

Guiding Patterns of Naturally Occurring Design: Elements

A Pattern Language Approach

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Abstract:

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Pattern language can be used to describe transformative ways of resolving disparate forces in complex contexts, making explicit the ancient practices of holistic architectural design, creating new forms with living quality. Discussed here are ways to use pattern language for learning from recurrent design patterns of nature. Common patterns of naturally occurring organization and transformation are used to search in great repositories of natural design patterns, and find diverse living

examples to learn from. For example, the familiar way designers work from early concepts to finished products is can be described as a recurrence of the natural process of complex designs developing from small beginnings to emerge in new forms. The technique of “pattern search” uses a “dual paradigm view” to separate the subjects of conceptual models and of observed natural forms, allowing attention to turn back and forth from one to the other as one studies their connections.

Keywords: pattern language; natural design; pattern repositories; living quality; dual paradigm; object oriented science

1. Introduction

The organization of this report, the choice of topics and their order, came from needing to introduce a broad field of research. Many years of natural systems science research on the complex patterns of naturally occurring design preceded this, and needed to be translated into a pattern language vernacular for communicating with a wider audience. It originated with the author’s years of original work on the complex natural patterns of eventful energy use in natural systems (1979, 1995-9). The paper is arranged somewhat as a series of vignettes, introducing numerous related topics, alternating general discussion with deep dives into advanced topics.

That is a somewhat pedagogical choice too, of presenting core subjects as a way to introduce a broad complex subject. The alternative would be to condense a general survey of the field, sure to be incomplete and likely to be less informative given the space and time available. The approach is both hoped to follow a logical sequence and to cover subjects both sufficiently developed to present and of general interest. The main interest is to provide a good sampling of the field giving readers places to start their own thinking on it. So each topic presents various parts of interesting problems and some of the kinds of solutions explored, thought of as a good way to give both advanced and beginning readers interesting and useful points of entry.

1.1. Origins

Christopher Alexander’s motivation for developing pattern language seems to first appear in “A city is not a tree” (1965), written when teaching architectural theory at Berkley. He recognizes a missing richness in the patterns of modern design, “some essential ingredient missing from artificial cities”, compared with treasured traditional cities of the past. He linked it with a loss of rich interconnections, that made modern urban design relatively dull and lifeless both aesthetically and unwelcoming as places to live. What was missing seemed to him to be a pattern of overlapping complexity in natural opportunities for connection, what he called “a semi-lattice” form of

relationships, that would offer a richness of unplanned possibilities.

My own interest in the general subject came from struggling with many of the same concerns with a lifelessness in modern design, but in the early 70’s a few years later. It was while studying architectural and environmental design in Philadelphia². His starting point was seeing inconsistencies between natural patterns of design and mathematical hierarchies, as “trees”. Mine was recognizing a difference between what I’d studied in physics³, a world of fixed rules, and the eventful nature of designs that would develop as individual unified wholes. Architecture is all about working with individual circumstances and perfecting uniquely individual designs for them. That’s a subject that physics treats only as “undefined”. My questions weren’t focused at first, but led to finding that “individuality” and “the liveliness of events”, are among the things most defined in nature, but the sciences generally leave unstudied, looking for universal laws.

What I eventually found was that the great success of physics as a language for nature was also very selective. By focusing only on natural relationships that can be defined mathematically, one inadvertently excludes all questions about things that work and behave individually, noticing ways that selectivity was a costly kind of trade-off. In the field of design, then, one studies the wonderful things that are possible, more or less in-between the laws for what things are necessary, requiring an interest in both. That not only includes learning to create individually whole systems of design, but also create designs to provide fully satisfying services. One controls many things, but the usual intent is to create a good home for some set of services and to understand the cultures providing and receiving them. It’s a comprehensive task, for serving independent interests, not an issue of imposing laws of control.

That confronted me with much the same basic dilemma Alexander faced, a feeling that what seemed increasingly dominating my world seemed so “lifeless”. I eventually understood that what physics actually defines are not “determinant causes”, really, but “knowable limits”. It’s between

² GSFA MFA in Archt.& Environmental Design, 1974
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³ St. Lawrence Univ., Physics, 1968. See also JLH CV (2015)

those limits where the liveliness emerges, in the complexity of the uncertainties, the part of our information that traditional science discards. That's the space that design and natural systems work within. That kind of insight really only came as a result of my graduate studies, doing studies of the how energy naturally moved in passive buildings, where I found a very lively pattern of emerging design in how organization develops around energy use, a sort of pattern language quite different from Alexander's (Henshaw 1979, 1995).

My first real hints of how organization develops around energy use were during school, observing the work in the design studio. With every design we'd begin with relaxed exploratory efforts that lead successively to more and more intense investments of energy that then tapered off again with the last finishing touches. Great crescendos of effort typically were needed to bring any design to conclusion, building as if following a natural course of expanding on some simple concept. In studio one occasionally pauses and sits up to notice what's happening around you. Observing the textures of sound in the room changing in nervous energy with the intensity of work going on is one of many things reflecting the big wave shape of the energy being expended as the designs develop. Studio projects always develop from scratch, with everyone working on the same problem, looking for how to start, then adding to the complexity and effort while staying focused on making it whole in the end, or it fails. Most often the projects in the studio all go off in different directions, with each individual's effort leading to something distinctly individual.

I also recall being inspired by hearing of Alexander's ideas back then too, well before his first general description of a pattern language (1977). I recall just from discussing in school, hearing about how he had studied the evolution of urban designs and changing shapes of public spaces. In the evolving shape of the Piazza San Marco he had found evidence of the environment having served as a pattern repository (Henshaw 2015b). The notable feature was how new patterns of design sometimes revived discarded features from the past, displaying a kind of environmental pattern memory for the future. It made me think about how that happened all the time during the work on any design project too. Having an accumulating pile of old versions and experiments as a design progressed allowed you to go back and find a version of something that had been discarded and later turned out to be really needed. Today there may no longer be piles of drawings to go back through physically, page after page, and review the whole evolution of a project and see how you got where you did, and what was lost. One hopes that still goes on somehow, and that the evolution of designs as accumulations of alternatives and experiments is still studied.

I also did a thesis length paper on micro-climates and how they characterized local places, and for my thesis then focused on a design for sustainable town planning. Where that thinking really became a study in new science was in the studies I began a couple years later, with the field research on how solar energy moves in

homes. I purchased portable instruments for recording building climates over 24 hour periods. After setting it up I would spend the whole day and night taking notes and tracing the development of both individual air currents and their evolving pathways, by which most natural energy movement travels. It always takes a tricky bit of organization, since for air to move anywhere other air needs to get out of the way. So the energy is effectively "trapped" by that, until the organization to make a pathway develops. So that very quickly became a study of the individuality of those designs, and how they evolved over the day as the sunlight changed direction. The flow patterns would kick up in the morning, reorganize and move several times in a day, and then fade away at night as the energy dissipated (Henshaw 1979a).

After a few months that led to recognizing a fundamental pattern, that all the emerging systems of organization evolved much the same general way, they developed and subsided by *progressive* patterns of accumulative development, step-wise design that multiplied and transformed. My first attempt to describe it as a natural pattern was in "An Unhidden Pattern of Events" (Henshaw 1979b). It seemed to imply a very clear opportunity studying how individual systems developed as wholes, particularly given that the emergence of new organization seemed associated with emerging energy use too. That also made it seem particularly surprising that it also appeared not to have been studied before. I think what happened was that I found a fairly practical to approach to studying whole organizational patterns, but the sciences that relied on equations lacked a way to study individually emerging systems. Having no mathematical way to represent them would make their organization "undefined" and so left unstudied.

What eventually drew me to Alexander's pattern language was how it developed to offer me this way to translate my earlier work. In later years it began to be adopted by other fields, and becoming a kind of universal language of design that any profession or field could use. I was mostly unaware of how it was emerging as it was making its important contribution of "object oriented design" for software development. My own introduction was in just the last couple years, as pattern language started being part of the systems thinking used in the commons movement (Finidori 2014, 2015)(Bollier, Helfrich Eds. 2014)(Roy & Trudel 2011)(Nahrada 2013), and led to my work with UN organizations finding ways to make a commons approach work, and learning to make explicit the patterns of relationships required for a commons approach to work (Henshaw 2013, 2014).

What was most useful was how the general model for pattern language had evolved fairly simple basic structure, a basic plan for identifying all the competing "forces" in a given context and a lasting way of resolving them all together. It would usually aim to be with some "recurrent principle" of elegant design. It's not always possible but it sometimes wonderfully is. One then adds

other details for describing the context and means of fitting the pattern to it. Altogether it captures the heart of the ancient principles of holistic design, an organization for unifying the forces, that incidentally produces wonderful emergent qualities.

It's not quite how Alexander presented it, but way of describing the common elements of Alexander's approach in the form that seems to be spreading to multiple professions and communities. Like everyone else, I constantly have to work on defining these "gems of good design", how to describe and applying them, define terms and standards, etc. To develop into a common language what remains essential is retaining the simple organizing principles common to all approaches, so they can be translated back and forth as they are added to. So this paper for PURPLSOC, and a companion paper for the October meeting of PLoP (Henshaw 2015c), are my initial attempts to apply a pattern language approach to recording a number of very interesting naturally occurring patterns of design. A few other mentions of those who inspired my work are listed in Acknowledgements.

1.2. Natural design patterns

The "object orientation" of pattern language rests on the whole pattern and the whole design of the things being discussed, not as theoretical objects, but actual designs. They are designs for unifying responses to some set of "forces" in some "context" creating a "center" of organization in the context that can act as a whole. This is a very common set of characteristics in natural environments, where you see tremendous varieties of distinctly individual systems, as organisms, cultures, or their working parts, as well as environmental and weather systems, and economic and communication systems. They all generally have both their own individuality of design and of roles in related contexts. It's both the ability to see the separations of these individual organizations as wholes, as objects that work independently, and also how they can combine to work together as "wholes of parts". It makes you think of diagrams, but the only adequate 'diagram' would be the actual thing, the service, place, community process or event and the relationships that unify it. So pattern language is more a language of generalities, than of abstractions, though it might certainly sound abstract sometimes.

The focus is also on versatile "recurrent patterns", that are more or less universal design concepts. For example a "door" is a "closure for an opening", a really wonderful solution to the need for both privacy and openness. It's something that can be used to bring satisfying resolutions of complex differences in numerous situations. Another example would be "seating things comfortably" as a way to mutually adjust the needs of many things at once, getting them to really fit. So those elemental patterns become both "design elements" and "end purposes" as well as suggestive models to learn from. More More complex design patterns, maybe called "house" or "government", become discussed as guides to what complex design for unifying the forces of common situations. You might perceive a frequent kind

of discord to understand, and perhaps call it "friction" or "misfit parts" and try to identify the pattern of forces that is out of balance, perhaps. Sometimes you'll need to formalize the description, and get input from others, and do random trials. Sometimes patterns are just discussed as observations and passed around informally.

So, design patterns are not actually '*solutions*' as much as they are '*guides*'. You use them to help you learn, either about 1) any particular context where they might be applied or 2) to find how to study working examples and their contexts. Here we are more focused on the second, becoming familiar with the world of natural design patterns we have to learn from, and using them as keys to unlock some of the secrets of natural circumstances where they are found to work.

For example for intentional design, for a product or service perhaps, designers may finish their own plans and direct any sort of work for implementing them, but it's always nature that really finishes the design. That applies equally to software or to buildings that designers produce, or public policies or laws passed. How the nature of the living systems to which the designs are applied respond is what actually finishes the design of how they'll work. What will matter is how well such designs happen to really work for both the communities that are serving the design and those being served by it. Purposeful designs are generally means of delivering services from one community to another. How those and associated communities "heal in" around the new service, is nature's living response.

As with a new product, new restaurant, new law or idea, it's the environmental response that determines if and how it thrives. Lifeless places are ones the living environment doesn't respond to, and doesn't take into its living designs. So in functional terms what design patterns may describe as "solutions" are not the really solutions. The real solutions are the matching of the living relationships being served. Some designs make that easier some harder. So what design patterns do is describe promising frameworks for getting things to work, to allow some part of nature to grow into and welcome or not.

From the software community, Jan Borchert (2001) nicely states "a pattern is a proven solution to a recurring design problem", one that "pays special attention to the context in which it is applicable, to the competing forces it needs to balance and to the positive and negative consequences of its application". Jennifer Tidwell (1999) touches on the heart of why framing them as simplifying ideals of design makes that possible: "They are not abstract principles that require you to rediscover how to apply them successfully, nor are they overly specific to one particular situation or culture. Instead, they are somewhere in-between: a pattern describes possible good solutions to a common design problem within a certain context, by *describing the invariant qualities of all those solutions.*" [italics added]

That design patterns define “whole working units” on which to base “object oriented design”, appears to have played an important role in reshaping the thought processes used in programming. It offered a way to define and give names to versatile modules of complete software design serving holistic purposes, independent of the software itself. Whether sufficient, it certainly seems essential for allowing software development to become “engineering”, and certainly greatly increases the ability of software developers to communicate. So while pattern language is still being used as an art, it also seems possible to spread to diverse other fields, like education, community building, firefighting or even medicine perhaps, all finding a better way to understand the needs of their work. The possibility that it might create “object oriented science” is briefly discussed at the end. The focus here is not on applications, though, but applying pattern language concepts to learning from naturally occurring patterns of design.

The companion paper (Henshaw 2015c) is on a particular application, a design pattern for guiding software engineers in bringing “living quality” to their software designs. The simple idea is to use the intentional parts of the design to lead you to finding better ways to serve both the system resources being used and the users of the service it provides. It’s like an extension of “getting to know your providers and customers”, usually very productive thing to do. Knowing who your users are helps you know what they need, understand what attracted them, might disturb them, discover other unmet needs.

The method here generally starts with using one pattern to look around for others, displaying new variations to broaden the understanding, learning to look for how it might apply elsewhere. Using one pattern to look for relates ones involves generalizing a subject pattern to be “search template” and doing a “pattern search”, to find instances of it in other places in the same environment or in other kinds of environments. For a general example, you might generalize a pattern called “home” to search for the diversity of examples to learn from. Starting with its simple design as both “enclosure” and “connector”, you’d find it’s a generally a location where some culture develops its own individual way of living, with very complex meanings.

You find out all sorts of things that way, like how the enclosures that living cultures make for themselves to live in are generally made as they grow, and then become what they use to transmit and exercise their cultures. The shell of a home both secures a culture’s domain like a kind of exoskeleton or “external body”, but may be outfitted with diverse services for what takes place inside. It’s the diversity of living examples you find that lets you discover the many ways the design pattern can work, suggesting good questions and examples of solutions to consider, not possible to know about any other way.

This approach also helps one get “unstuck” in one’s own thinking or that of others you work with too, just being exposed to unexpected natural ways for things to work. A pattern language

approach helps you recognize them as unusual combinations of forces being brought into play in novel unifying ways. What you find is that “*a door without a latch*” seems perfectly normal until you’ve see a door *with* a latch. Then you can’t think of a door as complete without one. Various combinations of things tend to be found to play critical roles like that, each transforming the meaning of the whole, as essential “simplifying ideals” needed to make it. Once the design is made “whole”, though, it can be hard to tell what the essential parts are, only seeing the whole. So the study of natural designs can take time, involve seemingly crazy thought experiments, waiting impatiently for something to jar your thinking, to help you stop seeing only the of smoothly working complexly of the parts. You look at the how connecting parts have opposite roles to work together and try to imagine what else could work if some random thing were removed.

As you learn from natural designs looking for their variations and opposites, to see every quality and feature in perspective, the useful alternatives become recognizable. As you do the essential features come clear, easy to recognize, letting you see the variation in how designs are adapted to different contexts. Almost anything we design is a variation on some natural model. Say the model pattern is called “vehicle”, and you are working on a design that needs one... Nature displays all sorts of different kinds you might think about, that can suggest unexpected options for your situation. ‘Vehicle’ might be “a conveyance” as for moving on something, or it might be a “channel” for moving along something, or it might be a “medium”, for moving in something, or moving a reaction like a “catalyst” that just alters the local chemistry of the situation. That the corresponding metaphors brought up by variations on a common pattern of meaning often directly correspond to variations of common patterns of organization is not really coincidental. It seems to come from what the meanings of language developed for, importantly for conveying how things work. So exploring the terms associated with patterns of design this way is just using the natural associations of natural language, exploring language as a repository and guide to patterns of design, something discussed more in Section 3.5.

1.3. The dual paradigm

One difference between “design patterns” and “natural patterns” is the presence or absence of “the designer”. Natural science describes nature as following the conceptual designs of the equations we find for making predictions, using mathematical rules as a metaphor for the designs of nature. Where we observe nature producing highly complex and often self-contained forms of design, what you can initially discuss are only the observable patterns of organization or traces of how they developed.

It doesn’t really describe them functionally to just have words for them, of course. The meaning of the words one uses for what is observed then mostly just identify parts one might go back to study later. As one attempts to sketch out the “anatomy” of natural systems step by step that way, trying to understand

things like the subcultures of a business, upstart social movements, how an ecology works, or an industry or professional community, one quickly notice they're beyond description. We see they behave cohesively somehow as if well defined by nature and so important for us to respond to, but they are also so complex and composed of individuals of undefined number and relationships, we need a new model for understanding them.

To further focus the problem, it's common to find such natural systems traceable to their origins, new cultural display or new product, as a relatively insignificant point of beginning. It leaves us close to nothing to point to for explaining the enormous consequences. With a business case at least you can often see a very purposeful "start-up" event, as burst of activity using external resources, then the business plan using profits to multiply its systems with records kept you can follow over time to get a clear picture of how the small upstart becomes a giant. It turns out that general pattern is rather universal, and offers a way to organize one's observation of the patterns of operation within a system as they develop.

These lively systems that define themselves as they grow also display a common tendency to retain the patterns they began with from their origins. Partly it's just that as how they grow they are adding onto their original patterns. The irony is that at the origin there's often no evidence of any pattern as if the systems develops from nothing, and so denying us literally every possible avenue of explanation. Efforts to explain them with "cause and effect" only seem to imply "lawless laws", producing great complexity without any "requisite variety" for explanation in an information theory sense (Ashby 1956).

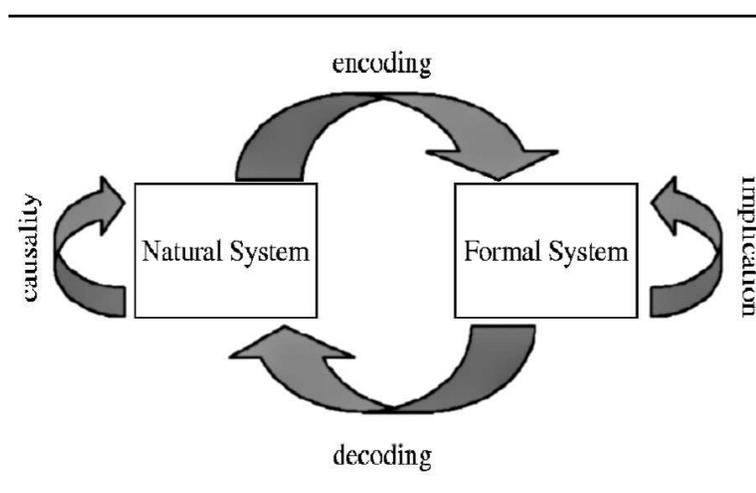
Still, in the case of an organism or a business, an industry or culture, or other kinds of naturally occurring organization, we can plainly see the complexity emerging as the system develops. It appears to start simply and then develop enormous variety in the design as it develops in a way that is never predictable. We can recognize the continuity in the design from its earliest origins, and various systematic behaviors, but we're left in the dark as what is really happening. The net result is that we get a much better match between subject and explanation just focusing on the general patterns observed, than on any explanatory theory. The visible patterns don't tell you everything, but they tell you something, often quite solid things you could build on.

So we apparently need at least two kinds of language for relating what we can predict, our rules for deterministic parts and the various clear patterns of design for organized wholes. Each addresses things the other omits, what I'll call a "dual paradigm" view, of a world needing both forms of explanation. What's common to studying either, a) natural patterns of design or b) deterministic theories with equations, is the same basic relation to nature (Figure 1). Any science is based on a practice of turning one's attention back and forth, between the subject in nature and

the method of description. One does it for studying natural design patterns and also for studying deterministic equations. The two are parallel conversations with nature that we need to have work together.

In the study of natural patterns the observer is exploring the limits of the patterns they find in a way intended to be well enough documented to return to them for further study and confirmation by others. If the observer has few preconceptions like an artist or a child they will make more objective observations.

• Rosen Model Relating Theory & Things •



1. Going back & forth between nature and theory

Figure 1 is Robert Rosen's model for the relationship between science and nature, a diagram of how its done (1991). It shows science engaging in process of learning from nature, turning its attention back and forth between "Natural Systems" and "Formal Systems", learning then testing and applying (encoding then decoding). Information is collected from natural subjects and used to develop formal theory, and then the theory is used to raise more questions about how the theory applies. The same operates for pattern language. The formal language of design develops by an accumulative process of finding the heart of what brings about complete resolutions. Pattern language differs from deterministic science in using natural language for its natural meanings, as that permits discussing holistic design patterns of common things. Traditional science uses mathematics to describe deterministic rules common things.

Both approaches rely on the human ability to maintain undivided attention on subjects of interest, being inquisitive in collecting objective impressions, as if directly "imprinting" one's mind with the forms of the subjects studied. They both lead us to ask questions for expanding our understanding. For pattern language the subjects are both more complex and the descriptions often a bit simpler, generally defined by appreciating what is observed rather than by analysis. So it's a matter of collecting observations forming good questions then testing and applying in a way like fitting a glove of description on the hand of nature. They differ in that pattern language

descriptions are more for fitting nature in a way that is comfortable and responsive to its self-organizing parts, rather than as for deterministic science fitting tightly the forms of nature that described rigidly.

One need not make a whole research project of it. It starts with a natural way of learning, as partly just a better way to pay attention to the relationships we rely on, the 'natural objects' of our lives. Then you learn to switch paradigms and talk about them conceptually, noticing when you switch from one view to the other.

To solidify your thinking as you learn about the subject you can take any paragraph that introduces a new idea and think of yourself as being in a study group, and think it through from different points of view as a group would. You might even invent different characters, being a stickler for details, the 'big picture' person, just looking for whacky views. It shakes up your assumptions and helps raise other perspectives to broaden your understanding as the experience becomes more memorable.

The test of doing it right seems to be whether if every time you recheck the patterns you learn something new. It's a simple way to validate what you're learning. That test also seems to be how one most directly validates the design patterns you write, by seeing if using them teaches you more about the subject.

2. Two Primary Patterns

2.1. The Natural Process of Design

Perhaps the most universal pattern of natural design is one I first noticed it in design studio projects, that design always takes time and follows a pattern of increasing then declining effort and energy. It varies a lot in how, but every project at home, in business, or any process of emerging change in nature as well, starts with small initial steps that lead to others getting progressively bigger, and then reverse and get smaller. So overall it's a pattern of escalating and then reducing intensity at the end, a "storm" of efforts that grows and subsides.

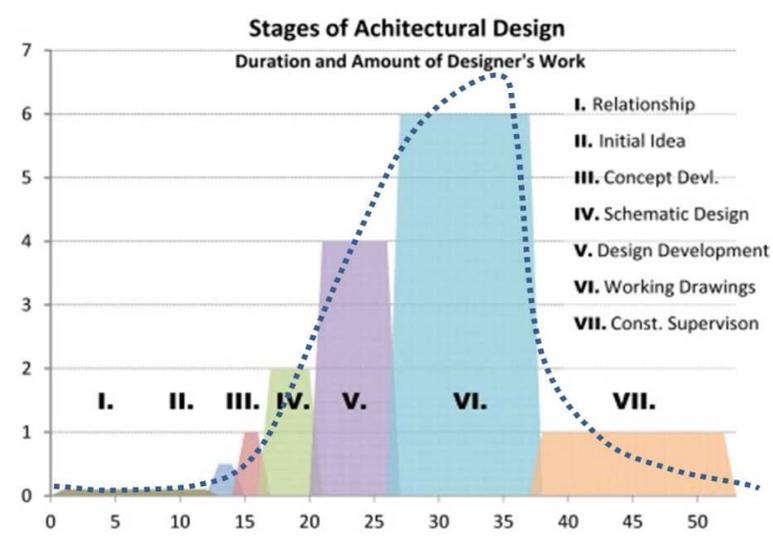
It's easy to examine closely in how design projects proceed. You first start with no idea how to start... and look for small hints and collect resources to use, and at the very end find a similar pattern of looking for finishing touches as the work approaches completion. That happens whether you "run out of time" or not, just altering the hurry of the process, either for getting started or finishing. If you think through any other kind of project the same applies. The phases of getting things started and finishing them up are critically important, as when "launching a product" or even when "making dinner". If you "get off on the right foot" everything can go much more smoothly, and the same with "bringing things to resolution" as an end. As a phrase, we just say "*designs develop*" or "have a cycle". They might develop either by well-practiced or wholly unfamiliar stages of rethinking, with each stage building upon the one before, so every step changes and is important to the whole as well. In the process the whole

design tends to change form again and again, a combination of projecting patterns and trial and error in guiding them.

For intentional design, as for designing buildings, the formal design and its construction are separated, with the formal design and its energy expenditure done before being turned over to others to expend their energy in executing (Figure 2, 3). The designer will often still be involved in watching the work take place, providing some finishing touches and clarifications during construction, but their work quickly tapers off till the final "check list" of defects is prepared, at the very end when the "key is turned over to the client", and the "house becomes a home".

In nature, of course, the design of complex organizations has no separate designer doing their work ahead of the development of the design, but the two occur at the same time, not following a predetermined course but following an evolving course of growth as the product is created (Figure 4). To really use this pattern you just need to recognize that studying how these steps of "searching for the next step" work as you do a design, make dinner or complete any other project, is at the same time a study of the kinds of steps nature has to go through too, not following a "design" but something more like a "search".

• Stages of Design and Degrees of Effort •



2. The general development pattern of design

In nature the same pattern of rising then falling scales of developing change and energy use are found in what we call "natural growth", usually leading to either a stable level of perfection or to a peak when something goes wrong. Just as for intentional design, natural growth generally originates from some initial pattern to build on, sometimes a visible start-up system or "seed" that "germinates" to get a larger system going. That "start-up" is usually followed by many stages of accumulative reorganization as development proceeds, you can call "graduations", to liken them to how our own educations proceed as we advance. In natural design, with the design of the system at the same time as the building of the system, the energy sources for the design and the building may be the same, or may

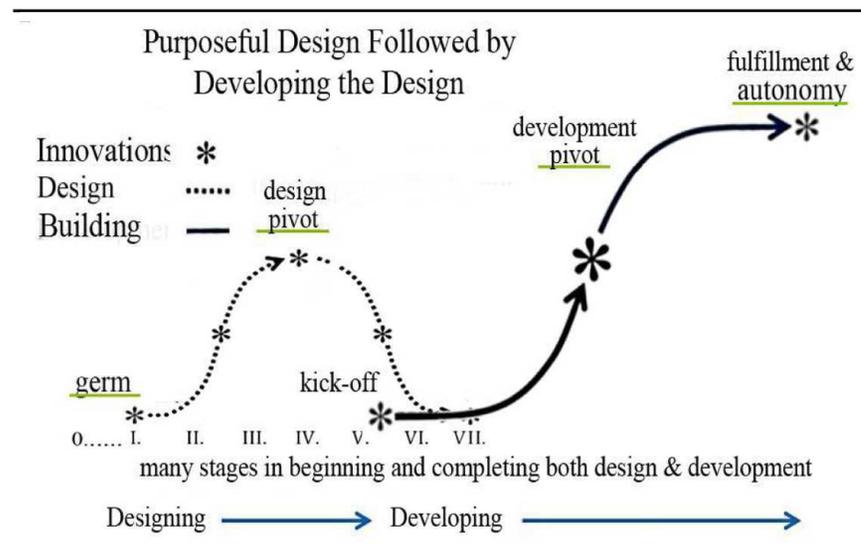
be somewhat separate. The energy used for adding new parts and for finding new parts to add can be alternating too. When a formal design precedes the development, as for intentional designs, those energy uses are clearly separate.

In economies the energy for simply operating and maintaining businesses comes directly from earnings for the sale of its products or services, with the profits put aside and accounted for separately. The energy for starting new businesses and expanding existing ones generally comes from one or another source of accumulated profits, used as a resource for starting new things. The spending of profits as investment in making things is for a limited time, stopping when they become self-sustaining (Figure 4). So the development and life of a system start together, but end very differently. The reason to notice these details is to learn to see the patterns of intentional design (Figure 3) as a “recurrence” and “special case” of the general patterns of natural design, just coordinated a bit differently for the advantages people get from it.

In architectural studio practice, distinct stages of design follow a fairly standard pattern, shown here as: I.-*The Client Relationship*, II.-*Conceptual Design*, III.-*Schematic design*, IV.-*Design Development*, V.-*Contract Documents*, and VII.-*Construction Observation*. They correspond to distinct changes in the types of “search for what to add” taking place, reflected in the a) complexity and funding of the work, b) the organization and size of the team, c) the deliverables, d) hazards, e) length of meetings, f) kinds of legal work, etc.. Each generally progresses from tentative and immature stages toward delivering robust and refined products. Looked at from beginning to end like that, the same general pattern of stages is found in all kinds of organizational processes, as changes in the character and content of emerging and going to completion.

As any design progresses the added tasks branch out again and again. That tends to creating an explosion of details needing to be completed, increasing the intensity and complications of the design effort. Just to “get it out the door” as if in a panic, pressed to deliver on time becoming a separate driving motivation concentrating everyone’s attention. It’s not a matter of poor planning, but completely natural, that as a design progresses it creates multiplying demands for finishing things, caused by each added part having become a place to add more. It originates from the “elemental pattern” at the beginning, that to initiate growth has to have a built-in pattern for adding parts that need more parts to be added, for later stages are built upon. So something else has to occur to reverse that progression before it exhausts the energy available to resolve the design as a whole, or things fall apart.

• Design Completes Before Construction •



3. Intentional design precedes the process of development

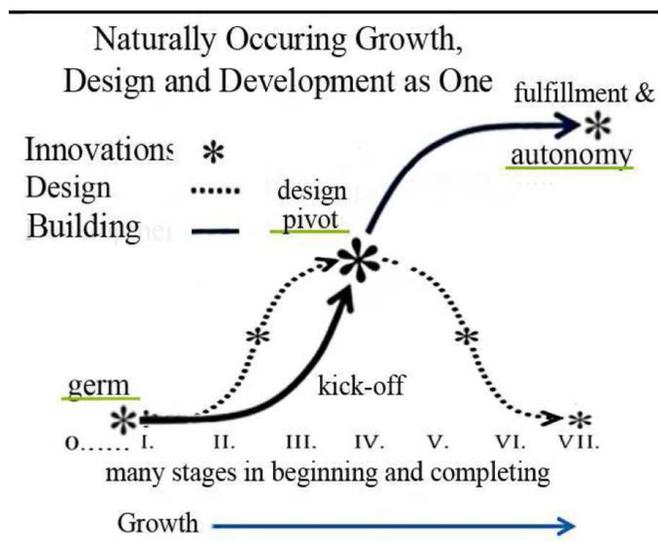
One can see in biological growth where that middle stage of most rapid increasing complexity occurs. It’s called “differentiation”, the time when the “basic frameworks” of different kinds of cells, different organs, the skeleton and other major systems all emerge. That framework basically “sets the plan” and creating a real explosion of places to add more parts. That’s similar to the stage in architectural design called *design development* (IV.) when the specific form of building frame and infill systems are all decided, and there’s suddenly loads more work for figuring out the details and connections.

You see these same generic stages in the work needed to produce a Thanksgiving dinner. You see a smaller scale version the lunch the next day. You always have the three major milestones, the *start-up* or “germ”, the turning point or ‘pivot’, and the *completion* point or “fulfillment”. Watching those thresholds being crossed also gives you more of a better idea of how the natural processes that exhibit them work too. Variations on those stages are there in the project to send a man to the moon. They are there in the stages of establishing anyone’s career. Every step takes a bit of inspired invention, starting with small tentative steps, to follow a pattern to take it a long way, on which the series of larger and then smaller steps toward fulfillment rely.

If you look at the common pattern of getting an education it all starts with early childhood, and one’s absorption of language and culture at home. Then there’s the long ladder of ascending levels, each usually seeming like an impossible challenge as you begin them. They are usually completed with a sense of mastery and joy, though, reflecting the real creative success story each represents, again and again. These stages of growth in learning correspond to stages of organizational complexity of our knowledge too, and generally correspond to growing scales of energy use as well. It’s maintaining that combined view of the progression of design and of energy use together that is the main way the design science and physical science become connected, as a link between the two different sets of “laws”. A swelling and subsiding use of energy doesn’t tell you what design process is

taking place, but it does tell you where... and that helps a lot if you have some general idea of what to look for.

• Design Begins and Ends During Growth •



4. Organic design occurs during development

Thinking of design as swelling and then subsiding energy use also gives it a series of mathematical markers to add to the three most directly visible, for use in tracing its course. The mathematical markers include the peaks and saddles and points where the curvature of the curve reverses. They also include changes in the character of the noise in the data, and mathematical evidence of strong continuity (flow) in the progression. If there is continuity there are also the implied accelerations and shifts in accelerations to signal to an observer what may be happening. Those are all quite informative for characterizing the identified whole system, what and how its' doing.

The most important, though, do seem to be those three “existential” points. Those are the points marking the “germ”, “pivot” and “fulfillment” as the end point of growth when the new form takes its role in its new environment. With a little experience these signals of systemic change can be fairly easily recognized, something solid as a pattern for beginning to learn how developing systems navigate their natural transformations.

2.2. Elemental forms of “Homes”

Homes are enclosures that allow good access to the resources of the world around them and within which cultures can create their own ways of living relatively free of outside interference. That “simplifying ideal” resolution of the forces is found extremely widely used. Homes create private worlds, for very individualized working relationships, with regulated relationships with the outside. Three simple types are depicted in figure 5, a ‘hut’, a “family home”, and a “town hall” to represent a community home.

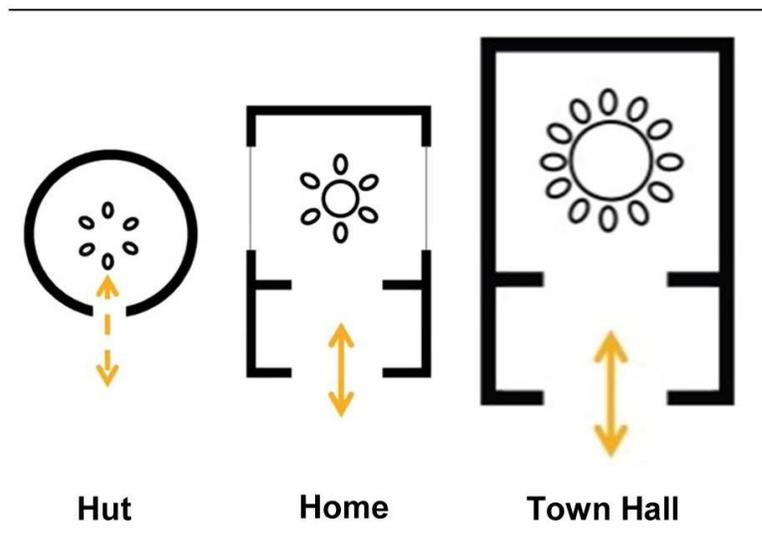
A biological cell is also a home, for the living chemistry within its enclosure, the enclosure giving that interior design selective access to the outside. It would be hard to count the great differences between the way of living within a cell and that

within a family home, or that within a meeting hall for a community. What you can see quite clearly is the commonality of the pattern of home. You can also describe many of the essentials for any home that each kind has. You can also notice frequent design elements with special functions, like how the internal life of family homes and biological cells both generally have a kind of “nucleus” around which the life of the cell is organized. In the family home or community center it’s the place for intimate communication, where the culture of the home is shared. In the cell it’s the place where the culture of the cell as the genetic code of the body is shared. The center of a family home may vary, but is usually a main room where people gather, often in a circle, and surrounded by symbols of its culture. In my family home it was around the kitchen table and dining room table as centers of conversation that alternated in location.

Whatever way a family centers its conversations is rather important in forming its individual way of living, to talk about family matters and share their common culture. With people so versatile it might be lots of things, but it has to work. Meeting in a circle as around a table, each person has the attention of all the others and is a witness to all the communication between the others, as a shared experience. It’s private as when sitting around a campfire at night, in a circle of well-lit faces. That design is a simplifying ideal for equitable communication, meeting around an open space that equally separates and connects all the individuals. It has been central to the life of homes in most human cultures for a very long time.

The Western design tradition of homes actually descended from the enduring Bronze Age Aegean culture centered on its design for “hearth homes”, as a way to bring the campfire relationship indoors! That distinctive architectural design also became a model for public architecture in the various advanced Aegean cultures that followed, later becoming the model for early Greek democracy’s public halls and the starting point for Greek formal architecture too (Dinsmoor 1902). The historic design is roughly sketched in the figure. It’s been so central to the early culture for so long, though there’s no recorded history it seems the attachment to a pattern for ideal human communication was, sitting around the large circular hearth in a wide room, tending small fires, was likely the reason for the endurance of the tradition and its presence in our world too. Like the campfire it brings people together as it holds them apart too, giving each person an equal audience with every other, sharing cultural roots far older than formal designs.

• Circle Family Community •



5. Homes shelter cultures of equitable living

It's where we regularly got together to eat and talk about family matters, as a common culture. Around a table each person has the attention of all the others, and is a witness all the communication between the others, as a shared experience. The simplifying design for equitable communication shown in Figure 5, meeting around an open space that equally separates and connects all the individuals, has been central to the homes of our cultures for a very long time.

The Western tradition at least, descended from the early Bronze Age design of Aegean "hearth homes", becoming a model for public architecture by many early Aegean cultures and later becoming the model for early Greek society public halls and formal architecture too (Dinsmoor 1902). The historic design was much like these figures, so central to the early culture for so long it seems it must have been for people sitting around the large circular hearth in a wide room, tending small fires in a vented "great room", defining the way of life and the home. Much the same relationship exists when sitting around a camp fire too, though, with the fire bringing people together as it holds them apart too, giving each person an equal audience with every other, having cultural roots far older than formal designs.

How strong and unique a family bond that special design serves is not appreciated until you experience "inclusion in the circle" or exclusion from it, and recognize how complete a kind of privacy is created by it. From the outside family cultures are literally invisible to others who don't participate in them, and from the inside they are common universe with ancient roots, that invisibly passes on its ancient inherited ways of living. Because they are indeed invisible from the outside, even if we can see through the windows, we still cannot see the relationships that hold the culture of the home together. So we tend not to think about these inner worlds we know both so much and so little about, until crossing the boundaries of their personal space and feel uncomfortable, embarrassed by not knowing how to act. The greatest separations can be between "homes" with invisible boundaries, like the walls of open cultures that serve as great homes for their societies having little to do with others. For the

invisible domains of neighborhood gangs or other groups averse to strangers, crossing the hidden lines can get one in trouble.

As children we first find other people's homes deeply mysterious, the homes of neighbors and relatives, full of special things that surprise us and show us how differently they live. As adults we are still frequently surprised if we go to someone else's home, and find they have their unexpected ways of living. We learn so little about how others live privately it also can take quite a long time to correct our initial misimpressions, being unable to understand who they are until we have had a long close association. So every culture is a "cult" in that way, an "alien" culture and way of life with its own deeply rooted manners and practices. To an insider small cues carry large meanings, which to any outside observer can go quite unrecognized.

As a result many of us, if not most, find ourselves living somewhat "invisible lives", as what makes private lives so private in many ways is rather universal. It's that they are designed from the inside. We may also have grown up in one of the many old inherited family cultures that are not the subject of the news or stories so much, perhaps filling the work places but not the media, mostly unrecognized and undiscussed publically. It's just in the nature of homes for the culture to not to be understood except by participants, a tradeoff for also being places where cultures most deepen and thrive. They tend to be private physically, organizationally and also in heritage. It keeps outsiders from understanding anything at all, up until something breaks their preconceptions, they develop empathy for the hidden ways of life they have long seen around but been unaware of.

3. A Starter Kit for natural patterns of design

The idea of offering a "starter kit" of techniques is to offer a collection of things to explore a bit and perhaps master later. They're intended to have some easy uses, with room to grow, offered as a way to introduce a complicated subject. It takes the "core" approach, offering general discussion along with advanced technique, rather than attempting a general survey. It's for giving people ideas of what to experiment with on their own. So to start one might first get a sense of your own place on what I show as the ladder of learning for the subject, depicted roughly in Figure 6. We all start with a great wealth of inherited cultural knowledge, our very broad foundation in knowledge of life's patterns, so we're *not* on the bottom rung.

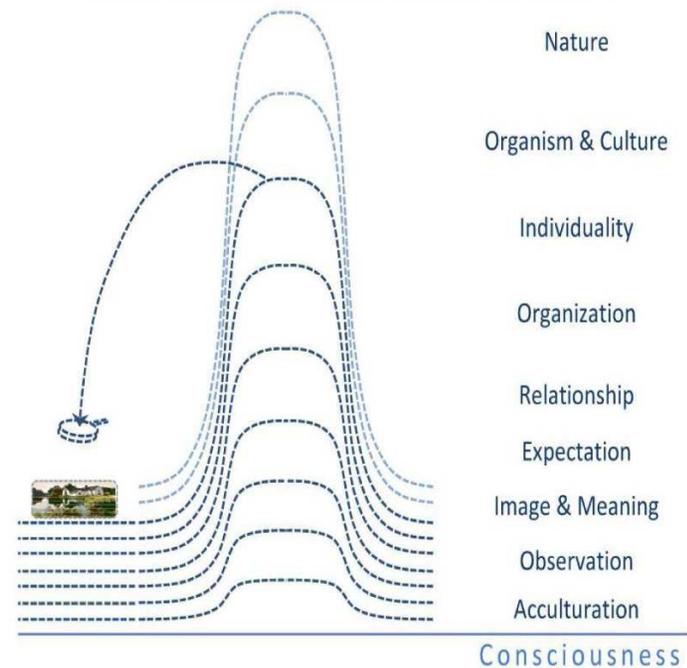
We may not have ever thought of it that way, of course, but more than likely we already have a variety of concentrated interests we've build up several layers of learning about. So this approach might be used to help extend and broaden those as well as begin interests in new ones. Some references that have been helpful to my working with pattern language include the collections of the Pattern Language Association (2015) and the Hillside Group (2015) and the meetings the latter sponsor. It's useful to search for discussions of Christopher Alexander and his formative and

more popular writings (1965, 1977, 1979, 1987, 2001-6). There are the books by the urban design critic Jane Jacobs, on the natural patterns of economies and cities and their sources of creativity (1961, 1970). Sophisticated patterns identified by of

Doug Schuler (2008) and Sebastian Denf (2012), as well as software pattern design essays by Jan Bochers (2001) and Jennifer Tidwell (1999) were all very helpful to me too.

Key concept:

At each level of Pattern Learning, layer by layer, finding living examples of that level, leads to recognizing patterns of the next level.



Levels of Natural Pattern Learning³ we look at levels of accumulating learning, added layer by layer, here starting from a base of biological consciousness, plus cultural absorption, then observation, information and experience. It's then using the model patterns at one level of abstraction, to explore their natural instances, that leads to recognition of the patterns at the next level.

6. Levels of natural pattern learning, a ladder of graduations

General introductions and Slide sets by Takashi Iba (2013) and Helmut Leitner (2014) are current and very helpful. Good books on ecology and living systems from a naturalist or “deep ecology” approach are a big help, such as books by or referencing D’arcy Thompson (1961) and Brian Goodwin (1994). Books that tell the stories of history, such as on the history of civilization, language, science, society and technology are all helpful, as are books on comparative anthropology and subjects like competitive strategy. Books on myths and children’s tales often addressing the same issues of “how things work” from a cultural view are all helpful, as well as the Bible and other ancient texts if read as documenting our earliest ways of thinking. Of course finding great teachers sometimes just carefully listening to things you hadn’t before, are invaluable as well.

3.1. Steps of Natural Pattern Study

The patterns of naturally occurring design one finds become ‘guides’ when somewhat generalized, to use as “model patterns” for searching the environment for working examples. Examples found that way are usually varied and rely on features and connecting relationships you wouldn’t expect. Those are what you learn from, adding to your own mental library of “ways things can work”. So the simple image in the mind connects you with the rich related patterns of natural cases. What you find

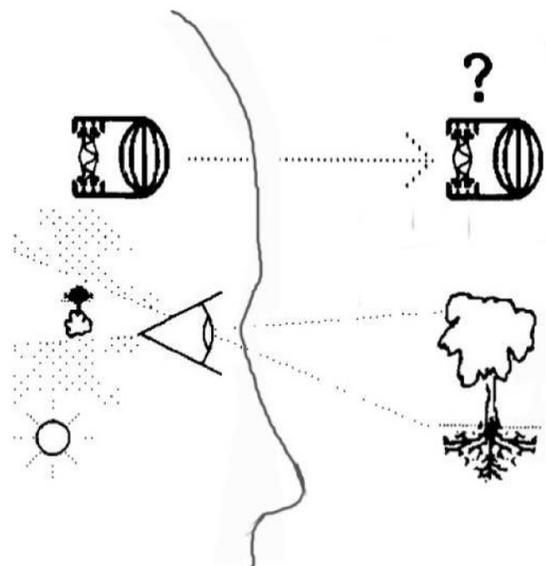
lets you see how the real subjects work. Maybe more importantly it lets you see the kinds of designs that serve both their internal and external worlds of relationships at the same time.

3.1.1 Perception

If your pattern idea is ‘tree’, you can reduce in your mind to the universal pattern of systems nested in their environments (Figure 7). You then use that general design pattern in your mind to look for and learn from particular examples. When you find them you’ll both increase your understanding of the natural subject and its variations of design, as well as your own natural limits for understanding them, noting what seems to get lost in translation perhaps. It helps you collect images of variations needed to get things to fit well, to experiment with when developing a pattern description or employing them in your own work. It also helps eliminate the ironic habit of many people, of interpreting nature as conforming to their own image (rather than the reverse), and so converting the mental images they construct as mental rules and beliefs about the things the images roughly imitate. What is a lot more useful is a way of seeing that is not misleading like that, and exposes the differences between what we observe and how we think it works, like retaining one’s raw impressions for continuity to compare with one’s theory.

What helps with that is a habit of using simplified patterns we recognize in nature to find new working examples, needing to be understood from how they do and don't differ from what we've seen before.

• Mental patterns for finding natural ones •



7. Creating a pattern to search for its recurrences

For example, a community might have the idea of 'growth' as a pattern of increasing wealth for relieving strains, and want to know will sustain that, relying on patterns of working design for it found naturally occurring. That would let them see more clearly the variations on the pattern that naturally develop, and the diverse results and varied consequences that result. That growth is a process of building something, usually to become a home for some culture would come from seeing the varied examples.

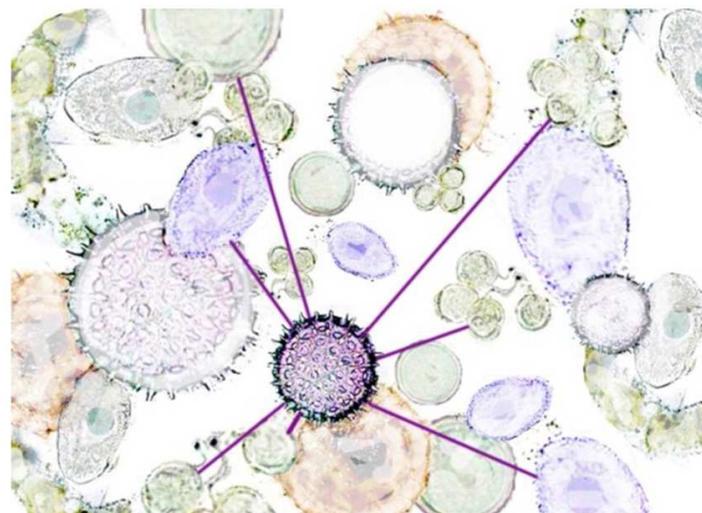
The basic designs for it change over time, 1) a 'germ' of design to get a chain reaction of change going to build on itself and 2) a 'pivot' to turn the process toward resolution in a fulfilling end as better goal than unbounded replication (Figures 2,3,4). There are obviously lots of secrets to be found or invented, as any stage of growth does seem to rely on original innovation at every step. What one also discovers is that growth is about conquering your own world, not numbers, and the period of it relieving strains is temporary, and something to come to terms with too. The natural way the 'forces' being faced change with growth is into relationships with new partners to preserve, in a world to join instead of conquer.

3.1.2 Architecture

Alexander's pattern language approaches these issues of natural design as a way of making the traditional methods of holistic design explicit. That's to identify all the forces of a particular circumstance to be resolved, doing so with a unifying design for satisfying services, contributing what he called 'living quality' to their surroundings. The practice of holistic design developing from his work applies well beyond architecture though, creating an art and science of holistic design potentially applicable to any

field. What seems to pull it all together is this new way of defining the usually unstated "motive to serve". 'Patterns' carry an implied intent to be responsive to the needs of varied individuals, their living cultures and environments.

• The General Pattern •



8. Cultures finding their roles in a complex worlds

Out of that need to serve, a tension between responding to forces and the ideals of doing it holistically arises, that is answered only completing them with a new form of design. That ideal of making things that serve helps one understand Lou Kahn's curious ways of expressing it, urging designers to ask "what does it wants to be", and to always begin every design by "reading book zero", the book of all things without preconception (Henshaw 2015b, Youd 2014). Such designs begun that way, in any circumstance, ideally find a point where everything else falls into place as if by itself, the way a crystal crystalizes, but in the living relationships being touched. If you don't find that the opposite tends to occur, however many 'Band Aids' applied, opposing unresolved forces tend to lead to endless struggle.

The greatest difficulty of ideal design is really its central purpose, looking for holistic bit counter-intuitive ways of combining things to be resolved together, hoping to discover "emergent properties" in satisfying new forms of design as the reward. One's knowledge is naturally limited by how many kinds of natural holistic design are quite hidden from outside view; leaving observers blind to how other they work (Figure 8). For that reason one is in constant need of breaking away from one's own perspectives, to allow small hints to be suggestive and begin to see things from fresh points of view. It calls for having various productive means of widening one's search, in a very neutral way. That lets your mind move easily between viewpoints without carrying assumptions with you to gain real perspective. Ideal design is also not always ideal too. One part may really need to be sacrificed to serve another perhaps, or it just may not be what you are asked to do. Still, asking what really needs to be served seems to be what allows anything to be controlled to have the purpose it can.

3.1.4 Practice

The good subjects to study this way could be anything of interest, but much better if something you know quite well, having some complexity and changes you are already familiar with to study. Your home town or city could be good to study for hints of a variety of different local cultures and the niches they create for themselves. You can often find signs of multiple local cultures on virtually any street corner, and aware of the boundaries between subcultures in familiar neighborhoods. You don't see it much, but those differing culture groups share common histories, connections and demographics, for each profession, age group and social group. So you just practice following your curiosity about them, reproaching them enough to start expanding your understanding of them. I tend to find that a combination of broad impressions and close detail produces the best follow-up questions for the next time, to build on what I learned before. Study of your own or another business community you have some connection with might be approached the same way, or your own or connected social network or professional culture too.

As you study their varied patterns of living relationships that get things done you get better at recognizing their variations. As a casual way of just paying attention to how things work it adds to the general ability to follow how anything works, as well as associations with the patterns you find. For finding applicable patterns to apply for balancing the forces in some other context you may or may not apply what your general practice of paying attention has shown you, but you will apply the comfortable way of exploring the context you're in. Designers don't design the living things that later inhabit their designs, but only the frameworks of services to make available to the expected users. That's what the real design is, a "facility". It's those common services that the coding, the pleasing of the client and the beauty of thing as well, all need to work together to harmonize in the end. A building or a program gets used by a great many people of many kinds, so most any design is a design for serving a whole community. So you might think of design as a kind of ecological service or caretaking, things for which there are patterns to study, but no specifications.

What anchors the process is still the work of accumulating reliable observations of how things work, noticing all the variations in how things are organized to work as a way of developing perspective, alert to the:

- 1) The ways of resolving forces by creating new forms of design
- 2) The inside and outside relationships,
- 3) The tradeoffs, special connections and conditions
- 4) The Stages of change, and how innovations discover new roles

That awareness of nature as full of creative design that works better if you see it is the solid foothold one develops. It's what lets you return again and again to validate what you found and

find out more. It then lets you share what you've found with others and give them ways they can check and for themselves and add to what you shared with them too. Surprisingly often the most valuable part of this kind of scientific observation is the gaps in the patterns you find, recognized as something missing and kept as place holders for things yet to be found.

In looking for where to apply this method in your own work you might consider just looking around for places where "something's missing" as a good place to start, perhaps considering how to approach situations like the following.

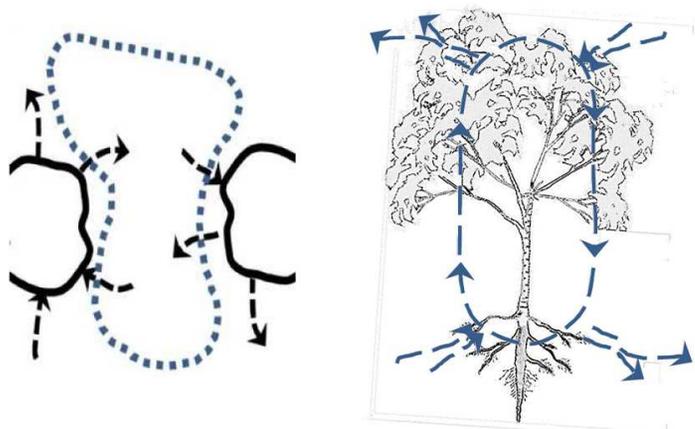
- 1) A community adapting to climate change,
- 2) A business that changed culture unexpectedly and no longer feels itself
- 3) A disorganized start-up that wants to become well organized
- 4) Software platforms that become monopolies and are stagnating
- 5) Communities that need to resolve cultural conflicts,
- 6) News organizations trying to get our world stories straight
- 7) Town meetings on disruptive social, crime or drug use cultures.

These are all also "healing problems" of one or another kind. You need as long a view of what is being healed as possible, of the established relationships and what they are struggling with, going back and forth between completely fresh thinking and studying the familiar. Generally you'd be looking around in hopes of finding what it is that will let the existing sets of relationships, and the new ones, all pull together to generate a fresh living quality for the place and to share with others.

3.1.5 Exploration

In searching for a true purpose for a design you might clear your thinking and explore the context with "fresh eyes" as if opening up pages of "book zero" but you need something to be looking for. For just learning from your environment having some neutral guiding pattern helps you look for the varied circumstances where it occurs. Using Alexander's 15 common patterns found in designs expressing wholeness (Table 4) is one collection that can be used to search with, for "pattern search". These spatial design patterns depict very recurrent shapes and natural forms, you can use to trace natural occurring designs and patterns of organization. The varied circumstances and ways they connect can tell you a lot. My most useful group of elemental patterns to trace for finding how things work are the natural process patterns, of growth and development as natural progressions of design (Figures 3 and 4), an of communication between whole systems through "mediums of exchange" (Figure 9).

• Open and Circulating Resource Pools •



9. Mediums of exchange link diverse varieties

Nature makes very extensive use of “mediums of exchange”, allow separated things to communicate. They teach us lots of things, like that communication really only occurs between separated things, a counter force to nature organizing so many to work by themselves. Mediums of exchange serve as continually replenished reservoirs of resources, information and patterns of design, often easily located by being what human and natural ecologies gather around. So mediums of exchange are natural centers of rich living quality and variety, allowing individuals to both complete and have freedom to work their own way at the same time, another simplifying ideal design like the design of ‘homes’, that allows things to thrive.

To look for natural mediums of exchange sometimes they’re recognized as what diverse cultures swarm around, another kind of “center” for living things. Looked at closely they’re most notable for their loose organization rather than their dense organization, the actual role they play is not as “centers” but as “in-betweens”, as collections of great varieties of things that are quite unattached and free to take. So they’re not “systems” in that sense, if also playing very important roles within and for working systems to operate.

The common specialized mediums of exchange we see that living systems use to communicate are things like economic “markets” or “ecologies”, a fresh water pond for one example and the blood stream for circulating one, but also “compost piles” and the social spaces where people like to congregate. Each of these varied spaces of free resources are great designs for communication of different kinds. You can use their easily recognizable patterns for “pattern search” like the others mentioned above, to find diverse working examples. That might be useful if you are designing a community center and want to know what connecting patterns create the diversity of resources that makes a community center thrive.

The natural patterns of “centers” that will be easiest to find and learn from, are then the ones you can recognize as serving common “cultures”. They generally have recognizable external boundaries and show evidence of highly creative internal designs. Those are most often the active parts of the environment too, leaving trails of artifacts we can often trace. It’s not only spatial designs and patterns we can trace, but also patterns of temporal change we can trace too. Natural designs leave trails of evidence that may expose their perhaps quite eventful histories and processes of development, leading you to how they originated from some common origin.

As you begin to explore these working relationships there may come times when you want to speed it up some, and quickly survey the field for issues related to a particular question. When exploring an environment searching for one natural design pattern you can’t do that. A nice adaptable way came out of my work at the UN as a versatile workshop design, called the 3Step process for working with nature (Henshaw 2013). It’s a design that frees up the thinking of the whole group to contribute observations of what matters in an environment for their concerns.

The trick to the design is that’s done by focusing not on a “problem” (presuming some theory) but on a group “ideal” (as an absolute). Then the group can freely explore for all the forces in the environment that would affect their ideal. It nicely puts off the thinking about how and what to do till later, and just collects a large and diverse collection of mostly unbiased fresh observations, which the group quickly organizes a bit at the end.

3.2. Mining Patterns Of Transformations

Learning to read records of change to recognize what in the environment is changing form, is probably easier done with storytelling than empirically at first, and even that takes a little experience. In a world in which ancient cultures and environments seem to be changing ever faster, it’s of course then also very important. That’s one of the side effects of “growth”. It naturally produces a design panic of a sort, a moment of “being a bit too pregnant” with juggling changes, like the panic in design projects as the tasks multiply as you’re trying to deliver the finished product. I don’t know a better way to introduce it than to just help people become fascinated by these amazing changes that go on all around us.

3.2.1 The Emerging Phrase “Pattern Language”

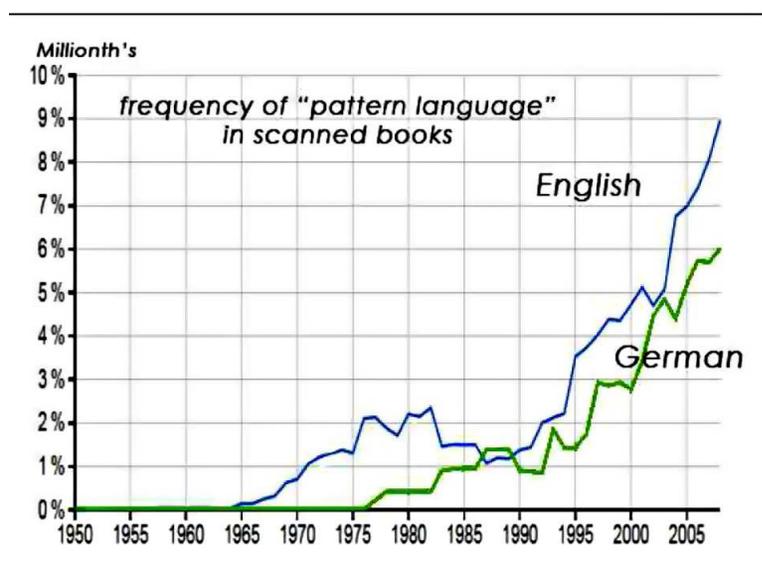
The frequency of the term “pattern language” in the books Google scanned⁴ provides a great example of a found “proxy” for cultural transformation. It’s the shape of the curves that are so telling (Figure 10). Both the curve for books in English and German show “progressive proportional change”, at least from ~1985,

⁴ Google Ngram for “pattern language” in books in English or German
https://books.google.com/ngrams/graph?content=pattern+language&year_start=1960&year_end=2008

very suggestive of spontaneous growth for an emerging new form of culture. The data source has definite limitations as scientific evidence. Here we are fairly certain what the term is referring to, as there was no prior use and it does name an emerging discussion. We may not be able to update the curve, for example, due language moving away from books to online sources changing what the measure means, as a common problem for historical data. There are also the irregular changes.

So instead of relying only on clearly defined and sourced information, the study of natural patterns assumes information is partial and not exactly defined. It makes the job of interpretation one of putting together a testable pattern on which to base good new questions about the subject, as a forensic research process. Some secondary sources might be found, for example, like media and journals. Still, the apparent explosion of the term's use show here still looks like strong evidence of an emerging culture. It is cultures that grow like that you'd look to for signs of the compound growth of the system producing it. It's a fairly universal sign of something new defining its own individuality as it expands its presence and makes its home. It's a kind of evidence that gives you a lot of pattern language kinds of questions to talk about.

• 1965-2008 Emerging Pattern Language •



10. Growth shows the pattern of organic emergence⁵

Here it lets us see differences in how the discussion of pattern language developed in English and German language communities. The two curves end up following about the same explosive growth trend from 1990 on, with the curve for English showing rise and fall in the frequency, a wave that peaked in ~1980. The German trend shows hints of a smaller related bump that peaked a little later, ~1987. The overall appearance is that the early wave of use might have reflected the original discussion about urban design and building architecture. That might be easy to check. That did not lead to widespread adoption, and so the later rapid growth then seems certain to mainly reflect the much wider spread of pattern language principally for computer

software development. It might include some spread to other professions, but that seems more recent.

If you accept that interpretation of the pattern the curve does seem to be a remarkable record of a transformational change, and shows us a variety of things we would not have known about otherwise. Seeing the two records of change as responses of two different communities, with slightly differing shapes, side by side, seems clearly to be two responses to the same transformative design method and conversation, a historic event in itself. It gives us "found data" that tells a story that could be followed further. The data was actually found by picking out shapes of this kind from the flood of new data sources now available, and so demonstrates a new use of "big data" too.

Found data is one of the more common sources for discovering unexpected change taking place, as things that were happening hidden from view, and questions were not being asked about. Exposing dynamic continuities of natural developments like this helps locate the centers of organizational transformation producing the data. The shapes of the curves are also fairly good evidence of some culture behaving as a whole. The two curves seem to have close to the same doubling rate, ~7.5 years, indicating their coupling, with the curve for English having a little head start. If we had other knowledge of what was happening we might find other ways to look at what is going on internally, and externally. Growth curves are generally also proxies for the growing scale of energy use and money invested, so there are a lot of things a systemic change of this kind would affect that might be looked at. Of course, from a pattern language view you'd want to know if the services to its communities and its environment that are making it thrive.

Rates of word use can be tricky to interpret, of course. An increase in word use fall off even if the associated change continued, but just wasn't news any more perhaps. Of course a minor spelling change, or a switch to using an acronym in favor of a phrase would also confuse the data. So as elsewhere, what you're really looking form is not 'data' but information that teaches you something that can be confirmed. The general impression is that these curves seem to fit what I generally know of the timing and relative sizes of interest in pattern language in American architecture, followed by the worldwide interest in it for software development. So, curve interpretation like this is built piece by piece like that, as forensic inquiry is generally done.

3.2.2 Big Data

Finding good proxies for what is happening in your own environment might possibly be automated, mining the data of all sorts now available. The "big data" now available are generally not being looked at this way though. It would certainly associate data with real events to use it to locate the great waves of organizational change we all feel, but people have nothing to point to talk about yet. It would also let you collect diverse cultural responses and their informative perspectives to draw

general attention to newly emerging phenomena, speeding the work of understand the patterns of organization that are growing. That could be greatly aided by having computers scanning the flood of statistics available for this and other patterns of whole systems of things working together in various ways, to prompt community and professional interest.

The shapes in the data don't say what is there, but just tell you *where* to look. Someday the various big data projects might publish online resources on how the world is changing in generally searchable formats, displaying emerging centers of ecological, cultural and economic change for people to study and find and work with. Some of the work on these pattern recognition methods has been done (Henshaw 1995-9, 1999) to offer a starting point. Ways of teaching pattern recognition of this kind, and using workshop methods for accessing the insights of people involved with it have also been proposed (Henshaw 2013 2014).

In addition to the wealth of economic data from national accounts, there's a flood of data in the form of "community indicators" and "comprehensive sustainability reports" for city and business sustainability reports becoming available. Combined with commercial data sources, the potential resource is enormous. Of course libraries, research centers and governments are all actively developing new ways to use the flood of data already. The UN has a major worldwide data collection and coordination effort for the Post 2015 sustainable development plan. That includes a focus on collecting a broad spectrum of information on what is generally called "ESG factors", for monitoring interrelated environmental, social and governance conditions worldwide. The interpretation of data still largely relies on isolated statistical correlations between numerical "goals" and "targets", treating societies as working by numerical pushes and pulls between categories we define for them. The UN's statistical programs and innovative Data Revolution council⁵ as well as CIVICUS civil society organizations⁶ and others are certainly trying to invent marvelous ways to use all this data.

It's not clear that's happening, though, as the paradigm shift to using data to find how whole systems of change are developing seems not to be happening. The main use of data still seems very strongly fixed on setting numeric targets. That treats complex cultural changes as working by statistics rather than as networked living systems. So work would need to be done to reorient the search toward finding patterns in the data revealing the forms of natural systems we need to work with. For cultures to respond you actually need to find how to feed their own internal motivations to make them the leaders of their own changes and learning. You'd rather not rely on the plans of business interests maximizing their profits given credits to meet certain statistical targets. As well-meaning as it may be that's just

neocolonialism. The study of our changing economies, ecologies and cultures is not taking place as a study of how their parts work as whole systems though. That makes the business model for responding to public demands the likely fallback strategy, even though that's not what the UN or anyone else really wants.

3.2.3 Locating Centers by Their Boundaries

We all become expert in recognizing boundaries, like between the sidewalk and street, or entering some private group's conversation or some unfamiliar culture's neighborhood. We quickly notice if we're approaching or crossing them, often tipped off by a gut feeling of either caution or anticipation that tells us to think of acting differently. Then we realize we should think of changing behavior as we approach. It's a well-tuned environmental alertness we all have, that prompts us to sharpen our senses and look closely for signs of what to do next. It may be to open up and become engaging, or to expect threats and be more cautious. What those signals are about is our entering or leaving someone else's home territory, its 'niche', "private space", "near environment" or "back yard", their peripheral space that mediates the separate worlds within and without.

• Pattern of Boundary Transition •



11. Centers surrounded with niche boundary zones

You can think of the general pattern in terms of walking through the woods and coming across someone's home (Figure 11), unaware of people or animals but seeing it as a well maintained place. You probably wouldn't approach to say hello unless you needed to. But coming across a boundary and being curious you'd look for where it goes, and for signs of how the relationships differ inside and out. If you had a question perhaps you'd judge whether you'd be comfortable walking up to the door, or had better keep to the fringes of the yard.

If it seemed OK and you did need some help, you'd look at details of the entrance for hints on how approach the door and get an

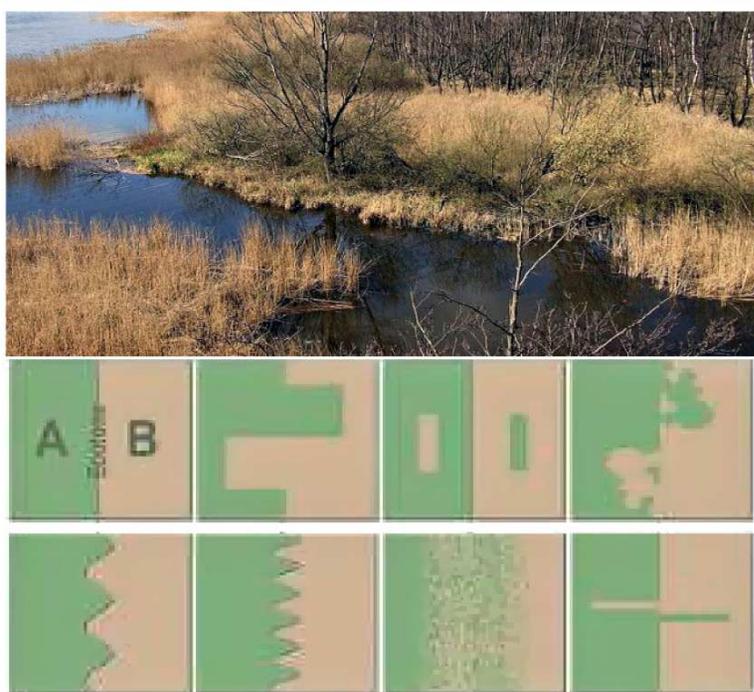
⁵ UN Data Revolution panel: <http://www.undatarevolution.org/>

⁶ CIVICUS 'DataShift' project <http://civicus.org/thedatashift/>

idea of what response to expect. We might stop before knocking if we noticed signs that the resident isn't really home. We might see the shades drawn, the patio unswept and the plants on it untended, realizing it must have been a hired service that recently mowed the lawn. Much the same sort of encounter may be experienced approaching a strange vendor's stall at a green market or crafts fair. We read the signs the same way, noticing details of the stalls that are more or less well-kept and arranged with joy, reading all the odors and visual signs.

As you approach you are encouraged to come close, but then you still need to size up how to interact with the vendor. Crossing into someone's personal space is a matter of presence, little ceremony, like a handshake. When you make contact with others you ideally want the timing to be right, and for both parties to engage in the greeting together, like using a mutual homing device to synchronize the contact motions. Those same fine details of negotiating boundaries might be found literally anywhere messages need to be passed from one domain to another.

• Patterned Boundary Succession •



12. Centers found with diverse boundary shapes

The natural shapes of boundaries are fascinating, hard to define but once noticed often then easy to pick out. We learn to be expert in reading them too, anywhere there's a "territory", it's likely to be filled with boundaries that define separations between one home culture and another. You find them between industries and business cultures. The variety of shapes one finds in all kinds of natural spatial boundaries are generally similar in character. Figure 12 shows one collection of geometries characterizing natural boundaries, these drawn for plant ecological zone transitions. They're complex and overlapping yet as distinctive as the signatures of people, both rather hard to explain but distinctive.

3.2.4 Following the energy

Locating centers of design is often a matter of locating centers of energy use, and found by following the traffic to and from them. The "desire lines" of trails across a snowy campus show where the foot traffic goes, and "where the energy" is. They're much like the pheromone trails that insects follow to a new food source. That's what the idea of "stigmergy" is based on too, as a programmable model for how behaviors develop following signs left by others returning from some place of interest. Energy uses leave traces behind of many kinds, as artifacts of what the energy was used for, leaving trails of interesting patterns of design that can be traced to their pattern uses, as well as their sources. In the case of economic energy uses, the trails of energy use eventually lead back to the homes of families and communities where the knowledge of how to use and get energy is concentrated, for example.

Patterns of melting snow on the roofs of houses shows interesting signs of energy use, but doesn't show much about the knowledge culture inside those houses, that is their real source of energy. The evidence of energy use just shows where such knowledge cultures are located. It's generally the hidden internal life of homes that is both drawing in the flows of energy they need and giving their occupants the insight and means of going out to get more. You'd learn a little more looking at all the other signs of the culture a group of similar homes arrange around themselves, the kinds of shops, public and private space, travel and other artifacts of how a community lives.

The money people bring home is a direct proxy for energy resources too, as are the products of energy use brought home with it. So money use can let you trace where society puts its energies of all sorts, in a far more truthful and inclusive way than the stories we tell. The homes of its families are arguably society's largest infrastructure and capital investment, where people both bring and enjoy the end products of using energy and exercise their own culture for how to enjoy products of their own energies. There's a reason for that.

If you didn't "follow the energy" to understand what is being done with it, you wouldn't come to realize that the energy used in homes is being invested in enabling its occupants' work in the world. The energy invested where we center our lives yields direct "returns on investment", enabling the occupants to go out and bring back money and goods to sustain their home cultures. Though rarely mentioned what it reveals is that, homes of all kinds are the real energy centers of a society, where the internal "flame of hearth and home" burns as a culture, teacher, motivator and source of healing, to enable our roles in the world. A healthy home then contributes its energy to enlivening surrounding centers of the community and culture too, in both direct and metaphorical senses. Being so private and hidden from outside view, our homes remain largely protected from any invasions of privacy, or judgment, as they empower the world.

A software program object it can be read somewhat the same way. Like a private home with its own internal culture within a larger network of software objects, any one has both a named pattern description and stated role in the system, as well as an actual electrical current use. The current use need not reflect the importance of its information process, but it tells you more about its users, and indicator of how it's service is being used in the network. It's adds a new perspective on what the design object does by learning about what it serves. If using a lot of energy it is probably deserving of attention.

Perhaps the most profound if confusing aspect of a natural world organized around serving cells of hidden internal design is that in the development of ecologies that hidden information is not needed. If an internal culture has a motive to relate to its external world in a way that avoids needless conflict, it seems only a very vague sense of how that culture works is needed by any other. The ecologies where species become so close knit and interdependent, responding only to external patterns, are dramatic examples. That's at least the implication, of tight interdependence between species that live so differently having nothing but external contact with each other. Nothing would seem to work but each taking care of itself, allowing others to build solid relationships without information on how or why. It helps you understand a bit of what you are looking at when you see boundaries indicating where something has made its home, as a kind of separation that connects.

3.3. Pattern Writing Templates

The usual way of design patterns are described is as a concise overview of its place in a complex world and how it is made. One collects diverse observations on the conditions and issues to be resolved, the simplifying ideal for resolving them and means of doing it, giving it a suggestive name and visual image. The focus is often some gem of expert knowledge, or way to achieve some natural change of state. Leitner (2014) and Schuler (2008) describe styles of pattern description using stacks of cards for group discussion. Table 1 shows a somewhat standard template for technical pattern writing, attempting to show the common elements of pattern writing for software design, social relationships, and other fields, based on the model of Iba (2014), including:

1. A suggestive name, and characterizing image
2. The circumstances where the design would apply,
3. The unresolved 'forces' to be balanced and resolved
4. A problem, or untapped opportunity presented
5. The unifying response that satisfies the whole,
6. The actions to take and outcomes expected

The intent is not to provide instructions, but to clearly record a holistic objective, that will be of particular help when trying to implement a design that manner. So it's both a recording device and a guide to what needs to be achieved in local circumstances. It's a way to start a very organized "conversation with nature" in

that sense, as someone uses it to become an expert themselves in responding the actual complex relationships with which they work. So its greatest value is for describing truly fulfilling purposes. The "object" is both the intent to resolve the forces in a fully unifying way, as well as a unit of design, for producing versatile working parts to work in larger systems. The written pattern is to make those relationships and intentions explicit, as an achievable ideal (Table 1, 2).

Every situation will require a unique response, of course. The ideal designs are often "counter-intuitive" and context dependent, and the realization not exactly duplicated in most cases, but to be discovered as fulfilling the ideal. If it is reasonably well validated and doesn't produce the expected change in form and emergent properties, there should be some clear reason. For implementing a design the design pattern is really just a place to start you learning about the actual circumstance addressed, having identified an apparent pattern match with its needs. Learning how to satisfy the needs of the real situation may then be either simple or complex, take minutes or years, depending on what kind of organizational transformation is involved. It's a process of learning from the real context and its actual forces to find what they will actually respond to, that produces the final fulfillment of the pattern design.

Table 1. A Template for Design Pattern Writing

Name	Context	Forces
Image 	Problem	
	Solution	
Subject	Actions	Results

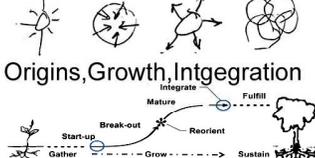
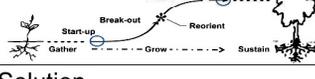
Table 2 shows some of how you might expand the template for describing naturally occurring design patterns. The main difference is needing to describe the emerging development process that occurs as the intended organization develops. For naturally occurring designs development is a natural process of self-organization, what conceptually takes the place of the "designer". Describing it would include identifying characteristics of its own stages of developmental transformation, its "Origins, Growth & Integration", depicted as a succession of stages that have already occurred to need to be arrange for or anticipated occurring later.

You'd try to relate the stages of development to the changes in the systems of organization at each stage. The stages of transformation themselves generally follow a pattern, generally progressing from "naïve" to "immature" to "adolescent" and then "mature" at the pace of the systems development. That would be a good general naming for a series of stages if no other is available. Each stage would also be thought of as a "cycle" of step-

wise change, of pattern accumulation. It's a series of smaller steps that that gets somewhere as the growth progresses, going from level to level.

For a design teams applying a pattern there are numerous models for "action learning", the most ancient being the design studio method of every individual pinning up their work and engaging in a group discussion with stakeholders, each working independently on their ideas for how to advance the group objective. A modern method for "agile design" of software products that has been widely adopted and varied is called SCRUM. Its organizing principle is somewhat like that of the studio model, but around delivering a testable product for every scheduled design review. From my own work, a learning cycle that could be used to augment any action learning process was developed to including a holistic sweep of the knowledge base for the problem to follow the design review, that I've discussed as a 4D principle of design. At each cycle you'd review the Internal and External relationships of the design, its Distant, connections, risks and purposes, and find a way to add up its Total Balance of tradeoffs⁷. That accounting for tradeoffs would include accounts of resource dependencies and energy costs. The whole cycle of self-examination starts rather simply and develops holistically with the rest of the design.

Table 2. A Template for Natural Pattern Writing

Name	Problem	Forces
Image 	<u>Context</u> <ul style="list-style-type: none"> • Scales & Centers • Roles & Partners • Stages & Events • Movements & Ties 	Distant, Inner, Outer, Totals  Origins, Growth, Integrate, Fulfill 
Simplifying Relationships	Object	Solution
Links	Anticipated Results and Open questions	

3.4. Great Repositories for Natural Patterns

One of the more surprising discoveries when applying Alexander's idea of design patterns to patterns of naturally occurring design is how many rich repositories of natural design patterns there are. It's more or less inherent in nature to accumulate traces of everything, both simple and complex. Some remnants are like echoes of the past others more like a compost pile or junk yard of designs, recording the accumulating variations on how old designs are being used too. Then there working patterns of the systems of nature themselves, what amounts to their genetic code of working patterns, the habits and practices of that organize our own lives that follow rituals with patterned design, the "night out" or the "day at the beach" or "school", etc. They're all resources, to build on, stores of

reminders of things that worked before, often refined again and again.

Human cultures themselves are the living storehouses of all the learning we inherit and build on, containing all our accumulated ways of knowing and living, offering endless reminders of the tricks we might not come upon during our whole lives if not reminded by bits of ancient wisdom and practice. One could even define a new meaning for 'culture' that way, as our evolving connection with our specie's shared experience of life. Cultures are a living memory and way of reproducing a community's total experience. Today we still learn from traces of lives lived a million years ago, and we clearly still have much to learn from our current way of living to record in our culture for those who follow.

Nearly every person knows a great deal about their own culture. That makes their acculturation a great resource of recorded natural patterns of response to common circumstances and familiar meanings for them. Of course, maybe more than anything else we all tend to take our own culturally inherited knowledge for granted, as we perhaps should. It really is our foundation on which all our understanding is built upon.

The natural patterns we know of from our own cultural inheritance would be hard to stand apart from to critique or compare, they are so deeply rooted in our feelings. They're often "too close" to recognize in that sense. It's a source of miscommunication that much of our tacit knowledge and ways tend to be hidden from us, so left out of our thinking about how we might affect others. So using your culture to discover natural designs can both awaken and refresh long held assumptions for current circumstances, rediscovering the real genius of their original sources perhaps. In other cases bring out hidden patterns offers security in finding things more solid, to help in living down some discovered mistake.

3.5.1 Cultures as Stores of Natural Patterns

It is curious how unaware people are regarding their own cultures, their natural designs built up silently over the centuries. Our cultures really do contain all our ways of living and knowing about life though. Somehow there seems to be a highly evolved complexity wrapped up in our every gesture and thought, meaningful only in its environment, and its environment reverberating with it. Individual expressions of people in one culture seem both as individually unique as if from different species as well as to display the recognizable patterns of every expression of others in the culture. Open connections between cultures appear unexpectedly often enough, with moments of empathy during shared experiences, but changing cultures seems as rare as grafting a plant onto new roots.

⁷ Henshaw- 4D Sustainability <http://synapse9.com/connection/>

Bridges to connect differing cultures can be found by more practical means too. One is by comparing independent observations on the same naturally occurring patterns of design. It can add to the richness of the meanings of the pattern to combine differing perspectives of the same thing that way. If different views add useful perspective it can be of critical necessity for getting things to work too. I mention it here not because of having some neat way to make that easy, as we're often not so culturally open.

- Cultures as deep patterns of how to live •



13. Cultures hold all our accumulated ways of knowing & living

Just being attached to certain styles of expression can keep us from listening to unexpected views, and people invent styles of expression to use as codes for their cultures in great variety. If they code for different common emotions it's easier to translate than for differing abstract theories. Theories following differing defined principles are not possible to connect, and we may be unaware entirely of why. That's the pattern that seems to be present to keep the fabled "six blind men" from being unable to describe "the elephant". They are kept from communicating with each other by each one abstracting the elephant as being the part they are touching. It seems to be a very common cause for intellectual confusion.

How so much of this cultural foundation of how we know and live is deeply hidden from our own view is expressed in Figure 13, showing a range of visible and hidden aspects of human cultures. It adds to the richness of the heritage to expose it, and study its roots. The majority of consists of tacit understandings that are quite unconscious, very vital and active but unspoken and hidden, with only surface features exposed like the tops of icebergs. Though people speak a lot and use words for all kinds of communication, the real foundations of our knowledge and

ways of living seem largely in non-verbal experience, and well worth exploring.

So this list of the visible and hidden natural layers of culture is hardly complete, very sketchy really. We just don't have any explicit record or statement of what a culture is, except that it's the root of everything we know and every way we live. Cultures are really remarkable living "artifacts" of lives lived and shared over time, easily more complex than our genetic codes, retaining patterns of relationships, lived by others, kept alive for the ages and always open for accumulating new variations too

3.5.2 Natural Language as a Pattern Repository

If you think about where natural language came from, it appears the role of words in our lives is for connecting our cultural meanings with the natural design patterns we found meaningful, and needed the words for referring to. Nouns, verbs and adjectives may have many related semantic meanings, but would mean little if they had nothing to refer to. Take the word "noun" for example. Without words that name things, the word 'noun' would not have much meaning.

Before exploring a few details, I should mention the ways this rich resource of natural patterns can be used. Any time you see a word in a sentence you can use this approach to search for the naturally occurring pattern of experience the word originated from. It might be a word noticed for having some pivotal meaning to an author or to the story or circumstance you want to better understand. Another pattern writer, Takashi Iba, uses a similar technique. He draws on what he calls "center words" that he finds in pattern descriptions to start his search for images to illustrate design patterns (Iba 2015). A good dictionary is of course also a good resource for learning more about what experience of nature a word refers to, but here we're also focusing on using words to study the germ of design in nature being responded to.

If you trace words to their subjects like that, what we generally find is that words are used for common traits that apply to numerous and richly varied examples, like "apple" referring to all the kinds of apples and our cultural uses and associations with the word. Looking for the natural design patterns being referred to uses natural language as a repository of references to natural designs we find meaningful. It can be either done simply or with more effort, but we essentially only need to explore the "contexts" the word refers to identify the "forces" that are brought into balance in our experience, to give them the meaning we find in their nature.

An easy example might be the word "frigid", which quickly brings to mind a number of situations where you'd use that. You just think over the natural patterns of relationships it brings up to see the combination we are responding to. It's a feeling of being somewhat exposed and almost attacked by the cold, not just about a temperature. So the way we use words to express qualities, most anywhere that word seems to apply it is likely the

circumstance leaves someone both somewhat exposed and attacked, as the pattern. I find it works very often and produces surprising insight, just from the use of words that seem intuitively right for the circumstance.

That way of looking at words as a reference to a natural pattern also makes the word a name for design pattern referred to, as well as for the collection of semantic and cultural meanings associated with it, a gigantic reservoir of associations really. I understand this probably seems unfamiliar at first, and may take searching around for how to become comfortable with at first. We start from thinking of words only in relation to the meanings that come immediately to us, with no thought of them referring to anything else, such as natural relationships and experiences.

For mining natural design patterns from words it can help to study families of words with related meanings. When taken out of normal context and looked at as a group, the meanings for a group of words can then stand out better, and be seen in relation to the original subjects they refer to. In English it can be done by looking at how words are built combining meaningful parts, a 'root' word with its modifiers, as 'prefixes' and 'suffixes'. What we find is that a modifier sometimes adds associated natural meaning to all the root words it modifies, sort of like a seed does the same job for every plant.

Take simple words ending with "-or", for example. That suffix adds the natural design meaning "doer" to each one, as in the words "tractor", "actor", "projector" or "progenitor". The root words mean something by themselves, but together with their action mean a lot more. The combination gives the new word strong "emergent properties", and most compound words seem to be built with combined meanings work like that.

The patterns of meaning added are clearer when looking at lists of words with the same modifiers. As you look at a number of them you recognize the common action being referred to, and see the richness the modifier adds, that highlights the pattern of the natural design referred to. You might think of these powerful combinations of simple meanings as "events", imagined as the "ah ha moments" at some moment in time when the two parts were put together to create the burst of new meanings. There are large collections of these kinds of words.

Figure 14 shows how the parts of the word "community" are assembled, combining "comm-" meaning 'together', and "unity" meaning 'one', so referring to things brought together as one, another word structure with curious transformative properties, referring to an important natural design. One would then need to study a number of root words transformed this way to become really clear as what forces are balanced and how that unifies the

connection of two thoughts. From there the next step would be to study the overall pattern of natural relationships as a nameable design, and identify the implied "forces" and the "unifying organization" that presents them as a nameable ideal.

- Pattern words that identify natural 'centers' •

Community: [*comm·unity*]
Bringing "together" a "unity"

The word structure turns our attention:

- to the common natural occurrences,
 - to it having natural properties and design
 - to a great variety of examples we each know of,
 - and the diverse and layered associations we are all familiar with.
-

14. Words built from names for natural designs

To better understand how modifiers amplify root meanings with their roles in nature, it helps to look at whole lists of similarly modified root word meanings. Below, for example, are a very few of the over 2,000 common words in English that have the "-tion" suffix. It helps to study some of the whole list to appreciate the kind of action the suffix fairly consistently associates with the root⁸. That then helps you turn your attention back and forth between the meaning of the word root⁹ and how the modifier,¹⁰ transforms its meaning, in this case to create names of common transformative processes and the ends states that result.

What these richly meaningful terms of English have in common is this simple way of being elevated in meaning. It's a linguistic invention that came to English from the Latin of early Rome¹¹. The added meaning the device produces has one more twist. What seems very curious and important is that these "-tion" words are used to both name how a transformation takes place and the end state it results in, a double meaning of both temporal and spatial designs. I was shocked when I first found that. The third part of the meaning is the association of those natural designs with all our accumulated cultural experiences of them. It is like a whole textbook of complexly related meanings in every word! (Figure 15).

So as for each word in Table 3, the compound word refers to both the end state and how it came about. "Abbreviation" refers to both the shortened form as well as the way it was shortened,

⁸ OneLook dictionary search for words ending in "tion":
http://www.onelook.com/?w=*tion&scwo=1&sswo=1

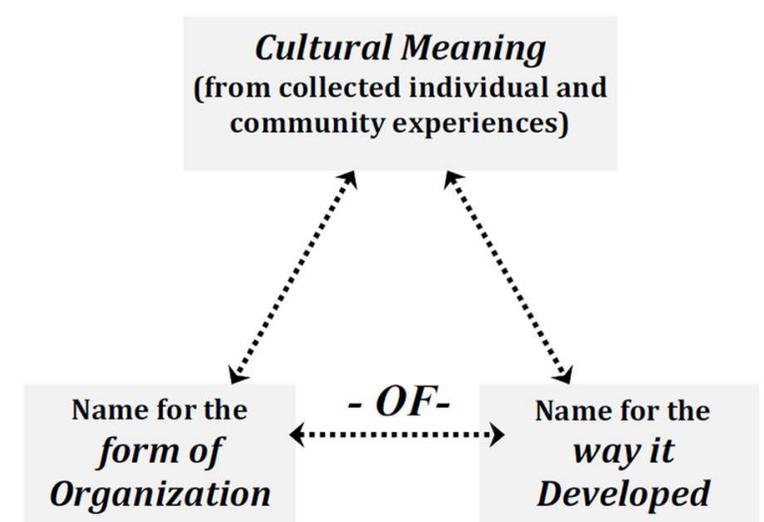
⁹ 'root' <http://www.thefreedictionary.com/root> "The element that carries the main component of meaning in a word and provides the basis from which a word is derived by adding affixes or inflectional endings or by phonetic change."

¹⁰ 'modifier' <http://www.orbilat.com/GeneralReferences/LinguisticTerms.html>
 "a word or phrase that makes specific the meaning of another word or phrase."

¹¹ - tion: suffix of Latin origin, to form abstract nouns from verbs or stems, to express actions, states or associated meanings -
<http://dictionary.reference.com/browse/tion>

along with all our cultural associations with both. To understand any state of being you'd surely want to know all three, but who would have guessed that combining 1) our recognition of important natural patterns, 2) our understanding of how they developed and 3) our cultural experience of them, would be all combined in the meaning of our words for them?

• Meanings from Perspectives on Nature •



15. Words with 3 Dimensions of grounded meaning

Table 3. Words modified to name transformations and their end states

Examples root words expanded in meaning with “-tion”

Root + Suffix	The Action	The Result
• <i>comm</i> ◦ <i>uni</i> ◦ <i>cation</i> :	The process	What was made one
• <i>co</i> ◦ <i>oper</i> ◦ <i>ation</i> :	The practice	What was achieved
• <i>vocal</i> ◦ <i>iz</i> ◦ <i>ation</i> :	The expressing	What was expressed
• <i>abbrev</i> ◦ <i>iation</i> :	The shortening	The short form
• <i>dele</i> ◦ <i>tion</i> :	The removing	What was removed

So as for each word in Table 3, the compound word refers to both the end state and how it came about. “Abbreviation” refers to both the shortened form as well as the way it was shortened, along with all our cultural associations with both. To understand any state of being you'd surely want to know all three, but who would have guessed that combining 1) our recognition of important natural patterns, 2) our understanding of how they developed and 3) our cultural experience of them, would be all combined in the meaning of our words for them?

This approach is easily done for very casually like this, or as a research. In either case it is likely to deepen your appreciation of the many living qualities that common language gives us access to, and to give you more ready access to them where it matters.

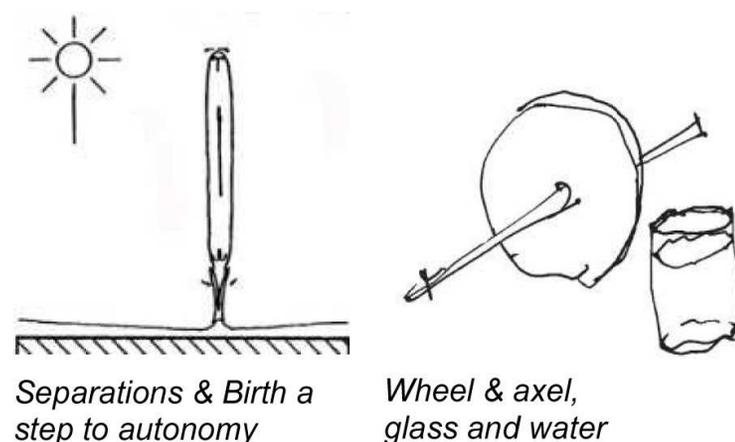
3.5.3 Individuality as a Repository of Unique Designs

Individuality is somewhat puzzling, seeming to refer to the uniquely special inventions of nature, which have no equals, grand examples of what the sciences call “emergence”. What we see in individually seems to be unique designs that can't be imitated, and are never to be seen again. It can be complex designs like species or cultures, or singular achievements. It can be singularly simple new forms of design with extraordinary influence, as if adding a new dimension to life.

Truly individual things seem to come about unexpectedly, and not to be exemplars or ideals of some category, but “true originals” with a form and category all their own. So individuality seems not to be a repeatable or recurring design. It makes “individuality” another mysterious property like “wholeness”, but for identifying things of extraordinary unrepeatable kind, good and bad. Of course, a problem with categorizing individuality that way is that, technically, nothing in nature is repeatable particularly for complex designs, as they all do seem to develop in individually unique ways. As they say, you can never step into the same river twice.

Still individuality is a very commonly used word, and easily spoken of as having varying degrees. So it evidently refers to something valuable for us to recognize and consider from many points of view. But it's not clear we can really study the individuality of things. What our minds are better suited for is studying the common patterns of things that we can put in a category. So it appears individuality may be something special, expressing the limits of our perception as as the aspect of designs that we admire but find beyond our understanding. So it may refer to the quality of natural designs that are so very original we find it hard to see them as having patterns, a matter of perception.

• Individuality as the Emergent Property •



16. Emergent individuality with abrupt change of state

As we get to understand naturally occurring designs we do often notice their uniqueness seems to undefinably pervade every part, like the body of work by a great artist, or a great culture,

that has readily identifiable ineffable traits we could never define. In that way we sometimes recognize it as containing something like having its own “science” or “language”. Every person is like that too, both having familiar traits as well as being truly unique individuals too, a duality of being both comprehensible and incomprehensible at the same time, having a lot of meaning for us.

Not knowing quite how to categorize individuality, I’ve just chosen some examples of “rapid” and “slow” emerging individuality. Figure 16 shows three images of rapidly emerging individuality. The individual air currents shown as having a rapidly rising column of hot air at its center is also in the process of abruptly separating from its hot air source, to become detached and independent. The combining of a wheel with an axel and water with a glass depict profoundly transformative simple dualities. They depict uniquely individual and influential innovations that take place abruptly and change the whole meaning of their parts. The funny thing is that these simple combinations that perform something quite new are not at all rare. Almost anything people use is used for joining complementary parts to benefit from their emergent properties when combined, as “what we ‘do’ ”. These three are just classic examples.

• Eventful forms of Relationships •



Relationships



Monuments of Art & Design

17. Emergent individuality with long development

Individuality is also seen in the variety of new forms with emergent properties that take extended periods of time and go through many stages of development. That’s the deeper story I notice behind the story of any really happy couple, for example, as well as for the great moments in time, such as the advent of

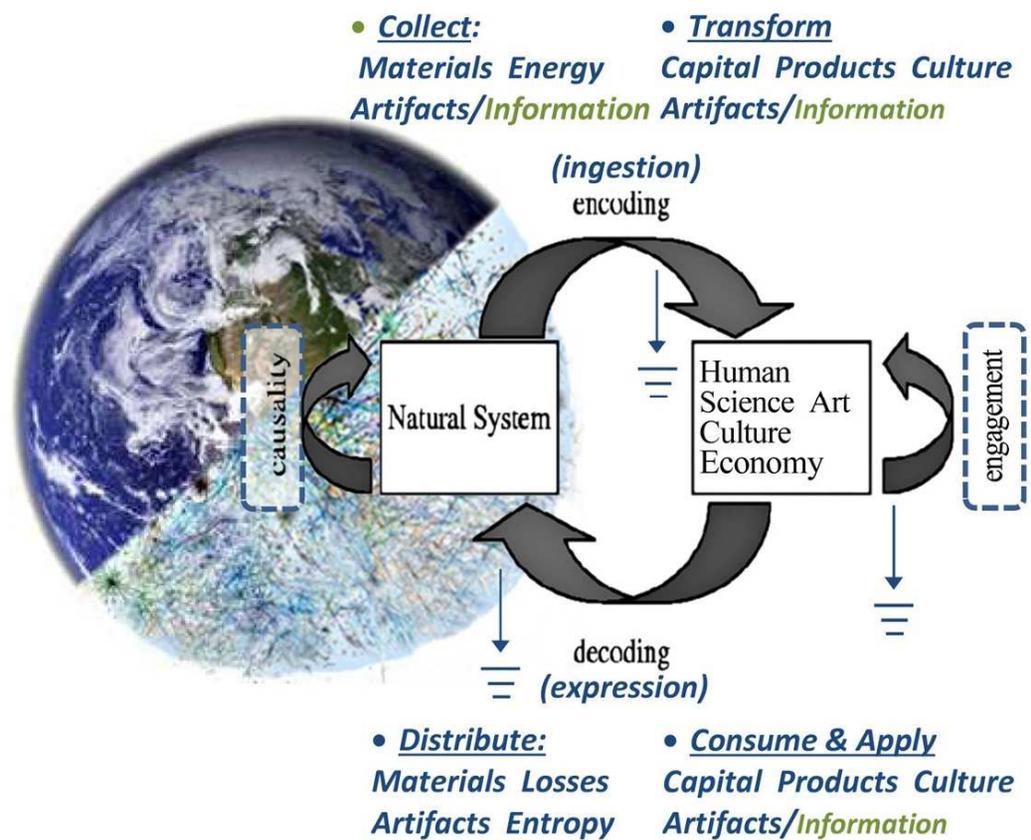
Greek architecture as monument in the history design (Figure 17). These are just special examples how great designs commonly involve long series of development, for both intentional and naturally occurring designs (Section 2.1). So perhaps “individuality” also about how such long gestation periods, perhaps allowing very little of the design or how it developed to be noticed, sometimes result in such dramatic moments when they mature.

Part the reason individuality appears to occur suddenly, even when it has taken a long time to develop, is that in early stages it may not be recognizable. The developing form may be too immature, or its roles not yet discovered. So to turn into the completed pattern that our minds are able to register, just needs to wait, to when recognition may occur suddenly. For example, though nothing changes when we graduate from school or achieve professional recognition, the meaning of all that went before can become suddenly apparent.

We also see individuality that very much puzzles us in mankind’s way living on earth, following the very long gestation of modern society, maturing with inventing ever more radical ways or reorganizing ourselves and monopolizing the earth that appear to lack real meaning. Like any growth process in nature, it leads to creating a new kind of species. In this case it’s as an experiment partly of our design and it seems we need to now look for a purpose. That would be a learning process, of engaging our conceptual thinking with nature’s systemic world (Figure 18), shown here as a variation on the Robert Rosen’s model of science as a cycle of encoding and decoding nature (Figure 1). It seems the challenge is to find meaning in our new way of living on earth, organized largely by the pursuit of wealth, as it seems to lose meaning.

The real point is about how hard it naturally is to recognize individuality when it is still immature. We might indeed not recognize who we really are until after we find out where we’re going with our creativity. The picture only shows a general diagram of the process. It does not show whether the “chicken and egg” cycle on its way to becoming a really fulfilling object oriented design or not. For all appearances we are in a difficult struggle to find how to make the earth our good home, but not yet really thinking about how homes work or even what homes are for. We will find whatever we find, by turning our attention going back and forth the usual way, between interpreting and acting on our world, hopefully learning to appreciate both what is found and lost in translation.

- Translation back and forth between natural & human designs •



18. Relationships between cultures as systemic learning

3.5.4 Alexander's 15 Principles

4 Table 4 shows various illustrations of Alexander's 15 recurrent features of wholeness (2002). The intent is to suggest using varied illustrations, examples for varied perspectives in the description of design patterns, as expressing richness "worth a thousand words". They help suggest where these or other rudimentary features are found and what they do. I've shown some of my illustrations and with those of two others, along with a few questions and suggestions.

5 Appreciating any complex subject takes looking at it from multiple viewpoints. So just as the fabled "six blind men" describing an elephant are handicapped by not looking for commonalities that would let them communicate, they are also handicapped by failing to "look around" for what else might be connected to their initial impressions. Looking at different views of the same thing 1) helps expose unexpected connections, and 2) helps keep one's own thinking fresh and avoid becoming stuck on any one view.

Alexander initially developed his 15 principles from an unusual pattern repository, a study of the timeless beauty of ancient Turkish carpets (1995). An interesting view of it from a carpet trader's view is found in Detlev Fischer's sort online article (2010). I see Alexander's 15 features of wholeness

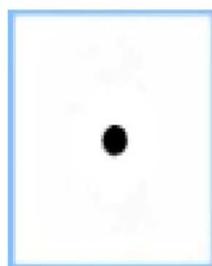
as a very useful collection of shape patterns found in natural whole systems, though not inclusive. They're all 'spatial' patterns, and a similarly diverse collection of 'temporal' patterns, like the "phases of growth", or ecological processes of allowed by "mediums of exchange" might be collected along with other design and pattern primitives too.

6 I see primitive pattern like these as most useful when used for "pattern search", used to trace the working parts of natural designs such as the communities that intentional designs are served by or serve. You could think of them somewhat abstractly as for pattern 'stigmergy', a way to use patterns to trace the origins and roles of things that an observer can follow as trails. So one can use the 15 principles and their variations for either helping to explain things where you find these patterns, or just to help explore what's living. For example Pattern 01 here, "Strong Center", is shown with three images of 'centers', a point, a cathedral plan, and a discussion circle under a tree. Those are totally different kinds of "strong centers" that never the less have a lot in common. Many others could be added. But you need to think of the variety to begin to understand both the common principles involved, and to become free with discovering and using their varying use in other circumstances.

Table 4. Images of Alexander’s 15 characters of wholeness

Illustrated by Leitner (2013), Reckard (2011) with related images and suggested occurrences in naturally occurring design by the author (Henshaw 2015b)

[01] Strong Center



Centers



Cultures & Commons



Hives of Activity,

[05] Positive Space, complementarity

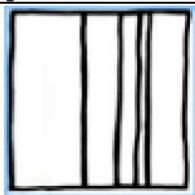


- Open environments
- Spaces of free association and adaptation
- Proximity with separation
- “In-betweens” and freedoms of movement.



Openings Permeability

[02] Level of Scales



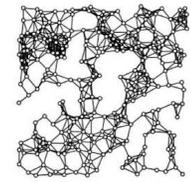
Density, organization & proportion



Waves & swells



Successions of form



Scaling patterns of

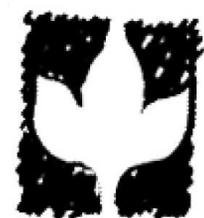


Distributions

[06] Good Shape & form



- Simplicity of design
- Comfortable and Complementary fit
- Serves intersecting needs
- Serves exclusive needs



[03] Boundaries, Geometry, Walls, Transitions, Limits



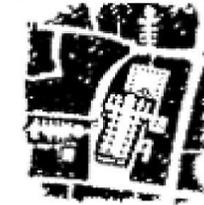
- paths of growth as natural bounds
- ranges of behavior as natural bounds
- Margins of ecologies -, trophic scales, neighborhoodscircles of relations
- Limits of Visibility, - of Reach, of Scale, of Change, of Versatility



[07] Local Symmetries



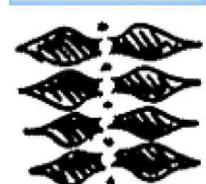
- Polarities: roots and branches
- Approaches and arrivals
- Interiors and exteriors



[04] Alternating, Repetition, Recurrence,



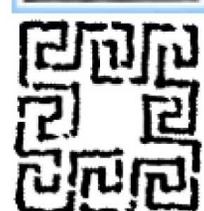
- Vitality, Resilience, Responsiveness
- Cycles and waves of change
- Practice & training, perfecting
- Looking back and forth, inside and out, forward and back, poking around
- Successive addition or subtraction, of layers of design, or branching from designs
- Hysteresis, Action learning, Exploration
- Semi-lattice (as added complexity with added variety of opportunity)
- Stigmergy (trail reinforcement)



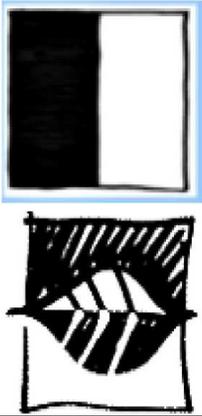
[08] Deep Interlock and Ambiguity



- The impossibly complex overlap of so many things working independently
- How nature can only organize separate things and our reason can only organize mutually defining things, looking for one world in a life of so very many worlds

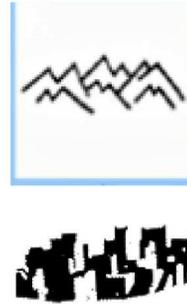


[09] Contrast, difference



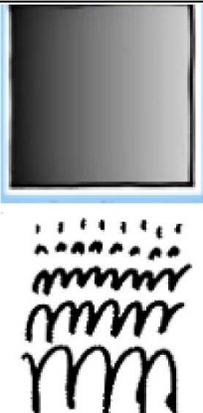
- A bridge between information and matter
- Revealing things hidden from view
- The potentials for complementary fit
- Signs of transition

[12] Echoes



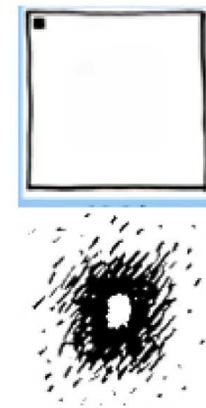
- Spreading and lingering reflections; elastic vibrations; memories of lost places, events; artifacts of periods of change
- Environments as repositories of fragments and footprints, a compost of discards,
- Traces of history as memory of all past learning and change, ornamenting things new

[10] Gradients



- Energy gradients to power organization
- Proximities, potentials, distance, values
- Margins, ranges, cushions, resilience, flexibility, continuity, versatility

[13] The Void



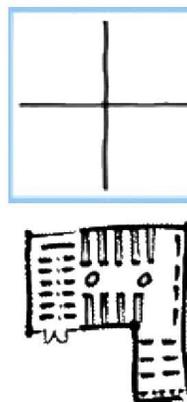
- A lack of form, absence,
- 'Book zero', the potential of formlessness,
- The uncertain silence, the moments of stillness, pauses, suspense, immobility

[11] Roughness, diversity



- Inconsistency, consistency, texture,
- Intermittance, irregularity, coarseness
- Surface, ground, skin,
- Fabric, aggregation, collection, granularity

[14] Simplicity

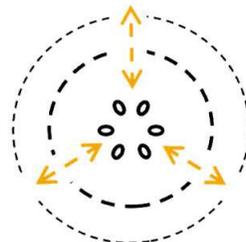


- Inner Calm
- Freedom of direction
- Balance
- Observing, listening, receptiveness
- Emergent couplings, organization
- Individuality

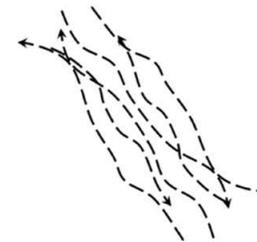
[15] not-separateness, "QWAN"



connectedness,
mutuality



Homes



Flows

- Homes, their receptive places and animating cultures
- Organization as a pairing of receptive places and active users, the material difference between parts and whole,

4. Discussion

I hope to have presented an interesting introduction that readers can use to explore natural patterns of design and expand the value of pattern language methods. The qualities and real meanings of both purposeful and naturally occurring designs seem to rest on having organization with emergent properties of the whole. I'm certainly very grateful for having found how Alexander's pattern language has evolved. As a general method for communicating sound principles of holistic design, it seems to give me a way to translate years of prior work to make it communicable. It lets me separate the discussion of purposeful designs and naturally occurring designs. It lets me serve them both equally and by being separated then better show how they can be understood as usefully connected. It adds "new forces" to my world, that allow the cooperation of previously disparate ones.

That serendipity gave me a freedom to discuss the details of two of my favorite natural patterns, the Two Primary Patterns discussed in Section 2, 'homes' as the strong centers of whole natural world, and stages of growth as its process of self-organization and means of energy use, characterizing both purposeful and naturally occurring design. I hope that brief look at these two key patterns was adequate, for then offering the "Starter Kit" for the method offered in Section 3. That "kit" composed of a few dozen variously simple and advanced ways for readers to branch out with their own thinking, presents a collection of naturally occurring designs to explore that have fascinated me tremendously. I'd like for others to find as well their own recognitions of the bridges between our purposeful designs and naturally occurring ones such as the one I presented that opened the door to everything else I found.

I've mostly referred to natural patterns of design as something we might study, but without discussing much of how they appear to work by themselves. I've also been critical of mainstream science, for representing nature with equations that omit many of nature's more prominent features. So below I offer remarks on those two subjects, first on how apparently autonomous natural design processes really "do it", and then pointing to where I think science may be heading in the near future.

4.1. Natural Patterns of Learning

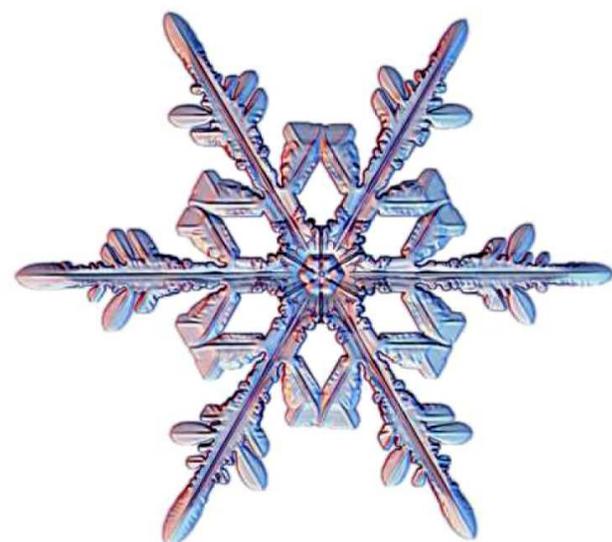
If you consider how new art forms develop, say "impressionism" as a style of fine art painting, or "Hip Hop" as a popular culture and style of rap music, it's clear they originated with a burst of innovation, but not clear quite what it came from. You do notice that the patterns of design they began with they also continued with, though, elaborating on it over time but remaining faithful to it as well.

That seems to be a common pattern in anything that develops by growth, forming complex systems that work as wholes. Natural designs of that kind seem to remain "true to their roots" that way, as if only able to extend the pattern they began with. It seems to be virtually universal, for any new design to develop by itself to need to have an original design for adding new parts that extends the same pattern for adding more parts. It needs to be have a "pattern of replication", making copies, as an essential function for designs that will "emerge", adding layers in a way that makes new places for more layers. Beyond that is seems the variety of natural patterns that replicate is exceedingly varied, perhaps as numerous as snowflakes, but also as uniquely individual.

It appears to mean that the small beginnings of things set a pattern that only attaches that extend the pattern, as if in the manner of a snowflake starting a pattern of crystallization that catalyzes more of the same pattern of crystallization. In a general way that also appears to be the natural form of adaptive replication, as the general pattern of what we notice replicating. It's also a fairly apt depiction of what people spend their days doing too, looking around for the next thing to extend their pattern.

It might set a somewhat new, but as a pattern for extending a pattern it can't be so different to break the replication. So for the evolutions of designs by growth, that we observe as accumulating creatively rather than deterministically such as what we see is resulting from growth, the original pattern needs to be replicated in an exceptionally faithful way, just to continue to do so for a great many replications..

- Design starting from an origin pattern •



19. Snowflake design developing from the center

So that process of extended replication also seems to be necessity for something small to get big, and so to seem universal. What a replication of parts also allows is a multiplication of faithfully

replicated parts, another feature of the general pattern for how small things get big that seems universal. If faithful replication were to be linear in how it progressed, a single fertilized cell in the womb adding another cell every week, it would take 19 billion years to reach birth weight with about a trillion cells! With every cell made doubling every week it only takes nine months. So it seems real complexity would not be remotely possible without it.

You can see these patterns of growth directly in the shape of a snowflake (Figure 19). The new layers don't exactly replicate the first ones, but add onto them while providing new locations that get added to, and so elaborate on, or branch from, the original. How the whole becomes so distinctive is by some crystal edges being more receptive than others for new crystal formation as "hot zones" for catalyzing new crystal formation. The form of the whole is then being determined by whatever parts replicate their crystal pattern the fastest.

The interior parts of the snowflake are highly symmetrical and repetitive, but outer branches actually become fairly irregular, so it seems the replication pattern deteriorates somehow. So, it appears the evolution of complexly organized designs is a matter of finding a very successful design for continually having an answer to the question "What's next?" but more of an open question than one answered by laws.

Much that same general kind of growth pattern can be seen in the course of the world economy (Figure 20). The way it builds on itself is by using the profits of businesses to add to the scale and kinds of businesses that make profits, the chain pattern of reliable replication that readily multiplies. That's expands the system by making more options for expanding the system. The big difference, of course, is that it is a highly complex cultural/*technological system*, guided by decisions based on information about monetary profits. That's a big difference, but other than the very different design for replication they start with, the two are similar in having to be faithful to their start and having no design for ceasing their replication.

The snowflake keeps attracting more layers of crystalizing water vapor as it falls, until the water vapor runs out or it meets warmer temperature at lower elevations. What would make the replication the world economy's parts stop before exhausting its resources or making economic environment unprofitable? You'd think the latter cause, general decline in profits as we are actually starting to see now, would only stop growth if profits declined toward zero, and investors withdrew their assets from risk. It's the logical end point of a growth system with not goal but growth, a "pattern problem", and "imbalance of forces".

It's one that would ideally call for some "unifying design" to resolve it holistically, rather than simply letting it run its course. To attempt that you'd first spend a lot of time looking for patterns that embody the same circumstance, to find working examples other transformations that are possible, and their "simplifying

ideals" for resolving the forces. Nature does indeed seem to display all kinds of creative ways of furiously replicating patterns that then smoothly resolve the imbalances that come naturally from it.

- Design starting from an origin pattern •



20. World economy growing from all cells at once

Whether it's a snowflake or a world economy, pattern language now seems to offer a way to identify and find ways of studying complex designs of many kinds, in terms of their recognizable recurrent design patterns. It could result in better understanding of both of our real subjects and our deep common roots of human understanding. Most importantly it allows individual forms of both intentional and natural design to be recognized as objects of organization based on natural design principle, each individual with its own separate origin and development by replication. We can identify and verify many of their stages of development, to be considered from many perspectives, based on what many can observe in common. It changes our perception of all these emergent forms, making them much better understood and relevant as tangible realities to work with. We might still find them mysterious, certainly, while we still become more and more able to confirm them as individually occurring and possible to study, mutually observed, and opening a new kind of discussion well-grounded in nature.

4.2. An "Object Oriented Science"

In the introduction and elsewhere I've long been fairly critical of mainstream science, for limiting its study of natural design to the invented equations we based on the categories of data we collected. That approach completely overlooks the dense centers of organization exhibited by individual energy using systems. Those include all the kinds of living organisms as well as living cultures, as well as any number of other kinds of complex energy using systems that develop their own organization by growth, giving them organizational independence while leaving how they work hidden from view.

It's those classes of "objects" that I see the sciences needing to find how to study. So here I'd like to briefly describe what I see as a way for mainstream science to recognize and start to explore this new territory, without abandoning the mathematical tools it uses. The sciences have mostly restricted themselves to looking at the rich multi-dimensional designs of nature through a lens of one dimensional measures, "data". Now science can potentially begin to also refer to the whole objects of nature, in their own forms, just by recognizing where they are by their locations. One can then study their uses of energy, for one thing, studied using the same "black box" methods as for machines. It won't reveal everything inside the box of course, but at least you'd have a "natural box", as the location of what is being studied, and to associate with what is learned about its inside. It's really just an incremental change in methods of boundary definition, that recognizing the boundaries of "whole systems" (Henshaw 2011)

With learning to recognize boundaries of independent organizations the potential is then clearly there to greatly expand the subjects that the sciences can define and study, that were never studied before. The individual systems then possible to study are found throughout nature on every scale, and if recognized as having boundaries could be named and studied as individually organized wholes. These objects of nature that do appear to work as wholes would then be recognizable as the units of design that life works with, expands the potential view of science further.

The expansion of subjects could also come directly from current conventional research methods in the mainstream sciences. It might be from scientists seeing a need for a better way of "taking notes", in following the hotly pursued search in complexity science for way to understand the emergence of new properties and forms. Feynman had a wonderful notation system that helped speed the advance of physics, for example (Moody 2009). It might be a notation, just to help with keeping track of shifts in organization observed while studying the uncontrolled behaviors of complex AI systems that spread to other uses, perhaps. It might also come from some taxonomy method used in forensic science, maybe later borrowing concepts from Alexander's pattern language, or not. All the methods that worked would get their validity from being means of learning from the same natural forms, and so be interconnected and interrelated by that.

Given the demonstrated potential power of a pattern language view, the emerging new views of nature in the complexity sciences and those of pattern language will eventually approach each other and meet in the middle. Each is likely to retain its individuality, and while using differing technique also learn from each other's perspective, producing a greater view than either when combined.

One can also imagine barriers to doing that arising, like institutional investment in old ways and resistance to change. Perhaps each science would insist on sticking only with its own

somewhat proprietary way of describing a different world. That would have each continuing to wandering off in its own direction more or less continuing the historic pattern, of studying very bodies of information as if different "realities", that as for the "six blind men" and the elephant, seeing realities that don't connect. To upset an entrenched habit you might need some unexpected event. It might possibly be like the BIG NEWS that a very useful way of making the ancient principles of holistic design explicit had been found. Upon hearing that, perhaps some new generation might look up from its boredom and "blink", to then take off on the task of connecting the new with the old and expand our whole way scientific thinking.

There are various names for it one might consider. Often new forms are named by happenstance and that's OK. As a "working name" I think the simple "object oriented science" is perhaps best. It's neutral, directly descriptive and already used as an expression that way. One can probably trust that interest in the qualities of "aliveness", "living quality", "individuality" and "wholeness" found in both the most appreciated kinds of intentional and natural forms of design, will carry over. Helmut Leitner and Franz Nahrada propose the more direct "liveliness science" as "lebendigkeit science" (2014), a nice way of saying it. I called my own research archive on the subject "the physics of happening" so I have affection for that. The first question I had that became productive for my studies was: "What makes life lively?" We could call the science "liveliness" then, or perhaps just "individuality" or "nature". With one of those terms non-scientists might more quickly get the whole idea... that the name actually refers to the real subject of study.

If we want it to spread, though, it needs to stay faithful to its roots while continuing to be clarified and made more relevant to users. It also needs to become more adaptable to new domains, shareable across disciplines, maintained as a broad common language, and to expand to new areas and disciplines, like this effort to introduce a direct way to learn from naturally occurring design.

5. Acknowledgements

I have quite a number of people and fortunate circumstances to acknowledge. It was the clear way that Christopher Alexander's pattern language was discussed in the software community that first made it clear to me I could use it too, which I greatly appreciate. It allowed me to translate my prior natural science work on these subjects into this more communicable way of discussing them. I had a fine education in physics too, at a small college with a wonderful physics department, professors Peckham and Rohmer at St. Lawrence Univ. They encouraged my odd studies of how lab experiments always misbehaved. I found inspiration at the Univ. of Pennsylvania school of design too, both from visionary faculty and the pervading presence of Lou Kahn's deep ways of thinking about the nature form. Of course I am also indebted to being taught how to observe natural patterns from a very early age by my father Clement L. Henshaw, a professor of

physics at Colgate. His idea of teaching was to show students where to find explanatory principles for themselves. I also owe thanks to a friend from high school, John A. Blackmore, who became a social scientist and I must credit with many of my key

insights, as well as being a constant intellectual partner with a wonderful appetite for any subject we could think of talking about, through all the years..

6. Table and Figure Lists

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2. A Template for Natural Pattern Writing
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3. Intentional design precedes the process of development
4. Organic design occurs during development
5. Homes shelter cultures of equitable living
6. The levels of natural pattern learning, a ladder of graduations
7. Creating a pattern to search for its recurrences

8. Cultures finding their roles in a complex worlds
9. Mediums of exchange link diverse varieties
10. Growth shows the pattern of organic emergence
11. Centers surrounded with niche boundary zones
12. Centers found with diverse boundary shapes
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17. Emergent individuality with long development
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19. Snowflake design developing from the center
20. World economy growing from all cells at once

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7 About the author:

Jessie HENSHAW began her study of new ways to combine systems principles of physics (laws of control) with architecture (design of services) some 40 years ago, with recognizing both as views of the same world natural systems. Her research on innate patterns found in individual natural whole systems, led

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