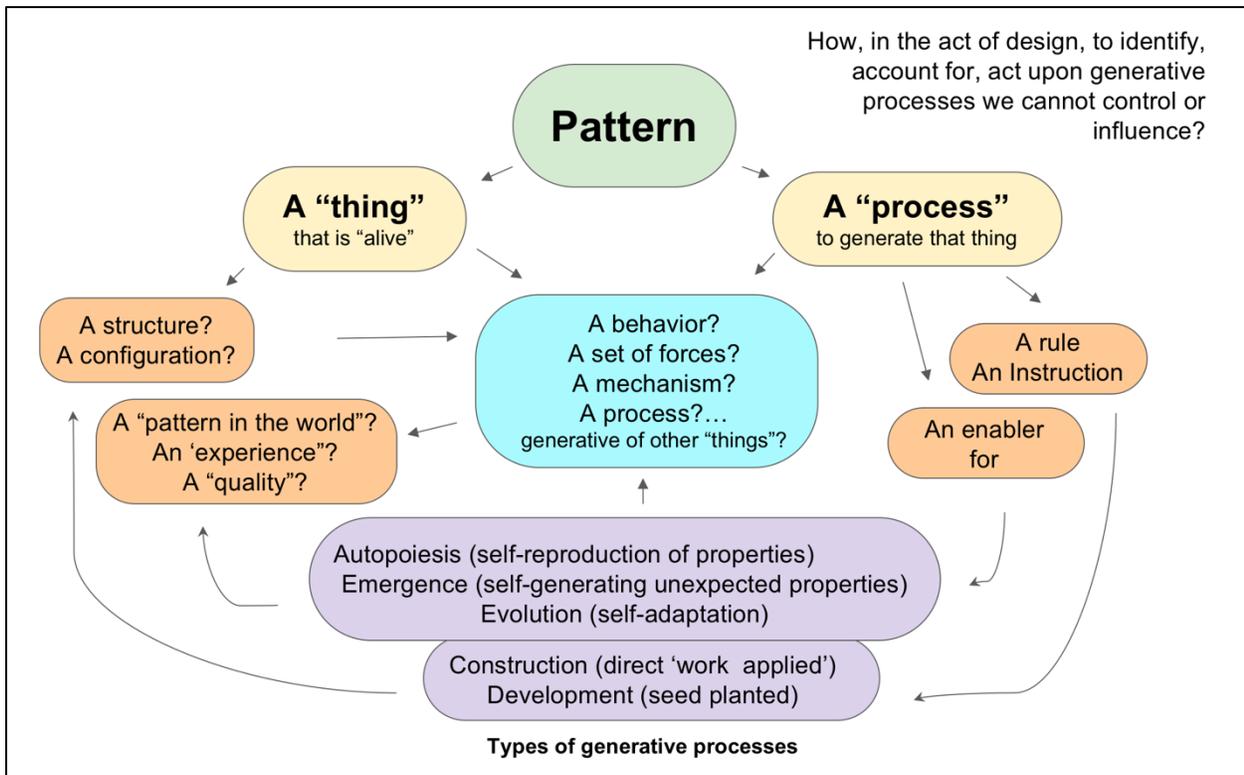


Figure 7: Pattern as thing and process, and the different types of generative processes.

First, the 'thing' that happens in the world, to be created, can be many things... Is it a structure? A configuration? A pattern in the world? A quality? An experience? A systems behavior? A process, itself generative of something else? The fact it 'happens' supposes some form of phenomenological event deploying in time, with possible aggregate or ripple effects, and therefore movement and change in context as well, involving other processes. Then, there is the *rule that tells how to create the thing*, which is a process itself, embedded in the larger process generated by the pattern language. Which of these processes generate the quality? Is quality or QWAN the 'thing' being built? Embodied and enacted in all processes involved?

"This quality in buildings and in towns cannot be made, but only generated, indirectly, by the ordinary actions of the people, just as a flower cannot be made, but only generated from the seed."¹²⁵

If we consider this from the perspective of the generating system described by Alexander¹²⁶, which generates systems that are whole, the pattern language as a sequence of pattern would be a generating system that generates the thing (a building), that generates a system that is whole (the system of social activity and interactions occurring in and around this building), itself generative of other processes and qualities (increased awareness, environmental and social continuous regeneration, aliveness, wellbeing, etc), themselves generative of changes of paradigm and thus other more whole systems?

All ordinary actions, or acts of design are generative, and shape the systems they are embedded in. The structure and behavior of systems and all the 'things' created directly or indirectly can be identified in the form of observational patterns. Bringing observational patterns more explicitly in pattern language practice would help unpack and evaluate the different changes in systems structures, processes and relationships at various levels and scales, and the various processes they generate.

¹²⁵ Ibid. p.157

¹²⁶ Alexander (2011)

To pursue this idea further we need to make distinctions between the notion of 'thing' designed, the notion of generative process and forces observed in the context of a design, or as a result of a design, both describable using observational patterns (category 1), and the notion of design process, or steps to proactively realize a design, encapsulated in patterns as rules for design (category 2). We must be aware however, that a generative process which indirectly designs a thing or another generative process may be observed and described in the form of sequences of steps -nature's designs-, akin to a design pattern. This may create some confusion in the use and understanding of terms such as structure, configurations, forces, behavior and process, in relation to design process, sequences or steps. These distinctions and confusions are underlined in Kohls' and Leitner's work.

A variety of generative processes may be involved at various levels¹²⁷. Patterns and pattern languages as we know them, in their 'process generative of the thing' dimension, clearly cover the process of building a thing, or planting seeds for the development of a thing (first to third generation pattern languages), which involve a rather direct act of design. How well do current patterns and pattern languages capture and describe other generative processes that do not involve direct action or production, those that are indirectly triggered, and that play out or 'run' on their own, such as fractal, emergent or self-reproduced processes, that may combine to produce various types of unexpected aggregated effects? This is particularly important to look at from the perspective of wicked problems, and how the complex systems of forces that may aggregate in the background at different levels can be approached. How would we identify and distinguish these generative processes of different nature and their synergetic effects when we discuss and describe patterns?

Roy identifies five different types of generative processes¹²⁸: construction, development, autopoiesis, emergence, and evolution¹²⁹.

With construction, components are the result of applied work aimed at producing a given direct effect. With development, the system is transformed through the realization of its potentials. Work is applied towards generating capacity / capability. With autopoiesis, the system (re)generates itself in interaction with its environment, maintaining its properties and continuously regenerating its own organization. With emergence, unexpected properties (synergies) result from the interaction between parts which do not prefigure these properties when taken individually. With evolution, the system transforms itself through adaptations and evolutions at different levels and scales of diversified processes which interact with one another.

All these processes (and there are probably others) interact at various levels and scales to produce the reality we encounter. Individually and in interaction, they can be mentally and materially represented in different ways. Pattern languages such as the first to third generation pattern languages I described in the first section of the paper capture construction and development processes quite effectively. But how well do they capture autopoietic, emergent or evolutionary processes, and the combinations of generative processes in interaction? Those which do not involve proactive application of 'work' or the planting of 'seeds', but simply 'unfold' 'in the world', most of the time in unpredictable ways, as not-so-visible underlying mechanisms and causal interactions? All these are part of the contexts, systems of problems, configurations of forces, and solutions that shape a given problem, and could be understood and expressed using observational patterns. A few systems science/systems thinking researchers and practitioners are using patterns in this fashion¹³⁰.

Complex systems, and in particular the challenges that they entail involve many processes of the autopoietic, emergent and evolutionary type. Systemic design in this context is not so much about finding 'solutions' to problems, but rather understanding and designing for autopoiesis, emergence and evolution and their combination in very indirect ways, targeting leverage points, in addition to more direct construction and developmental processes, and then evaluating resulting forms and actually generated behaviors.

Systemic pattern languages are intended to enable the design or orientation of complex systems through the identification of patterns in various dimensions of complexity, dealing with a variety of generative forms, at

¹²⁷ Mehaffy (2017) refers to *coded processes that generate form*, but he does not elaborate on the recursive

¹²⁸ Roy & Trudel (2011)

¹²⁹ which Mehaffy (2017) also describes.

¹³⁰ Mobus (2015), Bloom (2010), Troncale (1978) etc

different levels and scales. This interweaving and integration of inquiry and design, which involves new ways of seeing and envisioning, in a single act of systemic design brings together the drive for understanding and modeling of how things work (scientific approach) with the drive to create and build solutions (design approach), addressing the fragmentation mentioned earlier in the paper. This involves bringing the inquiry, and therefore the scientific approach, into the practice, the art, and the feedback of the practice or art, back into the science.

5. CONFIGURING PATTERNS AND PATTERN LANGUAGES FOR SYSTEMIC DESIGN IN PRACTICE: WAYS FORWARD

I highlighted above why pattern language could play a critical role in addressing complex systemic issues, and the questions raised by current pattern language form and practice to effectively support systemic design. In particular, I highlighted the semiotic and cognitive properties of patterns and pattern languages which could be leveraged to enhance our understanding of systems relationships and dynamics, their imbrications, and their implications, as well as our envisioning new forms and transformations in participatory ways.

The forms and methods to operationalize pattern language for systemic or societal transformation at scale are still in an exploration and experimental stage, yet to be defined¹³¹. Several initiatives are underway to extend the usability, use and reach of pattern languages¹³². The development of shared repositories and community practice are some of them¹³³. The set of questions in figure 8 are those that participants worked on at the kick off of the Future of Pattern Language session the PUARL2018 conference. A similar questioning is currently taking place in the systems community, in particular about how Systems Science and General Systems Theory could help more directly the practice of Systems Thinking and Systems Engineering. Patterns and pattern languages play a role there as isomorphism and cross-cutting concepts and forms are brought center stage, in an attempt to revisit General Systems Theory for the XXIst century.

I focus in this section on possible ways forward in terms of architecture of patterns and pattern languages that would support sharing, retrieval, semantic interconnection and composition of patterns from different origins into pattern languages, to inform Future of Pattern Language discussions.



¹³¹ I have shared some potential directions and examples in Finidori (2016) and Finidori & Tuddenham (2017)

¹³² Yoder & Manns Manifesto

¹³³ Köppe et al.

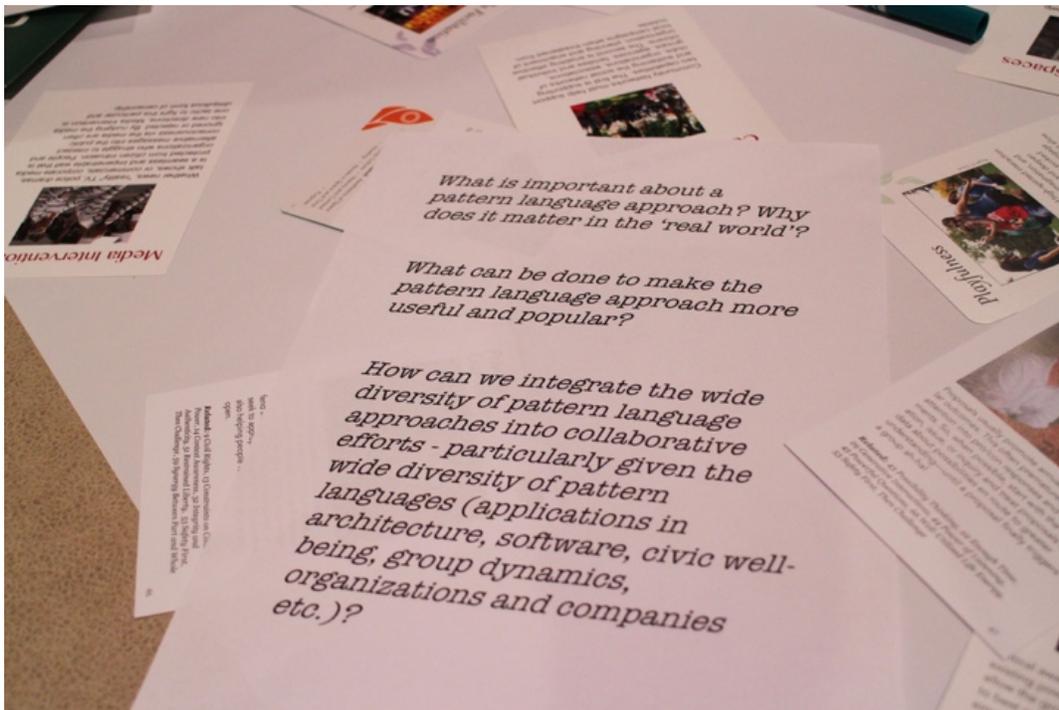


Figure 8 (2 pictures): The Future of Pattern Languages World Café questions, as kick-off for the PUARL 2018 conference.

5.1. Making patterns accessible: the ‘good form’ for the pattern

Alexandrian patterns are complex, elaborate structures with many related parts or sections describing different elements and angles, which Leitner calls *pattern aspects*. In the most extensive structure we can find context, problem, forces, solution, examples, resulting context, rationale, related patterns, known uses, pros, cons, figure, and more¹³⁴... Other aspects can be found in software patterns, such as intent, motivation, applicability, structure, participants, collaborations, consequences, implementation ...

There are two types of questions arising about the formalization and use of patterns in systemic and trans-disciplinary contexts. One, which I covered quite broadly above, is whether patterns are systemic enough to enable effective navigation of complex systems. The other is whether design patterns are not too complex or complicated to apprehend, store, use and keep alive. Leitner¹³⁵ suggests that there may be some confusion in pattern writing between pattern aspects, mainly among context, forces, problem, solution, resulting context or consequences. Wirfs-Brock notes¹³⁶, in the context of creating libraries of patterns in view of their reuse across communities, that there are too many details to go through when reading a new pattern, to check if and how it applies; too many discrepancies among pattern formats and sets of pattern languages at many levels, to pick and combine from different sets. One can add to the list too many different levels of abstraction and levels of detail to compare patterns to choose from. So pattern authors stick to their own pattern languages or collections of patterns, and reinvent the wheel, so to speak, when they don't find what they are looking for on their own shelf.

How can we deal with the complexity of pattern formalization and the expansion, if not scaling, of pattern production and use, while addressing potential shortcomings, i.e. avoiding too much abstraction, reduction or ‘freezing’, and confusion in the terms or processes?

¹³⁴ Matt Griscom mentions “counter-forces” as well.

¹³⁵ in a social network conversation

¹³⁶ Wirfs-Brock (2017)

I offer some questions here to be discussed in future of pattern language discussions and in conversations about how to design the pattern languages of the future:

How could we reach some clarity in expressing and differentiating the various 'aspects' of patterns, and in distinguishing the different processes at play and the building steps that need to be actively undertaken, the elements of description and the elements of prescription?

And how could we do this in such ways that the key elements of a situation, context and solution stand out so as to efficiently evaluate what applies?

Introducing some systemic elements in the structuring of design patterns and pattern languages, some insights on how to 'peel the onion' or unpack the 'ball of knots', and some discussion on 'agency', would probably be useful: for example, identifying 'who' or 'what' generates the processes and forces at play, in which manner and at which level.

This would involve the introduction of some pattern ontology, not quite to place things in categories or boxes, but rather seen as perspective taking, to facilitate meaning making and the differentiation of things, as a way to capture the multidimensional nature of what is, or what is to be designed, but also the multi-level nature of observation itself.

Cunningham and Mehaffy¹³⁷ suggested the pattern be considered as a research tool. Kohls described the pattern as 'reasoning' about context, problem, solution pathway. To expand the reach and use of patterns, this would have to be undertaken at the community and cross community level.

The architecture of such patterns would support community design and the collaborative or collective discussion and evaluation of patterns, with an ability to record different interpretations and perspectives, and points of agreement as well as controversies. Wikipedia currently supports this type of organization of knowledge, and its 'meta-stabilization'.

5.2. A modular form for interconnected patterns?

The modular discrete nature and versatile properties of patterns in their broadest definition support the description of different layers of elements or aspects that come into play in the systems we wish to understand, transform or design, and the comparison of the different ways we may understand and represent them. Adopting a modular form for the pattern, which leverages the characteristics of patterns in their broadest definition, would further support such methodologies.

It seems that Alexander, even if he didn't quite use it himself to its full extent, left the door open for such a modular approach. The way he described pattern language and individual patterns containing other patterns illustrates the recursive process through which both our material world and our mental representations of it are constructed. It enables deconstructions and (re)constructions, and therefore individual and collective pattern-based sense-making processes:

Each one of these patterns is a morphological law, which establishes a set of relationships in space.

And each law or pattern is itself a pattern of relationships among still other laws, which are themselves just patterns of relationships again.

For though each pattern is itself apparently composed of smaller things which look like parts, of course, when we look closely at them, we see that these apparent "parts" are patterns too.¹³⁸

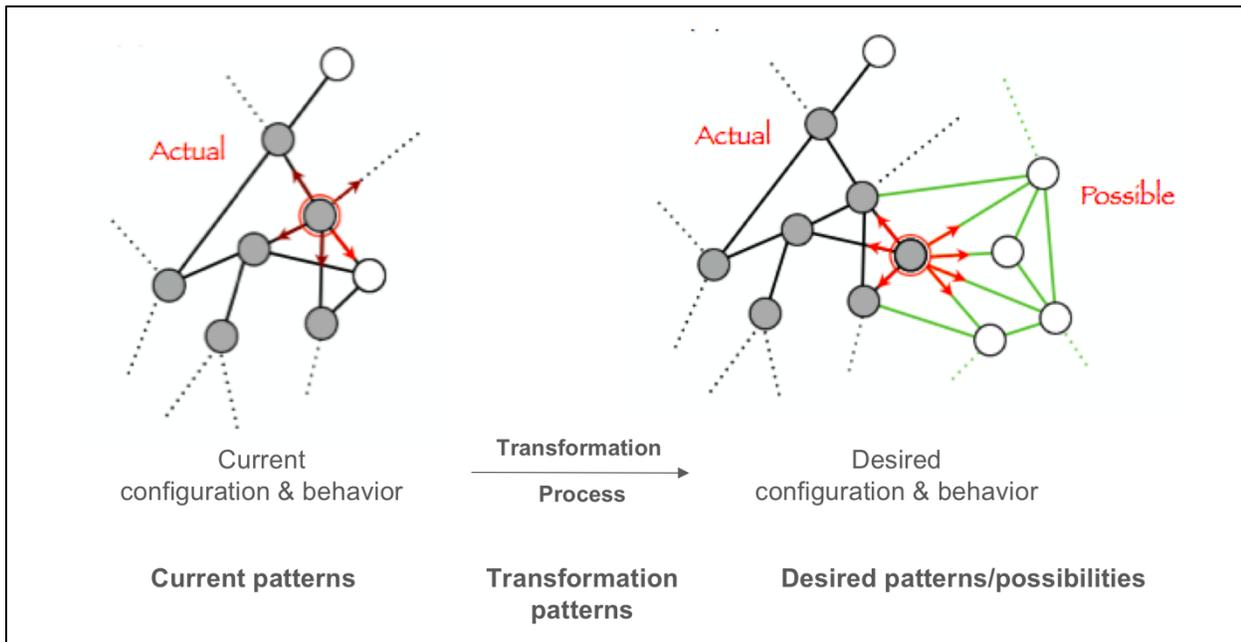
¹³⁷ Cunningham & Mehaffy (2013)

¹³⁸ Alexander (1979)

The smaller things that *are patterns too*, Alexander also called atoms or molecules from which a building or a town was made.

In this logic, observational patterns could be used as elements descriptive/ formative of design pattern aspects: contexts, problems and driving forces, and system behaviors that justify a design, as well as desired configurations or quality, or systems as wholes; highlighting the generative processes at play and those to be produced. We could see patterns as heuristic¹³⁹ elements that help recognize, distinguish and describe the structures, behaviors and processes or mechanisms involved in what is in focus and at stake in complex systems, and identify the hidden ones. This could enable a comparison of actual system behaviors and states with ideal or desired ones.

A problem in a context could be expressed as a set of patterns to transform. A solution, or desired systems behavior in a transformed context could be expressed similarly as a set of patterns to generate, they themselves generating emergent qualities. Other patterns aspects could be expressed as patterns also and be used as building blocks for other patterns, enabling the mix and mash of pattern aspects in the pattern representation, suggested by Leitner¹⁴⁰.



Then, there is of course the design pattern, the rule for design, and the generative processes that can guide a transformation from a set of patterns A (the current systems behavior, and the configuration and forces that drive it) to a set of patterns B (the desired future systems behavior, configuration and driving forces and the generative processes at various levels they may enable), composed into a larger design pattern, and then into a pattern language sequence or network, creating a system of design elements that function together to produce a design. Currently the 'pattern', is often seen as a 'proven path' from A to B. Introducing sense-making patterns at both the problem and solution level would help consider the problem, solution and transition pathway in more systemic and integrated ways, and help address the problem solution issue I described above.¹⁴¹

Kohls & Scheiter¹⁴² suggested something similar, transposed from schema theory, where the pattern schema is composed of a problem schema and a solution schema, themselves decomposed into sub schemata, with the solution schema activating structures such as planning, execution, elaboration etc.... The schema encapsulates a cognitive activation, just as the pragmatic cycles I have referred to above do. This is quite close to the definition I

¹³⁹ Ulrich (2006) was tempted to think his conceptual framework for boundary critique (critical systems heuristics) as a new pattern language that should help researchers and professionals of diverse fields in achieving reflective practice.

¹⁴⁰ in a social media conversation

¹⁴¹ This is a key topic for Future of Pattern Language discussions.

¹⁴² Kohls & Scheiter (2008)

have of a pattern, as something that is recognized and that triggers further inference and action, and as a result, further patterns.

Configuring design patterns more systematically as embedded nested observational patterns opens up further possibilities for collaboration and for the extension of the use of patterns across domains of application, in relation for example with General Systems Theory, which strives to find isomorphies and invariants or general systems principles that cut across domains.

5.4 Making patterns searchable and reusable

When considering the reuse of patterns from different origins, Wirfs Brock¹⁴³ notes that existing patterns, usually locked in application-focused or even author-proprietary libraries, are difficult to locate, remember and parse, in order to find a fit with new situations, so they are difficult to reuse. She suggests that "Perhaps, instead of categorizing our patterns we should characterize, that is, tag them with multiple characteristics, and let these characterizations emerge as we build our collections and share them with others." These characterizations or tags could be the sub-patterns contained in the larger pattern, as 'recognizable' chunks. Such indexing of patterns and emergent clustering of 'semantically' or 'morphologically' connected characteristics¹⁴⁴ could help refine our understandings of invariants or isomorphies, an approach convergent with that of General Systems Theory, and help build pattern aspects that could be shared across patterns and pattern languages as suggested by Leitner. More importantly it could help interconnect the increasing body of patterns and pattern languages, and navigate through patterns, via for example pattern search engines. This would open up more opportunities for exchanges and reuse of patterns and community practices as called for by Manns & Yoder.

Taking an interlinked pattern approach to invariants and homomorphy or isomorphy is compatible with the idea of a quasi-infinite and open pattern language rather than a finite one: an approach that allows to acknowledge and interconnect multiple expressions and representations of similar realities, and therefore multiple contexts. One can think of a thesaurus, which relates synonyms along multiple vectors of similarity¹⁴⁵, without trying to select a single word that captures an idea to the detriment of others. Focusing energy on agreeing on the most abstract and synthetic forms of invariants, detached from any context, given the fragmentation of contexts and related vocabularies and worldviews, seems a daunting task¹⁴⁶. Inter-relating instances of potentially isomorphic patterns via semantic relationships into networks or clusters of linked data, on the other hand, would help clouds of isomorphy or homomorphy emerge, which could become an object for study and discussion across disciplines and domains of practice¹⁴⁷, without losing the contextual information. Ultimately such linked-data could provide matter for actually enabling abstraction and synthesis, based on actual patterns of similarity between patterns observed in different contexts. This would open up whole new avenues for the practice of pattern languages.

13. CONCLUSION

The questions I brought up in this paper, on the role and form of patterns and pattern languages, meet some of those formulated by others at Plop 2017. They focus in particular on the role of patterns as heuristics for complex decision making and moving complex designs forward, and on the emphasis of patterns as structure, process and community, involved in larger systemic processes. From the perspective of such processes, the work of the designer

¹⁴³ Wirfs-Brock (2017)

¹⁴⁴ This could be operationalized using category theory, Kenneth Lloyd and Troncale

¹⁴⁵ the Visual Thesaurus provides graph representations of synonym relationships, allowing navigation into meaning, see <https://www.visualthesaurus.com/>

¹⁴⁶ The quest for universal principles exists in many domains and disciplines, as attested by Alexander's life work culminating in the fifteen principles of wholeness and the quest initiated by Bertalanffy for Unity of Sciences through General Systems Principles. In his Quest for General Systems Principles, Rousseau (2017) notes that "although the existence of principles is inferred from the existence of isomorphic systems patterns... knowing more isomorphisms only increases confidence in the existence of principles without making them easier to find." -abstract from Finidori & Tuddenham (2017)

¹⁴⁷ see plop 2017

does not stop once the 'thing' designed is completed¹⁴⁸, as the thing itself has agency. This resonates with the initial intentions of Alexander himself for creating an impact in the world, expressed forcefully at OOpsla 1996¹⁴⁹.

The long term endeavor I am engaged in is to explore how patterns and pattern languages can help systematize cognitive processes, and help the systemic inquiry that will lead to and support ongoing adaptive designs in a context where dynamics are entangled, and parameters are not fixed but move constantly. It is to examine how we can enhance their heuristic role, make them more systemic; use them for sense-making as well as constructing and developing; inscribe them in an extended act of design entailing larger systemic processes, make them more accessible; and keep them in use and alive.

Structuring patterns and pattern language of the next generation in ways that supports systemic understanding and design; tapping more explicitly in the observational and semiotic nature of patterns and pattern languages that connect the phenomenological, cognitive and representational aspects of patterns; and enabling the leverage and enhancement of pattern knowledge in view of pattern literacy as a means to empower and build capacity and ways for cooperation among researchers and users¹⁵⁰, is a way to start in this direction with both the pattern language and systems communities.

This was an exploration in the issues at stake for patterns and pattern languages to effectively support systemic design, where I shared a few possibilities of ways forward to further explore. Configuring patterns and pattern languages for systemic design is a whole topic of research that I hope a few in the pattern language community will take on.

Many thanks to my shepherd Matt Griscom; to Rebecca Wirfs-Brock who moderated this paper's writers' workshop session with thought provoking questions; to my writers workshop group members: Lisa Hvatum, Tomoki Kaneko, Yuki Kawabe, Maged Khalil, Julio Moreno, and Ayaka Yoshikawa, who all provided valuable and appreciated feedback; to Richard Gabriel, Pini Reznik and all the students of the Iba Lab who attended my Writing Systemic Patterns Mining workshop, and to Joe Yoder who helped me facilitate it; and finally to Takashi Iba for his continuous inspiration and support in my pattern language and complex systems journey.

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¹⁴⁸ Manns & Yoder (2017), Wirfs-Brock (2017)

¹⁴⁹ Finidori & al, (2015), Manns & Yoder (2017)

¹⁵⁰ Ulrich (2006) mentions literacy in his review of the Timeless Way of Building: *Promoting literacy in pattern languages promises to open up new avenues for capacity building and cooperation among researchers and users, as well as for emancipating users from those in control of knowledge, that is, professional experts, and those who can afford to pay them.*

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