

Undiscovered Patterns

David West
Transcendence Corporation

Jane Quillien
New Mexico Highlands University

Abstract

The idea of “patterns” begins in Alexander’s first book, *Notes on the Synthesis of Form (Notes)*, with “the idea of the diagrams.” The patterns presented in *A Pattern Language (APL)*, however are different in important ways from those in *Notes*. This paper discusses those differences in the context the “selfconscious” and “unselfconscious” processes discussed in *Notes* and concludes that is a large body of undiscovered, and potentially critical, patterns that should be explored. Why these undiscovered patterns are different and important provides the conclusion to the paper.

The idea of the diagrams (patterns)

“These diagrams, which in my more recent work, I have been calling patterns, are the key to the process of creating form.”

Notes, was Alexander’s attempt to create a “science,” indeed a “mathematics” of design. His treatment of “the diagrams” reflected a belief that they were nothing more than a visual representation of a resolution of inter-related forces — e.g. “In summer people sleep in the open,” and, “pedestrian traffic within the village.”

It was only in retrospect, in his introduction to the paperback edition of *Notes*, that he made the connection between the diagrams and patterns.

In Alexander’s mind the connection between the diagrams in *Notes* and the patterns in *A Pattern Language (APL)*, is quite clear. For the reader, however, the connection is a bit less obvious, as there is an important, but somewhat subtle distinction in ‘definition’.

Perhaps the most common contemporary definition of a pattern is “a solution to a problem in context.” In *Notes* however, the definition is:

“ ... a diagram, or pattern, is ... an abstract pattern of physical relationships which resolves a small system of interacting and conflicting forces, and is independent of all other forces and all other possible diagrams.”

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However subtle they may be, there are several critical differences between (A) the contemporary definition and (B) the definition in *Notes*. Among them:

- 1) Focus on problem and solution with context secondary (A) versus ‘naturally’ occurring ‘subsystems at equilibrium’ (B).
- 2) Abstraction from constructed world (A) versus natural world.
- 3) The potential for “pattern languages” (A) versus simple composition (B)
- 4) How each realizes “Form” and supports the concept of “Fit.”
- 5) The manner in which patterns are discovered and ‘documented’ — i.e. “pattern mining.”

The essence and importance of these differences is the focus of most of this paper. Before getting to that, however, two small asides; the first regarding “method” and the second about systems, are in order.

No Method!

Much of *Notes* focused on a “method” for enumerating and relating various forces or constraints and resolving them (more or less mathematically). This was, of course, entirely consistent with his desire to establish a science of design.

It is interesting to note, that Software Engineering adopted Alexander’s approach to establishing method, making method a key aspect of all software development.

Alexander was conflicted — part mystic / artist, part scientist / mathematician. His profession, architecture, was also conflicted, artist AND engineer. When writing *Notes*, the mystical and artistic was mostly suppressed, only to resurface and dominate when he wrote, *A Timeless Way of Building*. A bit more of the methodologist and engineer crept into *APL*, but Alexander’s dominating opinion of method is captured in his “Introduction to the Paperback Edition,” of *Notes*.

“...so many readers have focused on the method which leads to the creation of the diagrams, not on the diagrams themselves ... I am very sorry that this has happened, ... no one will become a better designer by blindly following method ...

Replacing method is the idea that designers can inculcate an “understanding” to guide their observations and support the discernment of systems, subsystems, elements, and the relationships among them. These observations can be captured as abstractions; visualizations like the diagrams in *Notes*, or formatted prose as in *APL*.

“... the idea that you can create abstract patterns by studying the implication of a limited set of forces, and can create new forms by free combination of these patterns — and realize that this will only work if the patterns you define deal with systems of forces whose internal interaction is very dense, and whose interactions with other forces in the world is very weak — then, in the process of trying to create such diagrams or patterns for yourself, you will reach the central idea this book is all about.”

Alexander’s ideas essentially recapitulate notions advanced by Plato roughly 2400 years ago:

“[First,] perceiving and bringing together under one Idea the scattered particulars, so that one makes clear the thing which he wishes to do... [Second,] the separation of the Idea into classes, by dividing it where the natural joints are, and not trying to break any

part, after the manner of a bad carver... I love these processes of division and bringing together, and if I think any other man is able to see things that can naturally be collected into one and divided into many, him I will follow as if he were as a god.”

- Plato

In both cases, Alexander and Plato, it is the ‘natural world’ that is observed, the “natural joints” that are discerned, and the (mostly) isolated subsystems or elements, that are identified as classes, patterns, or diagrams.

In all cases, Patterns are discovered, not authored. Once discovered, patterns can be articulated as visual or textual forms and communicated or shared. The means of discovery, is NOT method, not reducible to formula. It needs to be noted that using a ‘template’, i.e. the format and structure of a pattern as written in APL, is a method, and is suspect.

Systems

The notion of a system is common and common to Alexander’s work. It is important to note that although there is a single definition of a system — a set of elements and the relationships among them — there are two quite different system types: deterministic and complex. A parallel distinction between “artificial” and “natural” can be made as long as we take care not to equate artificial with deterministic and natural with complex. (Naturally occurring systems, like those studied by physicists are deterministic and social systems are artificial (arising from the actions of human beings) but complex.)

Elements of a system might be systems in their own right — at their own level of scale. This means that many, if not most, systems of interest are complex with subsystem elements that might be complex or deterministic; natural or artificial. Only in the case were we restrict our attention to discrete subsystems can we say with any degree of confidence that our system is artificial-deterministic or natural-complex in nature.

For example: in *Notes*, Alexander is concerned with designing a village in India — a natural system with obvious artificial subsystems, like cast; in *APL* attention shifts to the built environment which is artificial with substantial natural subsystems; and, in *Design Patterns* by Vlissides, et. al. the system is totally artificial and deterministic.

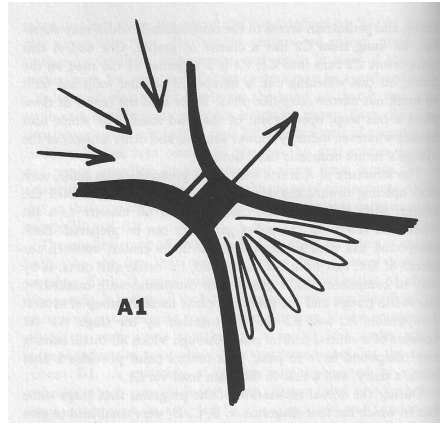
How we perceive the type of our systems of interest with looking for and documenting patterns, will affect our ability to discern forces, subsystems with dense inter-connections and loose intra-connections among elements, as well as the “fitness” and composability of our patterns.

Pattern Mining (a la Notes)

“... the idea that you can create abstract patterns by studying the implication of a limited set of forces, and can create new forms by free combination of these patterns — and realize that this will only work if the patterns you define deal with systems of forces whose internal interaction is very dense, and whose interactions with other forces in the world is very weak — then, in the process of trying to create such diagrams or patterns for yourself, you will reach the central idea this book is all about.”

We begin by observing, studying, natural systems with artificial elements (like an Indian village). We note that the system – in terms of inter-related elements – is not homogenous; there are clusters of forces with denser interactions among themselves than with other forces seen in the system. We are engaged in finding the ‘natural disjunctions’ (loose interactions) and identifying dense clusters. Each cluster is the basis for a potential pattern – the pattern being the way the forces in the cluster interact in order to maintain internal stability and semi-autonomy.

In his study of the Indian village, Alexander noted 141 forces in thirteen categories, e.g. caste, employment and agriculture. He determined which of these forces interacted in such a way as to form clusters. Each cluster was depicted with a diagram and a narrative.



... the sacredness of cattle (7) tends to make people unwilling to control them, so they wander everywhere eating and destroying crops, unless they are carefully controlled. Similarly the need to upgrade cattle (53) calls for control that keeps cows out of contact with roaming scrub bulls; and further calls for some kind of center where a pedigree bull might be kept (even if only for visits); and a center where scrub bulls can be castrated. Cattle diseases (57) are mainly transferred from foot to foot, through the dirt — this can be prevented if the cattle regularly pass through a hoof bath of disinfecting permanganate.

Although the narrative seems to be straightforward and reproducible by aspiring pattern miners, the diagram, and how it was arrived at is a total mystery!

If the pattern mining has been successful the resulting diagrams (patterns) will be “independent, unique, and composable” — composable in the sense that the entire village (diagram/pattern) is composed of four subsystems and 13 sub-subsystems. In theory, you could create numerous distinct Indian villages by combining the various systems / subsystems in alternate arrangements.

Perhaps most importantly of all, if the pattern mining is successful, each diagram/pattern will exhibit the quality of “fit.” Each pattern is not only ‘a solution’ or resolution of forces, but a solution (resolution) that is both elegant and enduring — qualities that would later be subsumed under the umbrella label QWAN.

The “unselfconscious process”

It was obvious, to Alexander, the manner in which one discerned operating forces, clusters of interactions, and somehow transformed them into a black and white diagram of arcs and arrows. To most of his readers, unfortunately, there seem to be large gaps and unresolved questions. (for example, one of the forces at play in the Indian village is to protect the herd from wandering ‘wild’ bulls, ignoring the force that the occasional dalliance outside the herd can actually improve the breed by diversifying the gene pool.)

Happily, Alexander provided a hint as to where the novice pattern miner might begin the search for clusters and patterns. The hint is contained in his discussion of the “unselfconscious process.”

Alexander believed that the operation of a natural system automatically gave rise to the clustering and resolution of forces. The process by which this occurred was lengthy — spanning multiple generations of human beings — and occurred below the threshold of awareness. Local forces were resolved, by happenstance, and improved by trial and error until an enduring and appropriate stability was achieved.

Given his interest in architecture, it is no surprise that Alexander provided examples of this process with regard to building:

“... building skills are learned informally, without the help of formulated rules. However, although there are no formal rules, the unspoken rules are of great complexity, and are rigidly maintained. There is a way to do things, a way not to do them. There is a firmly set tradition ... in the wealth of myth and legend attached to building habits.

Each myth, tradition, ritual, and taboo that we find, in any domain of interest, points to an enduring, “independent,” cluster of resolved forces — each of which exhibits good “fit,” lest they would have survived long enough to be mythologized. A body of myth and tradition comprises a rich vein of “pattern ore” that should be mined.

Alexander’s Misstep?!

A Pattern Language (APL) was the work of a committee, supervised by Alexander, and funded by a grant. As is true with any grant, certain restrictions and expectations as to outcomes were imposed. These constraints are important to consider, but relatively minor in comparison to other decisions that shaped *APL*.

First consider scope. In *Notes* the focus was on a rural village in India; in *APL* it was the entire built environment from nation-state to artifacts on the mantel. Scope alone dictated that the approach used in *Notes* was impossible: i.e. the enumeration of forces (from 141 to millions), the observation of interactions (potentially exponential to the number of forces), the observation of naturally occurring clusters (hundreds of thousands), and depiction of each cluster with a half-page narrative and line-art diagram.

Second, instead of observing a natural system, the APL group looked at multiple instances of artificial systems (architecturally designed systems). Similar sets of forces resolved more or less in the same manner across several instances replaced the “clusters” identified in *Notes*. A pattern became, de facto, the abstraction of commonalities across instances presented with sufficient interpretive context to allow for variations on a theme.

Third, Alexander and the committee, were guided by theory — a “selfconscious process.” Moreover the kind of academic theory that was decried in *Notes*.

“... with architecture once established as a discipline, and the individual architect established, entire institutions are soon devoted exclusively to the study and development of design. The academies are formed. As the academies develop, the unformulated precepts give way to clearly formulated concepts whose very formulation invites criticism and debate. ... With the teachable discipline called “architecture,” the old process of making form was adulterated and its chances of success destroyed.”

Because a “selfconscious process” supported APL, the resulting patterns had only a coincidental likelihood of exhibiting fit (or QWAN) or composability.

“My contention is this. These concepts will not help the designer in finding a well-adapted solution unless they happen to correspond to the [natural] systems subsystems. But since the concepts are on the whole the result of arbitrary historical accidents, there is no reason to expect that they will in fact correspond to those subsystems.”

Readers of *APL*, including professional architects have long noted that the patterns are analytical not instructional. That is to say, they can be used to analyze and explain failures, but they offer little guidance as to how to fill a blank blueprint with a good design. This lack of composability suggests that Alexander’s goal of creating a “pattern language” was unrealized and, given the constraints operating on *APL*, unrealizable.

A final, and perhaps the most important, divergence between *Notes* and *APL* concerns the identification of forces. A significant number of forces in any artificial system will arise, solely and exclusively, from the premises behind the artificial system. The most obvious example of this, for the software community, are the design patterns in the GoF book of the same name. Programming, even object-oriented programming (the domain addressed by the book) is clearly an artificial system. Even more artificial is any given programming language. Perhaps 4-5 of the 23 patterns presented in the GoF book address forces common to programming in general while the others resolve forces that are present only because of the constraints and assumptions arising from the C++ programming language.

Let’s Get Married

An example, familiar to most everyone, of how the *Notes* approach to pattern discovery varies from the *APL* approach, is the socio-cultural system we associate with the custom of marriage.

If we use the *Notes* approach we see a system of forces that include: procreation is a biological imperative; sex is pleasurable; the sex act can result in pregnancy; females invest more, biologically, in a baby than males; babies need to eat; mothers providing nourishment need to eat; lions and tigers and bears (and hordes) are threats; concept of “mine;” etc.. We also see forces arising from artificial subsystems like whether or not some of us are “human;” kinship, gender identification, and status.

Among these forces we readily see clusters of force resolution, like forces concerning sexual access related to forces regarding nutrition and forces regarding gender roles. E.g. males make sure females get food while pregnant and nursing in exchange for sexual access. Females grant access based on assessment of ability to provide and protect. Each of these could (if one were an artist) be depicted with a little diagram and hence comprise a pattern.

From the clusters/patterns we can compose more comprehensive systems (as in the Indian village), which also are clusters/patterns. Our patterns are fully composable, giving rise to a myriad of different systems – each of which constitutes a variant of the pattern we might label “marriage.”

Also there is an abundance of myth, ritual, taboo, and tradition that point directly to the small force resolution clusters as well as the larger scale systems that combine the smaller patterns. The marriage pattern yields forms that exhibit “fit” with varied contexts and includes forms ranging from polyandry to polygyny, from exogamy to incest, Nayar marriage, and same sex unions.

Taking the APL approach, we would focus our attention on artificial instances of marriage, e.g. legal or official or sanctified marriage. In this case the forces that must be resolved arise from the theory behind the artificial construct. For example: “sex is intrinsically evil, but sometimes necessary;” control your sexual access – control you; obey your husband; worthiness of sacrament, status, etc.

We can find clusters of interacting forces, but because the majority of forces at play arise from the artificial construct itself, they carry too much implicit context that they are not composable into either larger-scale systems (the village again) or in multiple forms like the natural forces leading to the marriage pattern as discussed previously.

Interestingly, there is an abundance of myth, ritual, tradition, and taboo associated with artificial systems of marriage. However much of it is suppressed — with interesting consequences. For example, when Dave taught cultural anthropology at an affluent Catholic university and asked for descriptions of marriage tradition; he often received assertions about white dresses and tiered cakes as essential elements of marriage all the way back to when Adam married Eve.

PLoP or PLoS

When the Hillside Group formed to explore the works of Alexander, the focus was on *APL* although all of Alexander’s work received some attention. (Today, Alexander’s, probably, last major work, *Nature of Order*, is receiving significant attention as well.) *APL* inspired a search for “pattern languages” appropriate for use in the world of software development. This is no surprise, as Hillside first convened at a software conference, OOPSLA.

The first conference, PLoP (Pattern Languages of Programs) reflected this focus on software and on programming. The first best selling book on patterns was *Design Patterns: Elements of Reusable Object-Oriented Software* by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides (the Gang of Four - GoF).

The patterns approach used by Alexander and his team when writing *APL* was a good match for the world of software, especially programming, as the software community is concerned, almost exclusively, with artificial systems.

APL is not, however, the best model as attention shifts away from artificial systems to incorporate natural and socio-cultural systems. And this shift was noticeable almost from the beginning of the patterns movement – with the first PLoP conference including papers on organizational patterns and others.

Instead, we recommend a return to the origin of the pattern idea, *Notes* and the diagrams, and application of the observation, discovery, describe and visualize approach described therein. We would go as far as asserting that the ultimate success of efforts to find pattern languages useful for educational, social control, and organizational systems depends on doing so.

The *Notes* approach will lead to discovery of overlooked systems and subsystems, different sets of forces, different clusters, and composable patterns. We will conclude with two examples, each of

which starts with a top level system (analogous to the Indian village); shows subsystems concerned with specific aspects of the whole, and finally discrete clusters of resolved forces identified with potential pattern names.

We do not have the time and space to replicate Alexander's work with the Indian village – starting with an extensive list of forces and aggregating upwards. Instead we present our examples in top-down fashion using labels and occasional descriptions of pattern names.

Education

Three distinct subsystems: Enculturation or the learning/teaching of all of the tacit knowledge that enables one to be a member of a culture; social replication or the transmission of knowledge, explicit and tacit, required to reproduce the social roles, including job roles, required for society to function; and, knowledge transmission and extension the most widely acknowledged function of public education systems.

Enculturation deals with forces like memory, motivation, psychological desire, and wanting to blend in and yields clusters with pattern names like: mother's knee, monster under the bed, fairy tales, follow the script, improve 101, and good girls don't.

Social replication might yield patterns like: family tradition, in your father's footsteps, stay-at-home mom, like this, wage slave, your vote counts, and Horatio Alger.

Knowledge transmission and extension systems tend to be very artificial in nature and many of the forces that are identified and resolved — e.g. 30 kids in a classroom, the politics of Evolution, fifty-minute class, etc. — are not natural. This means that patterns based on the resolution of those forces will lack composability. Most existing pedagogical patterns address this part of the educational system with a mix of natural (e.g. you learn what you do) and artificial forces.

Social Control

We can, again, identify three distinct subsystems resolving forces at different levels of scale from the individual to the state.

Individual control deals with forces affecting one person at a time and includes potential clusters/patterns named: mother's knee, meet me at the woodshed, listen to Grimm, Adam's Rib, boys will be boys,

Tribe or small group with patterns like: I see you not! (shun you), I speak for the Gods, No one owns the waterhole, Leader of the Moment, Leader of the Pack, I'll scratch yours if you scratch mine, and Rumspringa.

State: War!, Coventry, if you knew what I know, it is your fault, it is not your fault, you too can be 1%, Leopard Skin Chief, and "kill them all, let God sort them out." At the state level you are also dealing with artificial systems, grounded on abstract theory (e.g. Capitalism or Communism), and with almost all of the constraints for forces being artificial in nature. (Although it might be quite possible to develop and APL style pattern language for state level social control, it is unlikely that a Notes approach would yield anything useful – as natural systems of social control tend not to scale beyond small monarchy.)

In the case of education and social control there is an abundance of myth, tradition, ritual (e.g. rites of passage), and taboo that point both to natural forces needing resolution and the naturally occurring clusters where they are resolved.