

The Adapted Pattern Language Framework

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Abstract

Pattern language frameworks are of increasing interest to various sectors of the design community. They have already been successfully adapted and employed in software engineering and their use is now being considered in the field of human-computer interaction and various other fields of expertise. Previous work has largely concentrated on the potential utility of patterns as a means of understanding the social and interactional context of technology usage and of articulating core problems and solutions. The position adopted here is that an appropriately adapted pattern language framework may serve to inform requirements analysis of the domestic environment. Accordingly, this paper outlines 1) an adapted framework which sensitises design to empirical patterns of technology usage that exist in the home; and 2) an adapted patterns format for the presentation of empirical findings grounding design in the practical day-to-day circumstances within which technology is woven into the very fabric of domestic life.

Introduction

Pattern language frameworks have been successfully adapted and employed in software engineering (Gamma *et al.* 1995) and their use is now being considered in human-computer interaction (Bayle *et al.* 1998; Erickson 2000a), workplace studies (Erickson 2000b; Martin *et al.* 2000), and studies of the domestic environment (Hughes *et al.* 2000). It is not the purpose of this paper to review this body of work, but to add to it through the articulation of an adapted patterns framework informing requirements analysis of the domestic environment in particular and other environments in general. Accordingly, the architect Christopher Alexander's original pattern language framework (1979) and format for the presentation of findings (1977)

are briefly reviewed before considering their adaptation to the domestic environment and the day-to-day uses of the technologies that reside there. The original framework and format are not well suited to this task for as Vliissides (1997) reminds us,

one pattern format does not fit all. What does fit all is the general concept of pattern as a vehicle for capturing and conveying expertise, whatever the field.

Within the context of the home, the expertise in question is a matter of organizational expertise to do with such mundane but highly important practical matters as getting up and ready for work in a morning, making breakfast, taking the kids to school, cleaning the home, making dinner, entertaining guests – i.e. practical matters implicated in the *routine organization* of domestic life. Close attention to that expertise-in-action elaborates a host of reoccurring situations in which the use of technology is routinely implicated. Appropriate adaptation of the original patterns framework may, then, serve to sensitise design to common patterns of technology usage that exist in the home and reciprocally ground technology development in practical situations of use, thereby elaborating requirements for future technologies.

The Original Pattern Language Framework

Pattern language frameworks for design have their origins in the critique of architecture and efforts to reconstruct the discipline through evaluating the use and adaptation of towns and buildings (Brand 1995). The notion of a pattern language framework emerges specifically from the work of the architect Christopher Alexander (1979) and stands on number of foundational observation:

1. Towns and buildings are organized through patterns of events that people take part in over and over again. Being in bed; having a shower; having breakfast in the kitchen; going for lunch; going to the movies; taking the family to eat at a restaurant; having a drink at a friend's house; driving on the freeway; and going to bed again are examples used by Alexander to illuminate the point. Our lives are conducted in towns and buildings and for the large part organized in terms of *reoccurring of patterns of events*: of work, leisure, entertainment, relaxation, and the rest.

2. Although reoccurring patterns of events are implicated in the daily lives and practical actions of a society's individuals, a great many patterns are not

individualistic but organize “our lives together” as members of society. Thus, and for example, each morning people get up, shower, eat breakfast, and drive down the freeway to work, where they together engage in other patterns of events, such as checking their mail, attending meetings, or going for lunch, etc. A great many of the patterns of events whereby towns and buildings are organized are thoroughly *social* then, which gives them a general character.

3. The general character of patterns is warranted by the recognition that as a matter of ordinary social convention, patterns of events are *tied to particular places* within a society. So, for instance, having a shower is tied to the bathroom, eating breakfast to the kitchen, driving to the highway (and not the sidewalk), for example. In being tied to particular places, patterns of events are finite and therefore definitive (we do not normally eat dinner in the bathroom, or take a shower in the lounge, for example). It is worth noting also that the patterns which define a place – “larger” patterns in Alexander’s terminology or primary patterns in ours – are composed of “smaller” or component patterns (e.g. taking a shower is composed of the smaller patterns: turning the shower on and setting the temperature, washing, drying, etc.).

So towns and buildings (including the home) are made up of reoccurring patterns of events which have the properties of being social and generalizable as a result of a) being tied to particular places by social convention, b) being finite, and c) being definitive of place.

The preliminary objective of pattern analysis is to identify the finite patterns of events that occur in and define the particular places or sub-environments that make up the home: in the kitchen, the living room, the study, etc. The primary objective, however, is to explicate the *patterns of relationships* that obtain between patterns of events and the material arrangements of place. Placing analytic emphasis on patterns of relationships, Alexander draws our attention to the reoccurring ways in which people interact with their architectural environment and particularly the material arrangements that it is made up of. Thus, patterns of relationships elaborate the socially organized ways in which people *use* the material arrangements of place (entrances, passage ways, rooms, public and private seating arrangements, etc.), the purpose of which is to inform the design of improved material arrangements of place.

Alexander's Pattern Format

Alexander developed a pattern format to convey knowledge accrued through the application of the framework and to support both the sharing of that knowledge and the nature of improvements that might be made. He describes the layout of the format as follows (an example is provided below). -

First, there is a [pattern number, a title and a] picture, which shows an archetypal example of [a] pattern. Second, after the picture, each pattern has an introductory paragraph, which sets the context for the pattern, by explaining how it helps to complete certain larger patterns. Then there are three diamonds to mark the beginning of the problem. After the diamonds there is a headline, in bold type. This headline gives the essence of the problem in one or two sentences. After the headline comes the body of the problem. This is the longest section. It describes the empirical background of the pattern, the evidence for its validity, the range of different ways the pattern can be manifested in a building, and so on. Then, again in bold type, like the headline, is the solution – the heart of the pattern – which describes the field of physical and social relationships which are required to solve the stated problem, in the stated context. This solution is always stated in the form of an instruction – so that you know exactly what you need to do, to build the pattern. Then, after the solution, there is a diagram, which shows the solution in the form of a diagram, with labels to indicate its main components. After the diagram, another three diamonds, to show that the main body of the pattern is finished. And finally, after the diamonds there is a paragraph which ties the pattern to all those smaller patterns in the language which are need to complete this pattern, to embellish it, to fill it out. (Alexander *et al.* 1977, xi).

(N^o title) **54 Road Crossing**



(Introductory Paragraph) Under the impetus of PARALLEL ROADS (23) and NETWORK OF PATHS AND CARS (52), paths will gradually grow at right angles to major roads - not along them as they do now. This is an entirely new kind of situation, and requires an entirely new physical treatment to make it work.



(Headline) **Where paths cross roads, the cars have power to frighten and subdue the people walking, even when the people walking have the legal right-of-way.**

(Body of the Problem) This will happen whenever the path and the road are at the same level. No amount of painted white lines, crosswalks, traffic lights, button operated signals, ever quite manage to change the fact that a car weighs a ton or more, and will run over any pedestrian, unless the driver brakes. Most often the driver does brake. But everyone knows of enough occasions when brakes have failed, or drivers gone to sleep, to be perpetually wary and afraid.

The people who cross a road will only feel comfortable and safe if the road crossing is a physical obstruction, which physically guarantees that the cars must slow down and give way to pedestrians. In many places it is recognized by law that pedestrians have the right-of-way over automobiles. Yet at the crucial points where paths cross roads, the *physical* arrangement gives priority to *cars*. The road is continuous, smooth, and fast, interrupting the pedestrian walkway at the junctions. This continuous road surface actually implies that the car has the right-of-way.

What should crossings be like to accommodate the needs of the pedestrians?

The pedestrians who cross must be extremely visible from the road. Cars should also be forced to slow down when they approach the crossing. If the pedestrian way crosses 6 to 12 inches above the roadway, and the roadway slopes up to it, this satisfies both requirements. A slope of 1 in 6, or less, is safe for cars and solid enough to slow them down. To make the crossing even easier to see from a distance and to give weight to the pedestrian's right to be there, the pedestrian path could be marked by a canopy at the edge of the road.

A big wide road with several lanes of heavy traffic can form an almost impenetrable barrier. In this case, you can solve the problem, at least partially, by creating islands - certainly one in the middle, and perhaps extra islands, between adjacent lanes. This has a huge effect on a person's capacity to cross the road, for a very simple reason. If

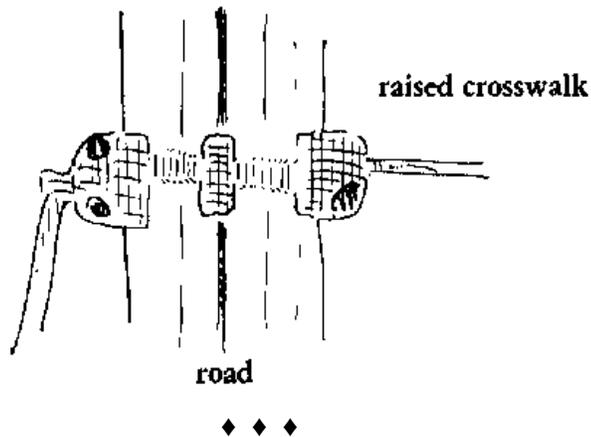
you are trying to cross a wide road, you have to wait for a gap to occur simultaneously in each of the lanes. It is the waiting for this coincidence of gaps that creates the problem. But if you can hop from island to island, each time a gap occurs in any one lane at a time, you can get across in no time at all - because gaps which occur in individual lanes are many many times more frequent, than the big gaps in all lanes at the same time.

So, if you can't raise the crossing, at least use islands, like stepping-stones.

Therefore:

(The solution) **At any point where a pedestrian path crosses a road that has enough traffic to create more than a two second delay to people crossing, make a "knuckle" at the crossing: narrow the road to the width of the through lanes only; continue the pedestrian path through the crossing about a foot above the roadway; put in islands between lanes; slope the road up toward the crossing (1 in 6 maximum); mark the path with a canopy or shelter to make it visible.**

(Diagram)



(Tying Paragraph) On one side or the other of the road make the pedestrian path swell out to form a tiny square, where food stands cluster round a bus stop - SMALL PUBLIC SQUARES (61), BUS STOP (92), FOOD STANDS (93); provide one or two bays for standing space for buses and cars - SMALL PARKING LOTS (103), and when a path must run from the road crossing along the side of the road, keep it to one side only, make it as wide as possible, and raised above the roadway - RAISED WALK (55). Perhaps build the canopy as a trellis or canvas roof - TRELLISED WALK (174), CANVAS ROOFS (244). (Alexander 1977)

Alexander employs this format as a means of conveying general architectural problems and solutions as seen and understood from a social and user-centred or interactional point of view. Each pattern describes a particular reoccurring problem occasioned by some particular material arrangement of place, followed by the new improved architectural solution to that problem. Gross generalities are eschewed and emphasis is instead placed on the particular relationships that obtain between particular patterns of events and the particular material arrangements to which those events are tied.

The Adapted Patterns Framework

While we might accept Alexander's basic conceptual framework as outlined above, it clearly stands in need of adaptation if it is to cater for the use of technology. Consequently, we extend the notion of material arrangements of place to incorporate the relationships that exist between patterns of events that occur in various sub-environments in the home and the technologies that reside there as the primary focus of the framework. We construe of technology in the *broad sense* of the word to include such things as the humble pen and paper, tables, noticeboards, etc., as well as sophisticated electronic and computing systems. As Venkatesh and Nicosia (1997) put it, we need to look at a whole range of technologies in the home no matter how mundane,

[for] in order to understand the adoption/use issues of computers, one must view the total technological space of the household ... very little insights will be gained by looking at computers alone. (p. 527)

So, for example, in the course of "making breakfast" certain pragmatic day-to-day patterns of relationships become apparent and make technologically-mediated arrangements of domestic life involving kettles, toasters, microwaves, radios, TVs, newspapers, and the rest, visible. Close attention to patterns of technical relationships in the home reveal *patterns of technology usage* in context: in the kitchen, dining room, living room, study, and in the making of breakfast, dinner, entertaining guests, or doing schoolwork, etc. Thus, the adapted patterns framework sensitises designers to common situations and patterns of technology usage that exist in the home and make those situations and patterns available to designers considerations of future technological arrangements of place (Borchers and Thomas 2001).

Empirical patterns of technology usage may be located and identified through “video ethnography” (i.e. the installation of video cameras in domestic settings) and the application of four discrete analytic procedures to the video data.¹

1. The molecular sequences of interaction captured on videotape consist of a grossly observable layer of *conversational formulations* over the unfolding course of which members articulate what it is that they are doing, what event is going on, or what practical project of action they are together engaged in here and now (Garfinkel and Sacks 1970). The pattern analyst’s first task is to describe these conversational formulations, and relevant non-verbal actions within which they are located, as they are hearably produced and recognized by parties to the talk.

Example: *An adult female (mum) enters the kitchen with a young child (Levi). Mum sits Levi at the kitchen table, gives her some junk mail to open and starts cleaning the kitchen. Levi is opening the mail.*

Levi: Can I have a biscuit?

Mum: You’ve left your apple.

Levi grumbles unintelligibly.

Mum: Stop making all that noise.

Levi: Will you get me some piece of paper?

Levi: Will you get me some piece of paper?

Levi: Will you get me some piece of paper?

Mum: Go and get your own up stairs.

Levi: No, I want you to get me some.

Mum: Oh wait a minute, I might have some down here.

Mum retrieves a couple of sheets of paper from a kitchen shelf and puts them on the table along with a pencil. Levi picks the pencil up and starts drawing on the paper and Mum carries on with the housework.

Levi: Can I paint?

Levi: Can I paint?

Mum: No, not today ‘cause we’ve got to keep the house clean.

¹ We are currently applying the framework to a large corpus of video data (some 6000 hours in total) gathered across a range of homes.

Levi: I want to paint.

Mum: Not today.

2. As the example makes plainly visible, household members accomplish “work” (i.e. practical activity) through their conversational formulations. Describe *the work performed* by members’ formulations then.

Example: Mum places Levi at the kitchen table and gives her some junk mail to play with while she gets on with the housework. Levi asks for a biscuit and is mildly admonished by her mum for not eating the apple she has already been given. Levi grumbles about this and mum carries on with the housework. Levi asks if she can have some paper? Mum gets Levi some paper and a pencil and resumes her work. Levi draws on the paper for a while then asks if she can paint? Mum refuses to let Levi paint.

3. The work is organized in terms of discrete “practices” or *reoccurring courses of practical action* (Button and Harper 1996). Describe those practices.

Example: The child is (a) sat at the kitchen table and (b) given something to occupy her in order that (c) the adult can get on with the housework. The child soon tires of the junk mail and (d) makes a request for some paper. The request is (e) turned down and (f) restated. The adult locates some paper and a pencil and gives it to the child. The child (g) starts drawing on the paper while (h) the adult carries on with housework. The child (i) makes a request to paint, which is (j) denied.

4. Members work-practices (reoccurring courses of practical action) make discrete *patterns of technology usage* visible. Describe those patterns.

Example: The sequence makes a pattern of kitchen table use visible where the table is employed as a technology to *coordinate activities* in the home. Here the table is used to coordinate the actions of mother and child, being employed as an appropriate location to do *drawing*, and on other occasions, *painting* while mum gets on with cleaning the kitchen. The placing of the child at the kitchen table allows mum to monitor the child and so *maintain awareness* of the child while doing the housework.

By attending to the molecular sequences of interaction that take place in and across the various sub-environments of the home, and which latch together to make up the home as whole, an empirical corpus may be assembled locating design in everyday patterns of socially organized events and technology usages in the home. Video ethnographies of the kitchen environment, for example, reveal that the kitchen table is an *activity centre* around which many discrete patterns of use are located and which coordination and awareness are integral features of. The kitchen table is used for the placing and sorting of mail and connected to display patterns where relevant mail is placed on noticeboards for the awareness of household members, for example. Similarly, the table is commonly used for writing and the sharing of written objects such as notes and shopping lists. Or again, for household management activities within which the use of diaries and ledgers are implicated. Books and magazines are read at the kitchen table, notebooks annotated, and schoolwork carried out there. In short, a plethora of patterns revolve around the kitchen table. Many patterns may be augmented with new technologies ranging from projected interactive surfaces and display devices to mobile networked devices making home content available on the fly. Empirical investigation will reveal many more possibilities for design around the home, grounding the development effort in a multiplicity of practical day-to-day circumstances which the success of domestic technologies will inevitably depend upon.

The Adapted Patterns Format

Just as we have adapted Alexander's pattern framework to cater for the socially organized use of technology, then so we have adapted Alexander's pattern format to convey knowledge of that use. The first adaptation we make is to construct a web-based rather than text-based format, which has more affordances than paper and greatly enhances dissemination. Although we retain the basic structure of Alexander's format we make the following changes.

While retaining the **PATTERN N^o#** we dispose of the picture, replacing it with an embedded hyperlink which is connected to the molecular sequence of video the pattern is derived from. We also retain a commonsense **TITLE** (e.g. "making breakfast", "doing homework", "assembling for dinner"). Given our emphasis on

patterns of technology usage, we add a sub-heading **Key Technologies** listing keywords that describe the technologies used in the video sequence (e.g. TV, mobile phone, microwave, kitchen table, etc.).

The Introductory Paragraph is renamed **Interactional Setting of the Pattern**. This section briefly describes a) where the pattern occurs (e.g. in a small kitchen in family home); b) who is involved in the sequence of interaction (e.g. one adult female and her young daughter); c) what the parties to the interaction are doing (e.g. cleaning the kitchen); and d) the primary pattern this pattern is a component of (e.g. doing domestic chores). Hyperlinks connect the pattern to a primary **patterns log**, where access to the corpus of component patterns making up the particular primary pattern is provided.



The Essence of the Problem is renamed **Organizational Context** and provides a formal summary of the practical domestic issue addressed by the pattern (e.g. Doing the housework with a young child in tow is no easy task. The child must be occupied in some way if the work is to get done. This pattern shows something of the work involved in coordinating the activities of children and adults, who have domestic chores to attend to.).

The Body of Problem is renamed **The Work of the Pattern** and describes the observable activities involved in the production of the pattern. The work is summed up in a synopsis, which precedes a transcript of the talk and relevant practical actions of the parties to the interaction. The transcript allows the reader to inspect the work for him/herself. The length of the sequence is specified by time marks at the beginning and end of the transcript. Partially audible conversational formulations are placed in square brackets and otherwise marked as [inaudible].

The Solution is renamed **The Practices Ordering the Work of the Pattern** and articulates the recognizable social practices implicated in the work's accomplishment. This section describes the familiar, recurring ways in which routine activities (such as cleaning the kitchen, doing schoolwork, handling the mail, etc.) "get done".

The Diagram is replaced with a more appropriate category to the task at hand, namely **The Pattern of Technology Usage**. This section of the format describes the technologies used in the sequence of interaction as elaborated by the work and the practiced ways in which that work is ordered by household members. (For example: The pattern consists of the use of the kitchen table as 1) a site for the placing and sorting of mail. 2) The kitchen table is also used for the doing of children’s activities (drawing and painting). In this respect, the kitchen table is employed to maintain awareness of children and to coordinate the actions of children and adults, who are engaged in other situated activities (cleaning the kitchen in this case)). This section is moved up and placed after the Organizational Context of the Pattern. We do this for reasons of relevance. We assume that persons, particularly systems designers, will primarily be interested in the patterns of technology usage. The other sections may subsequently be read for their relevance to the pattern and for its real world accountability.



The Tying Paragraph is renamed **Connected Patterns** and uses hyperlinks to connect the pattern to a **patterns index**, which provides access to other patterns that use the *same* key technologies. Connected patterns thus elaborate the *bricolage* of socially organized patterns of use that revolve around particular technologies and connect particular technologies together in the home. Thus, the bricolage elaborates various and multiple functional possibilities in the design of new technologies.

Function in Design

The reader may notice that no solution is offered by the adapted format. As noted in our introduction, “one pattern format does not fit all”, indeed the “fit” is relevant to the problem. Like many researchers interested in the domestic setting, our problem is one of understanding the day-to-day events and realities of technology usage that go on in the home and of identifying appropriate requirements for future technologies from out of that melee of happenings. So the format is not configured to provide solutions as that conflates the design task. Before devising technological solutions, we first need to establish a concrete sense of what is to be built? The adapted format is configured to address the *requirements problem* then, and so provides concrete

resources for thinking about the potential role of technology in the home and a means of elaborating the functional characteristics of potential solutions.

The adapted patterns format is concerned, then, with a very different order of problems and solutions than in software engineering (Gamma *et al.* 1995) being developed not for purposes of coding but as vehicle informing the articulation of the potential role and requirements for future technologies in the home. Configured to inform requirements analysis, the patterns of technology usage conveyed via the adapted format serve as a resource which designers may use to think about development and use to ground design in the lived day-to-day realities of domestic life. Sensitising designers to the social and interactional contexts within which technologies will inevitably be embedded in the home, patterns of technology usage play two discrete roles or assume two functions in the design process. Firstly, they allow us to *identify discrete domains for design*. In our own work to date, potential design domains include: awareness and coordination, children's activities, household management, security, education, internal and external communication, media services, and health and safety. Secondly, patterns work as resources for design in some very familiar ways, being easily assimilable into design practice in supporting *the construction of use scenarios* (Carroll 1994) and the articulation of functional requirements to meet the demands of these scenarios. Patterns of events and technology usage are everywhere in the home and designers may start their own studies anywhere. To do so they require willing subjects, video equipment, and the application of the adapted pattern framework's procedures to the interaction captured on the videotapes.

Appendix

Adapted Pattern Format	Original Pattern Format
<p>1. Nº-# TITLE (linked to video sequence) Key Technologies: (used in sequence)</p>	<p>1. Numbered title and picture Shows an archetypal example of a pattern</p>
<p>2. Interactional Setting of the Pattern Describes:</p> <ul style="list-style-type: none"> a) where the pattern occurs b) who is involved in the sequence of interaction c) what the parties to the interaction are doing d) the primary pattern this pattern is a component of (linked to pattern log which provides access to other component patterns making up the primary pattern) 	<p>2. Introductory Paragraph Sets the context for the pattern, by explaining how it helps to complete certain larger patterns</p>
◆ ◆ ◆	◆ ◆ ◆
<p>3. Organizational Context of the Pattern Provides a formal summary of the practical domestic issue addressed by the pattern</p>	<p>3. Essence of Problem Describes essence of the problem in one or two sentences</p>
<p>4. The Pattern of Technology Usage Describes the technologies used in the sequence of interaction as elaborated by the work and the practiced ways in which that work is ordered by household members</p>	<p>4. The Body of the Problem Describes the empirical background of the pattern, the evidence for its validity, the range of different ways the pattern can be manifested in a building</p>
<p>5. The Work of the Pattern Describes the observable activities involved in the production of the pattern. The work is summed up in a synopsis, which precedes a transcript of the talk of the parties to the interaction, allowing the reader to inspect the work for him/herself.</p>	<p>5. Solution The heart of the pattern – describes the field of physical and social relationships which are required to solve the stated problem, in the stated context</p>
<p>6. The Practices Ordering the Work of the Pattern Describes the familiar, recurring ways in which the routine activity of work “gets done”.</p>	<p>6. Diagram Shows the solution in the form of a diagram, with labels to indicate its main components.</p>
◆ ◆ ◆	◆ ◆ ◆
<p>7. Connected Patterns Uses hyperlinks to connect the pattern to a patterns index, which provides access to other patterns that use the same key technologies.</p>	<p>7. Tying Paragraph Ties the pattern to all those smaller patterns in the language which are need to complete this pattern, to embellish it, to fill it out.</p>

Adapted Patterns Format

PATTERN N^o. #. AND TITLE

Key technologies:

Interactional Setting of the Pattern: Location; event (weekday/weekend)

Time: . Date: . Study: #.

Body text

Links to patterns log



Organizational Context of the Pattern

Body text

The Pattern of Technology Usage

Body text

The Work of the Pattern

Synopsis:

Transcript:

The Practices Ordering the Work of the Pattern

Body text



Connected Patterns

Links to pattern index

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