AN INVESTIGATION INTO FACTORS AFFECTING THE ADOPTION AND DIFFUSION OF SOFTWARE PATTERNS IN INDUSTRY

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ABSTRACT

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This study examines the adoption and dissemination of software patterns amongst individuals and into organizations. Patterns and pattern languages are a new contribution to the area of software reuse and are becoming the tool of a growing community that is attempting to capture best practices in the software development industry. This study traces the roots of the patterns philosophy from the work of C. Alexander in the architectural built environment to the present, conflicting views of patterns in the software industry. It then presents a critical assessment of patterns in terms of a structure for documenting knowledge, a process for using that knowledge, and a community that is involved in the effort.

The research is prompted by the scarcity of resources for individuals who wish to introduce patterns into their organizations, and the almost complete lack of theory concerning patterns use. It is therefore an exploratory study for the purpose of building theory in this relatively unexplored area. The study borrows from diffusion of innovation (DOI) theory to build a theoretical framework proposing fifteen factors that are likely to influence individual use of patterns, and then utilizes three research operations, providing both quantitative and qualitative data, to examine and explain these factors. Findings show that ten of the fifteen proposed factors appear to have a direct influence on use, while four more are added as an indirect influence. Analysis of the findings offers guidelines for industry practitioners who wish to encourage pattern use in organizations and for researchers who wish to use this study as a foundation for ongoing research.

Table of contents

List of Tables

List of Figures

List of Appendices

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CHAPTER 1:

INTRODUCTION

1.1 Overview

Patterns and pattern languages are a new contribution to the area of software reuse. They have become the tool of a growing community that is attempting to capture best practices in the software development industry (Hillside, 2002). Unlike other approaches for doing this, patterns offer a template for documenting knowledge, a process for using that knowledge, and are found in a community that is involved in the effort (Coplien, 1996a; Rising, 1998c). In recent years, there has been a promising body of empirical and anecdotal evidence to suggest their value. Despite the benefits, adoption has been primarily among individuals (Hillside, 2002). Even though organizations would seem to have much to gain from a reuse approach to software development (Reife, 1997), there is little evidence that many are utilizing patterns to achieve it. If patterns are to continue to show promise for effectively capturing industry-wide best practice, one can argue that it is important to widen pattern adoption from individuals to organizations. However, there is anecdotal evidence suggesting that introducing patterns into an organization is a difficult and time-consuming task (Rising, 1998; Letourneau, 1999; Cockburn, 1999; BrownK, 1999). Despite this, the diffusion of patterns is a relatively unexplored area of research. To date the results of very few efforts are in the public domain (e.g. DeLano+, 1997; Seen+, 2000). Although this scarcity offers few resources for individuals who wish to lead an effort to introduce patterns into their organizations, it also provides a prime opportunity for new research.

This thesis is an exploratory theory-building study that examines the phenomenon of introducing patterns amongst individuals and into organizations. It is motivated by the need to inform researchers and practitioners about how they may position patterns in organizations to encourage a faster and more efficient adoption.

There are two goals in this research, one primary and one as a secondary point of interest. The first goal is to identify the factors that influence individual pattern use. The purpose is to cultivate an understanding of pattern use by individuals in organizations. The following question guides this primary goal:

What factors influence the use of patterns among individuals in organizations?

The secondary goal of this research is to examine the factors that are being emphasized by those introducing patterns into their organizations. The purpose is to prompt an understanding of what individuals are doing to influence the use of patterns. The following research question guides this secondary goal:

What factors are being emphasized by individuals introducing patterns into organizations?

The reasoning behind the inclusion of these two goals is that while one provides the view of those that use patterns, the other provides the view of those that are attempting to encourage pattern use. This approach supplies two perspectives for this theory-building study.

To meet the two research goals, the following objectives will be accomplished:

- To present an initial model and corresponding propositions that, grounded in innovation diffusion research, proposes to identify some of the factors that impact upon individual use of patterns in organizations.

- To refine the model through empirical investigation in a field study of individuals who use patterns and individuals who are attempting to introduce patterns into organizations.

- To generate insights into the phenomenon of individual pattern use by suggesting some explanations for the findings and some recommendations for further inquiry.

The initial model is framed in the patterns philosophy of C. Alexander and diffusion of innovation research grounded by E.M. Rogers and enhanced by others. The model, and its corresponding propositions, puts forward the personal and environmental factors that have the potential to influence individual use of patterns in an organizational context. The purpose is to build theory by refining this model and providing responses to the study's research questions.

The model is examined with multiple sources of data in three research operations. The first surveys individuals who use patterns in organizations to identify the correlations between pattern use and the fifteen proposed factors. The second explores the factors that appear in the practices of those who are introducing patterns or are planning to introduce patterns into organizations. Then, to provide explanatory insight for the quantitative results in the first two

operations, a third seeks feedback on the findings from those who supplied the data in the first two. This qualitative data will afford further strength for the data analysis and, in turn, the final model.

The next section presents the conditions that prompt the overriding motivation for the use of software patterns, the need for a more efficient and effective means of capturing and reusing successful practices in the software development industry.

1.2 Reuse of successful practice

There is ever-increasing pressure to deliver quality software (TaylorD, 1995). The once common notion that programmers and end-users will settle for software of poor quality is eroding (Gibbs, 1994). At the same time, mounting competition in the industry has made it critical to deliver products as quickly as possible (Gibbs, 1994; Sprott+, 1998). Developers and managers are further challenged by the fact that they must meet these demands as the systems continue to grow in size and complexity (Corfman, 1998; Coplien, 1994).

Despite the pressures, it does not appear that the software industry has found consistently effective ways to build its products. In 1968, the NATO Science Committee defined software engineering as "the application of a systematic, disciplined, quantifiable approach to the development, operation and maintenance of software" (Gibbs, 1994). Almost 30 years later, in 1994, the industry was criticized because, "the vast majority of computer code is still handcrafted from raw programming languages by artisans using techniques they neither measure nor are able to repeat consistently" (Gibbs, 1994). In 1995, Taylor reported that the 18-month project backlog had increased to three years in most organizations, while the time to complete new applications ranged from two to five years (TaylorD, 1995). The situation did not appear to improve in the following years as a five year survey by the CHAOS project, from 1995 through 1999, reported that only 26% of software projects achieved a successful completion (Standish, 2001).

The industry responded to what many termed the "software crisis" (e.g. Gibbs, 1994; Brooks, 1995a) by creating tools that supported the process of developing applications (Green, 1999). These included such things as fourth-generation languages, CASE tools, and object-oriented technology (TaylorD, 1995; Kishore, 1999). However, as late as 1998, the situation did not appear to be much different. Sprout and Wilkes wrote, "Software development has remained a 'craft' industry, beset with problems of delayed and cancelled projects, inadequate quality, long cycle-times and high costs" (Sprott+, 1998).

These conditions in an industry with complex and ever-changing problems has prompted many to examine the gains that can be made in building systems with less handcrafting from scratch and more reuse of previously built components (e.g. Wappler+, 1995; Poulin+, 1993; Yourdin, 1992; Woodfield+, 1987). Expected benefits include the production of more reliable and consistent systems in an efficient and timely manner with less maintenance costs (NIST, 1999; Goldberg+, 1995a; Tracz, 1995). However, the realization of these benefits has been mixed among organizations. Sampat (1999) reports that some claim to achieve rather impressive results, while others report frustrations and failures. In most cases, the experiences center primarily on the reuse of code artifacts such as procedures, data definitions, components and frameworks (O'Callaghan1998a). Gamma (1995) notes that the attempts to document industry-wide software knowledge prior to the mid-1990s, had focused on coding algorithms (e.g. Knuth, 1973; Glass, 1990; Arvo, 1991; Kirk, 1992). Yet, Rising (2002) points out that the widely applied code libraries do not even begin to tackle the problem of continually reinventing the wheel in software development. This emphasis on code reuse was also found in case studies by Fichman (1997) and has been explained by Tracz:

> *Most programmers tend to view reusability from the perspective of simply reusing code, whereas reusing other programming artifacts (e.g. designs, specifications, and tests) leads to more productivity* (Tracz, 1995).

The industry has only recently attempted to increase productivity by expanding its view of reuse beyond code to other artifacts from the system development process (Kogut, 1995). The importance of doing this was identified by Brooks as early as 1986 (Brooks, 1995a). He notes that advancements associated with programming have historically had only a small impact on reducing the complexity of building systems. His often-cited series of articles makes a strong argument that the industry should look for solutions in the "essential tasks", those that form the abstract software entities, rather than in the labor of representing these entities in code (Brooks, 1995a; Brooks, 1995b).

Kazman (1999) and Kogut (1995) stress that the industry needs reusable artifacts to support the design task because much of what software engineers do when designing solutions is innovative, rather than routine as in other engineering disciplines. Jackson (2001) points out that other engineering disciplines have long since specialized according to the types of problems that they solve and have an accumulated knowledge base that allows 90% upwards of their problem-solving to be routine. He argues that this is in contrast to software engineering, which has problems that are much too complicated because the discipline has not developed a similar knowledge base.

The lack of routine is likely due in some part to the fact that, unlike some other engineering disciplines, software engineering has not documented its practices in a reusable form. Kogut (1995) points out that the industry's documentation is incomplete, scattered across many sources, and has not been authored with a high level of industry participation. Coplien (1999b) takes this a step further by suggesting that the lack of common literature is an indication of the lack of common culture in software development. Therefore, many are suggesting that, after 30 years as a developing discipline, it is now time for software engineering to document its successful practices in a reusable form (e.g. Kazma, 1999; Kogut, 1995; Gibbs, 1994; Rising, 1998b).

The industry has made some attempts to do this. Tools have been developed and marketed as the answer, in this case to support the process of capturing, storing and sharing knowledge (Dordick, 1998). In the 1980s, expert system software offered a way to capture what experts do (Krovvidy, 1999). In the 1990s, groupware and knowledge management software was developed, by companies such as Lotus Development Corporation, in an effort to facilitate communication of knowledge from one person to another. Despite these efforts to provide the technical means to communicate knowledge and to document algorithmic structures, the industry has not achieved systematic reuse (Fichman+, 1997). While tools provided the technical means to store and share information, the process for using the tools to effectively capture and reuse the knowledge has not been adequately addressed (May+, 2002). In addition, there has been little emphasis on the non-technical issues such as building a culture that supports a knowledge sharing approach to system development (Fichman+, 1997; Griss, 1993).

Experiences support the importance of considering both the process and the cultural issues. Those that have studied or have been involved in reuse efforts report that reuse does not happen by simply providing artifacts and a particular technology to store and retrieve them. Rather, it is a process that involves a change in the system development culture to be successful (Griss, 1993; Griss, 1995). Many stress that the challenging non-technical matters, such as process, infrastructure and management, are vital to realizing a successful reuse effort (e.g. Boehm (1999); Fichman (1997); Lied (1997); Goldberg (1995b); Lenzi (1995); Joos (1994); Griss (1993)). In addition, Coplien (1999c) argues that the industry's focus on low-level details such as objects has caused it to lose the system perspective, and the preoccupation with planned design method has caused engineers to lose the human perspective. Therefore, it would appear to be in the industry's interest to consider not only

the technical matters, but the non-technical concerns of process and human involvement in this process as well.

In summary, the software development industry has attempted to get some relief from the "software crisis" by promoting software reuse. Rather than starting from scratch each time a new system is built, reuse of previously-built components is claimed to provide more consistency from one project to the next, more reliability in the final product, faster development time, and decreased maintenance. However, efforts have centered primarily on code reuse and technical solutions, resulting in limited and scattered success with reuse in organizations. Even when attempts have been made to store and communicate other forms of best practice, little consideration has been given to the process and the human perspective that supports a reuse effort.

The next chapter describes a rather new approach to developing and packaging reusable artifacts from various kinds of tasks in software development. Unlike previous attempts, this one, known as patterns, shows signs of addressing the important process and cultural issues. It therefore warrants some examination.

1.3 Roadmap of thesis

The organization of the remaining chapters in this thesis is as follows:

Chapter 2 (Patterns) presents the distinctive characteristics of patterns, the innovation under consideration in this research. This includes a discussion of the roots of the patterns movement in the work of C. Alexander, the application of Alexander's philosophy to software, the three qualities of patterns (structure, process, community), the tension within the patterns community over the most applicable view of patterns, and the difficulty of introducing software patterns into organizations.

Chapter 3 (Theoretical Foundation) builds the theoretical framework that guides the conduct of this study and the construction of the initial model. Diffusion of innovation research is explored to propose fifteen factors that are examined for their usefulness in building theory about how to influence the use of patterns among individuals in organizations.

Chapter 4 (Research Methodology) describes the three research operations that will be used to examine the factors and build the theory. The primary operation utilizes a survey to offer a response to the study's first research question. The second operation examines a candidate pattern language and role play exercises with that language to offer a response to the second

question. Finally, the third operation uses member checking to provide further insight for analyzing the results from operations one and two.

Chapter 5 (Results) summarizes the data and presents the quantitative results from research operations one and two. These findings propose responses to the study's two research questions and an empirical-based model of the factors that influence the use of patterns among individuals in organizations.

Chapter 6 (Analysis of Results) discusses the research model and suggests some explanations for the findings that underpin it. It explores the commonalities and differences in this study's findings for the types of pattern usage, as well as between the results in this research with those of other software process innovations. In addition, the comments from respondents in operation three are incorporated into the analysis to provide further support and explanation for the findings.

Chapter 7 (Summary and Reflection) summarizes the responses to the study's two research questions and the primary findings. It presents the value of this research by comparing the work to other studies in the use of patterns and by summarizing its nine novel contributions to knowledge. Finally, in the frame of this theory-building research, suggestions for further work in this area are put forward.

CHAPTER 2

PATTERNS

2.1 Introduction

The previous section presented the need for the software development industry to address the issues of the software crisis through increased reuse. Earlier attempts to do this with predominantly technical means have not as yet achieved widespread reuse throughout the industry. It has been suggested that the lack of artifacts other than code and the lack of attention to the non-technical issues, such as process and culture, have contributed to this. Patterns are considered within this perspective.

Simply stated, a pattern describes a recurring, general problem and the solution to the problem in a particular context (Berczuk+, 2000a; Coplien, 1998a; Rising, 1998b). The solution must be a well-tested one because the primary purpose is to capture successful experience and transmit it to others (Rising, 2001a). In software engineering, patterns were initially used to document successful experiences in object-oriented development, primarily in program design and the construction of frameworks (Gamma+, 1995; Buschmann+, 1996). They were most often represented in object-oriented development by commonly recurring relationships between classes.

The use of the term 'pattern' in software engineering was first introduced by Beck and Cunningham who presented, at the 1987 Object Oriented Programming Systems Languages and Applications (OOPSLA) conference, a 'language' of five patterns that captured design decisions for creating human computer interfaces in SmallTalk. This coincided with a realization in the object oriented (OO) community that the single class was not the natural unit of reuse. Previously, the notion of the class as a reusable module had been promoted by Cox's notion of the software IC (Cox, 1990) and Meyer's advocacy of the open-closed principle (Meyer, 1989). The 'open-closed principle' states that a class should be open to extension, via inheritance, but closed to modification, thus providing convenient capsules of reusable functionality.

The need for a level of design reuse, higher than that of individual classes, was addressed by Booch (1991) in what he referred to as mechanisms, structures providing high-level behavior that satisfies some requirement of a problem. Referring to these as the "soul of the design",

Booch stated that they represent strategic design decisions regarding the collaborative activity of many kinds of objects. For example, the drawing mechanism, commonly used in graphical user interfaces, specifies what kinds of objects must collaborate, such as a window and a view, but recognizes that the implementation details would vary depending on the context such as the language and the coding style.

Recognition of the need for a higher-level of design and reuse explains, at least in part, why the OO community was receptive to the idea of patterns. The patterns movement took root during the 1991and 1992 "Towards an Architecture Handbook" workshops organized by Anderson at the OOPSLA conferences. It was at these events that Gamma, Helms, Johnson, and Vlissides met for the first time and deliberated the work that resulted in the very influential *Design Patterns* book. Published in 1995, this book contains a collection of 23 "design patterns" that "describe simple and elegant solutions to specific problems in object-oriented design." The authors wrote that patterns allowed them to capture, "in succinct and easily applied form", software design solutions that "have developed and evolved over time" (Gamma+, 1995).

The publication of this book brought high visibility to patterns, creating the biggest impression to date on the software industry. It describes a pattern as having four essential elements: the pattern name, the problem, the solution, and the consequences. These general features are delivered, with other features, in a specific form, a pattern 'template'. Most pattern templates utilize these same key elements and add others. For example, the *Pattern-Oriented Software Architecture* (POSA) pattern template caters to the capture of software architecture constructs by including such sections as structure, dynamics, implementation, and variants (Buschmann+, 1996). The AG Communication Systems (AGCS) pattern template, used for patterns such as system testing and customer interaction, specifies elements such as context, forces, rationale, and related patterns (DeLano+, 1998b; Rising, 1998a).

In the years following 1995, a large number of books, articles, and web sites have appeared with a variety of patterns addressing recurring problems in building, managing, and organizing software systems (e.g. Buschmann+, 1996; Martin, 1998; Hillside, 2002). Patterns have been continually discussed and debated on electronic mailing lists and are a significant part of conference programs such as the ACM Object Oriented Programming Systems Languages and Applications (OOPSLA) and the OT conferences. It was during one of these conferences, the previously-mentioned OOPSLA'91, that the core of the non-profit Hillside Group was formed to support patterns activities such as the Pattern Languages of Programming (PLoP) conferences. Held annually in the United States, Germany, Australia,

Japan, and South America, these conferences are dedicated to the creation and review of pattern literature including four volumes of the *Pattern Languages of Program Design* books. These activities have allowed the number of patterns to grow rather rapidly. The editor of the recently published book, *The Patterns Almanac 2000* (Rising, 2000), estimated, in the year 2000, the number of published patterns to be over a thousand in approximately sixty-five domain categories. In addition, countless other unpublished ones can be found on an assortment of web pages (Hillside, 2002).

The number and variety of patterns is the outgrowth of the realization that the form may be appropriate beyond the coding level. Since recurring problems and successful solutions have been observed at all levels of software development, the industry is currently using patterns to document many different types of best practice experiences (Hillside, 2002; Rising, 2000; Buschmann+, 1996). This is facilitating the sharing of expertise in many different system development tasks, such as analysis (Fowler, 1997) design (Gamma+, 1995; Buschmann+, 1996), testing (DeLano+, 1998b), project management (Cockburn, 1998), and training (Manns+, 1998c).

The number of published and unpublished patterns, conferences, and web sites are among the signs of a growing, international patterns movement, an effort to bring the patterns vision to the wider software development industry. This phenomenon has been observed by Olson:

> *The incredible success of the Pattern Languages of Programming (PLoP) conferences, the need for members of the community to downplay the hysteria and fight the hype, the huge numbers of patterns and pattern literature being published on the World Wide Web, in software journals, and in books, all point to a wave swelling and soon to break over all of us in software development* (Olson, 1998).

One vehicle which confirms the wider acceptance of patterns and, at the same time, helps promote awareness is that of standards. The Unified Process (UP) for software development is an evolving standard for a process framework in software development. It includes patterns as part of its framework, defining them as "template collaborations" (Jacobson+, 1999). (This term should not be confused with the term 'pattern template' used earlier.) The design notation utilized by the Unified Process is UML (Unified Modeling Language). In UML terms, a template means any parameterized element (Jacobson+, 1999). Thus, in the UP, the notion of a pattern is essentially that of a mechanism, as described earlier, which is made generic through parameterization. Essentially the same idea has appeared in the Object Management Group's (OMG) Model Driven Architecture (MDA) which provides a standard meta-model for middleware environments. Patterns are described in OMG documentation as standard ways, or mechanisms, of mapping between elements in various types of MDA

models (Siegel, 2001). Some CASE tools and programming environments, for example TogetherJ (TogetherSoft, 2002), take the next logical step with this definition of patterns by supplying patterns automatically as parameterized components.

Although Gamma (1995) explains, "Point of view affects one's interpretation of what is and isn't a pattern. One person's pattern can be another person's primitive building block" the UP and MDA viewpoint appears to be somewhat reductionist. In a speech to the 1996 OOPSLA conference, Christopher Alexander warned the software development community that although it was using patterns as a "nice and useful format" that allows the documentation of "good ideas about software design in a way that can be discussed, shared, modified, and so forth", it was in danger of missing the point. The significance of this is that Alexander, an architect in the built environment, is the historical originator of patterns.

2.2 The foundation for patterns

Patterns in software engineering draw their inspiration from Christopher Alexander who is recognized as one of the most important building and urban planning architects of the twentieth century (Salingaros, 2000). Alexander used patterns to document successful design practices in the architecture profession. His focus on proven solutions rather than new and unique ones was motivated by his observation that modern day buildings and towns do not approach the beauty of the historical past. He notes that the vast majority of architecture since the end of World War II has been dehumanizing, of poor quality and lacking all sense of beauty and human feeling (O'Callaghan, 2001). This created his distaste for simply fashionable architecture and a preoccupation with the search for a design approach that generates beautiful structures (Garbow, 1983). His life mission to make architecture as emotionally rich as the people who live in it has been guided by his belief that this kind of design must be born of ordinary experience (Brown, 2000). His patterns describe "the obvious" which, he observes, is usually ignored because people are so often caught up in fashion and trends. In architecture, new and unique work is often rewarded even though it is not comfortable to reside in. Therefore, he argues for the "one timeless way of building" (Alexander, 1979). It is worth summarizing Alexander's philosophy of construction in order to better evaluate its significance for software development.

Alexander graduated from Cambridge University where he studied mathematics and architecture, and later received a Ph.D. in architecture from Harvard University. His more than one hundred books, papers, and monographs includes eleven books (table 1), three of which are well known in the software patterns community, *The Timeless Way of Building*, *A Pattern Language*, and *The Oregon Experiment*.

Volume	Book
1	The Timeless Way of Building (1979)
2	A Pattern Language (1977)
3	The Oregon Experiment (1975)
4	The Linz Café (1981)
5	The Production of Houses (1982)
6	A New Theory of Urban Design (1987)
7	A Foreshadowing of 21st Century Art (1993)
8	The Mary Rose Museum (1995)
9	The Nature of Order (yet unpublished)
10	Sketches of a New Architecture (yet unpublished)
11	Battle: The Story of a Historic Clash Between World System A and World System B (yet unpublished)

Table 1: Alexander's Books Describing a New Attitude to Architecture and Building

The roots of Alexander's patterns philosophy can be found in an earlier publication, *Notes on the Synthesis of Form* (Alexander, 1964). It presents a critique of modern design, contrasting what he regarded as the failure of the professional, rational "self-conscious" design process with an approach which he calls an "unselfconscious" design process. Modern design is distinguished from traditional craftsmanship by its "self-conscious" separation of design from the final product and its construction and its reliance on rules and formal models to produce abstract designs. In the face of modern conditions of increased complexity and accelerating change, society has specialized and spun off design into a separate profession. Alexander argues that placing the responsibility of dealing with all of the multiplicity and changeability of forces impacting a project on the shoulders of a single individual ('designer' or 'architect') rather than embedding it in a more general social process has been counterproductive. The cognitive burden of highly complex design is just too great.

In contrast to an approach that relies on rules, formal models, and a knowledge base rooted in abstract design, Alexander points to the historical success of the unselfconscious design process. This process is one that can be recognized in conditions where change rates were slow and design failures are experienced as one-offs. The knowledge of how to build, and therefore to design, is embedded in culture and tradition. This surrounding culture is slow moving and highly resistant to change, in other words, highly conservative. Alexander gives modern examples of the huts built by the Mousgoum tribe in Cameroon and the igloos of Eskimos. Traditions and cultures dictate how each of these kinds of structures is built. Those who live in these kinds of houses are the experts in building them. When a design failure is caused, for example by a river flooding a Mousgoum village, or when changing temperatures

require igloos to be ventilated or blocked up, the same design culture which dictated how the structure should be built also determines how they can be repaired. There are no specialist architects in these societies. There is no separate theory of design. Instead, there is praxis, the result of perhaps hundreds of years of accumulated experience, of building structures that has infused the design culture. In the unselfconscious design process, therefore, because the design failures which require changes to be made tend themselves to happen one at a time, and are typically familiar, adaptation is relatively easy. Also, because no professional specialist is involved, the feedback loop is immediate. The dweller makes the repair.

In contrast, in modern society, design failures are often caused by multiple forces and are often experienced as catastrophe. Repair is highly complex and requires the design profession to be called in. Therefore, adaptation becomes difficult and potentially risky. In the unselfconscious design process, the adaptation is easily accommodated into the design culture because of the culture's slow rate of change. Equilibrium between form and context is dynamically established and reestablished continually. In the modern selfconscious process, the rapidity and accumulation of changes, especially perhaps technological changes, has eradicated traditional design culture without replacing it. Change is experienced as crisis. Therefore, Alexander claims that successfully designed products or systems need to be homeostatic, that is self-adjusting. This is the quality that he found in buildings created using the unselfconscious design process and is, he argues, most wholly absent from modern structures. An individual tree may be considered an example of an homeostatic system. It presents a form that is optimally fitted to its environmental context. For example, its height is partly determined by its need to compete for sunlight with other trees in the canopy. The number of leaves and branches it presents is determined by the amount of moisture it requires in its specific situation. And even its shape is fashioned by prevailing wind conditions. Of course a tree has no designer. Its genetic code allows it to take account of and adapt its specific environment. Alexander's philosophy is concerned with finding the modern equivalent of a 'genetic code' for building which had been embedded in traditional design approaches but was lost along with them. We shall see below that, for Alexander, pattern languages supply that genetic code.

In the history of architectural theory, *Notes on the Synthesis of Form* is considered a post-modern classic (Lawson,1997). Drawing on the unselfconscious process, Alexander attempts to show the underlying correspondence between the pattern of a problem and the process of designing a form that answers that problem. Although his later works abandoned the algorithmic nature of the process he introduced in that book, the underlying design philosophy remained intact in the three books that have recently become familiar to many in the software

industry, *The Timeless Way of Building*, *A Pattern Language*, and *The Oregon Experiment*. In addition, the rough sketches that were a minor part of the original process grew significant and became the beginnings of the patterns he documented in the years that followed (Alexander, 1971).

Alexander does not seek to return to primitive methods of building, but rather proposes a new approach that captures some of the qualities of unselfconscious design. It is one that creates well-fitting form through adaptation and through the creation of a new design culture captured in the patterns. The idea is that the patterns can be the genetic code embedded in homeostatic design products.

The patterns work took shape in *The Timeless Way of Building* (Alexander, 1979) and *A Pattern Language* (Alexander, 1977). The former describes the philosophy and rationale for design that makes use of traditions, captured in patterns, in a piecemeal approach to creating well-fitting form. The latter presents the concrete details in a collection of related patterns that Alexander terms 'a pattern language'.

The Timeless Way of Building explains that every society which is alive and whole will have its own unique and distinct pattern language for building (Alexander, 1977). It is through the documentation and use of this language that this same society can obtain quality in structural forms. Pattern languages are designed to replace what has been lost from the traditional, unselfconscious approach to design (Blum, 1996). Their purpose is to capture the practices that will rebuild the quality once found in traditional architecture, but lost in modern structures, and to create a genuine culture of design.

Alexander claims that the 'languages' people have for building their dwellings and cities are so fragmented that well-fitting, quality form can no longer be obtained. To return to the capability of building such structures, *A Pattern Language* contains 253 patterns that form a collection of related practices for creating architectural form (Alexander, 1977). Each encapsulates a solution to a problem in urban architecture and design at a variety of levels of scale, from the construction of floors and walls, the placement of windows, and the details of gardens, to the design of city buildings, streets and surroundings. The patterns evolve from the community's culture and are designed to be used collaboratively by the builders and the community inhabitants. This practical method of architecture, which combines the responsibilities of all those involved in creating the entities in the community and the community as a whole, is the result of Alexander's strong belief that the inhabitants of the

community, rather than specialist architects or designers, are the ones who know most about what is needed to create quality.

Individual patterns are applied during the construction process when a problem in a given context creates the need for one. The problems result from conflicting conditions, or "misfits", in the system. The application of a pattern to correct a misfit results in a change in the system's state, thus creating a new context, with a new problem, to which a new pattern can then be applied. Alexander explains that, each of these acts is "done to repair and magnify the product of previous acts", which slowly generates "a larger and more complex whole than any single act can generate" (Alexander, 1979).

This gradual introduction of differentiations is what Alexander refers to as *structure preserving transformation* (Alexander, 1996). He relates it to the emergence of organic life which is generated, not through a plan that dictates where cells should be placed, but rather through a subtle organized cooperation of parts. Therefore, a living order is formed purely by the interaction of cells guided by the genetic code. He compares patterns in a language to seeds in a genetic system which, through millions of small acts, have the power to create form (Alexander, 1979). He argues that, as in biology, the structure of a town can and should be woven from the interaction of individual acts of building. This piecemeal approach should be guided by the culture's traditions rigidly maintained in a common language. The language, a collection of related patterns, is what governs the construction of the parts and, in turn, the orderly emergence of the whole (Alexander, 1979).

The essential fact, Alexander claims, is that as in organic structures, pattern form and the form of final whole structures, are not generated suddenly or through the use of some type of dictated plan, such as the abstract master plans commonly used in modern architectural design practices. Rather, patterns come into being as the result of a long sequence of tiny acts and transformations which, if they are repeated often enough, have the power to create a pattern and eventually a language of patterns (Alexander, 1979). Similarly, structures are shaped piecemeal, from applying patterns one at a time, causing transformations that preserve the whole at each step towards the creation of the final form.

This approach to design and building that allows the details to be fitted to the overall, evolving structure is best explained in Alexander's own words as follows:

> *The fundamental philosophy behind the use of pattern languages is that buildings should be uniquely adapted to individual needs and sites; and that the plans of buildings should be rather loose and fluid, in order to accommodate these subtleties*

> *... Recognize that you are not assembling a building from components like an erector set, but that you are instead weaving a structure which starts out globally complete, but flimsy; then gradually making it stiffer but still rather flimsy; and only finally making it complete stiff and strong.* (Alexander, 1977).

To envision this philosophy, Alexander compares the construction process of the novice to that of a master carpenter. While the novice's inexperience and fear prompts his desire and need for a blueprint, the master carpenter has the ability to make decisions about details and correct misfits with small, incremental steps while the construction is being done (Alexander, 1977). This is because, unlike the novice, the master has a pattern language for building in his mind and has the ability to combine these patterns to form a structure. Therefore, his actions are guided, not by a master plan, but "according to the processes given by the pattern language in his mind". Alexander points out that the master's approach allows the production of well-fitting form through a continuous analysis and repair of failures and continuous commitment to detail, variety, experimentation and wholeness (Alexander, 1979).

This method of construction, based on the piecemeal correction of misfits, is markedly different from modern architecture practice. Therefore, in the third of the patterns trilogy books, *The Oregon Experiment* (Alexander, 1975), Alexander describes by way of example at the University of Oregon, practical details for how his ideas for an entirely new attitude in architecture and planning may be implemented. This includes the creation of organic order, the role of community participation, the process for piecemeal growth, the use of patterns, and the importance of coordination and regular diagnosis in the planning process (Alexander, 1975). Coplien (2000) claims that it is a good source for the kind of culture and context that supports the writing and incorporation of shared, written patterns, something that computer science has yet to document.

In summary, the piecemeal approach governed by interdependencies between patterns is the cornerstone of Alexander's philosophy of building. It avoids the totalitarian order of a strict master plan that hinges on a view of an environment that is static and discontinuous. Instead, it recognizes an environment that is dynamic and continuous and therefore promotes moving forward in small steps. Ultimately, this permits organic order to arise, defined by Alexander as the perfect balance between the needs of the individual parts and the needs of the whole. The cultural needs are captured in a community's pattern language of general building principles. Because these principles are created by the community, they form a basis for shared agreement. The patterns can then be used by all stakeholders in building projects to, through small acts of building, create communities that meet the basic requirements, have the

quality the inhabitants desire, are usable and adaptable, and ultimately provide the basic necessity that design and engineering improve the human condition.

2.3 The relevance of Alexander's philosophy to software

The patterns effort in the software industry has begun to consider Alexander's patterns trilogy, described above, as a means to explore how his philosophy of a pattern and the underlying design and construction process that stems from it can be useful in developing software. It is not the building architecture knowledge that may be important to the software development, but rather what Alexander teaches about design. It is not simply patterns thought, but a broad approach to design that embraces the creation and use of patterns. This section presents some justification for the link between software design and Alexander's principles of design.

The software patterns movement was prompted by similar observations that prompted Alexander's life work. Alexander observed poor quality in architecture that he argues exists because of the lack of documentation for timeless, successful traditions in building and urban architecture. He also saw the need for a system-based process that supports the use of this literature, one that is able to build quality despite the need to handle the complex architecture demands. Similarly, as explained in chapter one, quality in software has suffered, to some degree, from the lack of a consistent use of its successful practices, and this has created a renewed interest in reusing proven practice throughout the industry. In addition, there is the nagging need to handle the growing complexity and decreasing quality in present day software products with a development process that can cope with this reality.

As explained, Alexander's philosophy resists a linear, master plan, development process and raises concerns about artificial models that separate the designer and the user. Instead, pattern-based design supports a piecemeal, participatory approach that weaves activities and the effects of those activities and integrates rather than separates the various roles. Rather than a master plan, the stakeholders in a project adopt a process that proceeds in an order governed by pattern interdependencies. Similar to the approach of the master carpenter, each step in the construction process involves an analysis of the current problems presented within the structure and the misfits with its environment. This is followed by an application of a pattern that corrects the problem and repairs the misfits. In this way, the final form of the structure is transformed, strengthened and brought to a closer equilibrium with its environment (Lea, 1998).

This piecemeal construction based on the stepwise application of patterns, is an alternative to the formal modeling, master plan approach often seen in software engineering. Piecemeal construction recognizes continual analysis, design and adaptation as an inevitable part of construction, a characteristic some have argued is central to handling the complexity of present system development projects. It is supported by Blum (1996) and Lawson (1997) who are among those calling for a design process that is able to manage change instead of one that requires knowledge of the complete product at the beginning. They point to the reality that information is never complete, and changes to resolve one problem often affect the choice of solutions to other problems. Therefore, Blum (1996) states that design is always "a contingent process" and must provide for "perpetual discovery". Henry Petroski, a well-known industrial author and speaker on success and failure in design, would agree with this need for perpetual discovery. Similar to Alexander's approach to building form through stepwise correction of misfits, Petroski explained, in a keynote to the 2001 OOPSLA conference, that the continual observation of failures and the effect of their correction on the complete system is a fundamental underlying principle that all designers follow (Petroski, 2001). In software, Gabriel points out that, in practice, software development work is rarely done with a thorough abstract design, but instead is accomplished through piecemeal growth (Gabriel, 1996).

In this piecemeal growth process, Alexander emphasizes the role of the community surrounding the project. Participation is encouraged from all levels during the creation of the patterns, the building of the structures from the patterns, and the decision-making about future growth. Collective development is made possible by a common pattern language of practices that all stakeholders in a project can use to create quality form (Lea, 1998). This resource discourages design models created by one group for the purpose of meeting the needs of another group. Instead, a common language allows all stakeholders to integrate, rather than separate, their roles. This is important in software development because, as Coplien (1996a) asserts, "human communication is *the* bottleneck in software development". Therefore, the potential of patterns to facilitate better communication between software developers and their clients, customers, and with each other "fills a crucial need of contemporary software development" (Coplien, 1996a).

In his OOPSLA'96 keynote, Alexander pointed to the "abundant connections" that can be drawn between his field and software development (Alexander, 1996). He asserted that his lessons are something that can and should be adopted by software engineers, proposing that the idea of a piecemeal design process forms the core of the computer science field and can become the natural process because software design methods are perfectly designed for it. He

stressed that, similar to living architectural structures, computer science has the means to view their software as a natural, genetic infrastructure in a living world. This, he claims, could "turn the world around, and make living structure the norm once again, throughout society, and make the world worth living again" (Alexander, 1996).

Three years later, when the presentation was published in *IEEE Software*, the foreword reported that the patterns discipline has become one of the most widely applied and important ideas of the past decade in software engineering (Coplien, 1999c). It has even been suggested that Alexander has perhaps had an even greater impact on computer science than on architecture (Salingaros, 2000). As Coplien (1999c) writes:

> *The curious parallels between Alexander's world of building and our world of software construction helped the ideas to take root and thrive in grassroots programming communities worldwide.*

Although Alexander's vision is not a complete theory, it does provide an evolution of thought in which the concept of patterns and a pattern language has remained a continuous element. Some in the software industry are attempting to promote this vision primarily because patterns provide a structure for documenting reusable artifacts. While this is the most visible benefit to many software developers, a patterns approach to software design also offers a piecemeal development process that preserves the integrity of pattern-based design and an industry-wide community that is dedicated to creating patterns and promoting their use. The following sections explain that patterns can be viewed as structure, as process, and as community.

2.4 Patterns as structure

Chapter one presented the software industry's need to find a better method for capturing and supporting the reuse of its common practices. The first part of this chapter explained that the software patterns movement is attempting to do this is with a collection of patterns and pattern languages. The structure of this new literature has its roots in the design philosophy of Christopher Alexander who used patterns to capture successful traditions in building from which quality structures can be created. His definition of a pattern is widely cited throughout the software discipline (e.g. Saunders, 1998; Buschmann, 1996; Coplien, 1996a; Gamma+, 1995):

> *Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without doing it the same way twice* (Alexander, 1977).

The problem and solution are the essential content in a pattern template. In addition, a pattern provides additional information such as the conflicting forces that create the problem, the context in which the pattern is applicable, and the rationale for and consequences of using the solution. A number of approaches for writing this information can be found in the literature. Some advocate the use of clearly marked sections to make it easy for the reader to find key elements of the pattern (Meszaros+, 1998) while others make use of a more free-form format that is closer to the original one used by Alexander (e.g. Olson+, 2002; Harrison, 1999). Various pattern template formats have evolved in recent years. However, Gamma (1995) writes that it is more important to explore the space of design patterns than to define a formal representation for them. The use of a variety of formats for software patterns has been encouraged in order to explore the one that may become the most effective (Coplien, 1995a). In the midst of this exploration, patterns have offered a structure for capturing abstractions that are not easily captured otherwise (Gabriel, 1996).

While an individual pattern documents a successful solution to one recurring problem, building relationships between them into what is known as a 'pattern language' provides the resource to handle truly complex problems (Coplien, 1996a; O'Callaghan, 1999a). A pattern language is a collection of patterns that are related, and thus are able to work together as a system in various sequences to build a variety of whole forms.

Alexander compares this to the English language, a system that allows the creation of "an infinite variety of one-dimensional combinations of words, called sentences". Just as the English language provides the words and the grammatical rules for arranging the words to generate various legitimate sentences, a pattern language provides the patterns and the structural connections that specify how the patterns can be used to generate various types of forms. Alexander's architectural language gives users the power to create an "infinite variety" of buildings, gardens, towns (Alexander, 1979). As an example, Alexander lists a sequence of ten patterns from *A Pattern Language* that were used to create a farmhouse in the Bernese Oberland and a sequence of eight patterns that were used to create stone houses in the South of Italy (Alexander, 1979).

Therefore, while single, unrelated patterns are used in isolation to solve isolated problems, building relationships between them into a 'language' allows patterns to work together to solve complex problems. To make this possible, an individual pattern, as part of its structure, documents its relationship to and its dependence on other patterns in the language. The relationships can manifest themselves in a variety of ways, showing complements such as specializes, generalizes, parallels, uses or completes, follows or proceeds (Meszaros+, 1998).

The resulting structure of the language reveals the meaningful order in which the patterns can be used in a variety of sequences, building on each other to create a variety of whole forms. The process of how this is done is further explained in the next section.

2.5 Patterns as process

In *The Timeless Way of Building*, Alexander describes how the life and beauty of great cathedrals arise from pattern languages:

> *... the rules which formed the great cathedrals were, to some extent, common rules of thumb, which defined the general form of "a" cathedral. ... And it is not only the obvious large scale organization which was composed of common patterns. At a smaller scale, there were patterns too. ... Indeed the most beautiful details were patterns too. ... There were hundreds of people, making each part within the whole, working, often for generations. ...each person in the whole had, in his mind, the same overall language. Each person executed each detail in the same general way, but with minor differences. ... the builders themselves knew enough of the shared pattern language to make the details correctly, with their own individual flair. But still the power and beauty of the great cathedrals came mainly from the language which the master builder and his builders shared. ... The building grew slowly, magnificently, from the impact of the common pattern language from which it was made, guiding its individual parts, and the acts which created them, just as the genes inside the flower's seed guide and then generate the flower. All the great buildings in history have been built like this, by language* (Alexander, 1979).

This excerpt refers to the shared language, the collection of related patterns, that guides the process of building. The most basic fact of this process, Alexander explains, "is that it enables the community to draw its order, not from a fixed map of the future, but from a communal pattern language". It is possible to replace the master plan with patterns because the tools and theory are worked out in the language (Alexander, 1975).

The process stems from the structural relationships between the patterns. These relationships define the use of the individual patterns in various sequences for building various forms. A sequence is driven by the application of a pattern that solves a problem, which then creates a new condition with new conflicts that must be addressed with the application of another pattern (Alexander, 1979). Coplien describes it in this way:

> *Patterns rarely stand alone. Each pattern works on a context, and transforms the system in that context to produce a new system in a new context. New problems arise in the new system and context, and the next "layer" of patterns can be applied* (Coplien, 1998a).

A pattern language builds a system that is continually transformed by the use of one or more patterns (Coplien, 1996a). Alexander believes that quality cannot be built with an isolated pattern, but rather with an entire system of patterns that are interdependent at many levels

(Alexander, 1979). In Alexander's language, the structural relationships between the patterns prompt sequences that move from larger to smaller patterns, such as those that create regions (e.g. Identifiable Neighborhood (14), Activity Nodes (30)) and the buildings in those regions (e.g. House For A Couple (77), Individually Owned Shops (87)), to those that are concerned with various levels of details that embellish the structures (e.g. Alcoves (179), Final Column Distribution (213)).

Therefore, it is the structural relationships that define the possible sequences in which the patterns can be applied in a stepwise manner towards the creation of a larger and more complex whole form (Alexander, 1979). Within any sequence, the application of a pattern solves one problem, but it is recognized that this action changes the state of an existing system, which then causes a new problem to arise and a new pattern to be applied to address that problem. Therefore, patterns related in a pattern language provide a dynamic process for the orderly resolution of the problems (Appleton, 1998; Beedle, 1998).

Despite the capacity for pattern languages to define a process, there are no examples of software projects created in the way Alexander describes how cathedrals are built. This is likely due to the scarcity of complete pattern languages in the software domain. Presently, software pattern writers are creating languages to help build parts of systems and to address various individual issues in this process of building. Pattern languages appear at more of a component level than a system level – they do not yet define the complete development process (Rising, 2000). While there is some concern that the focus has been primarily on individual patterns rather than the connections between them and the creation of languages (Rising, 2001b), others question whether it is possible to develop a pattern language for generating an infinite variety of software systems (Corfman, 1998; Johnson, 2000).

Despite a current scarcity of pattern languages that define complete processes for building complete products, an element of process can also be found in each individual pattern. Alexander explains that a pattern is both a thing and a process for creating that thing. It describes what you have to do to generate the entity which it defines (Alexander, 1979). A popular view recognizes that a software pattern focuses on the structure it creates and the process for building that structure (Winn, 2002). Therefore, the selection of a pattern prompts the use of a process. As Shaw explains, patterns are used in practice by developers who adopt one of more of them to help shape the design of their application (Shaw, 1995). It can be argued that this act of looking up a pattern to find a solution for a development problem is a very different process than inventing from scratch. And, as explained earlier, patterns are also viewed as part of a process in the UP and part of a standard metamodel in the

MDA. Therefore, even individual patterns have an element of process, both internal to the pattern and in the way they are used in a larger process.

The next section presents the community aspect of patterns. As stated in chapter 1, reuse efforts have suffered from the absence of a culture that supports reuse. Therefore, the patterns community, which is attempting to build a 'patterns culture' that supports the creation and use of patterns, is considered.

2.6 Patterns as community

Alexander stresses that community participation is an essential feature in the patterns philosophy. In order for the language to be used in the building process, all stakeholders, not just the architects, must take part in creating it. It is only then that it can become a communal language. He explains it in this way:

> [A pattern] *forms the basis for a shared agreement in a community. Each one is, therefore, a statement of some general planning principle so formulated that its correctness, or incorrectness, can be supported by empirical evidence, discussed in public, and then, according to the outcome of these discussions, adopted, or not, by a planning board which speaks for the whole community* (Alexander, 1975).

This shared agreement is important because, as explained earlier, order is drawn, not from a fixed map of the future but from a pattern language that belongs to the community in which it is used. It supports an approach in which projects move forward through local acts performed by members of the community (Alexander, 1975).

Alexander explains that this level of participation is important because it is those who will inhabit the structure that know most about what is needed. Secondly, it allows all individuals to become involved in their community, giving them a sense of ownership and some degree of control. He also addresses the criticism that this can result in chaos by pointing to the framework of shared patterns that assures "a rich and various order" (Alexander, 1975).

Therefore, it is the community that builds the language and constantly evaluates and improves it. As Alexander further explains:

> *... we must first learn how to discover patterns which are deep, and capable of generating life. We may then gradually improve these patterns which we share, by testing them against experience: we can determine, very simply, whether these patterns make our surroundings live ...* (Alexander, 1979).

In the software industry, the patterns community was formed around the goal of identifying the successful practices that occur in software development and documenting them in pattern

form (Corfman, 1998). This fostered one of the fastest-growing communities in contemporary software design (Coplien, 1996a). It was prompted by the actions of only a few individuals who realized that the advance of the software discipline is being limited by a lack of literature providing solutions to common problems (Johnson+, 1995). A timeline summarizing the evolution of this community appears in table 2.

	Event
OOPSLA'87	Beck & Cunningham present their human computer interface "patterns"
1991	Gamma & Helms begin to write "design patterns"
OOPSLA'91	"Towards an Architecture Handbook" workshop – the authors of *Design Patterns* meet
OOPSLA'92	Second "Towards an Architecture Handbook" workshop
1993	Beginning of what was to become the Hillside group – met twice – wrote patterns – planned first PLoP conference
1994	First PLoP conference held (in Illinois)
1995	*Design Patterns: Elements of Reusable Object-Oriented Software* published (Gamma+, 1995)
1995	*Pattern Languages of Program Design 1* published (Coplien+, 1995a)
1995	Second PLoP conference (in Illinois)
1996	*Pattern Languages of Program Design 2* published (Vlissides+, 1998)
1996	First European PLoP conference – EuroPLoP (in Germany)
OOPSLA'96	Alexander's keynote address (in San Jose)
1998	First ChiliPLoP conference (in Arizona)
1998, 2000	*Pattern Languages of Program Design* 3 and 4 published (Martin+,1998, Harrison+, 2000)
2000	First KoalaPLoP conference
2000	*The Patterns Almanac 2000* published (Rising, 2000)
1997-present	PLoP conferences continue

Table 2: Events in the Evolution of the Patterns Community

Within the last seven years, the evolving patterns community has taken on the task of creating a body of patterns literature to support software development (Appleton, 1998). It was established with the formation of the patterns administrative board, the Hillside Group. In the years that followed, much of the activity has centered around the previously mentioned Pattern Languages of Programming conferences. Within the framework of these conferences, the patterns community has defined a process for writing and reviewing patterns. It includes "shepherding", a phase in which a pattern author is assigned to another author in order to receive feedback for improving his or her pattern (Harrison, 1999). This is followed by a "writers workshop", a technique borrowed from the writing community that gathers a

collection of authors together at PLoP conferences to discuss ideas for further developing their patterns (Rising, 1998c; Johnson+, 1995).

In a discipline that stresses technical matters, it may be curious to note that the emphasis of the pattern community's effort is on building a culture that promotes sound design through patterns, rather than through the technology that supports it. Unlike technical-based methods for reuse, the patterns approach recognizes the importance of building a community which appears to be getting stronger as it encourages the capture of various kinds of best practice in software development while addressing the human and cultural issues that have been ignored in the past (Coplien, 1999c). Yet, despite this growing community in the industry, efforts to build patterns communities within organizations have not been as successful. This reality has prompted the work in this thesis and will be discussed in subsequent sections.

In summary, the previous sections have presented patterns as a potential answer to some of the limitations in software engineering's attempts to capture its best practices in a reusable and effective form. A software pattern has been described as a thing and a process for building that thing. It offers a structure for documenting knowledge and two other features that have been weak in past reuse efforts – process and community. The following section presents how these characteristics are presently regarded in the popular view of patterns.

2.7 Popular view of software patterns

As previously mentioned, Alexander has expressed his observation that patterns are being used by the software industry primarily as a "neat format", a tool for communicating good ideas about software design (Alexander, 1996). Even though he encouraged the industry to think about patterns as much more, there is no visible evidence that the pervasive view of patterns is anything more than what he has observed. As explained, the popular software development process, UP, regards patterns as entities within the process, rather than as defining their process in any way. In addition, the consistently reported benefits of patterns highlight them primarily as an effective way to capture expertise and pass it along to others in the form of a standardized vocabulary. This, in turn, improves communication, allows problems to be solved more quickly and has the potential to improve the quality and the maintainability of the final product (May, 2002; Coplien, 1996a; Gabriel, 1996).

While this notion of using individual patterns as a means to communicate successful practice is part of Alexander's philosophy, he takes it further. The popular view misses the important dimension of the process offered by the pattern languages.

The existence of those who recognize this vision in the midst of a majority who see patterns primarily as structure has spawned some disagreement in the patterns community. Some believe that because the pattern structure allows the industry to work towards capturing and reusing its best practices, it is enough, at least for now. Others see that it is vital to follow Alexander's philosophy of patterns in order to address some of the critical issues in designing and building complex software (Coplien, 1996a; Gabriel, 1996).

Some who believe the latter have criticized the view of patterns popularized by Gamma (1995). Despite the impressive sales of this book, there has been continuing debate about whether these artifacts should indeed be referred to as patterns (Coplien, 1996a). While the authors claim that Alexander's work inspired them, they also point out that their work does not have all the qualities of his patterns. In contrast to Alexander, the Gamma patterns do not contain the following: long-term, well tested, knowledge (such as that found in building and city architecture), an emphasis on the problem, rather than the solution, description, an order in which they should be used, and the ability to create complete structures (in this case, the structure of programs) (Gamma+, 1995). Jackson, in his book *Problem Frames*, also makes note of the Gamma patterns' emphasis on the solution, rather than the problem as Alexander originally intended (Jackson, 2001). The last two missing characteristics, a specified order and the ability to create complete structure, reveal that the Gamma patterns are related only loosely, are not part of a language and therefore do not have the structure that defines a process for using them (Gamma+, 1995).

However, the popularity and claimed usefulness of this book causes it to be the foundation for many developers' notion of what a pattern is. For them, the concept of a pattern is derived from Gamma and has little to do with anything called an Alexanderian pattern. In general, such people are either not familiar with the work of Alexander or don't view his work as relevant to software (Gabriel, 1999).

Concern over this attitude was discussed as recently as October 2000 at an OOPSLA conference panel titled "Sequel to the Trial of the Gang of Four". One of the authors of *Design Patterns*, John Vlissides, stressed that the purpose of the book was to "plant a stake in the ground", arguing that it is better to take incremental steps rather than attempt to wait until you can get it completely right the first time. Frank Buschmann appeared to agree when he reminded the audience of a "do it, reflect, start over again" approach. However, Coplien argued that if the authors began with a system perspective, we'd be better off today. He explained that, instead of creating individual techniques, they should have looked at how each structure could be part of a larger whole that contributes to the quality of life. He reminded

attendees Alexander emphasized, in his keynote at OOPSLA'96, that software developers have a social responsibility to do this because, unlike building architects, they touch everything. Dan Unger challenged the assumption that software can apply building metaphors to their discipline because the constraints are so different. However, Coplien insisted that the underlying theory, such as the process of creating organic structure, does map into software construction. He explained the need for a paradigm shift, claiming that Alexander's keynote in 1996 gave the software industry the wake-up call that they were in bad shape and had a reason to reflect. Just as Alexander noticed that the quality in architecture has virtually disappeared due to a lack of system perspective that puts the production of the environment in the hands of the people who use it, problems in software are system problems. Although Coplien admitted that the work in *Design Patterns* is useful, he underscored that only patterns that are part of a pattern language can work together and give developers the ability to build software with a system perspective.

Even though the panel ended with Unger's suggestion that it is now time to take this system perspective, the available evidence suggests that the popular view is still missing the important dimension of the process offered by the pattern languages. However, as explained in section 2.5, even an individual pattern introduces a process for using it. Intuitively, this popular view of using patterns as individual structures in a larger software development process must be driven, at least in part, by their potential to improve that process. Patterns as a software process improvement will be explored further in chapter three.

In the final section of this chapter, the challenge of introducing patterns into organizations is considered.

2.8 Pattern acceptance in organizations

It has been shown that patterns are gaining emerging attention in the software industry. Many individuals attend patterns conferences each year to present their pattern drafts and to discuss the issues surrounding the use of patterns as a literary form for documenting the industry's best practices. However, the authorship and use of patterns, and the corresponding growth of the community, is primarily through the efforts of individual contributors (Harrison+, 2000; Martin+, 1998). Despite the involvement of many individuals in the growing industry-wide patterns community, attempts to introduce and build communities within organizations have not been as successful.

A few organizations have tried to go beyond the use of patterns as an individual resource. AG Communication Systems, Geco-Prakla, Lucent Technologies, Bell Laboratories, British

Telecom, and Siemens are among those in this grass roots effort who have seen value in capturing and sharing expertise. They have mined patterns in various domains such as system architectural design, load building, marketing, legacy system transition, process improvement, leadership and mentoring. The patterns work at AG Communication Systems prompted Charlie Schultz, former Chief Technical Officer, to summarize the potential of patterns in this way:

> *Patterns can be a very effective collaboration tool. To become the company we want to be and to meet the needs of our customers on a timely cost effective basis, we have to be able to share solutions to the common challenges we face and then use these common understandings to build new products and capabilities. The reuse of successful patterns will result in shorter development and implementation cycles by causing us to focus on solving the problems for which we don't yet have a pattern* (Schultz, 1996).

The experiences of organizations that have attempted a patterns approach to reuse report that verbal and written communication was improved among and between various system development efforts (Rising, 1998a; Corfman, 1998; Saunders, 1998; Beck, 1998). This suggests that more benefits can be realized when they are used throughout an organization rather than simply by a few scattered individuals in the organization. Alexander further stresses this when he explains that the successful use of patterns depends on community involvement and common ownership of the patterns by those who are building the products (Alexander, 1975).

While this argues for the need to encourage organizational, rather than just individual, acceptance of patterns, the reality of pressures in developing complex systems in a highly competitive software market does not often leave a great amount of time for organizations to learn about patterns and become interested in writing and using them. The successful practices must be identified, formatted into patterns, quality controlled, continually updated, and incorporated into the process. The challenge of doing this is reflected in comments by those who have tried to lead their organizations towards a patterns approach. For example, at AG Communication Systems (AGCS), Rising writes:

> *In today's business environment, letting this process happen requires extraordinary management insight. The process requires introspection, which means time, a scare commodity when the rallying cry is "turn that around fast and move onto the next product"* (Rising, 1998a).

These demands are further complicated by the fact that the benefits in any reuse effort are in the long term and only after much effort, time, and resources to create the artifacts (McGregor+, 1992; Fayad+, 1996). In addition, it is difficult to quantify the impact of patterns (May, 2002). John Letourneau of Lucent Technologies explains that the urgent need

for bottom line results does not promote the simple incorporation of patterns into the system development process:

> *It's tough. We're dealing with product development cycles as short as a couple of months so there is no time to introduce something new. ... We're into instant gratification. We're not as willing to study things, internalize things, and make them part of the culture in order to get a big payback in the long term* (Letourneau, 1999).

The challenges suggest the need for understanding the problems that are likely to occur when individuals attempt to introduce organizations to patterns. This was first recognized in 1996 by DeLano and Rising who led an effort to document the recurring problems and corresponding solutions in a collection of patterns titled *Introducing Patterns into the Workplace*. The twenty-three loosely related patterns recorded the experiences of seven individuals who had introduced patterns into six different organizations. DeLano and Rising do not claim that it is a complete language. Instead, they refer to their collection as "the beginning of a pattern language", signifying that it is the first step in understanding the task of introducing patterns into an organization (DeLano+, 1997).

Therefore, although there is anecdotal evidence to suggest that the introduction of patterns into an organization comes with influential challenges, it has been a relatively unexplored area of research. This scarcity offers few resources for those who wish to introduce patterns, but it also provides a prime opportunity for research. It is the objective of this thesis to build theory for this unexplored area. It will do this by developing a theoretical foundation from innovation diffusion research, suggesting propositions based on this foundation, qualitatively and quantitatively exploring the relevance of these propositions, and then putting forward a model that proposes theory for the factors that have an influence the use of patterns among individuals in organizations. The theoretical foundation and research design will be described in the subsequent two chapters.

In summary, software reuse has been a challenge for Computer Science and software engineering since the "software crisis" was first recognized in the late 1960's. Despite considerable research in academia and industry, and some gains at the level of reusing code artifacts, no quantitative breakthrough has been achieved in the intervening thirty years. Experience of reuse research and practice suggests that more attention needs to be paid to the non-technical aspects of software development if a real leap forward is to be made. Sparked by the work of C. Alexander and the recognition of the need for a higher level of design and reuse, software patterns have become an emerging phenomenon in software development. They offer a structure for documenting successful solutions to recurring problems, a process for using that structure, and a community that supports their creation and use.

However, even though patterns and pattern languages are built to capture the successful practices of a community to then be used by the community, there is little to indicate widespread adoption of patterns within organizations. This may be due, at least in part, to the experiences supporting the notion that introducing patterns into a software organization is difficult. This suggests that there is value in understanding what can influence individuals in an organization to adopt patterns. It is the objective of this research to initiate this understanding.

CHAPTER 3

THEORETICAL FOUNDATION

3.1. Introduction

The distinctive characteristics of patterns and the challenge of introducing them into organizations have been discussed in the previous chapter. In this chapter, the theoretical foundation that guides the conduct of this study and the research model that is derived from this theory is presented.

Figure 1 illustrates the stream of research from which the foundation for this research is built. As shown, this investigation of patterns adoption will consider software process innovation (SPI) use, which is encompassed in the larger area of information technology (IT) use. Also as shown, studies in the use of various SPIs in particular and ITs in general have drawn their foundation from diffusion of innovation (DOI) research. This study will do the same, building upon this accumulated research knowledge.

In order to utilize existing theory, an argument is made to classify patterns as a SPI and to consider the larger research area of IT adoption. It is also argued that the process of introducing patterns into an organization may be understood by taking the lead of others who have used DOI research to gain insight into the factors that influence use of other types of innovations. Within this context, this chapter presents the research model and the factors that are derived from this framework.

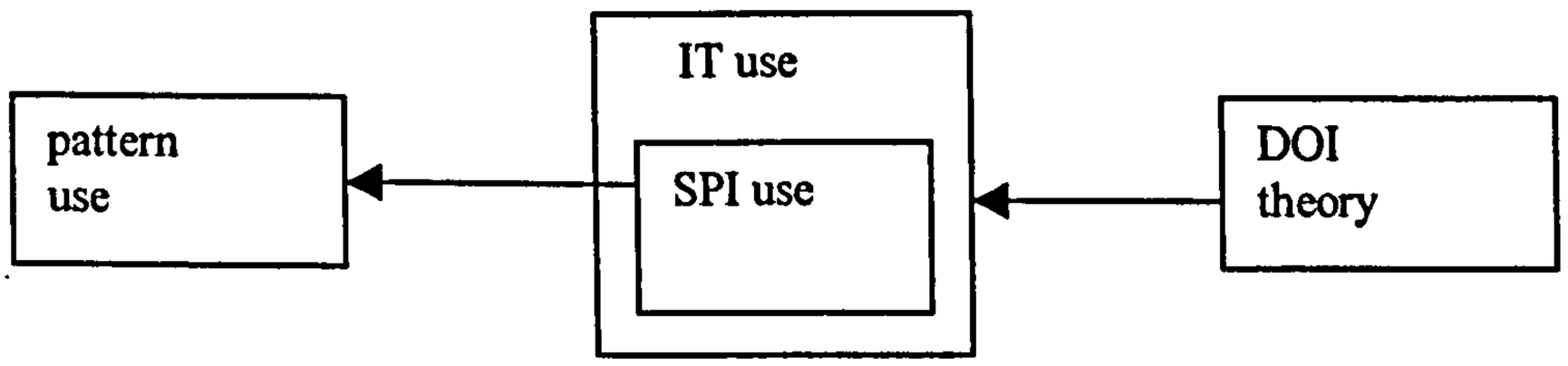

Figure 1: Stream of Research that Guides this Study

3.2 Patterns as a software process innovation

Chapter 1 summarized the software industry's attempt to cope with the "software crisis" over the past three decades with an array of technological and methodological innovations. When the purpose of such types of innovations is to add fundamental changes to the development process in order to improve it in significant ways, they are termed *software process innovations* (SPI) (Zmud, 1982;.Fichman+, 1994; Kishore, 1999). Some well-known examples of SPIs include: relational database management systems (RDBMS), fourth-generation languages (4GLs), rapid application development (RAD), prototyping, joint application development (JAD), computer-aided software engineering (CASE), software reuse, graphical user interfaces (GUIs), object orientation (OO), and Personal Software Process (PSP). As will be shown here, patterns possess many of the qualities the literature defines as inherent to a software process innovation.

The term *innovation* is commonly defined as an idea, practice, or material artifact perceived to be new by the relevant unit of adoption (Rogers, 1995; Dewar+, 1986). This clearly suggests that an innovation can be anything – idea, practice, or object – that is perceived as new by the adopting unit (Kishore, 1999). The attribute of perception is worth noting – what may be considered new to some people may be a traditional to others. Rather than defining a definitive timeframe of newness, it is how the idea is perceived by the individual that matters most (Green, 1999). Therefore, the model set forth in this research is applicable for organizations introducing patterns for the first time even though patterns may be a well-established practice in other organizations.

The second word in the term, 'software process innovation' identifies this category as a *process* innovation. As explained in chapter two, patterns related in a pattern language define a process for their use. In addition, each individual pattern is a structure that contains a process for its use. And, it can also be argued that the use of a pattern to solve a problem introduces a different process than developing the solution from scratch. In other words, any use of patterns involves some kind of process innovation.

This examination of both the terms innovation and process supports the argument for placing patterns in the category of software process innovation. This is the same approach taken by (Kishore, 1999) in a study of software reuse adoption, a point worth noting because patterns have been presented, in the previous chapters, as an innovation that facilitates reuse.

To study patterns as software process innovations, the characteristics of SPIs that have been proposed by previous research are presented. Fichman (1994) has shown, and others have supported the idea (Kishore, 1999), that SPIs are distinguished by two characteristics: substantial knowledge barriers and strong adopter interdependencies.

The first of these, *knowledge barriers*, is said to be a characteristic of SPIs because by their very nature they tend to be quite complex (Kishore, 1999). Unlike simple innovations, SPIs are not "packaged" as "black boxes" that can be easily adopted and used with a relatively low amount of learning (Attewell, 1992). Process innovations usually involve aggregates of tools, machines, people, and social systems (Tornatzky+, 1990). This, in turn, imposes a substantial burden on potential adopters to gain various kinds of knowledge (Eveland+, 1990; Kishore, 1999). Therefore, an individual must acquire broad tacit and procedural knowledge in order to use the innovation effectively, placing what Attewell calls "knowledge barriers" between SPIs and their potential adopters (Attewell, 1992; Kishore, 1999; Fichman+, 1994).

Secondly, SPIs have been shown to exhibit characteristics of *adopter interdependencies* (Fichman+, 1993). This means that SPI adoption by an individual depends in part on the adoption by other individuals in the community (Kishore, 1999). This is supported by the principle of "increasing returns to adoption", which states that the value of some innovations, such as process innovations, will increase as more individuals adopt it (Arthur, 1988). By definition, an SPI is a process innovation. Therefore, it has been argued that the value of a SPI to any individual involved in a process will increase as others in that process use it (Fichman+, 1992). Fichman (1994) also notes that adopter interdependencies infers critical mass dynamics be considered in understanding the overall rate of adoption. The formation of a critical mass of adopters in the early phases of introducing a new idea into an organization is vital, for if this is not established, successful adoption may not occur at the organizational level (Markus, 1987; Rogers, 1995).

Knowledge barriers and adopter interdependencies have important implications for the study of SPI adoption, and therefore pattern adoption. While adopter interdependencies support the importance of obtaining a critical mass, the existence of knowledge barriers can make this difficult. At the same time, slow or failed assimilation among early adopters will delay the learning that can serve to overcome a stalled adoption effort (Fichman+, 1994). Therefore, knowledge barriers and adopter interdependencies serve to reinforce the challenges of introducing patterns into organizations.

These characteristics raise a lesson about the vital considerations in the early time period of introducing patterns. While the interdependencies between potential adopters can make it difficult to reach a critical mass, the reliance they have upon each other highlights the need for positive communication between those who have adopted and those who have not. In addition, the existence of knowledge barriers emphasizes the need for training and mentoring. These two requirements call for a model that puts communication at the forefront of the diffusion efforts. As explained in subsequent sections, Rogers' (1995) classical diffusion of innovation (DOI) theory offers this focus. It centers on the notion that innovation adoption is a process of uncertainty reduction through various types of communication. Therefore, it will provide the foundation for this research and will be explored for its relevance to the diffusion of patterns. This will be described in more detail in upcoming sections.

This section has presented patterns as a software process innovation. SPIs are claimed to possess the potential of improving the systems development process in significant ways (Kishore, 1999; Fichman+, 1994). However, there is still a need for research in the area of SPI adoption (Kishore, 1999). Research to date tends to concentrate on the adoption of product innovations that are simple and have low adopter dependencies (Kishore, 1999). After reviewing these studies, Kishore (1999) calls for research that accounts for the unique nature of process innovations and the influences the organizational context has on the individual's decision to adopt. This research focuses on the adoption of patterns, a complex, process innovation, by individuals in organizations.

The next section reviews the primary goal of this research, followed by a description of how studies in the diffusion of software process innovations, information technology and innovation diffusion are integrated to form the comprehensive initial model in this study.

3.3 Guiding motivation for study

The motivation, primary and secondary goals, research questions, and objectives were posed in chapter one. This study is motivated by the need to inform researchers and practitioners about how they may position patterns in an organization to encourage a faster and more efficient adoption. It is a theory-building investigation to explore the factors that are likely to influence the use of patterns among individuals in an organizational context.

This type of research study has been conducted for many other types of innovations. Rogers (1995) was among the first to document factors that affect the adoption of innovation. Many others have used his classical diffusion of innovation (DOI) theory as a basis for their investigation of factors that impact upon the use of many types of product innovations

including spreadsheets (Brancheau+, 1990), word processing (Hightower, 1991), workstations (MooreGC+, 1991) and process innovations such as software reuse (Kishore, 1999), CASE tools (Iivari, 1996), and Personal Software Process (Green, 1999). In each of these cases, and others, various levels of support have been found for classical DOI and, as explained in a subsequent section, for the research work of those who have enhanced it.

However, there is no known study that has empirically investigated the factors that impact upon the use patterns. Seen (2000) proposed the characteristics in DOI as a way to assess the potential for design pattern adoption, but offered only opinion on the applicability and stopped short of suggesting any testable model. Based on the previously described infancy of patterns and the narrow attention that has been paid in the literature to the adoption of software process innovations in general, this study is designed to be exploratory. It is one in which theory will be built rather than tested. It does this by: 1) proposing a model that, grounded in innovation diffusion theory, attempts to identify the factors that impact upon pattern use, 2) empirically investigating this model, and then, 3) suggesting a refined model with explanations and implications for the findings. The next section presents this initial model.

3.4 The research model

To create the research model, this study has been founded on the current state of research in the area of individual acceptance of innovation. A case has been made for categorizing patterns as a software process innovation. As such, this study can follow the lead of others who have considered SPI acceptance in the larger category of the adoption of information technology (IT) innovations (Kishore, 1999; Iivari, 1996; Green, 1999). (See figure 1.) Within this realm, the scope of IT has traditionally included hardware, system software, and telecommunications components (Green, 1999) but has recently been expanded to include information systems, products, and technologies (Fowler, 1994), and the area of software development processes, techniques, and methods (Green, 1999; Kishore, 1999). Software process innovations, and thus patterns, fit into this last area. Therefore, just as other SPI adoption investigations have done, this study will look for insights in studies that have examined the adoption of an IT.

Individual acceptance of an IT has been researched from multiple theoretical perspectives using a wide range of constructs and definitions. The key dependent variable examined in this stream of research is individual use (Agarwal, 2000). A broad synthesis of some of the dominant factors that have been considered by other researchers to influence this use is presented in table 3.

Construct Groups	Construct Subgroups	Variables	Guiding Studies
Potential Adopters' Perceptions of Innovation Attributes	(None)	relative advantage	Rogers, 1995 (relative advantage)
		compatibility	Rogers, 1995 (compatibility)
		ease of use	Rogers, 1995 (complexity) MooreGC+, 1991 (ease of use)
		trialability	Rogers, 1995 (trialability)
		result demonstrability	Rogers, 1995 (observability) MooreGC+, 1991 (result demonstrability)
		visibility	Rogers, 1995 (observability) MooreGC+, 1991 (visibility)
		image	MooreGC+, 1991 (image)
		voluntariness	MooreGC+, 1991 (voluntariness)
Innovativeness of the Potential Adopters	(None)	innovativeness	Rogers, 1995 (adopter categories of innovativeness) Agarwal+, 1997 (innovativeness)
Potential Adopters' Perceptions of the Social System	Social	opinion leader	Rogers, 1995 (opinion leader)
		change agent	Rogers, 1995 (change agent)
		champion	Rogers, 1995 (champion) Beath, 1991 (champion)
	Situational	training	Attewell, 1992 (training)
		patterns repository	Kishore, 1999 (installed base of reusable objects)
		installed process	Kishore, 1999 (installed process for reuse)

Table 3: Dominant Factors that Influence Adoption of Innovation

The table summarizes the basis for the research model shown in figure 2. In the sections that follow, a case is made for the examination of fifteen factors that are proposed, in this study, to have the potential to influence an individual's use of patterns. These are categorized into the following three construct groups: the potential adopters' perceptions of patterns' attributes, the innovativeness of the potential adopters, and the potential adopters' perceptions of the social system into which the patterns are being introduced.

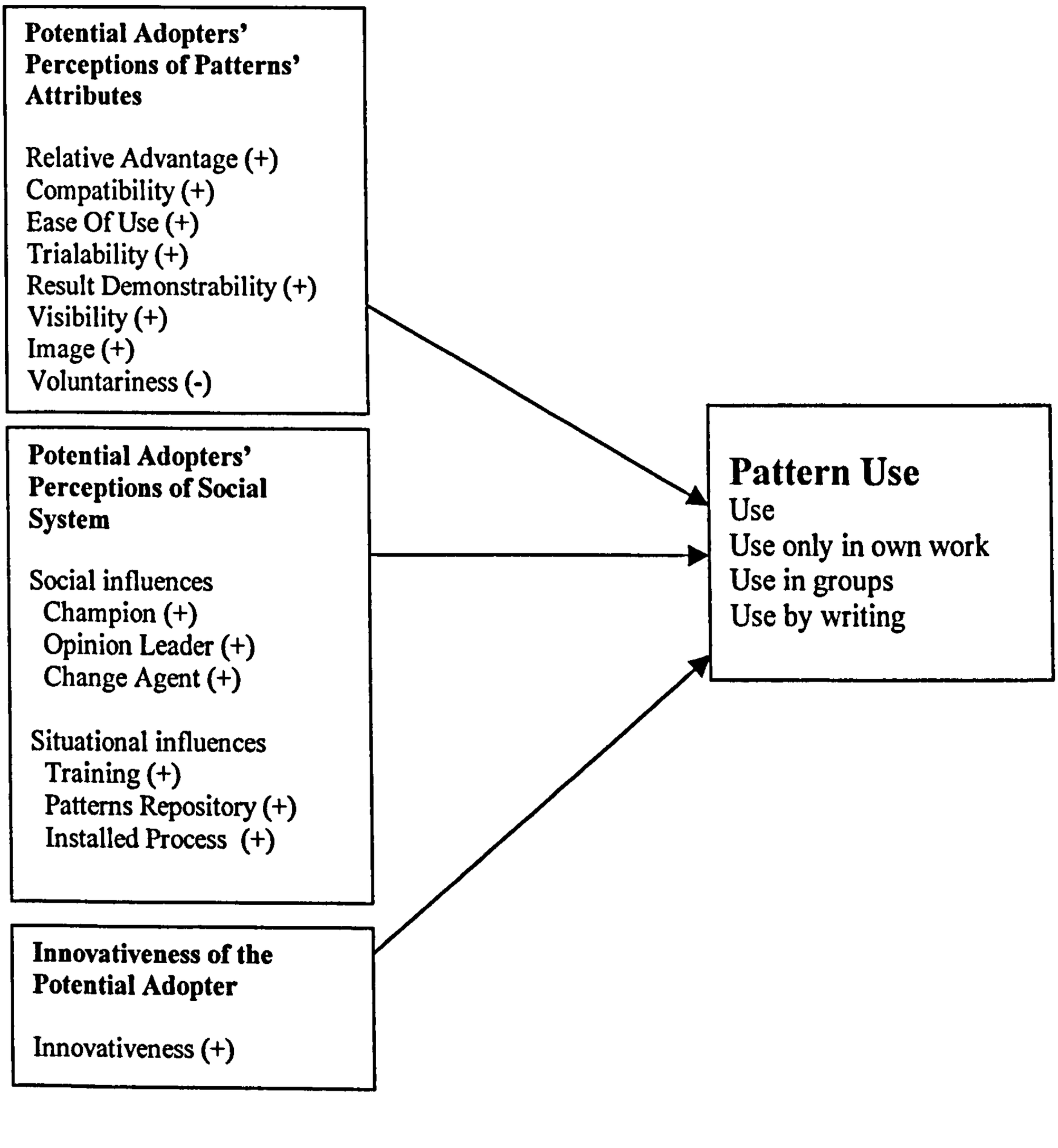

Figure 2: Research Model: Factors Proposed to Influence Pattern Use

The research model in figure 2 proposes that fifteen factors impact upon the individual's use of patterns. Although there are other factors that have been considered in other studies, such as expectation realism (Wynekoop, 1992; Iivari, 1996), developer involvement (Green, 2000),

and the infrastructure of the social system (Levine+, 1995), this study limits its investigation to the commonly examined eight individual perception factors, six social system factors, and one factor for individual innovativeness. The examination of other factors is left for possible future research.

The following section explains the basis that forms the overall framework for the model and the propositions that will be addressed in this study. It begins with an overview of classical, and frequently cited, diffusion of innovation (DOI) research. This social-communication perspective on innovation adoption, and the work of those who have enhanced it, will provide the theoretical foundation for this research in the use of patterns.

3.5 Innovation adoption research

Diverse streams of research have attempted to explain and predict individual acceptance of various innovations (Agarwal+, 1997). In recent years, information systems researchers have relied on diffusion theory for studying adoption of various innovations (MooreGC+, 1995). Kishore (1999) reports that most empirical studies in the IT adoption literature have based their research on either the diffusion of innovation model (DOI) (Rogers, 1995) or the technology acceptance model (TAM) (Davis+, 1989). This study makes the case to follow the lead of the considerable body of innovation adoption research that has drawn on the robust DOI theory of E.M. Rogers. As will be explained, it is widely used, offers a wide range of explanatory factors, and provides the social communication focus that takes into account the knowledge barriers and adopter dependencies characteristics of software process innovations.

Commonly known as the classical innovation model, DOI provides a framework for predicting the amount of time it will take an innovation to be adopted by individuals in a social system, such as an organization (Rogers, 1995). The usefulness of this type of research is based on the assumption that generalizations on individual adoption behavior in past research can be used to predict the adoption of future innovations. Such forward-looking investigations are sometimes referred to as *acceptability research* because their purpose is to identify a basis for positioning an innovation so that it will be have a more rapid acceptance throughout a social system (Rogers, 1995).

The synthesized DOI model is based upon a review of nearly 3,900 innovation adoption studies conducted in a variety of disciplines for over fifty years (Kishore, 1991). Its long and varied history is in contrast to the Technology Acceptance Model, which was proposed in 1989 specifically for the domain of IT (Davis+, 1989). Both the DOI and TAM models place

an emphasis on the connection between individuals' perceptions of an innovation and their use of it.

The influence of perception on use has considerable support in the literature (Agarwal, 2000). In classical DOI, an individual's perception of five innovation attributes has been shown to be predictors for the individual's acceptance of that innovation. These are the individual's perception of the relative advantage, compatibility, complexity, observability, and trialability of an innovation. Rogers asserts that from 49 to 87 percent of the variance in the rate of adoption of an innovation can be explained by these attributes (Rogers, 1995). In 1991, Moore and Benbasat expanded DOI, increasing the perceived attributes to eight. Keeping relative advantage, compatibility and trialability from Rogers model, they expanded observability into result demonstrability and visibility, replaced complexity with ease of use and added image and voluntariness (MooreGC+, 1991). Known as the Perceived Characteristics of Innovating (PCI) antecedents, the resulting eight have been referred to as the "most comprehensive set of user perceptions included in recent work" (Agarwal+, 1997).

In contrast, the Technology Acceptance Model has been criticized for its reliance on only two constructs as predictors: perceived ease of use and perceived usefulness. The conscious choice to include only two explanatory variables was based on the desire for "a belief set that ... readily generalizes to different computer systems and user populations" (Davis+, 1989). However, Mathieson (1991) raises concerns about TAM's assumption that beliefs about usefulness and ease of use are the primary determinants of acceptance decisions. He points out that ease of use and usefulness are "internal control factors", defined by Ajzen (1985) as characteristics of the individual. TAM does not consider any "external control factors" that are dependent on the situation such as time, opportunity, and cooperation of others. These include the various social influences such as the pressure one can feel from an individual's supervisor and the reputation one can acquire from coworkers. In addition, Agarwal (1999) has criticized the model for not taking into account other individual differences that characterize potential adopters.

The extended model of DOI, the Perceived Characteristics of Innovating, does consider social variables. As will be explained in a subsequent section, such issues as pressure to use an innovation has been captured in the 'voluntariness' factor and the view of coworkers captured in the 'image' factor. Classical DOI also takes into account external control factors such as opportunity to try out an innovation (trialability) and the influence of others such as change agents and opinion leaders. In addition to the characteristics of the innovation and the social

system, classical DOI describes how individual characteristics, such as innovativeness, affect innovation adoption behavior.

Some have argued that the two constructs in TAM are included in the constructs proposed in the DOI model. TAM's ease of use has been equated to DOI's complexity factor and usefulness has been equated to relative advantage (MooreGC+, 1991). While Davis (1989) found that TAM's two variables account for approximately 47% of the variance in IT usage, Taylor's comparison of TAM with two other models found this value to be only 34% (TaylorS+, 1995). This led Taylor to call for a broader explanation of factors. In a more recent comparison by Plouffe (2001), the significant performance of PCI over TAM constructs provided further evidence that PCI offers more detailed information regarding the factors driving innovation adoption.

This wide range of explanatory factors is one of the reasons DOI, in its extended version as PCI, is used in this study. The second reason is its social communication focus which takes into account the knowledge barriers and adopter dependencies characteristics of SPIs.

Classical DOI defines innovation *diffusion* as, "the process by which an innovation is communicated through certain channels over time among the members of a social system". As such, it is a kind of social change in which new ideas are invented, diffused, and accepted or rejected (Rogers, 1995). The unit of acceptance can be conceptualized at multiple levels of analysis from the complete organization to the more micro level of the individuals in the organization. However, the theory is most highly developed at the latter level in which the unit of acceptance is an individual and the social system is the individual's organization (Brancheau+, 1990).

The definition of diffusion implies that adoption is not an instantaneous act. Diffusion scholars have long recognized that an individual's decision about an innovation is the result of a process that occurs over time, consisting of a series of actions and decisions (Rogers, 1995). Rogers (1995) has shown that an individual generally passes through a five-stage process at varying rates – this is known as the innovation-decision process. During the first three stages, knowledge, persuasion, and decision, individuals gather information and form their attitudes about the innovation. During the last two stages, implementation and confirmation, those who have made a decision to adopt put the innovation to use in their work while welcoming confirmation that their decision was the correct one (Rogers, 1995; Brancheau+, 1990). This view is consistent with the stage model of information technology

implementation as proposed and empirically validated by Cooper (1990) and the innovation acceptance theory summarized by Mackie (1988).

DOI has been characterized as "a rich and complex information-centric view of innovation acceptance" (Agarwal, 2000). Various researchers refer to it as the social-communication perspective on innovation adoption and diffusion (Kishore, 1999; Attewell, 1992; BrownL, 1981; Sharma, 1996). This reference reflects the model's reliance on the communication flow in and around a social system. The theory asserts that adoption is a process of uncertainty reduction as individuals assimilate information about an innovation. During the stages in the innovation-decision process, individuals' perceptions of the attributes of an innovation and the communication sources in and outside the diffusion environment often interact to speed up or to slow down the rate of adoption in a social system such as an organization (Rogers, 1995). The central theme in DOI is that the communication sources have the power to alter individual perceptions. As Mackie (1988) explains, this communication is important because the advent of any innovation is likely to result in some level of disruption. This can lead to early resistance without accurate and reasonably comprehensive information to positively affect individual perceptions. Arguably, the presence of knowledge barriers makes it particularly challenging to deal with this resistance while the presence of adopter interdependencies makes the role of communicating appropriate information particularly critical.

In summary, Rogers' classical DOI provides a social-communication perspective on innovation adoption and diffusion. As the oldest and most widely used perspective in the body of innovation adoption and diffusion literature, its wide use, diverse collection of constructs, and ability to lend insight into the adopter interdependencies and knowledge barriers characteristics of SPIs are among the reasons it is used as a foundation in this research. Eight of the fifteen factors proposed to impact upon the adoption of patterns in this research are based on the extension to DOI. The one dependent and fifteen independent variables are explained in the following section.

3.6 Construct groups and factors

Diverse streams of research have attempted to explain and predict user acceptance of new information technologies. A common theme underlying these various research streams is the inclusion of the perceived characteristics of an innovation as a key independent variable (Agarwal+, 1997). In this study, the focus is also on the individual's *perception* of each factor. The reason is that there have been inconsistent findings in many of the studies that consider the primary attributes, those that are inherently intrinsic to an innovation. The

attempted measurement of primary attributes creates inconsistency because the behavior of individuals is determined by how they perceive those attributes (Downs+, 1976). When different individuals perceive characteristics in different ways, their behavior is likely to differ (MooreGC+, 1991). As Rogers explains, "The [individuals'] perceptions of the attributes of innovations, not the attributes as classified by experts or change agents, affect its rate of adoption" (Rogers, 1995). Therefore, this study follows the lead of others (e.g. Kishore, 1999; Iivari, 1996; Green, 1999; Brancheau+, 1990) who, when investigating the influences on innovation use, consider individuals' perceptions of the variables under investigation, rather than the attributes of the variables as potentially defined by others.

3.6.1 Dependent variable

A key measure of successful diffusion of an innovation in an organization is its *use* (Rogers, 1995; Fowler+, 1993; Green, 1999). In a review of information systems research in the area of information systems success, DeLone (1992) found that *use* is the most frequently reported measure of IT implementation success. In contrast, the dependent variable in the TAM model is intended use, based on the supposition that intention to use is a predictor of future usage behavior. However, one can argue that this adds a level of uncertainty to the model.

Among those who have chosen *use* as an indicator of adoption are Iivari (1996) for CASE, Green (1999) for Personal Software Process, Kishore (1999) for software reuse, and Moore (1995) for workstations. In DOI, use of an innovation corresponds to the fourth stage in the innovation-decision process, implementation. Up to this stage, the process is strictly a mental exercise. Implementation involves overt behavior change as the innovation is put into use. This may represent the termination of the process for most individuals, while others can have some degree of uncertainty and may therefore seek confirmation of their decision (Rogers, 1995). In order to define a feasible scope for this study, the research question and model does not consider any actions beyond the fourth stage in the innovation-decision process, the individual's decision to use patterns.

Four types of *use* are considered in this study: general use, individual use, use in groups and, as a related point of interest, writing patterns. The influence that each of the fifteen independent variables has on each of these four types of use will be explored and reported.

3.6.2 Independent variables and propositions

Different researchers propose a variety of explanatory factors for the decision to use an innovation. The key conceptualizations can be grouped into three construct groups: (1) potential adopters' perceptions of the innovation's attributes, (2) the innovativeness of the

potential adopters, and (3) potential adopters' perceptions of the social system originating from sources including the overall social system and the individuals within it (Kishore, 1999).

These three construct groups, as well as the factors that appear in each group, are explained below.

3.6.2.1 Potential adopters' perceptions of patterns attributes

There is considerable support in the literature for the connection between an individual's perception of an innovation and his or her acceptance of it (Agarwal, 2000; Mackie+, 1988). As explained, classical DOI proposes five factors which was expanded to eight by MooreGC (1991). Known as the Perceived Characteristics of Innovating (PCI), they are: relative advantage, compatibility, ease of use, trialability, result demonstrability, visibility, image, and voluntariness.

Researchers have considered the ability of all or part of these factors to predict the adoption of various types of innovations. For example, Kishore (1999) included the impact of all eight on the adoption of software reuse as Agarwal (1997) did on the use of the World Wide Web, while Iivari (1996) included only four on the use of CASE.

The first construct group in this research, potential adopters' perceptions of innovation attributes, includes all eight attributes. Each is examined for its impact upon the *use* of patterns.

3.6.2.1.1 Relative advantage

Relative advantage captures the extent to which an innovation is perceived as offering an advantage over the idea it supersedes (Rogers, 1995; Agarwal, 2000; Levine+, 1995). MooreGC (1991) point out that this is an important consideration because "...innovations are typically developed with certain purposes in mind, and they must be perceived to fulfill their intended purposes better than their precursors if they are to be adopted." A meta-analysis of 105 studies showed that *relative advantage* is one of only three perceptions consistently related to innovation adoption (Tornatzky, 1982). (The other two are 'compatibility' and 'ease of use,' described below.) Diffusion scholars have found it to be one of the best predictors of an innovation's rate of adoption (Rogers, 1995). Studies that have found this variable to be positively related to the adoption of software process innovations include CASE tools (Iivari, 1996) and software reuse (Kishore, 1999). This study examines whether the perception of *relative advantage* impacts upon the *use* of patterns with the following proposition:

P1: *Perception of the **relative advantage** of patterns is positively related to the use of patterns.*

3.6.2.1.2 Compatibility

A second attribute identified by Rogers is *compatibility*. It is defined as "the degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of the adopters" (Rogers, 1995). Rogers has shown that its positive influence on adoption is due to the fact that compatible innovations fit more closely to the individual's life situation and therefore come with more certainty and comfort (Rogers, 1995). However, *compatibility* is an ambiguous term that may be interpreted in a number of ways (Hightower, 1991; Kishore, 1999). Although Tornatzky's (1982) meta-analysis identified it as a second variable to consistently correlate with adoption behavior, they explain that some of the studies consider value compatibility, some consider practical compatibility, and some a combination of the two. The former refers to compatibility with the values or norms implying a compatibility with what an individual feels or thinks about the innovation, while the latter represents congruence with existing practices implying a compatibility with what an individual does (Tornatzky, 1982). In studies of adoption within organizations, some make the argument that it is more appropriate to consider practical compatibility, how an innovation fits with an individual's work or work style (MooreGC+, 1991; Kishore, 1999; Hightower, 1991). Therefore, this is what will be considered in this study, in the form of fit with an individual's work or work style.

In addition to the type of *compatibility*, the type of innovation may also affect how an individual perceives this attribute (Kishore, 1999). Many studies that find *compatibility* to be correlated with adoption appear to focus on innovations that are primarily for personal use rather then for organizational use. For example, MooreGC (1995) found *compatibility* to be a significant predictor of the uptake of personal workstation and Agarwal (1997) found the same for World Wide Web usage. In the case of software process innovations, *compatibility* did not surface as a predictor for CASE tools (Iivari, 1996) and found to be a weak predictor for software reuse (Kishore, 1999). A previous section has presented patterns as a tool for both personal and organizational use. This could contribute to an interesting analysis of the following proposition:

P2: *Perception of the **compatibility** of patterns is positively related to the use of patterns.*

3.6.2.1.3 Ease of Use

While complexity was the third construct identified by Tornatzky (1982) as consistently relating to innovation adoption, *ease of use* appears in this study. Complexity is defined by Rogers as the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers, 1995). *Ease of use* has been presented as an inverse to the complexity construct (Agarwal+, 1997). Defined as the degree to which an individual believes that using a particular innovation would be free of physical and mental effort (Davis+, 1989), *ease of use* offers the opportunity for a positive measurement. In addition, validated scales with high reliability (in excess of 0.90) are available for this construct (MooreGC+, 1991). In software reuse adoption, *ease of use* was found to be only marginally significant for individual aspects of reuse practice (Kishore, 1999). Iivari's (1996) study of CASE considered only complexity. It was not found to be a significant predictor, a result that surprised the author. However, *ease of use* has appeared as a significant predictor of acceptance in other IT research (Davis+, 1989; Mathieson, 1991; MooreGC+, 1991). The effect of the perception that patterns are easy to use is considered in this study with the following proposition:

P3: *Perception of the ease of use of patterns is positively related to the use of patterns.*

3.6.2.1.4 Trialability

Trialability is defined as the degree to which an innovation may be experimented with prior to a commitment to adopt it (Rogers, 1995). Rogers (1995) has shown that ideas that can be tried on a limited basis are generally adopted more rapidly than those that cannot. This reduces uncertainty and risk because it is possible for individuals to test how it works under their own conditions. Rogers asserts that this personal trial is more important to early adopters because, unlike later adopters, they have no precedent to follow (Roger1995).

Others have found this construct to be a weak predictor of software process innovation adoption (Kishore, 1999; MooreGC+, 1991). This led MooreGC (1991) to suggest that *trialability* may be less significant to individuals in an organizational context, especially in those organizations that make the innovation available at no risk to the individual adopter. However, Attewell (1992) asserts that innovations imposing knowledge barriers, such as has been previously explained with patterns, will be difficult to trial test in a quick but meaningful way and to anticipate the exact outcomes of its use.

Whether *trialability* has an impact on the *use* of patterns will be examined with the following proposition:

P4: *Perception of the trialabilty of patterns is positively related to the use of patterns.*

3.6.2.1.5 Visibility and result demonstrability

Rogers originally defined observability as "the degree to which the results of an innovation are visible and communicable to others". He indicated that software dominant innovations have "less observability and usually have slower rates of adoption" than hardware innovations (Rogers, 1983). While some studies of software process innovations have considered observability, they have also made the argument that the original construct is too complex (Levine+, 1995; MooreGC+, 1991). Therefore, they separate the two parts of the definition, visible and communicable to others, into *visibility* and *result demonstrability*, defining *visibility* as the extent to which potential adopters see the innovations as being noticeable in the adoption environment (Agarwall+, 1997) and *result demonstrability* as the "tangibility of the results of using the innovation" (MooreGC+, 1991). They point out that their findings agree with Zaltman (1973) who indicate that the more "amenable to demonstration the innovation is, [and] the more visible the advantages are ... the more likely it is to be adopted". While Iivari (1996) did not consider any three of these constructs in his examination of CASE, Kishore (1999) found no significance correlation between reuse frequencies and *result demonstrability* and found significant correlation with *visibility*. Both *visibility* and *result demonstrability* are examined in this study with the following propositions:

P5: *Perception of the **visibility** of patterns is positively related to the use of patterns.*

P6: *Perception of the **result demonstrability** of patterns is positively related to the use of patterns.*

3.6.2.1.6 Image

The *image* construct was previously considered as part of *relative advantage* by Rogers (1995). However, MooreGC (1991) revealed that in some instances it was a motivating factor on its own and defined it as capturing the perception that using an innovation will contribute to enhancing an individual's image or status in the social system (Agarwal, 2000; MooreGC+, 1995). While Iivari (1996) did not consider this variable, Kishore (1999) did not find that it correlated with reuse frequency. Other results concerning this construct's relationship to the adoption of product innovations vary (MooreGC, 1995; Agarwal+, 1997; Karahanna+, 1999). Kishore (1999) suggests that the lack of consistent findings may be due to the fact that this construct is not well understood, with validated instruments giving little consideration to whether it is a behavioral or normative belief. However, he also argues that, despite the need for more research to understand the nature and impact of this construct, it is important to consider *image* in an organizational context because individuals can be expected to continue using an innovation in an effective manner only when their social status in the organization is

at least maintained, if not enhanced by using the innovation (Kishore, 1999). This study considers whether *image* impacts the *use* of patterns with the following proposition:

P7: *Perception of a positive image as a result of using patterns is positively related to the use of patterns.*

3.6.2.1.7 Voluntariness

Another variable that has recently been considered in IT adoption research is *voluntariness* (Iivari, 1997; Kishore, 1999; Green, 2000). Described as "the degree to which an innovation is perceived as being voluntary, or of free will," it captures whether individuals have freedom to make personal adoption or rejection decisions (MooreGC+, 1991). MooreGC (1991) emphasize the importance of this variable in an organizational context because when the organization mandates or discourages the use of an innovation, the choice to use is taken away from potential adopters. Rogers also wrote of the influence of this concept when he discussed types of innovation decisions as being optional, collective, or authority (Rogers, 1995). Studies that have considered whether this factor is a predictor of SPI adoption have found a strong negative association – use increases with low *voluntariness* (e.g Iivari, 1996; Kishore, 1999; Green, 2000; Agarwal+, 1997). This has caused researchers to suggest that mandating an innovation directly through organizational policy (Iivari, 1996; Leonard-Barton+, 1988; MooreGC+, 1991; Kishore, 1999) or encouraging it indirectly through rewards and incentives (Leonard-Barton, 1987; Leonard-Barton+, 1988) can result in an increased use of the innovation. The following proposition reflects what innovation acceptance studies have found in their examination of the relationship between *voluntariness* and the *use* of an innovation.

P8: *Perception of voluntariness in using patterns is negatively related to the use of patterns.*

3.6.2.2 Innovativeness of the potential adopters

In conjunction with the perceived attributes of the innovation, Rogers has shown that an individual's innovativeness also influences the decision to adopt (Rogers, 1995). Therefore, the second construct group considered in this study is the innovativeness of the potential adopter. One factor is considered in this group – *innovativeness*.

3.6.2.2.1 Innovativeness

Rogers (1995) observed that individuals do not pass through the innovation-decision process at the same rate, and used the term *innovativeness* to refer to "... the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system". He noted that this dimension is a relative one in that any individual

has more or less of it than others in a social system. The earliest adopters often adopt innovations on account of their venturesome nature, while later adopters need more information and possibly persuasion from others, and the last to adopt will usually do so when there is pressure to conform to the social norms. *Innovativeness* indicates overt behavioral outcome, a bottom-line type of behavioral change, the ultimate goal of most diffusion programs. (Rogers, 1995). Therefore, Rogers concept of *innovativeness* is widely examined and cited in studies of IT adoption (e.g. Brancheau+, 1990; Kishore, 1999).

Midgley (1978) supports Rogers with the findings that in any given population, some people are more willing than others to adopt an innovation. Others have also found *innovativeness* to be an important determinant of innovation success (e.g. Lucas, 1981; Pierce+, 1977; Zmud, 1984). Kishore (1999) points out that proposing the impact of *innovativeness* on SPI adoption is well grounded. He argues that when considering the adoption of a complex innovation, an innovative attitude will encourage an individual to move forward when challenged by the need to learn a multitude of new features and functionality. This research examines the impact of individual *innovativeness* on the *use* of patterns with the following proposition:

P9: *Individual innovativeness is positively related to the individual's use of patterns.*

3.6.2.3 Potential adopters' perceptions of the social system

Many aspects of innovation adoption cannot be explained simply by individual behavior (Rogers, 1995). Diffusion researchers claim that the social system, originating from sources including the overall social system and the individuals within it, also has an effect on the decision to adopt. Therefore, this is the third construct group in this research.

Rogers notes the importance of the social system in diffusion research because similar innovations have different rates of adoption in different social systems (Rogers, 1995). Communication scholar Katz (1961) remarks, "It is as unthinkable to study diffusion without some knowledge of the social structures in which potential adopters are located as it is to study blood circulation without adequate knowledge of the veins and the arteries". However, Agarwal (2000) found that considerably less attention has been paid to the distinctive combination of person and situation influences. Rogers (1995) suggests that is likely due to the fact that it is difficult to separate the influences of the structure and/or the composition of the system from the effects of the characteristics of the individuals that compose the system. Despite the difficulties, the phenomenon of individual innovation adoption within an organizational context is important. Because organizational adoption can be successful only when all, or a large number, of the members for whom the innovation is intended for use,

successfully adopt it (Kishore, 1999), the organization is likely to provide various ways to encourage (or discourage) adoption and these cannot be dismissed.

IT diffusion research has suggested numerous individual, organizational and environmental characteristics of the social system that impact upon the actions of users to adopt or not adopt an innovation (Davis+, 1989; Orlikowski, 1993; Iivari, 1996; Green, 1999). In this study, the social system construct group is further divided into two subgroups: social influences and structural influences. While social influences capture the human influences in an organization, structural influences captures the resources and opportunities available to a person that have the potential to influence the targeted behavior (Ajzen, 1991). These two categories are closely related. Green (1999) combines the two into a category called IT diffusion environment, while Agarwal (2000) separates them into two categories, social and situational influences. This study follows Agarwal (2000) because his model is a product of a recent overview of existing literature in individual acceptance of IT. These two construct subgroups, as well as the factors in each one, are explained below.

3.6.2.3.1 Social influences

DOI research has shown that members of an organization develop perceptions of an innovation through social interactions that communicate attitudes and beliefs in complex and highly influential social systems (Rogers, 1995; Kraut+, 1998). Agarwal (2000) points out that these interactions, in the form of overt communication or more subtle form of suggestion, are instrumental in "generating shared meaning and mutual understanding in an organization and thereby provide an important basis for subsequent patterns of behavior".

Social influences have been found to originate from a variety of sources (Agarwal, 2000; Levine+, 1995). The influence that social influences have on the decision to use patterns will be examined in this study with the following factors: champion, opinion leader, and change agent.

3.6.2.3.1.1 Champion

The organizational innovation literature has strongly linked the success of IT innovations to the presence of a *champion* (e.g. Beatty, 1992; Ettlie+, 1984; Kanter, 1983; Maidique, 1984; Pennings+, 1987; Van de Ven, 1986; Prescott+, 1995). Rogers (1983) has identified the importance of champions to implementation success and IT research indicates management commitment is key to the success of an information system (Ginzberg, 1981).

The often-cited work of Beath (1991) defines an IT *champion* as a "manager who actively and vigorously promotes their personal vision for using IT, pushing [a] project over or around approval and implementation hurdles". Many empirical studies define champions as taking the form of management support for the innovation (Hoffe+, 1992; Wynekoop+, 1992; Rai+, 1994; Fayad+, 1996; Chau, 1996; Iivari, 1996). Management support is consistently reported to facilitate IT use (Iivari, 1996). It has been suggested that this is due to the fact that management controls the needed resources (Lucas, 1981), provides messages about the behaviors that the organization is trying to encourage (Lucas, 1981), is in position to develop a work culture that is open to experimentation and learning (Scott+, 1994) and to make structure changes that provide close interaction between innovation providers and users (Agarwal, 2000).

Studies have empirically demonstrated a significant relationship between management support and SPI acceptance such as CASE (Iivari, 1996) and structured software methods (Leonard-Barton, 1987). This factor is likely to be particularly important in SPI adoption because, as complex technologies, the long process of learning and implementation comes with rather high risk and discontinuance of use (Beatty+, 1988; Fleischer+, 1990; Lucas, 1981; Leonard-Barton+, 1988; Tornatzky+, 1982). Kishore, (1999) argues that a *champion* is needed to provide users and potential users with support and reinforcement during the time when the infrastructure for the SPI is being built. Therefore, this study considers the influence on the decision to *use* patterns with the following proposition:

P10: *Perception of the existence of a **champion** for patterns is positively related to the use of patterns.*

3.6.2.3.1.2 Opinion leader

An *opinion leader* is an individual who leads in influencing the decisions of their peers in their social system (Kishore, 2000). Rogers (1995) defines opinion leadership as "... the degree to which an individual is able informally to influence other individuals' attitudes or overt behavior in a desired way with relative frequency". Because opinion leaders have the quality of being highly respected individuals within their social systems, they therefore have the potential to exert influence over their peers in both an informational and normative form (Rogers, 1995; Kishore, 1999). This type of interpersonal communication drives the diffusion process towards the creation of a critical mass of adopters (Rogers, 1995), a characteristic that, as previously explained, is particularly important in innovations affected by adopter interdependencies.

There are not many studies in the IT literature that have focused on opinion leadership (Kishore, 2000). None of the SPI studies cited thus far report the impact of opinion leaders (e.g. Green, 2000; Iivari, 1996; Kishore, 1999). In a study of the adoption of expert systems, Leonard-Barton (1988) found acquaintance with users to significantly correlate with use. In e-mail adoption, co-worker behavior was found to be more influential than supervisor behavior in determining use, suggesting that the closer the source of influence is to the potential adopter, the more influential it is (Schmitz+, 1991). In this study, the influence of an *opinion leader* on the decision to *use* patterns is considered with the following proposition:

P11: *Perception of the existence of an **opinion leader** for patterns is positively related to the use of patterns.*

3.6.2.3.1.3 Change agent

A *change agent* is an individual who influences decisions to adopt or not adopt an innovation in the direction deemed desirable by the change agency. They may be brought in from outside the social system and, unlike opinion leaders, their role is more formal. Rogers (1995) asserts that *change agent* success in securing the adoption of innovations is positively related to the extent of the *change agent*'s efforts in contacting individuals. The agent is responsible for such tasks as assessing and developing the need for change, creating intents to change, and translating the intents into decisions to adopt. Kishore (1999) reports that few studies in the IS literature focus on the role of the *change agent.* This research examines whether, when present, a *change agent* is a factor that affects individual *use* of patterns with the following proposition:

P12: *Perception of the existence of a **change agent** for patterns is positively related to the use of patterns.*

3.6.2.3.2 Situational influences

The second subgroup in the social system construct group is the situational influences. Ajzen (1991) is among those who have found that resources and opportunities available to the person must to some extent dictate behavior. Davis (1989) refers to these "externally controllable factors" and includes such things as development methodologies and training. Numerous factors have been considered in previous research (Green, 1999). This research considers three that are particularly important to the diffusion of SPI: training, installed process, patterns repository. The choice of these three for this study is based on rather recent interest in the concept of whole product.

To become a whole product, innovations usually need to be accompanied by a range of adjunct products and services that are necessary for popularization, including such things as training, standards and procedures, and tool support (Levine+, 1995; MooreGA, 1999). One popular example of a model of whole product is by MooreGA (1999) who argues that an innovation must often be augmented by a variety of services and ancillary products before it can obtain a majority acceptance. This is based on marketing experiences that have shown a gap between the marketing promise made to the user and the ability of the innovation to fulfill that promise.

Levine (1995) asserts that "whole products are the embodiment of the maturation process" and propose that a majority adopter population (Rogers, 1995) is less likely to succeed with immature innovations because of potential adopters' intolerances for missing aspects of the whole product. Support was found for their proposition in their case study of rate monotonic analysis (RMA), a technique that helps software engineers design, build and maintain real-time systems (Levine+, 1995). They found that the existence of a whole product was so important to the adopters that they compensated for missing aspects in RMA by building an "in-house" version of the whole product. This, in turn, led the organization to become an early adopter of RMA (Levine+, 1995). There is further support from Finlay (1994) who found "stability" of CASE to be an extremely important factor in its use. In addition, Fichman (1997) suggests that the availability of tools and the existence of a defined process provide a safe way for novices to learn object orientation which can then encourage adoption.

Kishore (1999) explains that the problem of an unstable product, lack of "initial stability", becomes more acute in the process technologies because, by definition, these types of innovations are intermingled with tools, techniques, procedures, or methodologies in order to accomplish their intended purposes. Lack of existence or instability in any of these can be unsettling for individuals and discourage their decision to adopt (Kishore, 1999).

Following the lead of recent researchers, this study considers three components of a whole product: training, tool support, and procedures and standards (in the form of an installed process). Each of these is present in MooreGA's (1999) model and in the adaptation of that model by Levine (1995).

3.6.2.3.2.1 Training

The availability of *training* is a crucial factor in the successful diffusion of software process innovations (Green, 2000). It has been presented that one of characteristics of SPIs, and thus patterns, is the knowledge barriers that exist because SPIs are complex process innovations.

Unlike most simple innovations, they require users to acquire a broad range of tacit and procedural knowledge. In highly complex technologies, the challenge of training individuals in an organization can be the primary barrier to successful adoption (Attewel, 1992; Fichman+, 1994). When knowledge barriers are high, the ability to innovate becomes at least as important as the desire or opportunity to do so (Fichman+, 1997).

To reduce knowledge barriers, availability of various kinds of *training* was found to be a factor in successful diffusion by those who have studied such software process innovations as CASE (Kemer, 1992), structural development methods (Leonard-Barton, 1987), software reuse (Kishore, 1999), PSP (Green, 2000) and OO (Fayad+, 1996). In this study, the impact of the perception of available *training* on the *use* of patterns is considered with the following proposition:

P13: *Perception of the availability of training in patterns is positively related to the use of patterns.*

3.6.2.3.2.2 Patterns repository

The availability of tool support is another characteristic that is important to the diffusion of software development techniques (Green, 1999). This includes such things as software and hardware tools that the user would need to fully utilize the innovation. Both MooreGC (1991) and Levine (1995) include these components in their whole product models. Tool support is worth considering because when it is not present, potential adopters may become insecure about the success of the innovation (Fayad+, 1996). It can be argued that this insecurity can affect their adoption of it. Studies of the relationship between tool support and SPI acceptance include formal software development methods and OO software development methods. Findings in the former suggest that the unavailability and inadequacy of tool support represent serious barriers to widespread use of formal methods (Holloway+, 1996). In the latter, four case studies showed that cost of adoption, including learning-related costs, were magnified considerably by the absence or immaturity of tools to support OO development (Fichman+, 1997). In this study of patterns, only software tool support is considered, operationalizing it as *patterns repository*.

Kishore (1999) makes the argument that reusable components are a key element of software reuse because the higher the number available for potential reuse, the higher the utility of software reuse to the individual software developer. An installed base of reusable objects was found to have a highly significant positive influence on the infusion of software reuse

(Kishore, 1999). Following the lead of this finding, this study will examine the impact of an installed base of reusable patterns with the following proposition:

P14: *Perception of the existence of a **patterns repository** is positively related to the use of patterns.*

3.6.2.3.2.3 Installed process

A third category in the whole product models of MooreGA (1999) and Levine (1995) is procedures and standards. To gain insight into this rarely examined factor, this research looks for guidance in studies in Personal Software Process, OO, and reuse. It operationalizes procedures and standards as *installed process*.

Green (2000) found that software developers' perceptions of the control they have of the process in which an innovation is used affects their satisfaction with that innovation. Her study of Personal Software Process (PSP) showed that the more personal control developers have over how they used PSP, the less satisfied they were in using it. She suggests that the more the organization emphasizes standards and structure in its use of PSP, the more the individuals will be satisfied with this use (Green, 2000). She explains this may be due to the fact that software development tasks are complex. The existence of process and standards for using an innovation within software development can create the structure that reduces the overall task complexity, thereby increasing satisfaction among those who use the innovation (Green, 2000).

There is further argument for the existence of a defined process in achieving adoption of another innovation, reuse. This is considered here because patterns are a technique for capturing best practices for the purpose of reusing them. Research scholars have long supported that achieving reuse requires a host of process changes (Griss, 1995; Griss, 1993; Fichman+, 1997). To utilize reuse effectively in software development projects, an organization needs more than just reusable entities; it also needs processes and standards to effectively control how the new tasks, roles, and techniques will be incorporated into the organization (Fichman+, 1997; Kishore, 1999). It can be argued that these changes should not be added without any structure. In fact, Fichman (1997) found that the lack of mature process was a primary barrier to reuse. If changes are not made in the process, reuse tasks cannot be effectively performed because they are neither specified or supported (Kishore, 1999). Therefore, Kishore (1999) hypothesized that the degree of fit between an organization's process will impact upon the extent to which reuse can be effectively practiced by software developers. Support for this hypothesis was found -- an individual's perception

that reuse fits in an organization's process had a positive impact on the adoption of reuse. Similarly, this research examines the relationship between an *installed process* and the *use* of patterns with the following proposition:

P15: *Perception of the existence of an **installed process** for patterns is positively related to the use of patterns.*

3.7 Chapter summary

This chapter described the theoretical underpinnings of this research study. The research framework was derived by classifying patterns as a software process innovation and then considering the wider area of IT innovation. The purpose was to establish the factors that will be examined in this study. As other SPI and IT adoption studies have done, this study utilizes research in diffusion of innovation as its foundation because of its wide use, its focus on communication, and its choice of factors that have been studied and enhanced by others.

This study will render diffusion of innovation research more relevant to the specifics of pattern diffusion. It will examine the relevance of the model proposed in this chapter (figure 2), and the corresponding propositions (section 3.6.2) in order to provide a response to the first research question. It will also examine which of the factors proposed in the model are being emphasized by individuals introducing patterns into their organizations.

The next chapter presents the research design for this work.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

Chapter one presented the motivation, objectives and the primary and secondary research questions that guide this study. Chapters two and three respectively described the twin theoretical sources, patterns and diffusion of innovation research, which provide the foundation for the initial research model. This chapter describes the methodology that will be used to examine this model and build the theory that suggests responses to the research questions.

4.2 Research design model

The research design is illustrated in figure 3. As shown, there are two research threads, or operations, that converge on the goal of identifying factors. Both have their foundation in diffusion of innovation research and lead to building and explaining a revised model of pattern use and offering guidelines for organizations that wish to encourage this use.

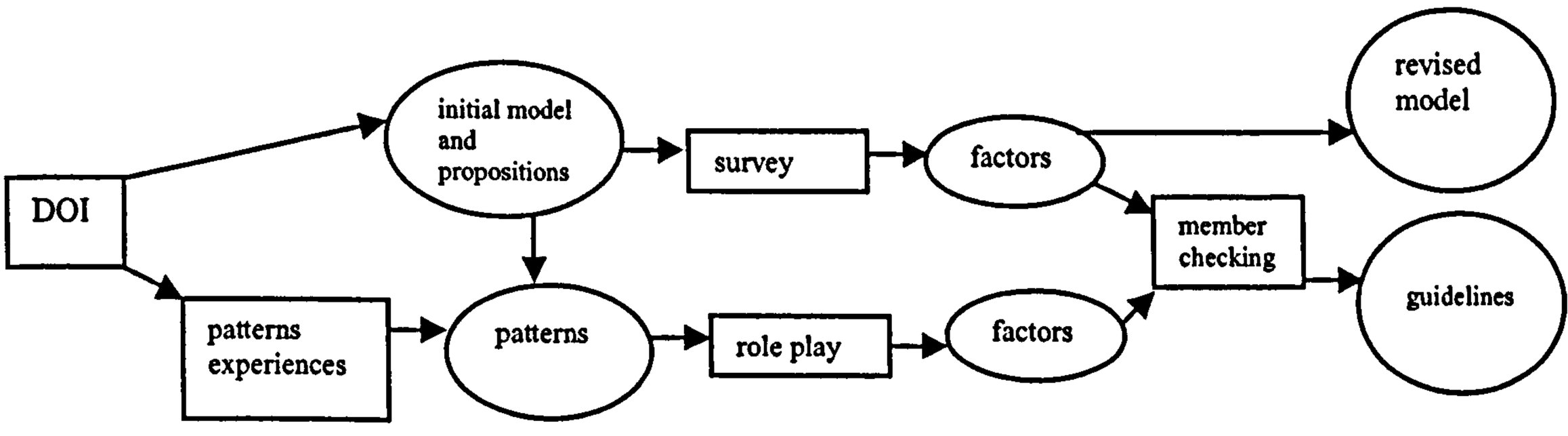

Figure 3: Research Design

Support for the initial model and propositions are explored in operation one. This is done with a survey that examines the support for each proposition by identifying the relationships between the dependent variable, individual pattern *use*, and fifteen different factors that are proposed to have an impact upon this *use*. The factors identified in this operation will respond to the first research question, as posed earlier:

What factors influence the use of patterns among individuals in organizations?

The second operation explores what individuals are doing to influence the use of patterns. It does this by first matching the fifteen proposed factors to forty-six patterns that capture successful practices in introducing patterns. It then examines the support for the factors through role play exercises that make use of the patterns. The factors identified in operation two will respond to the second research question, as posed earlier:

> What factors are being emphasized by individuals introducing patterns into organizations?

As also shown in figure 3, the findings from the survey and role play methods will be evaluated with member checking, a method that requests feedback from the subjects who provided the original data (Seaman, 1999). Finally, a revised model is presented with discussion and guidelines that can inform researchers and practitioners about how they may position patterns in organizations to encourage a faster and more efficient adoption. The following sections provide more details on the three sources of data in this study.

4.3 Field study

This research uses a field study approach to data collection. In contrast to an experimental approach, a field study is carried out with the natural environment in which subjects reside in mind. As such, correlations between the variables are examined without the researcher manipulating any of the variables or interfering with any natural events in the subjects' environments (Sekaran, 1992).

In a similar study of the factors that impact upon the use of the Personal Software Process approach, Green (1999) argues that the use of a field study is appropriate. If an experimental design were used, the manipulation of a large amount of independent variables, such as in this study, would be difficult and expensive. A field study that gathers data from individuals in multiple organizations has the additional benefit of increasing the external validity of the results of the study. These results can then be more confidently applied across a wider population, an important aspect of applied research (Green, 1999). Use of a field study is also supported by McGrath (1979). His "theory of method" for research has as its central thesis a five-stage model that aligns different data collection methods with the state of knowledge in the area of interest and the research purpose. In this model, research progresses through stages as more information is accrued about the phenomenon. In stage 1, when little is known about the phenomenon, he argues that exploratory research needs to be conducted using field studies to formulate theoretical models. It has been pointed out in a previous section that the phenomenon of introducing patterns into an organization has not yet been considered by any

significant research. Therefore, it is appropriate to examine the field rather than make assumptions about the field and then test them experimentally. Among the other works in the IS literature that agree with the thinking of McGrath (1979) are those who have studied the factors affecting the adoption of software process innovations such as software reuse (Kishore, 1999) and CASE (Iivari, 1996; Orlikowski+, 1991).

The two methods of data collection in this field study are surveys and role play exercises. A third method, member checking, is used to confirm the findings. This "triangulation of data" allows multiple sources of data, a practice that is particularly important in exploratory, theory building research (Bryman, 1989). While the survey and the role play supply quantitative data, the member checking inquiry gives a more qualitative view. Seaman (1999) argues that nearly any software engineering issue is best investigated using a combination of quantitative and qualitative methods. Because human behavior is too complex to be described only with statistics, qualitative data provides the explanatory information that helps in refining the propositions to better fit the data.

The multiple sources of data in this study assemble the "weight of evidence" (Seaman, 1999) and analysis power for building the theory proposed in the final model and corresponding guidelines. The specific way each method in the three operations does this is explained in the following sections.

4.4 Research operation one

The first operation in this study seeks a response to the first research question. As shown in figure 3, it begins with a theoretical foundation in diffusion of innovation. From this, an initial model is derived. The relevance of this model, and each of the corresponding propositions, is examined through a survey of individuals that use patterns. The survey questions seek to identify which of the fifteen proposed factors have a relationship to individual pattern *use*.

4.4.1 Survey

Studies of individual behavior in an organizational context rely most heavily on the use of survey questionnaires as the primary method of data collection (Hinkin, 1998; Stone, 1978). The survey instrument in this study serves to identify the target factors through individual responses to questions about pattern *use* (the dependent variable) and fifteen factors (the independent variables). These sixteen variables and the survey measures for each are shown in table 4.

Measured Variable	Item #	Item	Source
Use of patterns (dependent)	1	I use patterns.	Manns, 2002
	2	I use patterns only in my own work in my organization.	Manns, 2002
	3	I use patterns with others in design sessions or other team-oriented task in my organization.	Manns, 2002
	4	I have written patterns for my organization.	Manns, 2002
Relative Advantage (P1)	5	Patterns enable me to accomplish tasks more quickly.	Kishore, 1999; MooreGC+, 1991
	6	Patterns improve the quality of work I do.	Kishore, 1999; MooreGC+, 1991
	7	Patterns make it easier to do my job.	Kishore, 1999; MooreGC+, 1991
	8	Patterns enhance my effectiveness on the job.	Kishore, 1999; MooreGC+, 1991
	9	Patterns give me greater control over my work.	Kishore, 1999; MooreGC+, 1991
	10	I lose my creativity by using patterns.	Kishore, 1999; MooreGC+, 1991
Compatibility (P2)	11	Patterns are compatible with my work.	Kishore, 1999; MooreGC+, 1991
	12	I think that patterns fit well with the way I like to work.	Kishore, 1999; MooreGC+, 1991
	13	Patterns fit into my work style.	Kishore, 1999; MooreGC+, 1991
Ease of use (P3)	14	I believe that patterns are difficult to use.	Kishore, 1999; MooreGC+, 1991
	15	Using patterns require a lot of mental effort.	Kishore99; Moore&Benbesat91
	16	Using patterns is often frustrating.	Kishore, 1999; MooreGC+, 1991
	17	I believe that it is easy to use patterns to do what I want to do.	Kishore, 1999; MooreGC+, 1991
	18	Overall, I believe patterns are easy to use.	Kishore, 1999; MooreGC+, 1991
	19	Learning to use patterns is easy for me.	Kishore, 1999; MooreGC+, 1991
Trialability (P4)	20	Before deciding whether to use patterns, I was able to properly try out various methods, techniques, and tools for using patterns.	Kishore, 1999; MooreGC+, 1991
	21	Before using patterns in my work, I was able to use them on a trial basis long enough to see what they do.	Kishore, 1999; MooreGC+, 1991
Visibility (P5)	22	Pattern use is not very visible in my organization.	Kishore, 1999; MooreGC+, 1991
	23	In my organization, one sees many people using patterns.	Kishore, 1999; MooreGC+, 1991
Result Demonstrability (P6)	24	The results of using patterns are apparent to me.	Kishore, 1999; MooreGC+, 1991
	25	I believe I could communicate to others the consequences of using patterns.	Kishore, 1999; MooreGC+, 1991
	26	I would have difficulty explaining why patterns may or may not be beneficial.	Kishore, 1999; MooreGC+, 1991

Table 4 (part 1): Survey Measures

Measured Variable	Item #	Item	Source
Image (P7)	27	People in my organization who use patterns have more prestige than those who do not.	Kishore, 1999; MooreGC+, 1991
	28	People in my organization who use patterns have a high profile.	Kishore, 1999; MooreGC+, 1991
	29	Using patterns is a status symbol in my organization.	Kishore, 1999; MooreGC+, 1991
Voluntariness (P8)	30	Although it may be helpful, using patterns is certainly not compulsory in my job.	Green, 1999; Kishore, 19 MooreGC+, 1991
	31	My supervisors expect me to use patterns.	Green, 1999; MooreGC+, 1991
	32	Use of patterns is part of my job description and/or performance plan.	Green, 1999
Innovativeness (P9)	33	I prefer to wait until an innovation becomes fully mature before trying it out.	Kishore, 1999; Leonard-Barton+, 1988
	34	I always wish to learn and use something new that I encounter.	Kishore, 1999; Leonard-Barton+, 1988
	35	People tell me that I always experiment with new ideas and technologies.	Kishore, 1999; Leonard-Barton+, 1988
	36	I do not wish to expose myself and my organization to the high risks and learning costs associated with a new technology by being its first user.	Kishore, 1999; Leonard-Barton+, 1988
Champion (P10)	37	Management supports patterns in my organization.	Manns, 2002
	38	My manager is a positive influence on my use of patterns.	Manns, 2002
Opinion Leader (P11)	39	Co-workers in my organization use patterns.	Manns, 2002
	40	Co-workers in my organization are a positive influence on my use of patterns.	Manns, 2002
Change Agent (P12)	41	There is one (or more) person(s) who is/are responsible for providing information and leading the adoption of patterns in my organization.	Manns, 2002
	42	I have been positively influenced to use patterns by one (or more) person(s) who is/are responsible for providing information and leading the adoption of patterns in my organization.	Manns, 2002
Training (P13)	43	My organization provided me with the training I need to be able to use patterns effectively.	Green, 1999
	44	My organization provided me with patterns training at a time when it was appropriate for me to make use of patterns.	Green, 1999
Installed Base of Patterns (P14)	45	My organization has a patterns repository that is useful to me.	Manns, 2002
Installed Process (P15)	46	Patterns have been incorporated into the software development process in my organization.	Manns, 2002
	47	Patterns fit well into the process my organization uses to develop software.	Manns, 2002

Table 4 (part 2): Survey Measures

The survey instrument appears in appendix A. It contains two sections: (1) statements about pattern use, and (2) general information and open-ended questions. In the first section, the items use a 7-point Likert scale, following the lead of others who have recently surveyed the

factors that impact upon the adoption of other software process innovations (e.g. Kishore, 1999; Green, 2000; Iivari, 1996). Similar to these and other studies, the Likert scale used in this research instrument contains a set of items, all of which are considered equal in attitude or value loading. For each item, the respondents chose varying degrees of intensity on a scale ranging from strongly disagree through strongly agree. This includes a neutral choice that allows for those who are uncertain about their response for a particular item.

The reader is reminded that the survey items in this research do not capture behavioral outcomes, but rather attitudes. Therefore, the statements are worded so that they record the perceptions of the respondents. Chapter 3 described the dependent and independent variables. The following section presents the source and the reasoning for the measures for each variable.

4.4.1.1 Survey measures

As shown in Table 4, survey measures for ten of the fifteen variables were found in the existing literature. These measures were used directly in the survey instrument after minor changes to adapt them for the innovation being investigated. Measures for the other five constructs in the research model were not directly available. For these five variables, measures were developed following the recommendations of Churchill (1979), and recently applied by other IS researchers (Joshi, 1989; Mahmood+, 1991; Sethi+, 1991; Kishore, 1999).

The widely-cited Churchill (1979) explains that the operational definitions of constructs be derived from past literature. This was done in section 3.6. Churchill further recommends that each definition express only limited meaning. Therefore, for those constructs that do not have existing measures, their dimension was kept simple and the wording of their item kept straightforward. For example, item #2 (I use patterns in my own work in my organization) measures whether the individuals perceive that they use patterns in their own work. Similarly, item #45 (My organization has a patterns repository that is useful to me) uses the commonly understood word "repository" to measure whether individuals perceive that they have a *patterns repository*.

A summary of the source of each survey item is shown in table 4. Of particular interest is the contribution of Moore and Benbesat (MooreGC+, 1991) who, as explained in section 3.5, introduced the eight Perceived Characteristics of Innovating (PCI) antecedents as an extension to DOI. Their overall instrument to measure the relationship of the PCI antecedents to information technology *use* is widely utilized (e.g. Kishore, 1999; Green, 2000; Iivari, 1996; Hightower, 1991]). It has been extensively evaluated for reliability and validity with

Cronbach's Alpha for the eight constructs ranging from .73 to .95. Six of the factors had reliabilities of .80 and above (Hightower, 1991).

This study makes use of these measures to examine the factors in the first eight propositions (P1 through P8). The statements most closely match the wording used by Kishore (1999) in his study of the factors that impact upon an individual's adoption of software reuse. While Kishore based his wording on that of MooreGC (1991), he made small modifications to reflect the nature of the innovation under consideration. Similarly, in this study, the word "reuse" was replaced with the word "patterns".

The statements for the *innovativeness* construct (P9) were also extracted from Kishore (1999). There are few studies that include *innovativeness* as an attitudinal variable in comparison with innovation studies that utilize this variable as a dependent variable of interest (Kishore, 1999). Leonard-Barton (1988) is one of the few, using this variable to study the impact of individual *innovativeness* attitude on the use of an expert system package. Kishore (1999) based his four statements on the work of Leonard-Barton (1988) and the generalizations concerning *innovativeness* provided by Rogers (1995). With the exception of changing the word "technology" to "innovation", the wording for this factor matches that used by Kishore (1999) in his study of software reuse adoption.

To examine the influence of *champion* (P10), *opinion leader* (P11), and *change agent* (P12), Kishore (1999) used a rather open ended approach, asking survey participants to list those who influenced their adoption of reuse. This resulted in inconclusive results, so this study chose to continue the Likert scale approach, using two statements for each variable to inquire about the influence each of these three sources had on the respondent's *use* of patterns.

Statements to examine the influence of *training* (P13) are based primarily on the two considerations of Green (1999). In her study of the factors that influence the adoption of Personal Software Process, she examined the *training* and the timing of the *training*. Two of her statements were used in this study, after changing the word PSP to patterns.

While insight for the *patterns repository* (P14) variable came from Kishore's (1999) installed base of reusable objects variable, the wording was not used verbatim. Instead, it was deemed more appropriate to combine the information in his two statements into one statement in this study to address, in a straightforward manner, whether the existence of a *patterns repository*, which the respondent considers useful, correlates with pattern *use*.

The measure for the last independent variable, *installed process* (P15), was also developed by the researcher. The wording in the two statements is intended to capture if patterns have been incorporated into the individual's software process and whether the respondent perceives that they fit well into this process.

Finally, pattern *use* is the dependent variable. As previously explained, this variable for adoption follows the lead of many other innovation adoption studies. The measures for this variable are worded in a succinct manner to capture whether the respondent uses patterns, uses them only in his her own work, uses them with others in group activities, and/or writes patterns.

In the second section of the survey, respondents are asked to provide some descriptive data, the primary nature of their job, the length of time they have used patterns, and the type of software development activities in which they have used patterns. In addition, one open-ended question provides space for any additional thoughts on their pattern use and an optional request is made for information to do a follow-up interview.

While attempts were made to follow the guidelines of survey instrument development, any limitations in the construct measures and survey instruments are reflective of the lack of existing research on this topic and the intent of this study towards exploration and discovery. It is important to note that the intent of this research is not to develop construct measures and validate them. Rather, the present study can best be viewed as part of a research stream. As such, the intention is to shed light on some important constructs and relationships concerning the phenomenon of pattern adoption. It will be the basis for further evaluation in future research efforts. As Zmud (1991) writes, "... the development of high-quality measures is not restricted to a single research effort. Measurement instruments are not 'set in stone'; rather they evolve through an ever-extending process of development, examination, and refinement".

4.4.1.2 Sampling

The population for the survey is software developers that use patterns in their organizations. Because the purpose of this research operation, and the complete project, is not to produce results that are conclusive and generalizable, the sampling for the survey was not random. The reader is reminded that the survey is only one of three methods that aim to build theory rather than reach statistically significant conclusions. When this is the objective, Baroudi (1989) and Sawyer (1981) recommend the use of a purposeful sampling strategy known as homogenous sampling. Following the lead of Mahmood (1991), this sampling technique

seeks to increase the analysis power of the results by placing homogeneity over randomness in the sampling. In this study, a homogeneous sample was attempted by seeking individuals who were likely to mark a scale of five or greater in response to the first question in the survey: "I use patterns." Data collection opportunities were chosen with the goal of finding individuals who fit this profile.

Although Robson (1993) explains that the collection of standardized data from an undifferentiated group of respondents is a perfectly adequate way to find information about the incidence and distribution of particular characteristics and the possible relationships among them, Baroudi (1989) cautions that homogeneity sacrifices the power to obtain a broad view of the results. Therefore, this study sought to restore some generalizability in the survey results through a large sample size and multiple data collection sources. For quantitative analysis, samples in excess of thirty are considered adequate for most research (Mahmood+, 1991). In this study, data were collected from 133 individuals who were located and invited to be part of the study in five sources: 1) the EuroPLoP'01 conference, 2) the PLoP'01 conference, 3) the OOPSLA'01 conference, 4) a mailing list of individuals that expressed an interest in the topic of introducing patterns into organizations, and 5) a general patterns-discussion mailing list. Therefore, although the purpose was to find individuals who rate their use of patterns similarly, the variety of channels through which they were found permits some diversity, especially in the different organizations that are represented in this sample.

4.5 Research operation two

The second operation further investigates the fifteen factors proposed to have a relationship to individual pattern use. Unlike operation one which examines pattern use among individuals, this operation looks at what is being done to encourage this use. It seeks a response to the second research question.

As shown in figure 3, operation two begins with a theoretical foundation in diffusion of innovation and the successful practices of those who have attempted to introduce patterns into their organizations. These practices are documented in a language of patterns titled *Introducing Patterns into Organizations*. This language appears in appendix C.

To examine which of the factors included in this study are considered in the practices documented in this language, each pattern is matched to the proposition(s), and thus the factor(s), it recognizes. After this matching, the patterns are then used in role play exercises that create plans for pattern introduction. The use of a pattern in these plans lends further evidence for the need to recognize the factor(s) considered by that pattern.

The pattern language that documents the practices and the role play exercise that generates the plans for introducing patterns are described in the following sections.

4.5.1 The pattern language

The pattern language used in operation two is titled *Introducing Patterns into Organizations*, and appears in appendix C. It was authored by the researcher in this study, Mary Lynn Manns, and Linda Rising, who as previously mentioned, instigated a limited study on this topic in 1996. The patterns document the successful practices of those who have been involved in the task of introducing patterns into various organizations. They are supported by innovation diffusion research and were built under the guidance of Alexander's philosophy of patterns. As such, they offer the three features of patterns: structure, process, and community.

Each of the forty-six patterns provide a structure for documenting a recurring problem in introducing patterns into organizations, the conflicting forces that create the problem, a solution that has been shown to be successful through practice, the rationale and the resulting consequences, the links to other patterns in the language, and the known uses. Within each pattern's structure is a solution describing a process that has been shown to be successful in addressing the problem.

Following Alexander's fundamental philosophy of creating form, the language was itself built with a piecemeal rather than a master plan approach over a number of years. It started out in 1996 as a flimsy structure of twenty-three patterns, originally written by seven authors under the lead of DeLano and Rising. In 1998, five more patterns were added by Manns while she was working to introduce patterns into a research branch of a large telecommunications organization the western United States. A description of this experience appears in appendix B. In 1999, the twenty-eight patterns were evaluated by Manns and Rising, resulting in seventeen being carried forth into a united project. Under this joint leadership, the remaining twenty-nine patterns were written over a period of approximately two-and-a-half years.

The introduction of each new pattern to the collection was prompted by the recognition of a recurring problem and the existence of a successful solution. As each was added, its meaning in the context of the other patterns was documented in its relationships. In this way, the addition of each pattern transformed the language structure, making it stronger as it progressed towards the creation of the whole language form.

Although one cannot claim that this candidate language captures every known problem and solution, the relationships between the patterns allow users to generate various sequences through the language. Therefore, like other patterns that are related to each other in a language, the patterns in *Introducing Patterns into Organizations* provide a process for using them. In addition, each pattern has a process within it to define its use. Because of this, they could be used in a role play exercise, as described below, to design a plan for introducing patterns into an organization.

The language also has the third feature of patterns, community participation. The lead authors, Manns and Rising, drew on their experiences in introducing patterns into two different organizations. There were also many other contributors, from a variety of organizations, who wrote patterns, provided stories of known uses, and contributed continuous feedback. Participation was encouraged in a number of different ways. Working sessions on this topic were held at four software conferences. During OOPSLA'96 and OOPSLA'00, new patterns for the language were written and workshopped. At the OT'00 and OOPSLA'01 conferences, role play exercises were conducted to explore how the patterns can be used by those planning to introduce patterns into their organizations.

At various points throughout the growth of the language, formal peer review was acquired according to the norms of the patterns community through shepherding and workshopping at four PLoP conferences in 1997, 1999, 2000, and 2001. A portion of the language was published in the EuroPLoP'00 proceedings (Manns+, 2000). In addition, informal feedback was acquired throughout the duration of the project by posting the fledging patterns on a web page and by prompting numerous informal conversations and email correspondences.

This exposure allowed a large amount of community participation in creating the language. The patterns have been originated by twenty-five authors and known uses come from experiences at seventeen organizations. This diverse input supports each pattern as capturing a successful practice rather than simply a good idea. As Alexander notes, community participation in building the language is what encourages it to be useful to and, in turn, be used by the community (Alexander, 1975).

In summary, *Introducing Patterns into Organizations*, in appendix C, offers a structure for documenting successful practices in introducing patterns into organizations, a process for using the patterns, and the community participation that encourages its use. As such, it can be used by those who wish to introduce patterns into their organizations. Therefore, in operation two of this study, the language was the tool in two separate role play exercises in which

participants created plans for introducing patterns into organizations. To make it possible for these exercises to reveal which factors the participants believe are important to address, each pattern was matched to the factor it addresses. Then, the inclusion of any pattern in the role play plan signals that its matching factor(s) is regarded as important to consider when introducing patterns into an organization.

The matching of the factors to the patterns appears in appendix D. This matching is done under the assumption that each of the individual patterns recognizes the influence of one or more factors that can influence individuals to use patterns and therefore, by addressing this factor, can aid the effort to introduce patterns into organizations. The factor that each pattern recognizes was determined by looking at the primary purpose of the pattern. While it can be criticized that this task involved subjective decisions by the researcher, this same researcher is also one of the primary authors of the patterns and therefore is highly familiar with their contents and purposes.

The role play exercises in which they are used is described in the following section.

4.5.2 Role play

The purpose of the role play exercise is to identify factors that individuals planning to introduce patterns believe are important to consider. The exercise was piloted at the OT'01 conference in England in April 2001. Then, the first data collection session was conducted at the OOPSLA'01 conference in October 2001 at Tampa, Florida. Eight participants were split into four groups of two to create a plan for introducing patterns into their organizations. They were supplied with a copy of the patterns and a deck of index cards with a pattern name, abstract, problem, and solution appearing on each one. Each group produced a written record of the collection of patterns they chose to use in their plan.

In the second role play exercise, graduate students in the Object-Oriented Patterns and Architectures course at University of St. Thomas in Minnesota (USA) were given the assignment to create a proposal for a software "patterns program" within an organization. The assignment appears in appendix F. The participants worked in four groups of 3-5 individuals to produce a written "memo" with the collection of patterns they chose to use and the reasons for their choices.

The results of these two role plays appear in the following chapter.

4.6 Research operation three

In the third operation of this study, feedback was obtained on the findings from the first two operations. It makes use of a research method known as member checking, as described in the following section.

4.6.1 Member checking

Member checking is used to add confirmation and further insights by requesting feedback on the findings from the subjects who provided the data. In this study, it provides some qualitative explanation for the more quantitative results reported in the first two research threads. Seaman (1999) explains that this method is particularly well suited for most studies in software engineering because it allows subjects to understand more about how the results were derived which, in turn, helps to promote their support for the recommendations from these conclusions. This support can be useful because researchers in this area usually have a marketing role in promoting the innovation they are investigating.

In the member checking operation of this study, two personal messages were sent to the individuals who provided the survey data and agreed make to follow-up comments. The first message requested feedback on ten preliminary findings: the factors correlating with individual pattern use, use of patterns with others, writing patterns; the high mean for the *compatibility*, *relative advantage*, and *result demonstrability* factors; the low mean for the *patterns repository*, *change agent*, patterns *training* and *visibility* factors; the correlations between *patterns repository* and five other factors; the correlations between *installed process* and a similar five factors; the correlations between the choice to use patterns and six other factors; the influence of *change agent*, *patterns repository*, and *installed process* on the use of patterns in teams and the writing of patterns; and the opinion on the most important factors to consider when introducing patterns. Nineteen individuals responded with comments. A second personal message was then sent to the remaining survey participants to request feedback on the general guidelines that were generated from the findings. (The 'General Guidelines' follow in chapter five.) Twenty-three more individuals responded to this second request. Therefore, feedback was received from forty-two of the 133 individuals who completed the survey in operation one, a response rate of approximately 32%. Their comments allow this study to not simply report the qualitative results but also provide some explanation for them.

4.7 Chapter summary

This chapter described the research methodology. The study is designed to be exploratory in nature. The primary goal is to map out the relationships between pattern *use* and the factors that have the potential to affect that *use*. To provide a variety of data and sources for analysis,

the research design includes three research operations with three different methods. Each progresses towards the goal of building and describing a model, and corresponding guidelines, that proposes theory for the phenomenon of introducing patterns into organizations. In the first operation, this is done with a survey from the point of view of individuals using patterns. In the second operation, this is done with role play exercises from the point of view of those attempting to encourage pattern use. The output from these two operations is a quantitative view of the factors that are related to the use of patterns among individuals in organizations, as well as the factors that are being emphasized by those trying to influence this use. In the third operation, the results of operations one and two are member checked to provide qualitative data that lends insights for analyses. It is through this triangulation methodology that a final model is built and corresponding guidelines are suggested.

The next chapter presents the results of research operations one and two.

CHAPTER 5

RESULTS

5.1 Introduction

The primary purpose of this research is to build theory for the diffusion of patterns into organizations by mapping out the primary relationships between pattern use and fifteen factors that are proposed to influence that use. A significant portion of the task is to respond to the two research questions, posed in section 1.1. This was done with the two research operations described in the previous chapter. The results of these two operations are presented in this chapter. The first operation identifies the factors that are likely to influence pattern *use* by reporting the results of a survey of individuals who are using patterns. The second operation identifies the factors that are believed to affect this use by reporting the factors appearing in a candidate pattern language for introducing patterns and those appearing in the plans that use this language.

Many of the results are followed by a guideline suggested by the observation. The word 'guideline' is used after the fashion of Green (2000). The observed relationships indicate associations but can only suggest causations. Therefore, each is used in the sense of a tentative conclusion. The first five guidelines look at the predictor variables in the multiple regressions to identify factors that are likely to *have an influence* on increasing pattern use. In guidelines six through fifteen, the correlations with these predictor factors are examined to identify what other factors are likely to *play a part in* their existence. Finally, guidelines sixteen through nineteen pertain to the second operation of this study, an investigation of the factors that are being emphasized by individuals introducing patterns into organizations. In these last four guidelines, the practices and plans of these individuals suggest what factors they *appear to emphasize*. All the guidelines in this chapter are rather general; therefore, each one is titled a 'General Guideline'. The comments from research operation three (member checking) will then be incorporated to construct more detailed 'Operational Guidelines' for promoting patterns adoption within organizations. (These will appear in chapter 6.)

5.2 Research operation one: survey results

The purpose of the first operation is to examine which of the fifteen factors are correlated with pattern *use*. The statistics report the results of a written survey of individuals who use patterns. This survey appears in appendix A. Respondents marked 47 statements that

measured their perceived *use* of patterns and fifteen factors that are proposed to influence this *use*. Each statement offered a 7-point Likert scale ranging from 'strongly disagree' (1) to strongly agree (7). Responses on negatively worded items (such as numbers 10 and 14) were reverse-coded before any statistical analysis was done. This allowed for uniformity that made the results easier to interpret and analyze.

Reliability for the variables was measured with the internal consistency method, the most general form of reliability estimation (Nunnally, 1978) and the most widely used. Cronbach's alpha reliability coefficients (Cronbach, 1951) were performed on the survey items for each of the 16 variables. Each coefficient, reported in table 5, determines the degree to which the survey items for each variable are homogenous. A minimum alpha value of .60 has been suggested for theory building research and .70 for field research (Nunnally, 1978). This is consistent with other exploratory studies in the use of CASE (Iivari, 1996), IT (Mahmood+, 1991), and software reuse (Kishore, 1999).

With the exception of the four questions that measure *use*, all other variables meet either or both of the minima. This provides some confidence that the questions measuring the model's independent variables are reliable measures (Green, 1999). It is not a concern that the measures for the dependent variable do not meet the .60 minima because it is the intention of these four questions to address four different kinds of use.

Variable	Number of items	Alpha Reliability Coefficient
Use	4	.59
Relative Advantage	5	.75
Compatibility	3	.76
Ease of Use	6	.82
Trialability	2	.70
Visibility	2	.82
Result Demonstrability	2	.62
Image	3	.72
Voluntariness	3	.60
Innovativeness	4	.67
Champion	2	.66
Opinion Leader	2	.78
Change Agent	2	.74
Training	2	.95
Patterns Repository	1	n/a
Installed Process	2	.67

Table 5: Cronbach's Alpha Reliability Coefficients

Data was collected from 133 individuals. However, as explained earlier, this study made use of a homogeneous sample by considering only those who responded 5 or higher on statement 1 ("I use patterns"). This reduced the sample size from 133 to 130.

The following section presents the descriptive statistics on this sample and each of the study's variables. This is followed by the results from the multiple regressions and correlation analysis.

5.2.1 Descriptive statistics

The survey instrument collects information on each respondent's type of primary duties in their organization, the length of time the respondent has used patterns, and a description of how they have been used. Ninety-eight of the respondents reported that their primary duties are technical, ten reported that they were managers, and eleven noted that their duties were both technical and managerial. Six others reported that they are researchers, three are teachers, and two did not specify. The average length of time they have used patterns is 3.5 years with approximately one-third responding two or fewer years. Their brief descriptions of the activities in which they have used patterns included analysis, design, implementation, project management, and documentation applied in applications such as, but not limited to, telecommunications, insurance, e-commerce, and simulation.

Table 6 on the following page presents further descriptive statistics. The mean, minimum, maximum, and standard deviation are reported for the fifteen independent variables and the four questions examining the one dependent variable. The table presents aggregate statistics. Because in most cases there was more than one statement to measure each dependent variable, the mean of each proposition was used.

The descriptive statistics for Q2 through Q4 show how the respondents make use of patterns. Their prime *use* of patterns is in their individual work, as indicated by the highest mean of the three (6.3) as well as the highest minimum response (4). The mean response for writing patterns is the lowest (4.3) among the three, with the highest standard deviation (2.3) of all nineteen categories in the table. This indicates that pattern writing is variable and not fairly common among the sample population. The low mean for *patterns repository* (2.7) is likely related to this.

Variable	Min	Max	Std dev	Mean	Construct Group Mean
Q1 (use patterns)	5	7	.66	6.4	5.6
Q2 (use patterns individually)	4	7	.76	6.3	
Q3 (use patterns in groups)	1	7	1.4	5.5	
Q4 (write patterns)	1	7	2.3	4.3	
P1 (relative advantage)	3	7	.80	5.9	4.9
P2 (compatibility)	3	7	.83	6.0	
P3 (ease of use)	2	7	1.1	4.8	
P4 (trialability)	1	7	1.5	3.9	
P5 (visibility)	1	7	1.7	3.5	
P6 (result demonstrability)	3	7	.91	5.7	
P7 (image)	1	7	1.2	3.6	
P8 (voluntariness)	2	7	1.2	5.4	
P9 (innovativeness)	3	7	1.0	5.4	5.4
P10 (champion)	1	7	1.4	4.2	4.1
P11 (opinion leader)	1	7	1.3	4.9	
P12 (change agent)	1	7	1.8	3.3	
P13 (training)	1	7	1.9	3.3	3.4
P14 (patterns repository)	1	7	1.8	2.7	
P15 (installed process)	1	7	1.5	4.3	

Table 6: Descriptive Statistics of Respondents Surveyed

Five independent variables have the highest mean with a minimum response at 3 or higher and with standard deviations below or slightly above 1: *compatibility* (6.0), *relative advantage* (5.9), *result demonstrability* (5.7), *voluntariness* (5.4) and *innovativeness* (5.4). Among the four construct groups, the innovativeness category is highest (5.4). This indicates that the sample is generally innovative, perceives that they have a choice to use patterns, is aware of the results acquired from pattern use, and sees patterns as providing a relative advantage and as being compatible with their work.

The average reply is lowest for the *visibility* of patterns (3.5) and the existence of a *change agent* (3.3), *training* (3.3), and a *patterns repository* (2.7) in the organization. All have a minimum response of 1. Two of these variables, *patterns repository* and *training*, are among the three that compose the situational influence construct group. The mean for this group is the lowest of the four groups (3.4).

In summary, the majority of the individuals that responded to the survey have duties that are primarily technical. Most of them are not new to patterns. Although they make use of

patterns in a variety of ways, they do so predominantly in their own work. They consider themselves innovative and feel that patterns are compatible with their work. They believe that they understand the relative advantages and results of using patterns. They generally come from organizations in which pattern use is voluntary but not visible. In addition, many of their organizations do not have a patterns repository, a change agent or patterns training.

5.2.2 Multiple regression results

The strategy for assessing the viability of the relationships presented in the research model and the derived propositions is to perform a series of multiple regressions. The independent variables used in the multiple regressions correspond to those depicted in the research model developed in chapter 3 (figure 2). The number of regressions needed to examine the study's propositions is equal to the four kinds of *use* considered in the dependent variable. Even though there is only one dependent variable, its expansion provides further data for this exploratory research. Two levels of multiple regressions are run, one at the factor level and one at the construct group level. The first set, at the factor level, examines the potential influence of each of the fifteen factors on each of the four kinds of pattern *use*. The results of these four regressions are reported in table 7.

Question	Regression Result	Resulting Direction	p-value <.05	Model R-Square	Model p-value
Q1 – I use patterns	Relative Advantage (P1)	+	<.0001	.34	<.0001
	Result Demonstrability (P6)	+	.0001		
Q2 – I use patterns only in my own work in my organization.	Relative Advantage (P1)	+	<.0001	.43	<.0001
	Result Demonstrability (P6)	+	.0007		
	Trialability (P4)	+	.0141		
	Voluntariness (P8)	-	.0281		
	Innovativeness (P9)	+	.0257		
	Installed Process (P15)	-	.0209		
Q3 – I use patterns with others in design sessions or other team-oriented task in my organization.	Visibility (P5)	+	<.0001	.33	<.0001
	Compatibility (P2)	+	<.0001		
Q4 – I have written patterns for my organization.	Patterns repository (P14)	+	<.0001	.26	<.0001
	Result Demonstrability (P6)	+	.0003		
	Relative Advantage (P1)	+	.0242		

Table 7: Factor Level Multiple Regressions

The statistical significance of each of the regression models is indicated by the model r-square and p-values. The r-square shows how well the model explains the data. In order of magnitude, six factors account for 43% of the variance in the use of patterns in one's own work, two factors account for 34% in the general use of patterns, two factors account for 33% in use of patterns with others, and three account for 26% in writing patterns. Although there is no exact threshold for the required r-squared, values such as .28 and .26 have been referred to as "significant" in other innovation use studies (Green, 2000; Agarwal,1999). Therefore, the levels obtained in this study are satisfactory for building theory in this exploratory research.

Variables were entered in a stepwise manner into the model if their p-value met a .05 level of significance. However, eight of the thirteen entries are even more significant than this standard value because they are at or below a .01 level. In addition, all four model p-values were significant at the <.01 level. These low p-values indicate that it would be very unlikely to have obtained the stated relationships in this sample if in fact there were not similar relationships in the larger population. In other words, there is a tiny chance only that these results are not generalizable.

Table 7 shows that nine of the factors are significantly related to one or more of the four questions. This includes six factors from the first construct group, potential adopters' perceptions of innovation (*relative advantage*, *compatibility*, *trialability*, *visibility*, *result demonstrability*, and *voluntariness*), one in the second group, (*innovativeness*), and two in the third construct group, potential adopters' perceptions of the social system (*patterns repository* and *installed process*). Seven of these are positively related. The more individuals perceive the *relative advantage*, *compatibility*, *trialability*, *visibility*, and *result demonstrability of patterns*, the more their *use*, in one of three ways, increases. Similarly, the results suggest that the *innovativeness* of the individual and the existence of a *patterns repository* also positively influences pattern use. Two of the nine are negatively related, specifically to Q2, indicating that those who reported high on the existence of an *installed process* and the choice to use patterns (*voluntariness*) tended to report low on the *use* of patterns only in one's own work, and vice versa. In one of these two, *installed process*, the inverse relationship supports the opposite direction of that indicated in the proposition.

These results give insight into how the initial model may be narrowed. It identifies which of the fifteen proposed factors are likely to have the most influence on individual *use* of patterns and therefore suggests to organizations how they may promote pattern use. However, expansion of the *use* variable reveals which of the nine overall factors are likely to have the

most influence when organizations have specific objectives such as encouraging individual use of patterns, use in groups, and writing patterns. Therefore, the variables associated with each of the four questions are examined separately in four separate regression models.

In the first model, general pattern use (***Q1***) is positively associated with two variables, the individual's sense of the *relative advantage* (P1) and *result demonstrability* (P6) of patterns. This indicates that as an individual's perception of *relative advantage* and *result demonstrability* increases, their use of patterns also increases. It suggests the first guideline:

General Guideline 1 (GG1): *An organization's efforts to show the relative advantages to individuals in their work and demonstrate the results in patterns is likely to have an influence on increasing the general use of patterns.*

These same two variables also appear in the second regression model, pattern use in an individual's work (***Q2***), and are the only two, of the six, that have a significance level <.01. Two others are positively associated: the *trialability* of patterns (P4) and the *innovativeness* of the individual (P9) and two are negatively associated: *voluntariness* (P8) and *installed process* (P15). This suggest the following guideline:

General Guideline 2 (GG2): *An organization's efforts to make innovative individuals aware of patterns, show the relative advantages, demonstrate the results and offer opportunities for individuals to use patterns on a trial basis are likely to have an influence on increasing the number of individuals who use patterns only in their own work. In addition, an organization that does not have an installed process for the use of patterns, but requires patterns to be used is likely to have an influence on increasing the number of individuals who use patterns only in their own work.*

In the third regression model, an individual's use of patterns with others (***Q3***) is positively associated with individuals' perceptions of the *visibility* of patterns in the organization (P5) and the *compatibility* with their work style (P2). Each of these variables is significant at the .01 level. These results suggest the following:

General Guideline 3 (GG3): *An organization's efforts to make patterns visible in the organization and show how patterns are compatible with work style are likely to have an influence on increasing the number of individuals* who *use patterns in design sessions or other team-oriented tasks.*

The fourth regression model reveals that an individual's pattern writing (***Q4***) for the organization is positively associated with the existence of a *patterns repository* (P14) and, just as in the Q1 and Q2 models, the individual's sense of *relative advantage* (P1) *result demonstrability* (P6). The first two are significant at .01. This suggests the following:

General Guideline 4 (GG4): *An organization's efforts to establish a patterns repository and to demonstrate the results and the relative advantages of patterns is likely to have an influence on increasing the number of individuals who write patterns for their organization.*

The final analysis of the factor level regressions looks at the predictors that appear most often in the models. At the factor level, these are ***relative advantage*** (P1) and ***result demonstrability*** (P6), which emerged in three of the four models. This suggests which of the fifteen proposed factors are likely to have the most influence on *use*.

General Guideline 5 (GG5): *As organization's efforts to demonstrate the results in using patterns and the relative advantages of using them is likely to have the largest influence of the fifteen proposed factors on increasing pattern use.*

A second set of multiple regressions, at the construct group level, examine the potential influence of the construct groups on the four kinds of pattern *use*. This provides another level of results by combining the factors into the four construct groups shown in the research model: 1) potential adopters' perceptions of innovation, 2) innovativeness of the potential adopters, 3) potential adopters' perceptions of the social system: social influences and, 4) potential adopters' perceptions of the social system: situational influences. The results of these four regressions are reported in table 8 on the following page.

All four of the construct groups are significantly and positively related to one or more of the questions. *Perceptions of pattern attributes* (SP1) appears as the lone predictor in the ***Q1*** model and then continues to appear in the remaining three. SP1 is joined by *innovativeness of the potential adopter* (SP2) in the **Q2** model, by *perceptions of the social system: social influences* (SP3) in the **Q3** model, and by *perceptions of the social system: situational influences* (SP4) in the model for **Q4**.

Question	Regression Result	Resulting Direction	p-value <.05	Model R-Square	Model p-value
Q1 – I use patterns	Perceptions of pattern attributes (SP1)	+	<.0001	.27	<.0001
Q2 – I use patterns only in my own work in my organization.	Perceptions of pattern attributes (SP1)	+	<.0001	.32	<.0001
	Innovativeness of the potential adopter (SP2)	+	.0290		
Q3 – I use patterns with others in design sessions or other team-oriented task in my organization.	Perceptions of pattern attributes (SP1)	+	<.0001	.23	<.0001
	Perceptions of social system: social influences (SP3)	+	.0027		
Q4 – I have written patterns for my organization.	Perceptions of pattern attributes (SP1)	+	<.0001	.18	<.0001
	Perceptions of social system: situational influences (SP4)	+	.0135		

Table 8: Construct Group Level Multiple Regressions

One can argue that these results are as expected. The individualized characteristic of *innovativeness* appears to have an influence on individual use of patterns and social factors on the use of patterns with other people. Situational factors, which includes *patterns repository* as one of the two, appears to have an influence on writing patterns for the organization. These logical results add more merit to the other results found in this study.

These regressions were done primarily to view the influences on pattern *use* at another level. They provide some additional insight on the soundness of the results in the factor level regressions and suggest other factors that should be considered in building the theory. The results at this level provide strength for the pattern attributes appearing in the four factor level models (*relative advantage*, *result demonstrability*, *trialability*, *voluntariness*, *visibility*, *compatibility*), the innovativeness factor (*innovativeness*) in the model for **Q2**, and the situational influence factor (*patterns repository*) in the model for **Q4**. This, in turn, adds more weight to general guidelines 1, 2, and 4 above.

In addition, the results suggest an amendment to guideline 3. The factor level regression model did not reveal any factors from the social influence construct group (SP3) as predictors of **Q3**. However, the presence of SP3 in **Q3**'s construct group level model indicates that this

group of factors should not be ruled out as influencing pattern use in groups. Therefore, guideline 3 is amended as follows:

General Guideline 3(b) (GG3): *An organization's efforts to make patterns visible in the organization, to show how patterns are compatible with work style, and to provide social influences that support patterns are likely to have an influence on increasing the number of individuals who use patterns in design sessions or other team-oriented tasks.*

5.2.3 Correlation analysis

To examine the relationships between various pairs of factors across the sample, a correlation analysis is performed between all the independent variables and the dependent variables. This is of particular interest in developing theories because individual correlations lend support for other findings (Pyrczak, 2002) which, in this study, will suggest additional guidelines for organizations to consider.

The results are shown in table 9 on the following page. The discussion that follows will consider the correlations that are bolded. Those with an absolute value of .30 or higher at or below a .01 p-value significance level are considered for each variable. When no correlations exist at this level for a particular variable, the correlations slightly below .30 are considered instead.

The responses in most of the Q variables correlate positively with most of the others, the weakest being between ***Q3*** and ***Q4***. Therefore, even though the wording aims at different kinds of *use*, the variables are not completely distinct. This aligns with the intention to measure different aspects within the same variable. The highest correlation in the matrix is between ***Q1*** and ***Q2***. This suggests that a significant portion of those who use patterns do so only in their own work. Further evidence of this is revealed in the similarities of these two multiple regression models above, specifically the existence of *relative advantage* and *result demonstrability* as predictors in each one. This suggest the following point of interest for organizations:

General Guideline 6 (GG6): *Individuals that use patterns are more likely to use them in their own work than they are to write patterns or use them with others.*

	Q 1	Q 2	Q 3	Q 4	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P 10	P 11	P 12	P 13	P 14	P 15
Q 1	1																		
Q 2	.86	1																	
Q 3	.40	.48	1																
Q 4	.39	.33	.25	1															
P 1	.51	.50	.39	.36	1														
P 2	.42	.38	.39	.19	.55	1													
P 3	.39	.31	.14	.22	.49	.30	1												
P 4	.24	.27	.08	.22	.16	.18	.05	1											
P 5	.19	.25	.43	.23	.21	.04	.19	(.05)	1										
P 6	.48	.45	.33	.35	.42	.35	.29	.14	.21	1									
P 7	.09	.21	.18	.10	.19	.07	.03	.08	.32	.18	1								
P 8	(.21)	(.26)	(.37)	(.25)	(.20)	(.05)	(.12)	(.07)	(.56)	(.08)	(.17)	1							
P 9	.29	.33	.09	.22	.22	.16	.21	.23	.12	.24	(.01)	.01	1						
P 10	.19	.24	.22	.18	.23	(.02)	.17	.10	.54	.20	.34	(.43)	04	1					
P 11	.12	.22	.40	.22	.32	.13	.21	.01	.57	.21	.33	(.37)	.17	.57	1				
P 12	.07	.09	.32	.26	.17	.01	.09	.08	.48	.26	.19	(.42)	(.09)	.42	.32	1			
P 13	.11	.07	.11	.18	.13	.11	.16	.22	.22	.19	.25	(.25)	(.04)	.38	.25	.40	1		
P 14	.15	.19	.30	.38	.24	.06	.19	.10	.55	.16	.17	(.47)	.10	.41	.45	.46	.41	1	
P 15	.15	.12	.25	.27	.27	.10	.28	.13	.49	.28	.25	(.30)	.26	.48	.52	.37	.34	.57	1

Table 9: Correlation Matrix

The correlations with ***Q3*** are examined to discover which of the three social influences are most likely to influence pattern use. Although the social influences construct group (SP3) appears in the construct level regression, there is no indication which factor(s) this may be. However, the correlations suggest that the factor most likely to be of influence is *opinion leader* because it has the highest correlation with Q3 at .40. Therefore, guideline 3 is again amended as follows:

General Guideline 3(c) (GG3): *An organization's efforts to make patterns visible in the organization, to show how patterns are compatible with work style, and to provide an opinion leader for patterns are likely to have an influence on increasing the number of individuals who use patterns in design sessions or other team-oriented tasks.*

An examination of the independent variable correlations begins with ***relative advantage*** and ***result demonstrability*** because these two appear most often in the factor level multiple regression models. A significant correlation exists between *relative advantage* and *compatibility* (.55), *ease of use* (.49), and *result demonstrability* (.42). In addition, *result demonstrability* correlates with *compatibility* (.35). This could provide a view into what individuals see as the relative advantages in patterns and as the results that patterns demonstrate – specifically, their *ease of use* and their *compatibility* to work style. This is in alignment with the statements that measure *relative advantage* in the survey. Question 5 (accomplish tasks more quickly) and question 7 (make it easier to do my job) implies *ease of use*, and question 6 (improve the quality of work I do), 8 (enhance my effectiveness on the job), and 9 (give me greater control over my work) can imply *compatibility*. The relationship of *relative advantage* to *compatibility* and *ease of use* and *result demonstrability* suggests the following:

General Guideline 7 (GG7): *Any of the following is likely to play a part in the organization's ability to increase the perception that patterns offer a relative advantage: the perception that patterns are easy to use, the perception that patterns are compatible with work style, the perception that the results in using patterns can be demonstrated.*

The relationship of *result demonstrability* to *compatibility* and *relative advantage* suggests the following:

General Guideline 8 (GG8): *Any of the following is likely to play a part in the organization's ability to increase the perception that the results of patterns can be demonstrated: the perception that patterns offer a relative advantage for individuals and the perception that patterns are compatible with work style.*

The previous discussion included the ***compatibility*** factor which, as stated, correlates most highly with *relative advantage* and *result demonstrability*. It also has a .30 correlation with *ease of use*. This suggests the following guideline for this factor:

General Guideline 9 (GG9): *Any of the following is likely to play a part in the organization's ability to increase the perception that patterns are compatible with work style: the perception that patterns offer a relative advantage to individuals, the perception that patterns are easy to use, the perception that the results in using patterns can be demonstrated.*

The correlations with ***visibility*** and ***voluntariness*** are examined next. The highest positive correlations with *visibility* are with all three social influences: *opinion leader* (.57), *champion* (.54), and *change agent* (.48) and the two situational influences: *patterns repository* (.55) and *installed process* (.49). These high correlations show that a significant portion of the population reporting that patterns are visible in the organization also report the existence of these five factors. *Visibility* also has a very strong negative correlation with *voluntariness* (-.56), showing that those reporting patterns as visible also reported that they did not have a choice to use patterns. *Voluntariness* is also strongly negatively correlated with *patterns repository* (-.47) *change agent* (-.42), *champion* (-.43), *opinion leaders* (-.37), and *installed process* (-.30). Although the existence of these five factors may allow patterns to be more visible in the organization, the correlations also suggest that this *visibility* may come with the perception that the use of patterns is mandated. The relationship of *visibility* and *voluntariness* to each other and to five other factors suggests the following:

General Guideline 10 (GG10): *Any of the following is likely to play a part in the organization's ability to increase the visibility for patterns: a champion, a change agent, an opinion leader for patterns, a patterns repository, an installed process for patterns. However, the visibility of these factors may also play a part in increasing the perception that the use of patterns not voluntary in the organization.*

The two situational factors that appear in the models, ***installed process*** and ***patterns repository***, correlate with each other at .57. In addition, *installed process* correlates highly with *opinion leader* (.52), *visibility* (.49), *champion* (.48). *Patterns repository* correlates most highly with all three social influences, *change agent* (.46), *opinion leader* (.45), and *champion* (.41), and negatively with *voluntariness* (-.47). This suggests the following:

General Guideline 11 (GG11): *Any of the following is likely to play a part in the organization's ability to establish an installed process for patterns: a patterns repository, a champion for patterns, an opinion leader for patterns, visibility for patterns in the organization.*

General Guideline 12 (GG12): *Any of the following is likely to play a role in the organization's ability to build a patterns repository: mandated pattern use, an installed process for patterns, a change agent, an opinion leader, a champion.*

The last two predictor variables in the factor level multiple regression models are ***innovativeness*** and ***trialability***. *Innovativeness* correlates most highly with *installed process*

(.26) *result demonstrability* (.24), and *trialability* (.23). *Trialability* also correlates with *training* at .22. Although none of these are high correlations, they are significant at the.01 level. This suggests the following:

General Guideline 13 (GG13): *Individuals that consider themselves* ***innovative*** *tend to understand the results of using patterns, to come from organizations with an installed process for patterns and to try out patterns before using them in their own work.*

General Guideline 14 (GG14): *Any of the following is likely to play a part in the organization's ability to encourage individuals to try out patterns: patterns training and encouraging innovative individuals.*

Finally, the correlations with ***opinion leader,*** are considered because it was suggested to influence use by the construct level regressions and the correlations. This factor correlates most highly with *champion* (.57) and *visibility* (.57), suggesting the following:

General Guideline 15 (GG15): *Any of the following is likely to play a part in the organization's ability to provide an opinion leader for patterns: the visibility of pattern in the organization and the existence of a champion.*

5.3 Revised propositions and research model

In summary, the results in research operation one provide the statistics for responding to the first research question. These results identify the factors that influence the *use* of patterns among individuals in organizations. The factor level multiple regression suggests that seven of the fifteen proposed factors significantly and positively influence one or more kinds of pattern *use*. This supports eight of the propositions: *relative advantage* (P1), *compatibility* (P2), *trialability* (P4), *visibility* (P5), *result demonstratibility* (P6), *innovativeness* (P9), and *patterns repository* (P14). Two additional variables are shown to have a negative influence. One of these, *voluntariness* (P8), is in the proposed direction and the other, *installed process* (P15), is in the opposite direction. Multiple regressions performed at the construct group level and variable correlations suggest that the one other factor is also likely to have an influence, specifically on pattern use in groups -- *opinion leader* (P11).

The results of a correlations analysis are also reported. The purpose is to explore what may play a part in the existence of the ten factors identified as influencing pattern use, thereby providing additional information for this theory-building research. All of the results, from

both the multiple regressions and correlations, are illustrated in figure 4 on the following page.

Propositions about the direct influence on use appeared in chapter three. They are edited and expanded to reflect the findings reported in this section:

P1: Perception of the *relative advantage* of patterns is positively related to the general use of patterns, to the use of patterns only in one's own work, and to writing patterns for the organization.

P2: Perception of the *compatibility* of patterns is positively related to the use of patterns with others.

P4: Perception of the *trialability* of patterns is positively related to the use of patterns only in one's own work.

P5: Perception of the *visibility* of patterns is positively related to the use of patterns with others.

P6: Perception of the *result demonstrability* of patterns is positively related to the general use of patterns, to the use of patterns only in one's own work, and to writing patterns for the organization.

P8: Perception of the *voluntariness* in using patterns is negatively related to the use of patterns only in one's own work.

P9: Individual *innovativeness* is positively related to the use of patterns only in one's own work.

P11: Perception of *opinion leader* support for patterns is positively related to the use of patterns with others.

P14: Perception of the existence of a *patterns repository* is positively related to writing patterns for the organization.

P15: Perception of the existence of an *installed process* for patterns is negatively related to the use of patterns only in one's own work.

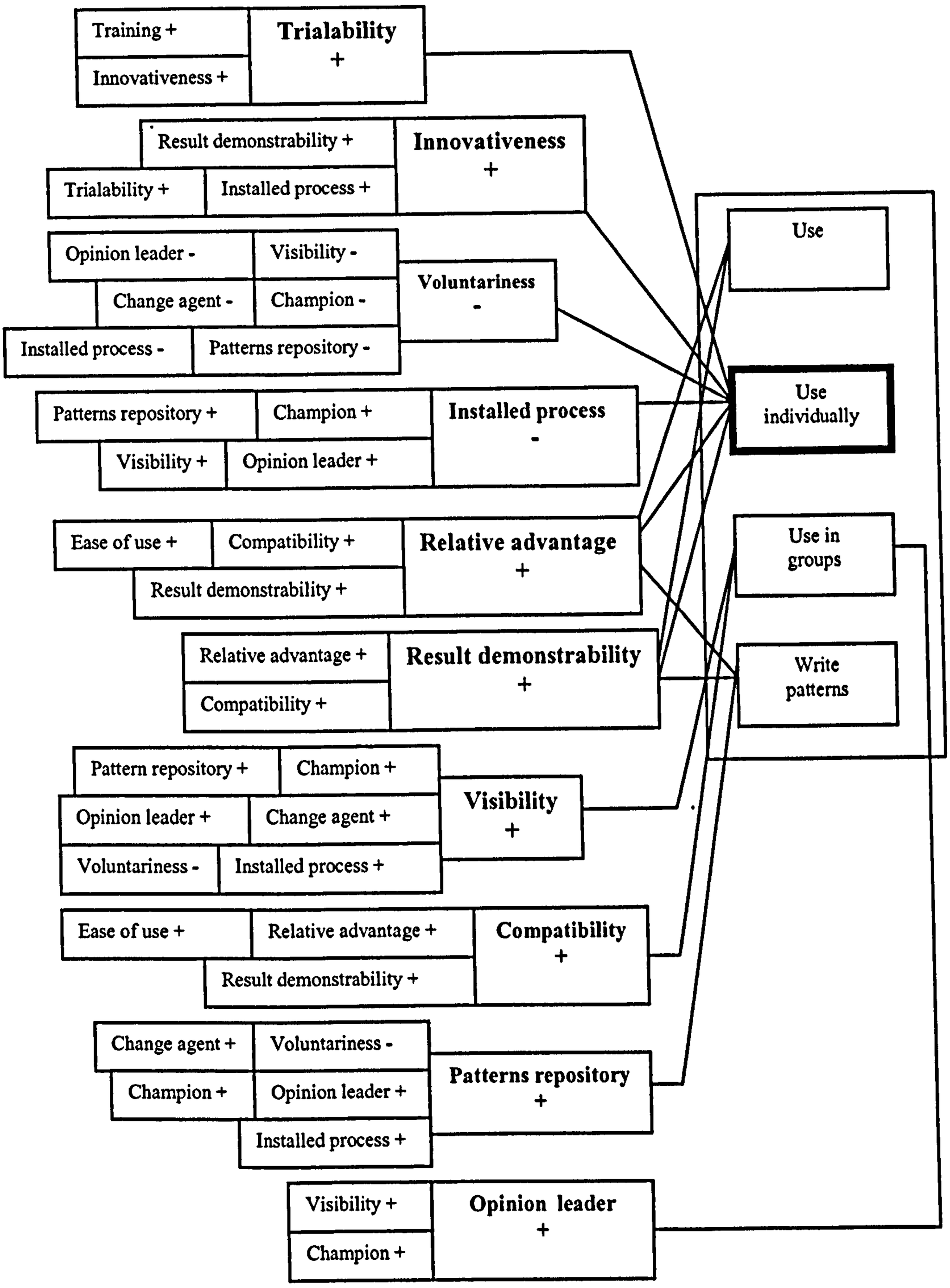

Figure 4: Final Research Model: Factors Influencing Use of Patterns

5.4 Research operation two: pattern language and role play results

The purpose of the second operation is to examine which of the fifteen factors are considered important by individuals introducing, or planning to introduce, patterns into organizations. These factors will be identified by inspecting the practices and plans of these individuals. As explained in chapter 4 (section 4.5.1), the practices of individuals introducing patterns into organizations were captured in a candidate pattern language titled *Introducing Patterns into Organizations* (appendix C). As shown in appendix D, each pattern in this language was matched to the factor(s) it recognizes. A summary appears in this chapter in table 10. The matching exercise allows a reference to a pattern to also designate its corresponding factor(s).

Factor (Proposition)	Matched to Patterns	Number of Patterns
Relative advantage (P1)	32, 39	2
Compatibility (P2)	29, 32, 33	3
Ease of use (P3)	26	1
Trialability (P4)	21, 25	2
Visibility (P5)	5, 7, 12, 13, 21, 22, 24, 34, 40, 44	10
Result demonstrability (P6)	21, 25, 39	3
Image (P7)	6, 21	2
Voluntariness (P8)	8, 14, 23, 24	4
Innovativeness (P9)	23	1
Champion (P10)	9, 15, 28, 37, 45	5
Opinion leader (P11)	2, 14, 15, 17, 36	5
Change agent (P12)	11, 16	2
Training (P13)	1, 5, 7, 20, 21, 26, 29, 30, 31, 35, 41, 46	12
Patterns repository (P14)	1, 18, 19, 20, 31, 35, 46	7
Installed process (P15)	(0)	0

Table 10: Summary of Factor to Pattern Matching

The research results in operation two first identify the factors that appear in the patterns in the *Introducing Patterns into Organizations* language. They then identify the factors that appear in the plans that make use of these patterns.

5.4.1 Factors appearing in the practices

The patterns in the *Introducing Patterns into Organizations* language were created by individuals involved in introducing patterns in various organizations. Therefore, the existence of a pattern in this language suggests that its corresponding factor was considered by these

individuals. Because of the subjectivity in the pattern matching and analysis, the purpose of this exercise is not to look at all the finer points, but rather to identify which, if any, of the factors were considered far more or far less than the others.

Table 10 shows that *training* appears in twelve patterns and *visibility* appears in ten. This suggests that the contributors to this language emphasized the importance of providing patterns training and making patterns visible in the organization. One factor is not recognized in any of the patterns, *installed process*. This suggests that those introducing patterns did not consider an *installed process* to influence pattern *use*. These results suggest the following guidelines:

General Guideline 16 (GG16): *Individuals introducing patterns into organizations appear to emphasize the following: provide patterns training and make patterns visible in the organization.*

General Guideline 17 (GG17): *Individuals introducing patterns into organizations do not appear to emphasize the installation of a process for using patterns.*

The eight patterns in the language that could not be matched to any of the fifteen proposed factors are also considered because this indicates what may be missing from the model. Five of the eight patterns recognize the importance of seeking help in the effort to introduce patterns: Ask for Help, Beyond The Fire Hose, Corridor Politics, Fear Less, and Shoulder To Cry On. Closely related are two other patterns that recognize the value in showing appreciation for this help: Just Say Thanks and Treasure. However, the solutions in these patterns describe that the help is sought and in turn, affects those leading the effort to introduce patterns. Therefore, it seems practicable to regard this "help" as having more of an influence on these people. The eighth pattern, Sustained Momentum recognizes the importance of sustaining interest in patterns by keeping the work to introduce patterns an on-going, pro-active effort. The influence of an on-going effort was not considered in the original model. However, it should not be ignored because those introducing patterns thought it should be included. This suggests that two additional factors be considered:

General Guideline 18 (GG18): *Acquiring help could have an influence on the effectiveness of the person(s) introducing patterns.*

General Guideline 19 (GG19): *Maintaining a proactive, on-going effort for patterns could have an influence on the use of patterns.*

5.4.2 Factors appearing in plans

To further examine the factors that individuals introducing patterns into organizations believe are important to consider, the patterns in the language were used in two separate role play exercises. These two exercises were described chapter 4 (section 4.5.2). In each one, groups of individuals were asked to create a plan for introducing patterns into an organization and record the names of the patterns they used. The order of use was not regarded, just the patterns that were chosen by each of the eight groups. The table in appendix E shows the use of each pattern by each of the eight groups.

The data in appendix E is summarized on the following page in table 11. It shows how the patterns that appear in the plans match to the factors. The fourth column records the total number of times any of the patterns in that factor group were included in any of the eight plans. However, since the "total times used" is likely to be affected by the number of patterns that exist in the language for each factor, a proportion of the total times used to the number of patterns is calculated in the fifth column. The last column for each of the factors records the number of different groups (of the eight) that used one or more of the patterns appearing in the factor group; in other words, how many different groups considered that factor to be important to include it in their plan.

Just as in the analysis of the first part of operation two (factors appearing in the practices), only the factors that stand above and below the rest are considered. Again, *visibility* and *training* are prominent. They have the largest total times used and are the only factors appearing in all eight groups. In addition, *opinion leader* is worth noting because it was used twelve times by seven groups. *Compatibility* was used ten times by seven groups and also has the second largest proportion of total times (3.3). The largest proportion belongs to the *trialability* factor (3.5) used seven times by 6 groups. The lowest proportions belong to *ease of use* and *image*, which appear in only one pattern and earned the lowest number of times used (1). Finally, *innovativeness* is included because it appears in only one pattern and was used by only two of the groups.

This examination of the eight plans suggests additions to guidelines 16 and 17 above.

General Guideline 16(b) (GG16): *Individuals introducing patterns into organizations appear to emphasize the following: provide patterns training, make patterns visible in the organization, encourage opinion leader(s), show how patterns are compatible with work*

style, and provide opportunities for individuals to try out patterns before using them in their own work.

General Guideline 17(b) (GG17): *Individuals introducing patterns into organizations do not appear to emphasize the following: install a process for using patterns, show that patterns are easy to use, accentuate the image of those who use patterns, and make innovative individuals aware of patterns.*

Factor (Proposition)	Patterns in conference role play	Patterns in university role play	Total times used	Proportion total times used / # of total patterns	Different groups
Relative advantage (P1)	32(3), 39(1)	32(2)	6	6/2 = 3	6
Compatibility (P2)	29(1), 32(3), 33(1)	32(2), 33(3)	10	10/3 = 3.3	7
Ease of use (P3)		26(1)	1	1/1 = 1	1
Trialability (P4)	21(1), 25(3)	25(3)	7	7/2 = 3.5	6
Visibility (P5)	5(2), 7(4), 12(1), 13(1), 21(1), 22(1), 24(1), 34(2), 40(3)	5(1), 7(2), 12(2), 13(3), 24(1), 34(2), 40(1)	28	28/10 = 2.8	8
Result demonstrability (P6)	21(1), 25(3), 39(1)	25(3)	8	8/3 = 2.7	7
Image (P7)	21(1)		1	½ = .5	1
Voluntariness (P8)	8(2), 14(2), 23(2), 24(1)	14(1), 24(1)	9	9/4 = 2.3	5
Innovativeness (P9)	23(2)		2	2/1 = 2	2
Champion (P10)	28(1), 37(1)	9(4), 15(2), 45(1)	9	9/5 = 1.8	6
Opinion leader (P11)	2(3), 14(2), 17(1), 37(2)	2(1), 15(2), 37(1)	12	12/5 = 2.4	7
Change agent (P12)	16(1), 11(1)	11(1), 16(1)	4	4/2 = 2	4
Training (P13)	1(1), 5(2), 7(4), 21(1), 29(1), 35(1), 41(1)	1(1), 5 (1), 7(2), 26(1), 30(1), 31(1), 35(1), 41(3)	22	22/12 = 1.8	8
Patterns repository (P14)	1(1), 18(2), 35(1)	1(1), 18(1), 19(1), 31(1), 35(1)	9	9/6 = 1.5	6
Installed process (P15)	(0)				

Table 11: Summary of Factors Considered in Role Play

In summary, the results from the second operation provide the statistics for responding to the secondary research question in this study: the factors that are being emphasized by individuals introducing patterns into organizations. The statistics suggest that five factors are receiving the most emphasis: *training*, *visibility*, *opinion leader*, *compatibility*, *trialability*. It

was also noted that four are not receiving as much emphasis: *installed process*, *ease of use*, *image*, *innovativeness*. In addition, component two revealed two potential factors that may influence pattern use but were not included in this study: help for the *change agent* and a sustained momentum in the effort to introduce patterns.

5.5 Comparison of results to other findings

The primary goal of this research is to identify the factors that influence the *use* of patterns. Therefore, the findings in operation one are compared with three other studies in table 12. These studies were introduced in section 3.6. They are used as a point of comparison in this section because they are among the rare collection of studies in the use of software process innovations by individuals in organizations. Iivari (1996) examined the influence of eight factors on the use of CASE; five of these appeared in this study, in addition to 'complexity' which is proposed as an inverse to *ease of use*. Kishore's (1999) extensive model of the factors that influence the adoption of software reuse included all of the variables in this study in addition to eighteen others. Green's (2000) model proposed the influence of eight factors on the *use* and satisfaction of the Personal Software Process approach to development; four were included in this study.

Factor	This study	Green (PSP)	Kishore (reuse)	Iivari (CASE)
Relative advantage	significant (+)		significant (+)	significant (+)
Compatibility	significant (+)		moderate (+)	not sig.
Ease of use	not sig.		not sig.	Complexity (-) not sig.
Trialability	significant (+)		not sig.	
Visibility	significant (+)		significant (+)	
Result demonstrability	significant (+)		not sig.	
Image	not sig.		not sig.	
Voluntariness	significant (-)	significant (-)	significant (-)	significant (-)
Innovativeness	significant (+)		not sig.	
Champion	not sig.	not sig.	(not reported)	significant (+)
Opinion leader	moderate (+)		(not reported)	
Change agent	not sig.		(not reported)	
Training	not sig.	significant (+)	moderate (+)	not sig.
Patterns repository	significant (+)		Base of Objects significant (+)	
Installed process	significant (-)	not sig.	ISDM significant (+)	

Table 12: Comparison of Results to Other Findings

The comparisons show the additional support that exists for five of the factors found to be significant in this study: *relative advantage*, *compatibility*, *visibility*, *voluntariness*, and *patterns repository*. Similarly, there is agreement on the lack of influence found for two other factors: *ease of use* and *image*. However, there are some differences among all the findings for *trialability*, *result demonstrability*, *innovativeness*, *champion*, *installed process*, and *training*. The implications of these comparisons will be discussed in the following chapter.

5.6 Chapter summary

The purpose of research operation one and two in this chapter is to answer the study's two research questions.

The first research question is:

- What factors influence the use of patterns among individuals in organizations?

The results from the first operation provide the statistics for responding to this question. The multiple regressions and correlation analysis distinguish ten of the fifteen proposed factors to have a direct influence on one or more kinds of pattern use. These are as follows: *relative advantage*, *result demonstrability*, *visibility*, *compatibility*, *patterns repository*, *trialability*, *installed process*, *innovativeness*, *voluntariness*, *opinion leader*. This provides support for nine of the propositions in the anticipated direction and one in the reverse direction. In addition, a correlation analysis explored the factors that are likely to play a part in the existence of each of the predictor factors appearing in the regressions. All of the factors are shown in figure 4.

The second research question is:

- What factors are being emphasized by individuals introducing patterns into organizations?

The results from operation two provide the statistics for responding to this question. The pattern language and role play exercises reveal that five of the proposed factors are being emphasized. These are as follows: *training*, *visibility*, *opinion leader*, *compatibility*, *trialability*. Operation two also revealed that four factors are not being emphasized: *installed process*, *ease of use*, *image*, *innovativeness*. In addition, it suggested the potential for two factors to be considered in further research: help for the change agent, and a sustained momentum in the organization's effort to introduce patterns.

The implications of these findings are discussed in the following chapter. The analysis will include contributions from the third research operation in this study.

CHAPTER 6

ANALYSIS OF RESULTS

6.1 Introduction

The previous chapter presented the statistical results from the converging operations one and two, offered guidelines for organizations, and proposed a new version of the research model. The multiple regression and correlation statistics reveal that fourteen of the fifteen factors proposed in this study appear to play either a direct or mediating role in influencing pattern use. Ten of the factors appear to have a direct influence on one or more kinds of pattern use: *relative advantage*, *compatibility*, *trialability*, *visibility*, *result demonstrability*, *voluntariness*, *innovativeness*, *opinion leader*, *patterns repository*, and *installed process*. Nine of these are in the proposed direction and one (*installed process*) in a direction opposite to the proposed. The new propositions, presented in section 5.3, reflect these findings.

All ten of these factors also appear to play some indirect, mediating role. In addition, four other factors have a mediating role: *ease of use*, *champion*, *change agent*, and *training*. *Image* is the only proposed factor that does not appear in the model presented in figure 4.

To contribute further understanding to the phenomenon of pattern use, this chapter discusses the empirical-based model in figure 4 and suggests some explanations for the findings which underpin it. This is done by exploring commonalities and differences between the different types of pattern usage and by exploring commonalities and differences between the results in this survey and those of Green (2000), Kishore (1999) and Iivari (1996). The results of operation two (the pattern language and role plays using the pattern language) are similarly compared with the research model and an argument is offered for consistencies and apparent inconsistencies that appear. In addition, the comments from respondents in operation three are incorporated into the analysis to provide further support and explanation for the findings.

The analysis in this chapter suggests seventeen 'Operational Guidelines' for promoting patterns use within organizations. The level of detail in these guidelines allows patterns from *Introducing Patterns into Organization* to then be recommended as ways to implement these guidelines.

6.2 Comparison of factors that influence pattern use

As figure 4 clearly shows, four kinds of patterns use are considered in the updated research model. These are general patterns usage, the use of patterns exclusively in one's own work, the use of patterns in group situations or in teams, and the activity of pattern writing. Figure 4 also graphically depicts the factors that impact, both negatively and positively, on each of these four types of use when multiple regression techniques are used to analyze the survey results. It is useful to compare and contrast these factors as they affect the different kinds of usage.

There are two factors which positively influence the general use of patterns. These are *relative advantage* (P1) and *result demonstrability* (P6). The proposition that "the perception of the relative advantage of patterns is positively related to the use of patterns" was tested by eliciting responses to items 5-10 in table 4. Each of the statements refer to advantages conferred directly upon the individual user: for example, "improve the quality of work I do", "make it easier to do my job", "enhance my effectiveness" and so on. The proposition that "the perception of the result demonstrability of patterns is positively related to the use of patterns" was tested by gauging respondents' reactions to items 24-26. Again, these items are phrased in highly personal terms such as "the results of using patterns are apparent to me", "I believe I could communicate..."

These same factors were shown to be positive influences on two of the three particular kinds of pattern usage that are reflected in the model. Both individual use of patterns and the writing of patterns are positively influenced by these two factors. But neither is shown to be significant in the use of patterns in design sessions or team-oriented tasks. Instead, three completely different factors, those of *visibility* (P5), *compatibility* (P2) and *opinion leader* (P11) are shown to be positive influences where *visibility* is defined in terms of the number of people seen to be doing patterns work in an organization and *compatibility* is in terms of being complementary with work, work styles and the way work is done. This is a highly interesting result, less because of the presence of these two factors and more because of the absence of *relative advantage* and *result demonstrability* as predictors of group use. This absence mitigates against the two most likely pathways by which individual use in an organization might be expected to transform into group use. P1 and P6 would be expected to be influences if the pathway was a top-down one, for example. Organizations might be expected to "sell" such a process improvement by stressing the gains that would be expected as a result. But if the process were entirely bottom-up, that is by the number of adopting individuals growing to the point they became a critical mass, then the same factors influencing individual use would be expected to be influencing group use also. There is no

evidence in the survey results to support either hypothesis. A different explanation has to be sought. The proposition that "the perception of the existence of an opinion leader for patterns is positively related to the use of patterns" is examined by testing items 39 and 40 in table 4. These are "Co-workers in my organization use patterns" and "Co-workers in my organization are a positive influence on my use of patterns". This strongly suggests that the key to transforming individual use into group use is peer pressure of one kind or another and that the effect of such peer pressure is relatively independent of the perception of relative advantage or demonstrability of the results of pattern use on behalf of the potential adopter.

The writing of patterns is, in common with general patterns usage and individual use of patterns, positively affected by perceptions of relative advantage and the demonstrability of results. But in addition, it is positively impacted by the perception of the existence of a *patterns repository* (P14). Intuitively one might expect to see a rather linear model of maturation of patterns use. That is to say that patterns might be expected to begin with their consumption by individuals, spread to social units consuming patterns and finally, for this process to be crowned by individuals beginning to write patterns for their organizations. But this chain seems to be broken by the presence of *relative advantage* and *result demonstrability* as factors affecting pattern writing as well as individual use, yet their absence as factors impacting upon group use.

The absence of an *installed process* (P15) as a positive influence also is suggestive of the notion that the writing of patterns has, in practice, little to do with the maturation of a patterns process for the organization. Whereas clearly group use appears to follow individual use (since it is the use of patterns by other individuals which seems to be influential in bringing about such situations), the writing of patterns is, relatively speaking, decoupled from how far patterns have disseminated within an organization. Pattern authors seem to be influenced to write patterns because there is somewhere for them to be stored and published, but such repositories can presumably be set up at any stage in the patterns adoption process with no requirement that anyone else in the organization is actually using them.

The type of pattern usage that has the most factors impacting upon it is the use of patterns exclusively by individuals in their own work. In addition to *relative advantage* and *result demonstrability*, the propositions that "the perception of the *trialability* of patterns is positively related to the use of patterns" (P4) and that "the perception of individual *innovativeness* is positively related to the individual's use of patterns" (P9) are also shown to positively influence individual usage. On the other hand, perceptions of *voluntariness* (P8) and an *installed process* (P15) negatively influence this type of patterns use. *Voluntariness* is

explored in the survey through items 30-32 which ask whether patterns are compulsory in the respondents' jobs, whether patterns use is part of their job descriptions and/or performance plans, and whether their supervisors expect them to use patterns. Statements about patterns being incorporated into the software development process in the respondents' organizations, and patterns fitting well into the development process explore the predictor of an *installed process* impacting individual patterns usage.

The rather surprising outcome is that as *voluntariness* (the ability to choose whether or not to use patterns) diminishes, the likelihood of usage by individuals rises and, similarly, as perception of the existence of an *installed process* goes down the likelihood of usage by individuals rises. One might expect there to be a correspondence between the mandation of the use of patterns by an organization and the perception that there is an *installed process*, and that they would have similar impacts upon individual usage, but instead opposite effects are seen. The less choice there is (and therefore, by implication, the more patterns usage is mandatory) the more individual usage is seen but at the same time, the more a process exists the less usage of patterns by individuals is seen. This apparent contradiction needs to be explained. The best argument seems to be that patterns are perceived to be a deeply personal way of working, while 'processes' are considered to be inherently social. This perception is, it would seem, held by managers and development staff alike. Thus a manager or supervisor's instruction to a developer to use patterns is a mandate for individual, even private use, presumably considered to improve the individual developer's effectiveness, productivity and the quality of her or his product. It is not an instruction to use patterns in a shared way, as part of the public, formal process. There is strong research evidence to suggest that such an approach is based on reason. The quality of individual programmers is the greatest single factor which impacts upon cost estimation of projects. Boehm (1981), for example, estimates a multiplier in the range of more than 1 to 20 between the novice programmer and the expert. If patterns usage is generally considered to be an essentially individual matter, then this is consistent with the otherwise surprising outcomes of the survey concerning group use as discussed above.

This insight also offers an explanation for the different emphasis on the predictors expressed in operation one (factors influencing use) as compared to those highlighted in operation two (factors emphasized by individuals introducing patterns). These differences were presented at the end of chapter 5. In using the pattern language, for example, factors such as *training* and *visibility* were highlighted, whereas no emphasis was placed on *innovativeness*. In retrospect, and especially in the light of the discussion above, it seems likely that the plans constructed in the role plays were not strongly based on any experience of introducing patterns into

organizations. The model shows that the transformation from patterns being used in a private way to being used socially in group-based situations and team-based tasks probably occurs through the incremental accumulation of the numbers of individuals using patterns exclusively in their own work, with critical mass being attained as a result of peer pressure growing from the role of opinion leaders within an organization. At this point, software patterns are shared and used in design teams and the like. The vast majority of the respondents to the survey only had experience of the use of patterns exclusively in their own work. Analysis showed that this was probably typical of the general population of pattern users. What evidence there was for group use showed no positive relation between top-down approaches to adoption (e.g., management-driven) and the use of patterns by teams.

It is possible therefore that when role-playing top-down approaches participants were drawing on experiences other than those of introducing patterns into organizations. Factors were emphasized which show up in other kinds of SPI adoptions where the formal, public processes of an organization are being targeted. This does not mean that the evidence from the role plays can be disregarded, but it does mean that any conclusions which are heavily reliant upon that evidence can be relied upon less than those that emanate from operation one, for example. In the case of the guidelines presented in chapter 5, for example, G1 through G15 attract more confidence than G16 through G19. This understanding is taken forward when operationalizing these guidelines later on in this chapter (section 6.5).

6.3 Comparison with other SPI studies

If the conclusion just stated, (i.e., patterns usage is generally regarded as an individual matter) is true and patterns are still to be considered 'process', then they clearly are seen as a very different kind of process from traditional software processes. Support for this idea can be gained by comparing the results of this study with those of Green (2000), Kishore (1999) and Iivari (1996). All of these studies investigated SPIs: Green reported the factors affecting the adoption of the Personal Software Process, Kishore investigated the adoption of software reuse practices while Iivari reported on the diffusion of CASE technology. There are common points of reference with all three studies as can be gleaned from table 12.

All three of these studies used classical DOI theory, to varying degrees, as the basis for their hypotheses testing. Twelve of the predictors utilized in the research model are also reported in Kishore's research. No report is made on the equivalents of P10, P11 and P12 (*champion*, *opinion leader* and *change agent*) because of problems with the data (Kishore, 2001). There are mappings between six of the predictors in the research model (P1, P2, P3, P8, P10 and P13) and Iivari's work. Iivari did not investigate *trialability*, *visibility*, *result demonstrability*,

image, *innovativeness*, *opinion leader*, *change agent*, *patterns repository* or *installed process*. *Ease of use* (P3) is examined through its symmetrically inverse property, *complexity*, in Iivari's research. Green measured four of the predictors, P8, P10, P13 and P15.

Kishore has the same outcomes as this research model for seven of the twelve matching predictors. His results differ for *trialability* (P4) which he found to be insignificant for the diffusion of software reuse, whereas this research showed it to significant in a positive way for patterns use. He similarly found *result demonstrability* (P6) and *innovativeness* (P9) to be insignificant for reuse while they both show up as being significant positively for patterns. On the other hand Kishore found *training* (P13) to be moderately positive for software reuse, whereas the patterns survey found that it was insignificant. Finally, Kishore found the existence of an *installed process* (P15) to have positive significance for software reuse, while the research model shows it to be negatively significant for patterns use. The differences are explainable by the distinct characteristics of patterns as reusable artifacts compared to traditionally reusable software assets. These differences were fully discussed in chapter one. In the light of the discussion above, however, we can say that in particular it is the public, social character of general software reuse compared to the private, individual character of patterns usage which seems to explain an elevation of the positive influence of factors like *visibility*, *training* and the perception of an *installed process*. Again, if software reuse has a social character which can be formalized in a software development process it is much less likely to be affected by a requirement that its results be demonstrable to an individual's satisfaction prior to its adoption by that individual.

Four of the six matching predictors in Iivari's study of CASE tool adoption have similar outcomes to those depicted in the research model. However, *compatibility* (P2), which is found to be positively significant for patterns use is insignificant for CASE, while the opposite is true for *champion* (P10). It is not significant for patterns, but is significant for CASE tools. Two of Green's matching four predictors differ in their significance for PSP compared to their significance for patterns adoption. *Training* (P13) is shown to be positively significant for PSP while insignificant for patterns; the existence of an *installed process* has a negative relation to patterns adoption, but is insignificant for PSP. Again, one explanation for these conflicting results is the relationship of the innovation to public, social processes. CASE tools are often introduced to improve a software development process by changing it. The nature and scale of the investment in CASE technology implies a top-down approach to making such changes, and it therefore seems reasonable to suppose that the existence of a *champion* would affect the likelihood of its successful introduction. On the other hand, if patterns use is considered to be a private, individual matter it would be important that at the

very least it would not conflict with existing styles and ways of working, whereas the existence or otherwise of a *champion* would be unimportant to its spread. While PSP is personal, by definition, and therefore requires no *installed process*, it is also formal and may require *training* before it can be adopted. Patterns use is not only personal, and often private, and therefore may reasonably be considered likely to be affected negatively by an *installed process* for patterns.

In summary, comparison with the previous SPI studies does seem to provide powerful support for the explanation of the survey results. This is most likely because patterns, in contrast to CASE, software reuse, and PSP, are considered to be essentially both personal and private, primarily useful in improving a developer's own work rather than directly the socially produced work of a design session or team-based task.

6.4 Evaluating the individual variables

The previous paragraphs in this section provide an explanatory framework within which the results pertaining to each of the individual predictor variables can be explored. In this section, the individual findings for each of the sixteen variables are summarized. The discussion for each variable includes the comments that emerged in member checking, the third operation of this study. Member checking was previously described in section 4.6.1. It offers participant feedback on the quantitative results in operations one and two, and is included here to provide further insight for this theory-building research.

6.4.1. Patterns use

The results reported in the previous chapter suggest that most individuals use patterns only in their own work. Respondents indicated that they were not surprised by these results, claiming that pattern use is presently a personal decision and discipline because of the lack of widespread acceptance, adoption, and understanding surrounding patterns. They expressed concerns that although this allows individuals to see how patterns are useful in their own development, personal use does not exhibit the underlying, long-term benefits to the organization that other forms of reuse promise. For this reason, some suggested that individual use has no impact – it is team use that makes the big difference. This is compatible with the previously noted "increasing returns to adoption" characteristic of SPIs which suggests that, if applicable to patterns, would cause the benefits of patterns to increase as more individuals adopt them. What is left open is whether this increase is merely quantitative, or whether the increased quantity also turns into a new quality at the level of the organization.

Respondents' opinions on the advantages of using patterns in groups focus on the concise design vocabulary that makes it easy to communicate ideas in the conceptually demanding task of design. Also noted was the potential role of patterns in standardizing techniques the team uses, improving their documentation, and providing information for training new members.

The respondents' impression on the use of patterns in groups is that it starts with individuals using patterns who then tell others. This is consistent with the previously explained findings suggesting that peer influence is the key to transforming individual use into group use. One respondent cautioned that this influence will not be effective unless the team is open to new ideas rather than entrenched in a single mentality. This is consistent with the finding that the *innovativeness* of the adopting individual has a positive relation to patterns use. Another respondent suggested that group use would increase if there were well known domain specific patterns that could provide a vocabulary specifically for what the group is trying to do. This leads to the intuition that there is value in encouraging the team to write its own patterns where such systems of patterns do not already exist.

However pattern writing has the lowest mean among the three types of pattern use. Respondents observe that pattern users greatly outnumber pattern writers primarily because pattern writing is difficult and time consuming while the time pressures in development leave little room for tasks that don't contribute to the bottom line. Respondents point out that the pattern authors in the organization are often creative people who enjoy writing. Pattern writing may therefore be driven not by a growing maturity of an organization's use of patterns (a conclusion already drawn above), but by the need of talented individuals to feed their creativity. Others claim that they are rewarded for meeting short-term goals, not for contributing to things that may help in the longer term. Still other respondents point out that the activity of pattern writing is most useful for teaching about patterns because so few are good enough to make it into a repository.

Still, many note the long-term benefits in pattern writing for an organization, such as capturing expertise so that it is not lost and sharing information for problems that are solved over and over again in the organization. Therefore, they suggest that management consider making pattern writing part of some individuals' jobs or providing incentives for those who write quality patterns on their own.

Finally, respondents also observe two other issues that organizations might address to promote pattern writing. First, a balance must be found between encouraging the writing of

patterns and reviewing their quality so that a high standard is maintained in the repository. Second, effective pattern mining techniques need to be identified for those who wish to write patterns when the domain expertise lies with other individuals.

6.4.2 Relative advantage and result demonstrability

R*elative advantage* and *result demonstrability* are the two factors that appear to have the most influence on the use of patterns, general use, individual use and pattern writing. In operation two, the role plays using the pattern language, neither surfaced among the most important factors considered by individuals introducing patterns. However, they were not ignored. *Result demonstrability* appears in three of the patterns and was applied by seven of the groups in the role play. *Relative advantage* appears in two of the patterns and in the plans of six groups. In addition, it may be that the relative advantage of patterns can be espoused when individuals are using other patterns such as those that focus on training (e.g., Just Enough and Hometown Story).

The significance of *relative advantage* in influencing use coincides with the results of the previously described meta-model of Tornatzky (1982) and the findings of Kishore (1999) and Iivari (1996) as discussed above. Leonard-Barton (1987) suggests that the benefits from SPIs are primarily in the long-term and accrue to the organization as a whole. Yet, the results in this study draw primarily on the experience of individuals using patterns only in their own work. Their comments specified advantages that are relevant to the individual as well as the organization. To the individual, this included the ability to improve the design, organization, and documentation of code and to decrease the effort taken to produce it. Among the advantages to the organization that were enumerated are enhanced communication with the introduction of a vocabulary and improved production and quality with the retention of expert knowledge. This suggests that patterns offer an exception to the conclusions of Leonard-Barton in that benefits accrue to the individual as well as the organization. Such a conclusion is perfectly consistent with the findings discussed in section 6.2. At the same time it provides no evidence either way as to whether group use would provide direct advantages at the organizational level or only indirectly through the accumulation of advantages that accrue to the many individuals within it.

As discussed above, the finding for *result demonstrability* contradicts Kishore (1999) who did not find it to be a predictor of the infusion of software reuse. However his methodology is a case study in an organization that offered incentives for software reuse. Kishore postulated that these incentives provide indirect benefits to individuals, which are not likely to

demonstrate the results in the same way as they would to individuals who are realizing the benefits directly from use.

The pairing of these two factors throughout the multiple regression results may be explained by the respondents' comments. They stress that the organization cannot simply talk about the relative advantages – it must also provide examples where this behavior "contributes to the bottom line" and helps individuals and the organization meet their goals. This adds some support for general guidelines 7 and 8 discussed in chapter five.

6.4.3 Compatibility

Compatibility emerged as a strong influence on the use of patterns in groups, suggesting that individuals see how patterns are compatible with a team's work style. Even though it was not identified among the most important factors in operation two, it nevertheless appears in three patterns and was used ten times in the role plays by seven of the groups. And, just as with *relative advantage*, the *compatibility* of patterns may be discussed within other patterns.

The significance of this factor agrees with the Tornatzky's (1982) meta-analysis but it disagrees with Iivari (1996) and only mildly agrees with Kishore (1999). However, Kishore and Iivari investigated only the individual use of software process innovations, software reuse and CASE respectively, while *compatibility* is a predictor of team use in this study.
The results are intriguing because the survey questions asked about the *compatibility* with individual work style. Yet, the factor emerged as having an influence on the use in groups. This suggests that when individuals see that patterns are compatible with their own work style, they will be encouraged to use them with others. This is a useful finding because it suggests that an organization showing the *compatibility* of patterns at the individual level may prompt pattern use at the group level.

The respondents' comments revealed that an organization's efforts to help individuals see patterns as compatible in their work comes with challenges such as: the attitude that there is no need for patterns because software engineering is such a well-defined discipline, the belief that pattern descriptions are too obscure, and the inability of many individuals to see the similarities between patterns and the problems they face. Interestingly, these comments relate to two of the variables that correlate with *compatibility*, the first one to *relative advantage* and the second and third to *ease of use*. This provides further support for general guideline 9 in chapter five.

6.4.4 Trialability

Trialability emerged as an influence on the individual use of patterns, suggesting that respondents had experience trying out patterns in their own work. This factor also surfaced in operation two, an indication that those introducing patterns should consider it important to provide opportunities for individuals to try out patterns before they are used in development work.

The finding that *trialability* has an influence on use is surprising because previous research has concluded that it may not be important to individuals in organizations and may not even be possible in innovations that impose high knowledge barriers (MooreGC, 1991; Attewell, 1992). In addition, the significance does not agree with Kishore's (1999) findings with software reuse. However, the disparity may be explained by Rogers (1995) who claims that *trialability* is more important to early adopters of an innovation because they have no precedent to follow. This significance may be exacerbated further in a context where the innovation is perceived to have an essentially personal character as suggested by the discussion in section 6.2. Therefore, not merely the lack of maturity in patterns seems to be prompting the need for trial, but also the need to experiment for personal use.

The innovative nature of the sample and the correlations between *trialability* and *innovativeness* gives a profile of the type of individual who is likely to conduct these trials. The second highest correlation with *training* suggests that some organization's training may offer opportunities to try out patterns. However, *trialability* through projects may be the most effective way, as indicated in the following comment on the finding for this factor: "The fastest way to introduce patterns into a company is for some project to use them, succeed, and offer some credit to the use of patterns".

6.4.5 Ease of Use

Ease of use did not emerge as an influence on pattern use. In addition, the results in operation two are a sign that organizations are not placing emphasis on showing how patterns are easy to use. It is the focus of one pattern in the language which was used by only one of the groups in the role play. In other words the results from all three operations are consistent in regard to this factor.

The finding does not agree with the general meta-analysis of Tornatzky (1982) but does agree with Kishore (1999) and Iivari (1996) whose investigations were specific to SPIs. The issues surrounding this factor are examined because, as shown in figure 4, it appears to play a part in helping form the attitude that patterns offer relative advantages and are compatible with work style.

While some respondents noted the role of patterns in handling complexity, one respondent summarized the *ease of use* issue as follows: "It takes work to learn them, and skill and experience to employ them". Comments also raised some of the problems that stand in the way of helping individuals perceive patterns as easy to use: a disregard for the negative consequences in using a pattern, the misperception that patterns can be used as an "out of the box" solutions, and the lack of guides to support efficient matching of a pattern to the problem at hand. Two of these comments appear to relate to two of the factors that correlated with *ease of use*, the second to *relative advantage* and the third to *compatibility*. This provides further support for general guidelines 7 and 9 in chapter five.

6.4.6 Visibility

The *visibility* of patterns in the organization surfaced as an influence on the use of patterns in groups. It was also regarded as the second most important factor to consider when introducing patterns. Kishore (1999) found it to be a significant predictor of software reuse adoption, and questioned the factors that are likely to create a perception of *visibility*. The correlations in this study indicate that *visibility* for patterns may be created by all three social factors and two of the situational ones, as noted in general guideline 10. *Visibility* also has a high negative correlation with *voluntariness*; this is discussed further below.

Respondents commented that lack of *visibility* for patterns does not necessarily mean they are not used because, as the statistics in this study indicate, many use them in their own work. However, others pointed out the importance of making others aware of this individual use because it gives people the sense that patterns may be useful in their own work. Although some cautioned against making too much "noise" which can prompt a reaction against 'overmarketing', others suggested that patterns should be made more visible throughout the organization in places such as meetings, documentation, and training.

6.4.7 Voluntariness

Voluntariness appears to have, as proposed, a negative influence on use, specifically on the use of patterns only in one's own work. Its lack of appearance in the results for operation two does not mean that organizations are ignoring the choice to use patterns. It is the focus of four patterns in the language and is included in the plans of five of the groups.

This finding for *voluntariness* in operation one agrees with all three comparison studies in table 12. Both Kishore (1999) and Iivari (1996) raise the issue of whether *voluntariness* (or rather the lack of it) can defined as being affected by encouragement from management or co-

workers as well as by mandate. As documented in general guideline 10 in this study, the high negative correlation between *voluntariness* and *visibility* suggests that attempts to make patterns visible in the organization can also give the impression that there is little or no choice to use patterns. Green (2000) and Kishore (1999) offer further insight on *champion*, one of the variables that appear to play a role in patterns *visibility*. They suggest that managers who have too much involvement or who clearly express their preferences, rather than simply provide support, create the strongest impression that there is a lack of choice in using a SPI. This agrees with the respondents who commented that too much management control of the patterns work can make developers resentful and resist the effort.

Despite the consistent evidence that low *voluntariness* increases use, Green (2000) also found that a lack of choice decreases the user's satisfaction. This shows that even though perception of a lack of choice can increase use, developers are more satisfied when the choice is voluntary. Therefore, although mandates and other pressures may be instrumental in obtaining the critical mass shown to be important to innovations that have "increasing returns to adoption", the organization will need to use other techniques to sustain that use. Green's guidelines recommended that managers balance pushing a SPI to encourage use with support and encouragement to allow satisfaction with that use (Green, 2000).

Respondents had varying opinions on the negative presence of *voluntariness* in this study. Some question whether patterns are beneficial in organizations where developers are forced to use them, while others propose that patterns should be required in teamwork. However, the overriding comments express concern over the finding and suggest that, instead of mandating, managers should encourage use by removing the barriers and providing incentives.

6.4.8 Image

Image did not emerge in any of the multiple regressions and was not identified as playing a part in any of the predictor variables. It appears in operation two among the variables that are not receiving emphasis in an effort to introduce patterns. Its slight correlations with *champion*, *opinion leader*, and *visibility* suggests what may play a part in creating a positive *image* for patterns. The lack of presence of this factor in this and Kishore's (1999) study may be explained by Karahanna (1999) who found *image* to have more of an influence on the continued use of an innovation. Therefore, it may be that *image* is more influential in the 'confirmation' stage of the innovation-decision process (Rogers, 1995) which, as previously explained, is beyond the scope of this research.

Since *image* did not appear in the results sent to the respondents, no comments are presented. Instead, the possibility that the *image* factor plays more of a role in continued use is offered here as an issue to be considered in future research.

6.4.9 Innovativeness

Innovativeness appeared in the model for individual use of patterns. This disagrees with the findings of Kishore (1999) who concluded that *innovativeness* may be a mediating factor that influences other variables such as *relative advantage* or *complexity*, rather than a direct influence on use. The results in this study indicate that innovative individuals tend to use patterns only in their own work. One respondent defined patterns innovators as developers who are not afraid of abandoning their code in favor of new techniques that can lead to a superior design. Others observe that there are few people who are willing to act in this way, and so find themselves in agreement with Rogers' (1995) observation that innovators represent only a small portion of most social systems. Still others commented that even the most innovative individuals find it difficult to make the time to learn patterns or are often unmotivated to do so because of the perception that patterns capture the old way of doing things and therefore do not facilitate innovating. If we assume that there is some consistency in these remarks, this seems to suggest all pattern innovators are creative designers; however, not all innovators use patterns.

The multiple regression results and the high means for *innovativeness* and individual use coupled with the low means for social and situational influences are signs that many people use patterns on their own initiative. This seems to accord with the conclusions suggested in 6.2. The results in operation two suggest that organizations are not putting an emphasis on using these innovators as role models to influence others and this, too, may be consistent with the idea that patterns are for use within the scope of one's personal work. The comments in operation three suggest that it is possible to widen the influence of innovators only if the innovator's role as an *opinion leader* is promoted and supported by management.

6.4.10 Opinion leader

Opinion leader emerged as the most likely of the three social factors to influence pattern use, specifically in groups. It also is among those that appear to be emphasized in the effort to introduce patterns. Kishore is the only comparison study that included this variable, but problems with the data did not allow him to report the results (Kishore, 2001). Comments from respondents in this study reflected their belief that positive role models who use patterns are a good basis for spreading the idea throughout the organization. These comments also ring true with the conclusion made in section 6.2, that peer group pressure seems to be the single

biggest influence in transforming patterns use for personal work into patterns use in design sessions and the like.

The previous discussion of *innovativeness* recommends that opinion leaders are likely to be found in the innovative individuals who are presently using patterns in their own work. However, Rogers (1995) cautions that highly innovative individuals may not be effective opinion leaders because more practical individuals are often suspicious of their claims. This dilemma was reflected in the comments of the respondents. Many suggested that it is possible for individuals to become opinion leaders only if they are respected as role models and have a mix of general applicability and specific knowledge of the particular situation. Yet, those attempting to be opinion leaders claim that the lack of understanding about the benefits of patterns makes others believe they are doing something obscure and, therefore, makes it difficult to espouse patterns. This potential ineffectiveness of innovative individuals as opinion leaders and, as previously explained, their small representation in most social systems, suggest that organizations also look to other types of individuals as opinion leaders. The previously described "adopter interdependencies" characteristic of SPIs and Rogers' (1995) assertion that adoption is a process of uncertainty reduction stresses the importance of interpersonal communication in introducing patterns into an organization. Therefore, the role of the opinion leaders appears to be one of reducing uncertainty in potential adopters and, in turn, helping to obtain the critical mass that, as previously explained, is particularly important for process innovations.

Opinion leader has very high correlations with *visibility* and *champion*. The first of these may be explained by respondents' observations that opinion leadership happens automatically. The significance of the second may be captured in the comments which stress that managers need to support role models' efforts to learn about patterns and to communicate the information to others.

6.4.11 Champion

The *champion* factor did not surface in this study as an influence in its own right on pattern use or as any of the factors appearing in operation two. As just discussed, it does appear in correlation to the *opinion leader* factor. Although Green (2000) also found *champion* to be insignificant, Iivari (1996) found that increases in *champion* support are directly associated with the use of CASE. This was discussed in 6.3.

Champion's correlations with five of the predictor variables imply that management may have more of mediating role than a direct influence on pattern use. Its high correlation with

opinion leader and the comments in the previous section suggest that its main role may one of support for opinion leaders.

Respondents report that encouragement for patterns rarely comes from above because management is largely unaware of patterns. Even when aware, they view the immaturity of patterns and its lack of skill set as creating too much risk. In addition, management tends to emphasize the deadline at hand and is unwilling to accept that the return on a process innovation is usually in the long term. Respondent note that managers seem to care about patterns only if they can help the developers meet their short term goals. This focus on the deadline is consistent with the argument made above that a mandate to use patterns is most likely to increase individual developer's effectiveness, productivity and the quality of the final product, rather than an instruction to use patterns in a shared way, as part of the public, formal process. Despite these conditions, respondents stress that managers are important for creating and funding an environment that supports new ideas such as patterns.

6.4.12 Change agent

The existence of a *change agent* did not surface in any of the multiple regression models or in any of the results in operation two. The correlations suggest that it plays a positive role in creating the perception of three predictor variables, *visibility*, *opinion leader*, and *patterns repository* and a negative role in creating the perception that the use of patterns is voluntary. Just as with *champion*, this suggests that a *change agent* may have a mediating role rather than a direct influence on use.

Respondents had few comments on this factor. This may be due to the fact that they had little experience with a *change agent* for patterns, as indicated in the low mean of 3.3. Its highest correlation among the social factors is with *champion*, suggesting that a *change agent* may be most likely to exist when there is a *champion* who supports this role.

One respondent questioned the need for a *change agent* because "patterns sell themselves with the right people". This tallies with the experience of patterns adoption as a bottom-up process characterized by personal use. Others suggested that a change agent's role is to work with the *champion* to keep people motivated and interested because, as one commented, "You can have as many change agents as you want. If you don't employ the right attitudes, forget it".

6.4.13 Patterns repository

Patterns repository emerged as a significant influence on pattern writing. This finding seems logical since individuals are not likely to write patterns for their organization if there is no place where they can be stored and potentially shared. As previously explained, this factor was based on Kishore's (1999) "installed base of objects". His study found that it was the "reusefulness" feature of the objects that had the most significant influence on the introduction of software reuse. This study in patterns considers only the existence of a repository, not the "reusefulness" of the patterns within it. Therefore, these two studies suggest that while the existence of a repository influences writing patterns, the contents of the repository may need to be perceived as "reuseful" in order for that repository to influence the other types of pattern use, i.e., individual use of patterns and group use.

The correlation of *patterns repository* with the three social factors, an *installed process*, and mandated use suggests that it is part of an organizational effort. However, it has the lowest mean among all the independent variables, indicating that repositories for patterns are not prevalent in organizations. Some even questioned the need for one, suggesting that the large number of patterns in books and on the web would not allow the use of patterns to be stalled by a lack of organizational repository. Again, if patterns use is viewed as essentially personal there is no particular reason as to why the existence or non-existence of a repository should affect its spread.

Respondents further commented that the creation of a *patterns repository* is usually a grass roots effort because management views it as opportunistic, second to the delivery of functionality. This management view is also consistent with the perception of patterns use as essentially personal, separated from the pressing social tasks that are typically project-managed. Yet, others point out that the difficulties in establishing a repository are political, training, and hosting issues. Therefore, they stress that an effort to build a repository needs management support to address these issues, encourage quality submissions, and promote the use of the patterns.

6.4.14 Installed process

The existence of an *installed process* for patterns emerged as having a negative influence on the use of patterns only in one's own work. But since *installed process* does not appear in other models, one cannot conclude that its existence will influence the use of patterns in groups or pattern writing. However, its correlations with Q3 (use in groups) and Q4 (pattern writing), at .25 and .27 respectively, does not rule out this possibility.

Kishore (1999) found that the existence of an information systems development methodology (ISDM), which incorporates software reuse, emerged as a strong predictor of reuse. He concluded that such a process makes potential users more secure about the success of reuse and the organization's commitment to it. In Green's (2000) study, the existence of a disciplined software process did not appear to increase the use of PSP, although it positively influenced the adopter's satisfaction with that use. The contrast with the results of this study again seem to be explainable by the argument that patterns use is seen as a personal development, something that helps a programmer or developer become better at their job as individuals. An *installed process*, which seems to be important for other SPIs and for software reuse in general, would likely only come into a positive relation with patterns adoption if this apparently widespread perception were itself changed

6.4.15 Training

Training surfaced as the number one factor expected to influence use even though it did not appear as an influence on pattern use in any of the multiple regression findings. Its only role is a rather weak correlation with *trialability* and, unlike the other five social and situational factors, it does not have a significant correlation with *visibility*. The results are surprising because, as previously explained, the complexity of software process innovations is likely to create "knowledge barriers" that usually suggest the need for some form of training. Presumably the perception is that training becomes more important and influential when the organization is trying to widen use beyond the present individual level because use in groups would seem to add more complexity.

Despite the findings in operation one, the data in operation two and the comments in operation three indicate that training is considered to be important by those introducing patterns. The high correlation with *patterns repository*, *change agent*, and *champion* suggests that it is offered when the organization has other things in place that show some commitment to patterns.

The comparison studies show varying results for *training*. While it was found significant for PSP (Green, 2000), it was found only moderately significant for software reuse (Kishore, 1999), and not significant for CASE (Iivari, 1996). These discrepancies were discussed in section 6.3.

The differences in the operation one and two results for this factor reveal that the training which individuals introducing patterns think is important is not effective in influencing pattern use. Yet, respondents claim that patterns *training* is most effective when it is included

in other related object-oriented topics, such as Object-Oriented design and testing. The low correlation with *visibility* suggests that organizations are not conducting their patterns training as an explicit and separate field of study. None of the respondents recommend traditional training classes, but instead point out the effectiveness of study groups and mentoring.

6.5 Operational guidelines

This section summarizes the findings and suggests additional guidelines with specific issues that will aid the efforts of organizations and individuals attempting to introduce patterns. Because of the level of detail in this collection of guidelines, they are titled 'Operational Guidelines' and will be followed by recommendations for implementing them. These recommendations are made in section 6.6 with suggestions from the patterns in the candidate pattern language, *Introducing Patterns into Organizations*.

The results indicate that the use of patterns is primarily by innovative individuals in their own work. Among the factors that influence this kind of use is the perception that the *relative advantage* of using patterns can be demonstrated (*result demonstrability*). These perceptions also influence general use and pattern writing for the organization. Currently at least, the perception is that organizational benefits result as an accumulation of the benefits that accrue to individuals. This in turn suggests the following:

Operational Guideline 1 (OG1): *An organization should demonstrate the relative advantages of patterns to individuals.*

One way to demonstrate the relative advantages of patterns is through trials (*trialability*). Individuals using patterns only in their own work appear to be influenced by opportunities to try out patterns before using them in their own work. This suggests the following:

Operational Guideline 2 (OG2): *An organization should offer opportunities for individuals to try out patterns before using them in their own work.*

The *innovativeness* of the individuals in the sample and the low means for the social and situational factors suggest that individuals are conducting trials on their own initiative. Yet, respondents comment that the lack of time and the perception that patterns do not offer anything new to innovators may stand in the way. This suggests the following:

Operational Guideline 3 (OG3): *An organization should show that patterns are useful to innovators.*

Operational Guideline 4 (OG4): *An organization should allow time for innovative individuals to learn about patterns.*

There is further evidence that individual use of patterns will increase if individuals are required to do so. However, other studies provide evidence that it may also stifle satisfaction with that use and suggest that the perception of little or no choice can be prompted by managerial mandates or too much management involvement in the diffusion effort. This may explain the recurring theme in the comments recommending that management take more of an indirect position by supporting opinion leaders and others who are leading the effort. This suggests the following:

Operational Guideline 5 (OG5): *Management in an organization should find an appropriate level of support for patterns that will help the effort rather than give the impression the use of patterns is being mandated.*

To widen pattern use from one's own work to use in groups, individuals appear to be influenced, in part, by the perception that patterns are compatible with work style. To show compatibility, respondents observe that organizations must address the misperception that there is no need for patterns in software engineering. They recommend that one way to do this is to show individuals and their teams how patterns are relevant to their problems. This suggests:

Operational Guideline 6 (OG6): *An organization should overcome the misperception that there is no need for patterns in software engineering by showing individuals and teams how patterns can apply patterns to the problems they are trying to solve.*

Results also indicate that individuals will be further encouraged to use patterns in groups if patterns are visible in the organization. Comments suggest that the appropriate level of *visibility* must be found to avoid creating the impression that pattern use is required.

Operational Guideline 7 (OG7): *An organization should find effective ways to make patterns visible throughout the organization without creating the impression of pressure or hyperactive marketing.*

The third factor that surfaced as an influence on the use of patterns in groups is the existence of an *opinion leader*. This suggests that the organization can use opinion leaders to, among

other things, make patterns visible and spread the word about the *compatibility* of patterns. Although it would appear that the innovators who are using patterns in their own work are the likely role models, it has been pointed out that they are a small percentage of the population and their opinions are not necessarily respected by less innovative individuals. This would suggest that opinion leaders also be identified in other, less innovative individuals.

Operational Guideline 8 (OG8): *An organization should identify many different types of opinion leaders to help spread the word to others about patterns.*

Three factors were identified as influencing an individual to write patterns. Two of these, the most commonly occurring factors *relative advantage* and *result demonstrability*, are discussed above. The third is the existence of a *patterns repository*. Respondents observed that pattern writers are often creative innovators who are enthusiastic supporters of the idea of patterns. Their creativity is stimulated by writing patterns. They are encouraged by the existence of a repository, irrespective of the current use of the repository by the rest of the organization. This implies that pattern writing is an activity which, if encouraged, may generally help the pattern writing process by keeping key opinion leaders enthused.

Operational Guideline 9 (OG9): *An organization can use a patterns repository to stimulate pattern writing and thus sustain the general patterns adoption process.*

Operational Guidelines 1 through 9 are based on the factors that are suggested by this study to directly influence the use of patterns. Four others were found to have a mediating role in this influence. The first of these, *ease of use*, appears to play a part in the perception that patterns offer a *relative advantage*. Respondents noted that the effort to show patterns are easy to use is challenged by the beliefs that patterns descriptions are too obscure and their negative consequences are not understood. However, they observe that encouraging individuals to write patterns can overcome some of this. It was also noted that it is difficult to find a pattern and, even when found, it cannot be used as an easy solution. This suggests the following:

Operational Guideline 10 (OG10): *An organization should help individuals understand pattern descriptions.*

Operational Guideline 11 (OG11): *An organization should help individuals to see the costs as well as the benefits of using specific patterns and to understand that a pattern is not used as an "out of the box" solution.*

Operational Guideline 12 (OG12): *An organization should create ways to help individuals locate the patterns they need for the problems they are trying to solve.*

The second factor to play a mediating role is *training*. Comments advise organizations to teach patterns with other topics and recommend the types of training that appear to be most effective in doing this. This suggests the following:

Operational Guideline 13 (OG13): *An organization should teach patterns in the context of where they are relevant to the work individuals are doing.*

The third factor to play a mediating role is *champion*. The function of a manager who serves as a *champion* appears to be one of providing support for opinion leaders and for training, a repository, and other things an organization may need to build the infrastructure for patterns. However, respondents also pointed out that gaining this support may not be easy because management is largely unaware of patterns, view the immaturity of patterns as conferring too much risk, and are more consumed with short term deadline than the longer term benefits that patterns may provide. This suggests the following:

Operational Guideline 14 (OG14): *An organization should make managers aware of patterns.*

Operational Guideline 15 (OG15): *An organization should address the concerns of management that patterns have too much risk and have unknown long term benefits.*

Operational Guideline 16 (OG16): *An organization should encourage managers to support opinion leaders and others who building the grass roots effort for patterns.*

The last factor that appears to have a mediating role is *change agent*. However, the lack of experience with a change agent among the respondents provides further evidence that the use of patterns is largely an individual initiative. The comments propose that this role is one that works with the *champion* to create interest and maintain motivation, suggesting that a *change agent* is a useful support when an organization is ready to broaden the use. This suggests the following:

Operational Guideline 17 (OG17): *An organization should consider establishing a change agent to provide a consistent force in creating and keeping interest in patterns.*

6.6 Implementation of operational guidelines

Since the previous seventeen guidelines presented in this chapter are 'operational', recommendations for implementing them are made in table 13. This is done by suggesting patterns from the previously introduced candidate language, *Introducing Patterns into Organizations*.

Operational Guideline	Patterns
OG1: An organization should demonstrate the relative advantages of patterns to individuals.	Use Personal Touch to discuss and demonstrate the benefits.
OG2: An organization should offer opportunities for individuals to try out patterns before using them in their own work.	Use Just Do It to gain first hand benefits of patterns.
OG3: An organization should show that patterns are useful to innovators.	Use So What's New and Adopt A Skeptic to explain what patterns can offer experienced developers and Fear Less to get skeptical innovators and involved in patterns.
OG4: An organization should allow time for innovative individuals to learn about patterns.	Use Personal Touch to encourage innovators to attend a Brown Bag held during the lunch break or another event that does not require a large time commitment, such as Big Jolt.
OG5: Management in an organization should find an appropriate level of support for patterns that will help the effort rather than give the impression the use of patterns is being mandated.	Suggest to the Local Leader and the Corporate Angel that they express their support, rather than mandate the use of patterns. Encourage them to endorse the efforts of the Evangelist, Dedicated Champion and opinion leaders.
OG6: An organization should overcome the misperception that there is no need for patterns in software engineering by showing individuals and teams how patterns can apply patterns to the problems they are trying to solve.	Use Personal Touch and Gold Nugget to point out the relevance of patterns to individuals' problems.
OG7: An organization should find effective ways to make patterns visible throughout the organization without creating the impression of pressure or hyperactive marketing.	Use any of patterns you believe are appropriate for spreading the word about patterns in the organization: Big Jolt, Brown Bag, e-Forum, Hometown Story, In Your Space, Involve Everyone, Plant The Seeds, Stay Close, Trinket.
OG8: An organization should identify many different types of opinion leaders to help spread the word to others about patterns.	Encourage individuals such as Innovators, Early Adopters, Early Majority, Respected Techies, and Connectors to Just Do It. Ask for Help in telling others, using such patterns as Hometown Story, Personal Touch, and Adopt a Skeptic.
OG9: An organization should create a patterns repository to encourage creative individuals to write patterns and stimulate their interest in patterns.	Encourage pattern writing with Gold Mine, A Pattern of Their Own, Ghost Writer, Time for Reflection, Pattern Writing Guided Tour.
OG10: An organization should help individuals understand pattern descriptions.	Provide opportunities for broadening the pattern-writing effort by using A Pattern of Their Own, Pattern Writing Guided Tour, Workshop As Teacher, and Play-by-Play Workshop.

Table 13 (part 1): Implementation of Operational Guidelines with Patterns

Operational Guideline	Patterns
OG11: An organization should help individuals to see the costs as well as the benefits of using specific patterns and to understand that a pattern is not used as an "out of the box" solution.	Arrange Brown Bags and Study Groups for individuals to discuss appropriate uses for patterns.
OG12: An organization should create ways to help individuals locate the patterns they need for the problems they are trying to solve.	Use Personal Touch to identify problems others are having and suggest patterns that address those problems. Use In Your Space and e-Forum to publicize patterns that match commonly occurring problems in the organization.
OG13: An organization should teach patterns in the context of where they are relevant to the work individuals are doing.	Provide opportunities for individuals to discuss the relevance of patterns in more informal sessions such as a Study Group, Brown Bag, or Hometown Story. Offer projects a Pattern Mentor to show how patterns can be used during development process.
OG14: An organization should make managers aware of patterns.	Use Evaluation Phase to gather the Respected Techies to evaluate patterns for management.
OG15: An organization should address the concerns of management that patterns have too much risk and have unknown long term benefits.	Use Study Group, Hometown Story, and Big Jolt to create a skill set for patterns. Use Personal Touch to persuade developers on the short-term benefits of using patterns. Ask for their help (Ask for Help) in building evidence for the long-term benefits to the organization.
OG16: An organization should encourage managers to support opinion leaders and others who building the grass roots effort for patterns.	Seek various forms of support from a Local Leader and a Corporate Angel. This may include funds to Do Food, bring in a Big Jolt, or buy Treasures, encouragement for and Ghost Writers to help build a patterns repository, initiation of an Evaluation Phase to get Respected Techies involved, time to Just Do It, or sponsorship for a Dedicated Champion.
OG17: An organization should consider establishing a change agent to provide a consistent force in creating and keeping interest in patterns.	Give the role of the Dedicated Champion to opinion leaders in the organization.

Table 13 (part 2): Implementation of Operational Guidelines with Patterns

6.7 Chapter Summary

In this chapter the results from the three research operations were analyzed in order to evaluate the new research model. Comparing the factors that positively and negatively relate to the different kinds of patterns use revealed some unanticipated findings. An explanation for what might otherwise be regarded as inconsistencies was offered, and further evidence provided by comparing the research model with the results of previous SPI studies. The results seem to be explained by the difference in nature between patterns considered as an SPI

and other kinds of SPIs. In particular it is apparent that patterns are by and large considered by their users to be a means to an end, which is personal skills development. The prevalence of this view has consequences both for the interpretation of the research results and also for developing guidelines by which patterns adoption can be accelerated within and by organizations.

The final chapter in this report reflects and the findings and suggests work that may follow this theory-building study.

CHAPTER 7

SUMMARY AND REFLECTION

7.1 Introduction

The purpose of this research was to initiate an understanding of the phenomenon of pattern use by individuals in order to inform researchers and practitioners about how patterns may be positioned in an organization to encourage a faster and more efficient adoption. It sought to achieve this, in part, by answering two research questions, one the primary focus and the second offered as a point of interest. Given the almost complete absence of prior research efforts in this area, the scope of the study was limited to theory construction, hypotheses building rather than hypotheses testing. To do this, a number of propositions were formulated and tested using three different research operations that utilized between them both quantitative and qualitative methods.

Diffusion of Innovation research theory was utilized as a theoretical background for the proposed factors and the corresponding model. The theoretical framework, model, and corresponding propositions were presented in chapter 3. The research design was presented in chapter 4. The study made use of three research operations. The first research operation, the survey, provided the response to the first research question and the second research operation, the pattern language and the role plays, provided the response to the second research question. The third operation, member checking, provided the qualitative data that supported the analysis of the quantitative data in the first two operations.

Findings in operations one and two were presented in chapter 5. This included a statistical summary and nineteen general guidelines to help organizations make use of the findings. Chapter 6 discussed the implications of the results of operations one and two with support from Diffusion of Innovation research and the comments of survey respondents. From this analysis, seventeen more guidelines were proposed. The guidelines that attracted the most confidence were expressed additionally in terms of patterns from the candidate pattern language, *Introducing Patterns into Organizations*.

7.2 Immediate answers to the research questions

The first research question was:

What factors influence the use of patterns among individuals in organizations?

Through a comparison of appropriate studies in the broad field of Diffusion of Innovation theory, fifteen factors were proposed as being influential. These are as follows:

- Relative advantage
- Compatability
- Ease of use
- Trialability
- Visibility
- Result demonstrability
- Image
- Voluntariness
- Innovativeness (of the individual)
- Champion
- Opinion leader
- Change agent
- Training
- Patterns repository
- Installed process

Ten of the fifteen proposed factors emerged as predictors of one or more kinds of patterns use from the statistical analysis of the survey results. Eight of these ten factors were shown to be a positive influence – *relative advantage*, *result demonstrability*, *visibility*, *compatibility*, *patterns repository*, *trialability*, *innovativeness*, and *opinion leader*. Two surfaced as a negative influence – *voluntariness* and *installed process*.

Of course this is not pretended to be an exhaustive list of possible factors affecting the adoption of patterns. It is deliberately and strongly scoped by the prior research established in case studies and surveys rooted in Diffusion of Innovation that were considered to be close enough to the subject area to bear comparison. Whether a particular factor was considered or not can, from one point of view, be considered an historical accident determined by the choices of earlier researchers. It is expected that in the future other researchers will want to explore the impact of other possible factors on the dissemination of patterns and compare them to this original list. Re-evaluation of the significance of these and other factors will be a natural feature of the evolution of this area of research. Nevertheless, by basing the first exploration on established theory and practice, a solid foundation has been laid for that future research, some of which is discussed below.

It must also be noted that the sample used in the initial survey came primarily from individuals that appeared to be committed to patterns use, as evidenced by the average length of time reported for pattern use (3.5 years) and their participation in the particular conference

events and e-mail distribution lists where the various research operations were carried out. As discussed earlier, this would normally represent a dangerous bias in the context of hypotheses-testing and theory validation. This risk of this is normally ameliorated by ensuring randomness in the sampling. However, this study was attempting to explore propositions rather than test hypotheses. There is a clear distinction. Because the aim of this study was to build theory not to test one, it was right to ensure a necessary minimum of experience of patterns usage among the respondents in order to have sufficient raw material from which to construct an initial set of findings. When it does become time to test theories, then respondents who have not yet used patterns or who are even actively resistant to their adoption will have as much valuable information to contribute as those who actively support patterns dissemination. Any surveys testing hypotheses as to why patterns are adopted will have the burden of eliminating the 'bias' that was deliberately, and necessarily, built into this study.

The second research question was:
What factors are being emphasized by individuals introducing patterns into organizations?

The use of the pattern language on the one hand and role plays using the patterns on the other were used to determine the answer to the second research question. Five of the fifteen originally proposed factors emerged as being the ones emphasized by patterns adopters: *training*, *visibility*, *opinion leader*, *compatibility*, and *trialability*.

As has been explained, this research question is offered only as a point of interest. In addition, the analysis of these results (section 6.2) noted some evidence that participants in the role plays drew on their experiences introducing other innovations into their organizations. While this does not disregard the conclusions reported, it does lend some discretion in accepting at face value the collection of factors that surfaced as a response to this research question.

However, the research did not stop with simple responses to each of the questions. The respondents' feedback on the findings for each of the research questions provided some explanation and support and, in addition, suggested guidelines for making use of these findings in practice.

7.3 Related research

There is a considerable amount of research currently taking place into software patterns. A search of the IEEE Digital Library produced 858 distinct references. The overwhelming

majority of these studies seek to reframe patterns in traditional Computer Science terms by trying to find ways to express them formally and/or embed them into new computing tools (e.g. Kramer+, 1996; Meijers+, 1996; Budinsky+, 1996). However, only three studies were found which examined the use of patterns. O'Callaghan (1998b) conducted a case study to establish the feasibility of integrating pattern-based techniques in an industrial strength object-oriented process model. Czichy (2001) presented an overview of the usage of patterns in practice. However, neither of these studies reported any findings on the issues that may encourage pattern use. The previously noted study of Seen (2000) is the only other known study to propose the diffusion of innovation theory as a way to predict the adoption of patterns into mainstream practice. However, it was published two years after this study, presented here in this report, was begun; in addition, it offered only opinion on the applicability of DOI rather than suggesting any testable model.

7.4 Contributions to knowledge

This research study has made the following novel contributions to knowledge in addition to the immediate answers to the research questions:

- *A critical review of the practice of software reuse, which places patterns in this context.* Although there exists a large amount of work that examines software reuse from the perspective of code artifacts such as components and frameworks, patterns were examined in this study as a way to facilitate other kinds of reuse in the software development process. It was shown that software patterns emerged out of a need to establish which design practices worked and which did not in the crafting of object-oriented frameworks. That this need existed at all implies that the more traditional approaches to the issues of reuse had failed. In counterpoint, the widespread use of design patterns in the object-oriented community suggests that they have been shown to be of value.

- *A critical assessment of software patterns in terms of structure, process and community.* Existing research either borrows directly and uncritically from Alexander a definition of a pattern as a solution to a general, recurring problem in a context or paraphrases it. In contrast, this study examined the different ways that patterns are described and used within the patterns movement and the wider object-oriented community. By utilizing the reference points of structure, process and community it was able to present a critical analysis of the nature of software patterns as practiced by patterns users. This is the first such analysis that appears anywhere in the research literature.

- *A presentation of different, and potentially conflicting, perspectives on software patterns.* These were examined by comparing and contrasting the notion of patterns as 'template collaborations' with that of 'pattern languages' as they appear in the literature. In the former, a pattern is a piece of reusable structure in the form of a particular layout of classes while, in the latter, an individual pattern is merely a sentence in a highly configurable language of design that itself embodies the essence of a design culture. One important commonality, from the viewpoint of the research study, is that of patterns as 'process'. This enabled patterns to be investigated as a software process innovation within the framework of diffusion of innovation theory.

- *A critical review and analysis that links Christopher Alexander's first patterns work, Notes on the Synthesis of Form, the patterns trilogy, (The Timeless Way of Building, A Pattern Language, and The Oregon Experiment) and his 1996 address to the OOPSLA conference at San Jose, California.* Doug Lea contrasts the ideas in *Notes* with those of the patterns trilogy (Lea, 1998) and Jim Coplien (1999c) has written about the forthcoming *Nature of Order* as an evolution of the three patterns books (Coplien, 1999c). But this is the first review demonstrating continuity from the 1964 work to the three publications that are most widely accepted by the software patterns community. This review revealed the evolution of Alexander's thought in design as the basis for his concept of pattern languages as expressions of design cultures. Without such a review, much of the significance of the findings of this research may well have been missed, particularly the point (discussed below) that the general view of patterns held by software developers is radically different to that of Alexander and his supporters.

- *An extension of Diffusion of Innovation research applied to the adoption and dissemination of patterns.* The initial model integrates knowledge from classical DOI and the software process innovation and information technology studies that have enhanced it. From this, fifteen factors were proposed to influence four kinds of pattern use. The wide range of factors considered not only the perception of individuals towards the characteristics of patterns, but also the social and situational influences and the inherent innovativeness of the individual. There is, of course, a large body of literature in DOI covering hundreds of different fields, but this study represents the first time it has been empirically applied to software patterns.

- *A candidate pattern language, titled Introducing Patterns into Organizations, that captures successful practices in introducing patterns into organizations.* The language is authored jointly by the researcher and Linda Rising, each providing approximately equal input over a number of years. Although the language has not yet been formally validated, the patterns have received diverse input from numerous individuals who have written, reviewed, and provided known uses. This grants some support for their relevance and usefulness in addressing the wider issues raised in this study. The insight uncovered in this study that most patterns practice is highly individual indicates that further iterations over the candidate patterns are needed to improve the language by more fully embracing this new understanding. Nevertheless it stands, even in its current form, as a significant and unique contribution to the body of patterns literature.

- *An empirically supported model that provides a testable theoretical framework for the use of patterns by individuals.* The factors in this model give insight into where industry practitioners, such as managers and software engineers, can allocate resources to influence what is most likely to increase pattern use. The corresponding analysis brings to light the issues organizations should consider when allocating these resources and makes specific suggestions for increasing the effectiveness of the allocation. In addition, the findings are useful to the software engineering research community. The model and analysis raise a wide range of issues and suggest hypotheses that can be tested in future research. This is discussed further in the following section.

- *A set of operational guidelines to aid organizations wishing to promote patterns use.* The analysis of the results from the three research operations enabled the development of an initial set of operational guidelines and their further refinement. Prior to their publication, there has been no information in the public domain as to how organizations might further the use of patterns and so aid their promotion. Confidence in the utility of the guidelines is drawn from the fact that they were abstracted from a knowledge base established by an authoritative survey of patterns users, refined by qualitative approaches that included the member checking activity. In short, the guidelines are abstracted from the experience of a statistically significant and representative sample of the pattern-using population worldwide.

- *An insight that patterns use is widely regarded by patterns users, and apparently by their managers, that the main purpose of patterns is to develop the skills of the individual.* This was an unexpected revelation which is unanticipated in the literature. The division between the view of patterns as reusable pieces of structure (e.g., the 'template collaboration' view of the RUP) and as elements in a pattern language was noted. A commonality that was utilized in the study was that of process, but another commonality was also revealed – that patterns are generally seen to be an appropriate tool for communication and learning. The strong implication (not explicitly tested in this study, but one worthy of further research) is that overlaying the already stated differences between the two conflicting views of patterns is a further divide as to whether they are best used for individual development or for social development. If we associate the former with patterns as pieces of structure and the latter with (Alexanderian) pattern languages, then the evidence of the survey suggests that Alexanderian viewpoint appears to be upheld by a very small minority of the wider patterns movement.

7.5 Further research

The purpose of this study was not to produce conclusive results but rather to build theory that can then be tested by others. Rather than hypotheses testing, propositions were presented and explored. A measure of this study's success, therefore, is the number of questions it poses that demand hypothetical answers. No less than nine distinct novel contributions to knowledge have been made during the course of this study, in addition to the immediate answers to the research questions posed at the beginning of this report. In addition, the creation of the pattern language, the role plays, the member checking and, in particular, the analyzed results of the survey have raised a multitude of interesting questions that can be explored by further research. The most important hypotheses which result from the discussion of the results in chapters five and six are as follows:

Hypothesis 1 (H1). *Software patterns provide a resource of expert help that can raise the skill levels of individual software developers.* From the study, it is strikingly clear that developers who are using patterns do so primarily because they perceive there to be demonstrable value to themselves. It seems likely that the perceived benefit lies in an increase in their own qualities as programmers and developers. Typically they have become convinced of these benefits through trials with patterns. However research is needed to validate these perceptions, identify the particular benefits being sought, and measure them.

Hypothesis 2 (H2). *By deploying a set of "Operational Guideline" for promoting patterns use, organizations can increase the number of individuals using patterns within an organization.* The "Operational Guidelines" offered in chapter six are abstracted from the research results, but are still only hypothetical. They need to be tested in longitudinal case studies where the effect of deploying these guidelines in an organization can be objectively measured in terms of the number of individuals who adopt patterns in their private work, and the rate of any increase.

Hypothesis 3 (H3). *A validated and comprehensive pattern language for Introducing Patterns into Organizations can aid the adoption of patterns within an organization.* The candidate pattern language, the current form of which is found in appendix C, was authored with input from a wide spectrum within the patterns-using community. Its potential effectiveness was demonstrated in the role plays. Nevertheless it currently stresses factors other than those stressed in the research model. It needs refining and validating in a research environment, specifically one or more longitudinal case studies in which the language is consciously and explicitly used to spread patterns usage within organizations. Recording the active sequences of patterns used in such attempts, as well as measuring quantitative results of their active use is needed.

Hypothesis 4 (H4). *The use of patterns in group-based situations or team-tasks is served better by Alexanderian Pattern Languages than by pattern catalogues.* In many ways, the most intriguing issue that emerges from this study is that of individual patterns or sets of such patterns in catalogues versus pattern languages. Much of that intrigue comes from the fact that, because the study revealed that the overwhelmingly preponderant use of patterns is in individuals' 'private' work, there is very little data on the impact of pattern languages. For Alexander, as was demonstrated in the critical review of his theory, patterns are individual elements in a social language which is shared and used by all stakeholders in a design project. Given the almost wholesale absence of group-based patterns work, it may be the case that organization-based patterns work is only achievable in the context of a pattern language of the Alexanderian kind. This hypothesis needs testing by the construction of a language which is considered hypothetically comprehensive enough, and then using it in experimental constructions in controlled, laboratory conditions to see if it serves an organization better than do individual patterns, in promoting group-based use of patterns.

Many other questions arise, but the four hypotheses above are strongly grounded in the research study and demonstrate that it has accomplished its purpose in terms of theory-building about patterns use. Through the use of research instruments validated by previous

research practice, and the application of established theory such as DOI in particular, its results have established a firm foundation for ongoing research into this area and for new contributions to knowledge to be made in the immediate and more distant future. In short, it has opened up an entirely new field of research into the adoption of patterns in the software development community.

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Appendix A: The Survey

Patterns Use Survey

Information and Consent Form

General Information
You are invited to participate in a study to identify the factors that influence individuals to use patterns in their organizations. Your opinions and perceptions are extremely valuable. They will provide information on the individual and organizational factors that impact upon an individual's choice to use patterns. The results will contribute to understanding how organizations may position patterns in order to encourage efficient, widespread adoption.

Risks and Benefits
There are no reasonable foreseeable risks associated with completing this survey. There may be no direct benefit to the participants, although knowledge from this study may contribute to a better understanding of the nature of pattern adoption among individuals in organizations. In addition, each participant may request a copy of the results by contacting Mary Lynn Manns by e-mail at manns@unca.edu or by phone at 828-251-6858.

Confidentiality
Individual names will not be associated with any responses. To ensure confidentiality of responses, this form will be separated from the attached survey prior to analysis. In any presentations or reports that will be based on this survey, no individual will be identified or identifiable, and only aggregated data will be presented.

Further Information
If you have any questions about the study or your rights as a research subject, please contact
Mary Lynn Manns by e-mail at manns@unca.edu or by phone at 828-251-6858.

You are making a decision about whether to participate in this study. Your signature indicates that you have read the information provided above and have decided to participate. If you wish, you may withdraw from the study at any time after signing this form.

Name (print) _____

Signature _____ Date _____

Patterns Use Survey

The statements in this survey relate to your use of patterns in your organization and the factors that may have influenced your use. For the purpose of this study, the term "pattern" refers to software patterns that capture best practices in various activities in developing software. This includes, but is not limited to, patterns such as analysis, design, testing, project management, and any other types that capture other practices in software development.

There are two sections in this survey. Results will be compiled by Mary Lynn Manns who can be contacted at the following address:

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Section 1: Statements

Please read each statement carefully and circle, on the scale to the right of each statement, the choice that best represents your situation.

Circle only ***one*** of the seven responses for each statement.

Circle neutral if you are not sure about your position or do not know the best response for a particular statement.

Strongly Disagree	Disagree	Disagree Slightly	Neutral	Agree Slightly	Agree	Strongly Agree
SD	D	DS	N	AS	A	SA

1.	I use patterns.	SD	D	DS	N	AS	A	SA
2.	I use patterns only in my own work in my organization.	SD	D	DS	N	AS	A	SA
3.	I use patterns with others in design sessions or other team-oriented tasks in my organization. .	SD	D	DS	N	AS	A	SA

Strongly Disagree	Disagree	Disagree Slightly	Neutral	Agree Slightly	Agree	Strongly Agree
SD	D	DS	N	AS	A	SA

4.	I have written patterns for my organization. . .	SD	D	DS	N	AS	A	SA
5.	Patterns enable me to accomplish tasks more quickly.	SD	D	DS	N	AS	A	SA
6.	Patterns improve the quality of work I do.	SD	D	DS	N	AS	A	SA
7.	Patterns make it easier to do my job.	SD	D	DS	N	AS	A	SA
8.	Patterns enhance my effectiveness on the job. .	SD	D	DS	N	AS	A	SA
9.	Patterns give me greater control over my work.	SD	D	DS	N	AS	A	SA
10.	I lose my creativity by using patterns.	SD	D	DS	N	AS	A	SA
11.	Patterns are compatible with my work.	SD	D	DS	N	AS	A	SA
12.	I think that patterns fit well with the way I like to work.	SD	D	DS	N	AS	A	SA
13.	Patterns fit into my work style.	SD	D	DS	N	AS	A	SA
14.	I believe that patterns are difficult to use.	SD	D	DS	N	AS	A	SA
15.	Using patterns requires a lot of mental effort. . .	SD	D	DS	N	AS	A	SA
16.	Using patterns is often frustrating.	SD	D	DS	N	AS	A	SA
17.	I believe that it is easy to use patterns to do what I want to do.	SD	D	DS	N	AS	A	SA
18.	Overall, I believe patterns are easy to use. . . .	SD	D	DS	N	AS	A	SA
19.	Learning to use patterns is easy for me.	SD	D	DS	N	AS	A	SA
20.	Before deciding whether to use patterns, I was able to properly try out various methods, techniques, and tools for using patterns.	SD	D	DS	N	AS	A	SA
21.	Before using patterns in my work, I was able to use them on a trial basis long enough to see what they do.	SD	D	DS	N	AS	A	SA

Strongly Disagree	Disagree	Disagree Slightly	Neutral	Agree Slightly	Agree	Strongly Agree
SD	D	DS	N	AS	A	SA

22.	Pattern use is not very visible in my organization.	SD	D	DS	N	AS	A	SA
23.	In my organization, one sees many people using patterns.	SD	D	DS	N	AS	A	SA
24.	The results of using patterns are apparent to me.	SD	D	DS	N	AS	A	SA
25.	I believe I could communicate to others the consequences of using patterns.	SD	D	DS	N	AS	A	SA
26.	I would have difficulty explaining why patterns may or may not be beneficial.	SD	D	DS	N	AS	A	SA
27.	People in my organization who use patterns have more prestige than those who do not. ...	SD	D	DS	N	AS	A	SA
28.	People in my organization who use patterns have a high profile.	SD	D	DS	N	AS	A	SA
29.	Using patterns is a status symbol in my organization.	SD	D	DS	N	AS	A	SA
30.	Although it may be helpful, using patterns is certainly not compulsory in my job.	SD	D	DS	N	AS	A	SA
31.	My supervisors expect me to use patterns.	SD	D	DS	N	AS	A	SA
32.	Use of patterns is part of my job description and/or performance plan.	SD	D	DS	N	AS	A	SA
33.	I prefer to wait until an innovation becomes fully mature before trying it out.	SD	D	DS	N	AS	A	SA
34.	I always wish to learn and use something new that I encounter.	SD	D	DS	N	AS	A	SA
35.	People tell me that I always experiment with new ideas and technologies.	SD	D	DS	N	AS	A	SA

Strongly Disagree	Disagree	Disagree Slightly	Neutral	Agree Slightly	Agree	Strongly Agree
SD	D	DS	N	AS	A	SA

36. I do not wish to expose myself or my organization to the high risks and learning costs associated with a new technology by being its first user. . . . . SD D DS N AS A SA

37. Management supports patterns in my organization. . . . . SD D DS N AS A SA

38. My manager is a positive influence on my use of patterns. . . . . SD D DS N AS A SA

39. Co-workers in my organization use patterns. . . SD D DS N AS A SA

40. Co-workers in my organization are a positive influence on my use of patterns. . . . . SD D DS N AS A SA

41. There is one (or more) person(s) who is/are responsible for providing information and leading the adoption of patterns in my organization. . . . . SD D DS N AS A SA

42. I have been positively influenced to use patterns by one (or more) person(s) who is/are responsible for providing information and leading the adoption of patterns in my organization. . . . . SD D DS N AS A SA

43. My organization provided me with the training I need to be able to use patterns effectively. . . . . SD D DS N AS A SA

44. My organization provided me with patterns training at a time when it was appropriate for me to make use of patterns. . . . . SD D DS N AS A SA

45. My organization has a patterns repository that is useful to me. . . . . SD D DS N AS A SA

46. Patterns have been incorporated into the software development process in my organization. . . . . SD D DS N AS A SA

47. Patterns fit well into the process my organization uses to develop software. . . . . SD D DS N AS A SA

Section 2: General Information

48. Circle the word that most closely matches the *primary* nature of your duties in your organization (circle only ***one***).

a) technical
b) managerial
c) other: please describe _____

49. Briefly describe the type of software development activities in which you've used patterns.

50. How long have you used patterns in your organization? _____

51. If you have no objection to be contacted for a few follow-up questions, please include your contact information below:

Name: _____

E-mail: _____

52. In the space below (and on the back if needed), please provide any thoughts you have regarding your use of patterns in your organization and/or the factors that have influenced your use.

Appendix B: Pilot Study

The researcher joined a research unit of a large telecommunications company in the western United States for a period of seven months. The agreed project was to build a patterns repository that captured best practice in the organization's software development efforts. At the same time, employees had to be educated about the pattern concept and the use of these and other types of patterns.

The organization is involved in applied research, including first generation product development. Projects are either pilot feasibility studies requested and funded by business units or strategic corporate-funded projects. The teams are small, highly productive, and technically strong. There is high mobility between teams resulting in some cross-fertilization of experiences and ideas focused around the explicit results of targeted research. However, successful practice in developing projects appeared to be rarely passed from one project to another.

From the host organization's point of view, the attractiveness of the research study lay in the possibility of acquiring a double benefit: 1) to learn about software patterns for potential downstreaming to the company's production teams where appropriate, and 2) to improve and disseminate knowledge of best practice within the research branch. Therefore, there was a potential for immediate, direct benefit to the branch and a more general, long-term benefit to the company. In terms of the DOI theory (Rogers, 1995) discussed in this study, this meant the organization accepted that there was relative advantage to be gained from the patterns and their compatibility with existing in-house software development practice was assumed. The reader will recall that these are two of the "attributes of innovations" that Rogers deems to be factors in the adoption rate for an innovation.

The activity for this phase of the research began by seeking advice from the patterns community on knowledge acquisition and pattern mining techniques. The term mining is used to refer to the patterns discovery process (DeLano, 1998a). An inquiry made by the researcher to recognized patterns experts and a patterns mailing list (PD, 1999) revealed that various techniques have been attempted in the mining of patterns. It also suggested that structured, open-ended interviews with identified software development experts were likely to be the most effective way to mine in this context. Meetings with managers helped to identify these individuals while, at the same time, solicited support for the project. Referring again to DOI, these meetings laid the basis for affecting opinion leadership and/or Beath's (1991) champion role by getting respected figures within the organization's software development process to identify the project as one of value to the company. This was also a minimum requirement for the researcher as a "friendly outsider" to play the role of change agent.

During the months when the interviews were conducted and patterns were drafted, various pattern awareness sessions, open to all employees, were held on site. These sessions, together with other activities described below can be considered to be addressing the issue of knowledge barriers as identified by Attewell (1992) and discussed in a previous section. The first of these sessions was an "introduction to patterns" tech talk[1] led by the researcher and an employee who had experience with Gamma (1995) patterns. The attendance of approximately thirty employees was higher than at most other previous tech talks held on other topics. Interest was also high during more informal talks led by individuals that had used patterns in the organization and an invited presentation by a well-known book author, Jim Coplien from Lucent Technologies. Approximately seventy employees heard him speak about organizational patterns during the live presentation or the follow-up tape viewing. In short, while largely interpersonal and localized communication channels were used to promote patterns, when the opportunity arose, cosmopolite tactics were also usefully

[1] "Tech talks" were a regular company event.

employed in the way Rogers (1995) suggests, early in the innovation-decision process. This combination was deemed appropriate by both the researcher and the stakeholders given the main characteristics of the development culture described above. Pattern writing sessions were also organized. The attempt was made to keep patterns visible through ongoing informal discussion, an internal patterns mailing list, and a pattern-of-the-week bulletin board. The higher-than-average attendance at these events suggests, incidentally, that relative advantage and compatibility of patterns as an innovation were understood widely in the development teams, and not confined to the senior figures that agreed to the project at its inception.

This ongoing education helped to maintain a constant stream of domain experts. Following each interview, candidate patterns were drafted. The researcher then iterated over each pattern with the interviewee. Review was also acquired from others in the organization who provided their input on the technical content and the presentation of the pattern. Often, other candidate patterns emerged from these review sessions.

The resulting repository contained a catalogue of twenty-four patterns. They captured solutions to common problems that were reflective of the organization's rather innovative project development efforts.

Peer review was also obtained from the patterns community. The catalogue was presented and discussed at a Pattern Languages of Programming Conference, ChiliPLoP'99. While those in the writers' workshop session expressed confidence that the researcher had a catalogue of patterns, they also pointed out that it was only the beginning of a language. While accepting the validity of this criticism, it must at the same point be pointed out that the project brief agreed with the client organization that it did not include the goal of completing a language.

It did, however, aim to introduce patterns to the host organization. Approximately 4 to 6 project teams were influenced and the personal practices of a handful of developers were observably changed by this project. Because of the dynamic way in which development teams are put together on a project-by-project basis in this branch of the organization, it is impossible to quantify the impact of these individually changed practices on the wider organization. The difficulty of doing this is in line with the findings of (Coplien, 1995b). A company resource, in the form of a pattern repository, has been initiated but, at the time of this writing, is not widely used. This project is therefore deemed to have been partially successful because there is not yet a patterns culture in place. In terms of individuals, some small number of individuals began implementing the use of patterns and confirming that implementation through a permanently changed personal practice. The wider group of development personnel who were exposed to the patterns awareness activities certainly have knowledge, may have been persuaded, may have made a decision to adopt, but have not yet moved to implementation. In the organization as a whole, the majority of developers remain unacquainted with even basic knowledge of patterns.

In terms of the organization itself (as opposed to individuals within it), it can be seen to have passed through initiation to the point of adoption. The DOI activities associated with that phase, namely continual agenda-setting and problem-solution matching can be shown to have been carried out. However it had not carried out all the implementation activities by the time the project terminated. Arguably, by adopting a specific template for describing the twenty-four patterns in the repository, some redefining or restructuring had taken place. Indeed these newly uncovered patterns were themselves evidence of the innovation being fitted to the organization's specific needs. However, the complement of this (the organization changing to fit the innovation) was not observed. The minimum that would have been expected to be observed had this been the case would have been the permanent establishment of pattern

writers workshops. Clarification, because it required widespread implementation had not started, and this in turns rules out routinization.

In fact at the time the project's final report was submitted the organization could be considered to have been at the critical point of adoption whereby either, through successful implementation, it drove forward with increased momentum or else, failing that, moved into reverse. The final, confidential, report to the company by the researcher, made the recommendation that an individual be assigned to carry forth the project in her change agent role (Manns, 1998b). This was done, but the individual concerned left the organization shortly after the project was completed and the role was not reassigned. Therefore, the growth of the patterns culture has stagnated and it can be anticipated that it may go into reverse. This is in line with Rogers' (1995) assertion of the importance of the role change agent; the loss of this role lost the momentum the researcher as change agent had established at a critical point. This in turn led to the loss of the opinion leader/champion roles as senior managers lost the feedback from the change agent that could have re-energized them. Subsequently, experiences with pattern adoptions at AG Communications (DeLano, 1999, Rising, 1999) and British Telecom (O'Callaghan+, 1997) have been reported that confirm the criticality of this role up and until the implementation processes have been completed.

From the organization's point of view, awareness of patterns was raised and a repository that captures and helps to disseminate best practice was begun. These at least can be considered more or less permanent conquests. The researcher obtained insight into the challenges of introducing patterns into an organization and some potential techniques for addressing these challenges. Some of these strategies came from the DeLano and Rising (DeLano+, 1997) pattern language. Others surfaced during this experience and were formatted into the first seven patterns in the researcher's *Evolving a Patterns Culture* language. Other instances of use for the patterns were acquired during a workshop the researcher led at the OT'99 conference (Manns, 1999a) and birds-of-a-feather sessions led at the OOPSLA'98 (Manns, 1998a) and OOPSLA'99 (Manns, 1999b) conference. These patterns were subsequently reviewed at the 1999 Pattern Languages of Programming conference (Manns, 1999c).

Appendix C: The Pattern Language

Introducing Patterns into Organizations

A WORK-IN-PROGRESS

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The work in using and writing patterns began with Christopher Alexander who wrote *A Timeless Way of Building* [Alexander79] and *A Pattern Language* [Alexander+77] in the 1970s. When the software community began studying his ideas, interest in patterns began to spread throughout the software development industry in the 1990s. However, efforts to introduce patterns into organizations have had mixed success. The patterns presented here are the beginning of a pattern language whose focus is the introduction of patterns into an organization, with the long-term goal of developing a patterns culture. The contributors are from organizations all over the world. We have found a close connection between our experiences, which is reflected in the patterns we have written.

The creation of a pattern language should be the work of a community. Many people have contributed, and continue to contribute, to the development of this language. These include the pattern authors, those who have attended the *Introducing Patterns into an Organization* workshops, and the countless other individuals who are providing feedback and ideas for improving the patterns.

Especially valuable was the effort of all the shepherds who have worked with us along the way: Ken Auer, PLoP '97, David DeLano, PLoP'99, Jim Coplien, EuroPLoP'00, Brian Marick, PLoP'01. Special thanks also goes out to Alan O'Callaghan for his unwavering support and his invaluable help with many of our workshops.

As Christopher Alexander states, we hope that "many of the people who read, and use this language, will try to improve these patterns—will put their energy to work, in this task of finding more true, more profound invariants—and we hope that gradually these more true patterns, which are slowly discovered, as times goes on, will enter a common language, which all of us can share." [Alexander77:xv]

Pattern Abstracts

The patterns in this collection are used when introducing patterns into an organization. The objective is to build a grass roots group of individuals who become interested in patterns and can help with the growing effort in spreading the word throughout the organization.

A Pattern of Their Own

Help individuals play a role in the patterns effort in your organization by mentoring them through the process of writing a pattern of their own.

Adopt a Skeptic

Pair those who have accepted patterns with those who have not.

Ask for Help

Since the task of introducing patterns is a big job, look for people and resources to help with your efforts.

Beyond the Fire Hose

Take time near the end of a patterns event to plan what to do next with patterns in the organization.

Big Jolt

To give more visibility to the patterns effort, invite a well-known person to do a presentation.

Bread Upon the Waters

To gain credibility for patterns inside your organization, have your patterns work published in an external source that is recognized by your colleagues.

Brown Bag

Use the time when people normally eat lunch to provide a relaxed atmosphere for learning about patterns.

Connector

To help you spread the word about patterns, seek help from people in your organization who know and connect with many other people in the organization.

Corporate Angel

Acquire high-level managerial support. It is necessary for any activity to thrive and to provide access to resources.

Corridor Politics

Informally work on the decision makers before the decision point. Make sure they fully understand the problem area and the consequences of the decision.

Dedicated Champion

To increase your effectiveness in leading the effort to introduce patterns into your organization, find a way to make your patterns work part of your job description.

Do Food

Turn a patterns class or meeting into a more special event by bringing food into the meeting.

e-Forum

Set up a bulletin board, distribution list or listserver for those who want to hear more.

Early Adopter

Ask for Help from individuals who can serve as opinion leaders early in your efforts to introduce patterns.

Evaluation Phase

Gather the Respected Techies and other interested individuals in the organization to have a close look at your new idea and evaluate it for their managers and other developers.

Evangelist

To introduce patterns into your organization, begin by letting your passion for the new idea drive you.

Fear Less

Identify resistance to your new idea and turn it to your advantage.

Ghost Writer

Capture the knowledge of domain experts who don't write patterns by writing the pattern for them.

Gold Mine

Combine pattern authoring with another activity that is part of your workload.

Hero Story

Before starting to write a pattern, have students list their areas of expertise. These become topic areas for patterns.

Hometown Story

Encourage and assist individuals in presenting their patterns experiences to others.

In Your Space

Keep the patterns effort visible by placing reminders throughout your organization.

Innovator

When starting to introduce patterns, Ask for Help from a group of co-workers who are quick to take an interest in new ideas.

Involve Everyone

For a new idea to be successful across an organization, give everyone the opportunity to be part of it.

Just Do It

To prepare yourself for spreading the word about patterns, gather first hand information on their benefits and limitations.

Just Enough

To ease individuals into the more difficult concepts behind patterns, provide them with brief exposure to these concepts in the beginning with resources for them to learn more when they are ready to do so.

Just Say Thanks

To make people feel appreciated, say "thanks" in the most sincere way you can to every individual who helps you.

Local Leader

Enlist the support of first-line management. When your boss lets patterns activity become part of your job, you can truly be effective.

My Gold Nugget

Show students many different patterns to find ones that are most likely to address problems the students have struggled with. Try to find a "gold nugget" for each student.

Pattern Mentor

When a project wants to get started with patterns, have someone around who understands patterns.

Pattern Writing Guided Tour

Teach students the structure of a pattern by directing them in writing a pattern as a group.

Personal Touch

To convince individuals of the value they can gain from patterns, show them how patterns can be *personally* useful and valuable to them.

Pieces of Clay

To convince the organization of the value it can gain from patterns, tailor your message to the needs of the organization.

Plant the Seeds

Carry pattern materials (seeds) to plant the idea of patterns whenever the opportunity arises.

Play-by-Play Workshop

Do a writers' workshop demo. Give running commentary as students participate.

Respected Techie

Enlist the support of senior-level technical people who are esteemed by members of the organization.

Royal Audience

Arrange for management and members of the organization who have helped with the patterns effort to spend time with a special Big Jolt visitor.

Shoulder to Cry On

To avoid becoming too discouraged when the going gets tough, make opportunities to talk with others who are also interested in patterns.

So What's New?

When experts believe that patterns don't add value because they are so obvious, welcome their comments as validations of a pattern while showing the value of patterns to novices who don't have the same experience as the experts.

Stay Close

Once you've enlisted the support of key individuals, make sure they don't forget about you.

Study Group

Form a small group of colleagues who are interested in a specific topic as a next step for newcomers to learn about patterns or a good way for those familiar with patterns to continue learning.

Sustained Momentum

Take a pro-active approach to the on-going work of sustaining the interest in patterns in your organization.

Treasure

To recognize individuals' special efforts with patterns, give them something they value.

Trinket

To help keep a patterns event alive in a person's memory, hand and out a small token that can be identified with the topic being introduced.

Whisper in the General's Ear

Managers are sometimes hard to convince in a group setting, so set up a short one-on-one meeting to address their concerns and to offer them the opportunity to announce the new idea as their own.

Workshop as Teacher

After writing their first patterns, have students writers' workshop each other's patterns.

The Known Uses

The known uses of the patterns are shown in *italics*. Company names are abbreviated as follows:

A - medium-sized telecommunications company in the southwestern United States

B - research and development division of a large international communications technology company

C - medium-sized IT consulting company with offices throughout the United States

D - large company focusing on product design and data management with offices across the United States

F - organization in Brazil

H - state department of health

I - small company that develops software tools, located in the southwestern United States and Europe

J - large international IT corporation

G - large international company with expertise in seismic acquisition and processing

L - large international communications technology company

M - large international company providing integrated communications solutions and embedded electronic solutions

N - medium-sized university in the southeastern United States

P - research arm of a large international company that focuses on document management

R - small company that provides services and solutions to business and government located in the eastern United States

S - large international engineering and electronics company

T - large international high technology product company

W - research division of a large telecommunications company in the southwestern United States

A Pattern of Their Own

Help individuals play a role in the patterns effort in your organization by mentoring them through the process of writing a pattern of their own.

You're an Evangelist or Dedicated Champion who wants to use a Personal Touch to get people interested in patterns. Some of these people have valuable experience to share.

Most people who adopt patterns will be interested primarily in using them. But some people will want to contribute more and you want to help them to do so.

Taking the time to appreciate the value in someone's effort is important in encouraging change to take place. Individuals who see their work as worthwhile and useful are likely to be more enthusiastic about continuing to do it and encourage others to do the same.

"Writing patterns is difficult work, and those who have struggled to capture the essence of their experience in a pattern are in a good position to help others who have chosen the same path." [Rising98:80]

Therefore:

Encourage individuals to write a pattern of their own. Suggest that individuals write about something they have observed many times.

Use My Gold Nugget, Pattern Writing Guided Tour, Hero Story, Play-by-Play Workshop, and Workshop as Teacher to teach individuals to write patterns.

Show a few "good" patterns to use as models. Brainstorm to get an outline. Give time to read and then discuss "A Pattern Language for Pattern Writing" [Meszaros+98].

Be enthusiastic and encouraging while the pattern is being drafted. Give immediate feedback. Help writers understand that theirs are as important as GoF or any other patterns. At the same time, be realistic about the fact that it takes time and plenty of feedback to develop a good pattern. Introduce the writer to the shepherding and writers' workshop processes.

After the first pattern, authors may become excited about writing more patterns. They can also help in spreading the word and building the Early Majority.

This pattern can takes time to do well. Those who dislike writing, have poor writing skills, or have trouble thinking at the abstract level of patterns will need time-consuming attention paid to them. You can use Ghost Writer in these situations. But when a person is willing to work at it and is teamed with a mentor who enjoys teaching, the experience can be memorable and rewarding.

You may wish to give a Trinket or Treasure to all who participate.

Coplien suggests that they read analogous sections in *The Timeless Way of Building* [Alexander79] and *The Oregon Experiment* [Alexander+75] to learn more about pattern languages.

A has a pattern writing class in which individuals write patterns and workshop them. Often, after having successfully written a pattern in the class, students will go on to write more patterns, especially if a reward system is in place to encourage this. At AG Communication Systems, authors were given a copy of a patterns book (a Treasure).

L expanded a one-day introduction to patterns to two days to allow time for pattern writing and workshopping.

ChiliPLoP uses this technique in their "newbies" track.

An introductory-level patterns tutorial at the OOPSLA'99 conference was held over two days to allow time for attendees to write and review their own patterns.

Originator: Mary Lynn Manns

Shepherded and workshopped at OOPSLA'99 (August 1999).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Adopt a Skeptic

As a Dedicated Champion, my cubicle was right next door to a skeptical Respected Techie. I tried Personal Touch without success. Finally I found someone who supported patterns, who was also someone the skeptic respected, someone he had worked with at the company for a long time. I asked for his help in convincing the skeptic. He agreed and now the former skeptic is a supporter.

Pair those who have accepted patterns with those who have not.

You are a Dedicated Champion. Progress to introduce patterns has been slowed by individuals who are resistant to the idea of patterns. You have tried using Fear Less with these individuals, but have not been successful in lessening their resistance.

Some individuals who resist a new idea can be convinced only by some special attention.

It is not possible to convince everyone of a new idea at once. Some individuals are relatively quicker to adopt new ideas than others. [Rogers95] and [Moore99] are among those who support the widely known and tested "adopter categorization on the basis on innovativeness" scheme that categorizes individuals into one of five categories: innovators, early adopters, early majority, late majority, and laggards. The decision period of those in the latter categories is longer than that of the innovator and early adopter—individuals who are in the late majority and laggards categories tend to be much more *skeptical* of new ideas and more traditional in their thinking. [Rogers95:265] Therefore, some people are naturally skeptical. It's just the way they are.

But, those who have accepted a new idea can have an influence on those who are slow to accept. Most of the uncertainty about a new idea must be removed before skeptics will feel safe to join the majority – others can help with this. [Rogers95:265]

Therefore:

Ask someone who is convinced of the value in patterns to "adopt" someone who is skeptical.

Pair individuals who have similar values and interests. Rogers points out that talking with someone who is markedly different requires more effort. However, "when two individuals

share common meanings, beliefs, and mutual understandings, communication between them is likely to be more effective. Individuals enjoy the comfort of interacting with others who are similar." [Rogers95:287] In addition, individuals who have a reputation of being thoughtful, yet successful, in their use of new ideas have the greatest degree of opinion leadership in an organization and therefore can be more effective in "adopting" skeptics than someone who is known to be more venturesome with new ideas. [Rogers95:264]

Since the skeptic does not see a need for patterns, the role of the "adopter" is to create that need for them. Use Personal Touch.

The "adopter" can also try using Fear Less on a more personal basis by taking a special interest in the individual skeptic's point of view. Use So What's New? if the skeptic thinks patterns are too obvious to add any value. A skeptic that cares about the organization may be convinced by Pieces of Clay.

[Rogers95] has also shown that some skeptics, known as "laggards" on the innovativeness scale, will accept a new idea only after most or all or their co-workers have accepted it, and even then, may require some pressure to do so. In this case, it may be best to just wait for these individuals to come to your side, if they ever do, rather than putting a lot of effort into trying to persuade them.

While this pattern is closely related to Personal Touch, it is different in that it considers the unique challenges of convincing a skeptic. Skeptics tend to be suspicious of innovations and those who are promoting them. Therefore, the effort to provide information about how patterns can be personally useful to them [Personal Touch] is not likely to be effective by itself. Skeptics need more – they need most of their uncertainty to be removed, evidence that most others in their organization have already accepted patterns, and perhaps a little gentle pressure too. [Rogers95:265]

In some cases, the skeptic is simply suspicious of the person with the new idea and not the idea itself. Many hard-boiled veterans will not listen to a newcomer, no matter how knowledgeable that newcomer may be. The veterans need to hear about the new idea from one of their own, someone they trust. If no adopter is available, Just Do It. Most experienced people will appreciate anything that makes their jobs easier.

If someone takes on the challenge of adopting a skeptic, remember to Just Say Thanks.

One Evangelist has used this pattern many times in political situations when a small majority needs to be convinced of a move forward that the majority is interested in taking, and a straight vote would have created dissension.

Thanks to the students in Mgmt 386 at N who inspired the title for this pattern during a class assignment on introducing innovation into organizations.

Originator: Mary Lynn Manns

Shepherded for PLoP'01 (August 2001).

Ask for Help

When I started talking about patterns, someone who attended a Brown Bag told me, "No one knows you. If you talk to Jeff or Greg, they know how to get things done and I'm sure they'll help you." That made a big difference. They told me how to reach the editor of the on-line daily newsletter to announce upcoming events. They introduced me to the tech support person

who could set up a bulletin board for patterns. They were there whenever I had questions. I felt like I had a chance at it after that.

Since the task of introducing patterns is a big job, look for people and resources to help with your efforts.

You're an Evangelist or Dedicated Champion working to introduce patterns into your organization.

The task of introducing patterns into an organization is too big for one person.

When you're trying to get patterns going in an organization, you may initially think it's easier to do things yourself, but probably sooner than later you will find that one person alone can only do so much.

It may take time to get help but the return can be worth it. Unless you take the time to find out, you won't even know what resources are available, let alone how to take advantage of them.

As you try to do everything yourself, look around. There are always resources available to help you—with publicity, with presentations, with internal organizational structure, with special printing and graphics capabilities.

Therefore:

Don't try to do it all alone. Ask as many people as you can for help whenever you need it.

Even before you begin, find a few partners who really share your values and passions. The single biggest failing of many innovators is that they do not look for partners. They believe they can do it themselves, or they feel like they cannot ask for help, lest they reveal their own uncertainty. Virtually every significant change initiative starts with a genuine partnership among a small number of deeply committed individuals, often as few as two or three. [Senge+99:55]

Don't do it alone. We all have blind spots that limit our credibility. The thing to remember about blind spots is that we cannot see them. [Senge+99:201]

Sometimes it takes digging—you might have to talk to someone who knows someone, and so on, before you get the help you need. Every organization provides some kind of support—web development, graphic design, special printing, free advertising, corporate publications, secretaries, and assistants. Help can be there for the asking. Take advantage of the resources that are available. Sometimes just wandering over to a support area and stopping at someone's desk can help you discover what's available. To understand how powerful this technique is, read about how it applies in the work of Jim and Michelle McCarthy [McCarthy01]. They show that when team members ask for help, the team becomes increasingly productive.

Connectors, Respected Techies, Innovators, Early Adopters, and Local Leader are good places to start your search. These people can then help you find other resources such as money to Do Food or to bring in a Big Jolt. They can also help to build the Early Majority with Personal Touch and Adopt a Skeptic, and may even be interested in leading a Study Group or doing a Hometown Story. Ask for help with the work for In Your Space and e-Forum. Remember to Just Say Thanks.

When in doubt, ask. When not in doubt, ask. If you are not in doubt, you may be kidding yourself.

Most people will help you, particularly if you're not a threat to them, and if you can read when they're not busy or uninterested. You need not admire everything about them to learn from them, and learning from them will tend to bring out the best in them. [Senge+99:129] Use Fear Less.

Don't be discouraged if the help is slow in coming. Even a small start can help you promote your ideas, leading to more resources in the future. Each time you ask for help, you'll bring in more interested individuals.

As the old saying goes, "When the student is ready, the teacher appears." Unfortunately, there are many organizations that discourage people from asking for help. Macho cultures discourage it because they foster an image that "I can do it myself." Many organizations reinforce the message that asking for help is a sign of incompetence. Those who must continually project an air of certainty to be credible find it difficult to acknowledge that they do not have all the answers. All of these operate to create isolation among innovators and isolation breeds blindness. Perhaps the single biggest reason people do not ask for help is that they are unaware that they need it. They "don't know what they don't know" until it is too late to do anything about it. [Senge+99:104]

"What separates those who achieve from those who do not is in direct proportion to one's ability to ask others for help." [Donald Keough, former President of the Coca-Cola Company, as seen in the movie *The Journey*]

The Dedicated Champion at A used this extensively. Support for the patterns activity was provided by the training department, the external web developers, graphic artists, administrative assistants, and other managers in addition to the Local Leader and Corporate Angel.

The Evangelist at N used this to jumpstart her patterns effort. She found the person who led the center that could give her resources to advertise and hold patterns workshops and to Do Food at these events.

Originators: Jim and Michelle McCarthy

Shepherded for PLoP'01 (August 2001).

Beyond the Fire Hose

At the end of a patterns training class, one of the attendees stopped by my desk and said, "I really enjoyed the class today. That's one of the perks I get working here—the chance to learn the latest but the problem is, I go back to my cube and I don't know what to do about it. Any ideas?" I realized then that I was saturating students with knowledge but not helping them to apply it.

Take time near the end of a patterns event to plan what to do next with patterns in the organization.

You are leading an interactive patterns event in the organization.

A patterns training class, or another patterns event, can leave attendees uncertain about what to do next, what to do with the things they have learned during the event.

Patterns training classes are useful for sharing a variety of kinds of information about patterns in a short, intensive period of time. However, the experience can often be compared to drinking from a "fire hose" because it can leave participants exhausted, overwhelmed, and discouraged about applying anything they have learned to their real work.

Rogers tells us that when an innovation enters an organization, it must be redefined to accommodate the organization's needs and structure more closely, and the organization must be modified, in some way, to fit with the innovation. [Rogers95:395] Time must to be devoted to how this can be done.

In the "Make It A Mission" exercise of the *Project Retrospectives* book, Norm Kerth notes that a project postmortem can be used to launch a revolution because "It can excite [people] so much about what they learn that they want to carry their message throughout the organization." [Kerth01:202] Similarly, a successful patterns event can stimulate excitement in the attendees to do more. It is best to make use of this excitement before the attendees leave the room.

Therefore:

Take time near the end of a patterns event, such as a training class, to brainstorm about what the organization can do with patterns after the class is over.

Include discussion on such topics as what can be done to help individuals learn more about patterns, what can be done to spread the word about patterns to others, and where patterns can be put to use in the organization. Should you start a Study Group? Invite a Big Jolt? Begin an e-Forum? Make a list of ideas. Then prioritize them and decide what can be done now and what should wait until later. Add some time frames. Get the learners involved. Ask for volunteers to lead each action item. Innovators have lots of enthusiasm initially. Remember to Just Say Thanks.

Email the list to everyone as a reminder. Use e-Forum and In Your Space to publicize the plans. Ask for Help from those who attended the event.

You have a captive audience that just learned some new things about patterns. This is the best time to plan the next step, before they leave the room. It is an opportunity for the organization to begin moving beyond a few people who took a patterns class towards a plan for building a Early Majority.

If you have experience in introducing patterns into organization, you may be tempted to tell the attendees what they should do next. It is best to avoid the temptation to do this because they know their needs better than you do. Therefore, allow them to brainstorm ideas and form a plan. Provide help by making subtle suggestions only when appropriate.

Norm Kerth lists some ways to teach people how to become activists when they are interested in continuing a "mission". Because these techniques can be useful in a "mission" to spread the word about patterns, the reader is referred to [Kerth01:202-4].

This pattern "builds" the opportunity for people to plan and to get involved in introducing patterns into their organization.

When the authors of this book give patterns training class, they use this pattern in the last 30 minutes or so of the training to lead the attendees in a brainstorming session of what they would like to do next with patterns in their organization.

Originator: Mary Lynn Manns

Shepherded for PLoP'01 (August 2001).

Big Jolt

I was invited to give a patterns presentation at a company in another city. Afterwards the Evangelist who had invited me said, "You didn't say anything I couldn't have said but more people will listen to you. Your talk will have more impact and then they'll come to me for more information."

To give more visibility to the patterns effort, invite a well-known person to do a presentation.

You're an Evangelist or Dedicated Champion working to introduce patterns into your organization.

Event such as Brown Bags and Study Groups draw some attention and give patterns some visibility in your organization. But at various points, you need to attract a lot of attention to the patterns effort.

Some people see themselves as too busy to attend events such as Brown Bags or Study Groups, but would make the time to attend a one-time event with a speaker they perceive as an expert in the field. When a speaker has this type of credibility, most people will believe and become intrigued by what they have to say.

When a "big name" speaker is invited, especially when the speakers have credibility, most people will believe them and become intrigued by what they have to say. Even individuals who have adopted patterns need to have their interest reinforced so it does not fade.

Big names can be convincing! Rogers has found that communication from outside the individual's social system has a significant impact when the individual is being introduced to an innovation and is in the process of gaining some understanding of it. [Rogers95:196] Those who are already making use of patterns need a "big jolt" too. It will serve to re-energize their interest and help to confirm their decision. As Rogers cautions, a decision to adopt an innovation is not the end. People still desire information to provide confirmation and may reverse their decision if not provided with that information. [Rogers95:20]

Therefore:

Invite a well-known person who has credibility to those in your organization to do a presentation.

Be certain that this person is willing to speak at a level the organization can absorb. "Big name" people usually have a large amount of experience and may wish to talk about something that individuals in the organization are not prepared to understand. (See Just Enough.)

If funding is not available to pay speakers, entice them by pointing out that this is an opportunity to get publicity for their latest project or book. Their book could serve as a possible topic for a Study Group in your organization. It's always good policy to Just Say Thanks.

"Big name" people usually expect a big audience, and may even consider it an insult if they don't get one at your organization. This is especially important if they are not being paid for speaking. Increase the probability of a significant audience with lots of publicity before the event, using In Your Space and e-Forum, and personally inviting and reminding people. Tell the Connectors.

If possible, Do Food.

If the speaker permits it, videotape the presentation and hold one or more video sessions for those who could not attend the real thing.

Arrange a Royal Audience. This can be a good opportunity to reward those who have helped with the patterns work in the organization and to make an impression on the Corporate Angel and Local Leader. But Stay Close with the managers after the Big Jolt's visit.

A big name speaker will raise awareness and the credibility of patterns even among busy people. However, it must be held in the context of a bigger plan. Without a follow-up, the enthusiasm is likely to fizzle.

Treat these events as just periodic bursts to stimulate interest of people new to patterns and to re-energize others. It will also serve to re-energize those who already subscribe to patterns. Even those who do not attend the presentation may be impressed by the publicity before the event and the talk about it afterwards.

"Many community builders use celebrity events to create a 'buzz' that raises the overall level of awareness about the community. On the other hand, dealing with celebrities often involves a lot of extra overhead and expense and the results may be short-lived. Celebrity events can divert resources and distract you from higher-priority tasks without necessarily contributing to your long-term community development." [Kim00:257]

This can initially create more excitement than can be handled. Enthusiastic individuals that aren't given some guidance can imagine that patterns are the latest silver bullet; these individuals will eventually be disappointed. As Rising notes, "The patterns community prides itself on the avoidance of hype." [Rising98:3]

This pattern "builds" an event that gives visibility to and provides training for your patterns effort.

The interest in and inquiries about patterns increased significantly at W after Jim Coplien did a presentation there.

A Dedicated Champion at A says they "use this as much as we can. For some reason, people don't listen to the in-house experts as well as a visiting 'dignitary.'"

The Dedicated Champion at G invited a well-known speaker and saw a difference in those who heard him talk and those who did not—most of those who did were willing to hear more while most of those who did not were still skeptical about patterns.

Originator: Mary Lynn Manns

Shepherded and workshopped at PLoP'99 (August 1999).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Bread Upon the Waters

Five authors working in the same company realized they weren't having the impact they needed when they tried to introduce patterns into their organization. They decided to write a book on Pattern-Oriented Software Architecture and now they find their credibility has vastly improved!

To gain credibility for patterns inside your organization, have your patterns work published in an external source that is recognized by your colleagues.

You're an Evangelist or Dedicated Champion trying to introduce patterns into your organization. You're allowed to publish externally, after proprietary information has been removed.

Your patterns work doesn't have the amount of credibility you would like it to have in your organization.

"A prophet has no honor in his own country." Reputation is difficult to establish and easy to lose.

External publications have more credibility than internal technical reports. Internal technical reports are often WODs (write-only documents), sometimes distributed widely but only at a management level.

"Cast thy bread upon the waters, and after many days it will return to thee a hundredfold." [Ecclesiastes 11:1]

Therefore:

To gain credibility inside your organization, have your work published in an external source that is recognized by your colleagues. Market your ideas externally so that people inside your organization become aware of them.

To do this, you can:

- Publish in journals read by your internal customers, especially Respected Techies and Connectors.
- Present your work at conferences attended by your internal customers.
- A last but time-consuming option is to write a book and get it published by an external publisher.

People in your organization will learn about your work through trusted channels. Development departments might invite you for in-house presentations, workshops, consulting, etc. If development departments transfer money to your group for these activities, you will have funding for the work.

Advertise the publication in an e-Forum or In Your Space. Give a Brown Bag on the topic or start a Study Group.

Risks involved in external marketing include the following:

- Be sure the publications reflect the facts, as you know them.
- Topics must be relevant and useful or your colleagues might dismiss them as academic.
- Others across the organization might label your group as 'writing only and not working.'

You can address top-level management by carefully choosing the publication channel. This approach might be useful for finding a Local Leader or Corporate Angel.

A variant to external publication is the use of a Big Jolt visit to bring your ideas into your organization.

At S, technology transferred this way includes distributed object computing (CORBA etc.), patterns, object orientation, and Java.

A manager at T's Technology Center wrote a book on object-oriented design that was read by their developers.

This pattern has also been used at F. A paper was submitted to a local conference and was ranked first place among those submitted. The Corporate Angel learned about this honor and spread the word throughout the company. This really helped credibility in other parts of the company.

Several papers and a book were published about patterns at A. These not only were exciting for authors to see their work in print but each publication increased the credibility of the patterns movement in the organization.

At one division within a global Fortune 500 company, Dedicated Champions produced white papers and journal and conference publications based on their work. This visibility within the company and across the industry helped spread the word about the value of their work. [Radler+01]

Originator: Peter Sommerlad

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Brown Bag

One of the engineers stopped by my cube the other day. "You've had such great success with patterns. I have an idea but I don't know how to get started. Any ideas?" I told him that I started by announcing a Brown Bag and talking to people who showed up. It was the beginning but the people who were there were those who were interested in the topic and they were willing to help me take the next steps.

Use the time when people normally eat lunch to provide a relaxed atmosphere for learning about patterns.

You're an Evangelist or Dedicated Champion who has called a meeting to introduce patterns. Members of the user community are free to attend or not.

People can be too busy to attend optional meetings held during their work hours.

There is always other, more important, work to be done. Even though most people have a natural curiosity about new ideas, it's hard to find the time to learn. This makes it difficult to find a time when people can attend meetings about patterns. But, since almost everyone wants to eat lunch, a meeting over lunch will often find more people with available time.

Therefore:

Hold the meeting in the middle of the day and invite the participants to bring their own lunch.

People are often willing to attend a meeting over lunch. This is not viewed as wasting time that could be spent doing "real" work, since the time would be spent eating anyway.

Use this opportunity to Plant the Seeds. Advertise the event in an e-Forum or In Your Space. Talk it up with Connectors or Respected Techies.

Ask for Help, enlist the support of a Local Leader, or spend a little of your own money to Do Food.

You may not be able to have a Brown Bag if the corporate culture doesn't accept food in meetings or having meetings over lunch.

This technique has been used to increase attendance to information sessions set up to introduce patterns and other new technologies to A.

An Evangelist for patterns at R organizes Brown Bag conferences. He makes the following recommendations:

- *Create a program committee to organize the event.*
- *Give presentations in the middle of the day and invite attendees to bring their own lunch.*
- *Have a presentation every day at lunchtime for one to two weeks.*
- *Draw presenters primarily from inside the organization.*
- *Invite corporate executives to host the session introduce the speaker.*
- *Advertise the conference so that it is perceived as an event.*
- *Track who signs up and attends each session.*
- *Send reminders to participants who registered.*
- *Have door prizes and snacks at each session.*
- *Measure attendee satisfaction after each session.*

Charles Schwab uses brown bag training sessions to provide on-the-job training for Java developers. http://www.zdnet.com/eweek/stories/general/0,11011,2601709,00.html

Originator: David E. DeLano

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).

Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Connector

The people who were the most helpful to me when I started introducing patterns—were the secretaries. Some of them know everybody and everything. They are the power behind the managers who make the most important decisions. They know who to talk to about any issue. They became my most powerful resource.

To help you spread the word about patterns, seek help from people in your organization who know and connect with many other people in the organization.

You are an Evangelist or Dedicated Champion trying to introduce patterns into your organization.

Most organizations are too big for one person to reach everyone.

You are doing Brown Bags and Big Jolt to give exposure to patterns, but you know that many people still need more of a Personal Touch. However, it is difficult, or even impossible in large organizations, for you to talk with everyone.

Rogers tells us that communication with others is the catalyst in an individual's decision to adopt a new idea. Other individuals provide them with the information they need to reduce their uncertainty about the new idea and eventually adopt it. [Rogers95:207]

In *The Tipping Point*, Gladwell tells us that "word-of-mouth epidemics" are the work of people he calls Connectors. These are people we rely on to connect us with others. The success of this kind of epidemic is "heavily dependent on the involvement of people with a particular and rare set of social gifts [for] bringing the world together." They have "some instinct" that helps them relate to the people they meet. While most people choose those they want to be associated with based on similar interests and proximity, Connectors don't see the world in the same way; rather, they see possibilities in everyone they meet. Therefore, they know many types of people in different social circles, creating the effect of bringing these many types of people together. Gladwell says that because of this, "... the closer an idea or a product comes to a Connector, the more power and opportunity it has." [Gladwell00]

Therefore:

Find the Connectors—those individuals who know and communicate and "glue" with many other people in your organization.

These people are usually rather easy to find because they know so many people, including you! People who are networked into various subcultures can help bring new ideas in. Use Personal Touch to convince them of the value of patterns. If they are Innovators, it should be easy to convince them. If not, it will be well worth your effort to take the extra time with them because once they become interested in helping you, their connection to others will decrease the time you will need to spend in spreading the word.

Once Connectors are convinced of the value in patterns, they will help you convince others. Since they have the special social ability to connect with others, encourage them to use Personal Touch and Adopt a Skeptic. Remember to Just Say Thanks.

If a Connector is a Respected Techie, he can help you with the important task of sharing the news of patterns with the technical staff and with management.

Since Connectors have their feet in many different circles, they may be able to help you find a Local Leader and/or Corporate Angel.

Although they are good at talking with people one-on-one, you may also want to ask them to do a Hometown Story when they acquire some experience with patterns.

Connectors are not close friends with all the people they know. Gladwell emphasizes the "strength of weak ties." While friends (strong ties) occupy the same world, acquaintances (weak ties) usually serve as an individual's tie to other social circles. Connectors have many of these weak ties and therefore can help you spread the world in a variety of circles. [Gladwell00] However, Rogers also stresses the value of linking people who are alike because people are often more comfortable talking with those who have similar interests and backgrounds. [Rogers95] Therefore, you should not discount any opportunity to "connect" people – whether they are close friends who can talk easily because of their similarities or acquaintances that can talk with people from different social circles.

Connectors are effective because they are members of many "communities of practice—informal networks through which new ideas and innovative practices spread in and across organizations. Studies of the ways in which innovations diffuse within large organizations have consistently pointed to the importance of these informal networks; this is how people learn about new ideas, coach one another in trying them out, and share practical tips and lessons over time. The information that passes through them has credibility. When people we know and rely on talk about something new they are doing, we naturally pay attention. Experimenting with new ideas requires help and counsel in a safe context. [Senge99:17,49]

Many times you will have a good idea but fail to introduce real change because you are unable to play the Connector role. This will be the case for someone who is new to an organization or for someone who is naturally an introvert or not a convincing speaker. Gladwell has observed that three roles are critical for introducing real change: Salesman, Connector, and Maven [Gladwell00:60]. Many times a technical idea is proposed by a Maven—someone who has knowledge and the respect of his peers but unless he can reach the right people and unless he can sell his idea outside his immediate circle, no real change will occur.

Rogers has shown that earlier adopters of an innovation have more social participation and are more highly interconnected through interpersonal networks in their social system than later adopters are. [Rogers95:273] Therefore, Connectors are potential Early Adopters.

There were many Connectors at A because it was such a social company. The company funded organizations that encouraged these communities -- the music club, the flying club, the golf club, etc. Those people in some cases had known each other for years -- it was a way to know people outside work -- but they talked about work, of course. To use this pattern you have to be aware of the existence of these communities and make sure you have someone in each who knows what patterns are all about and can get the word to the other members. There were also people who played bridge at lunch—who went out for lunch every other Friday (pay day), and so on.

Originator: Mary Lynn Manns

Shepherded for PLoP'01 (August 2001).

Corporate Angel

I remember when my boss stopped by my cube and said, "Linda, I hear you've been giving brown bags on this patterns stuff. I think you should give a presentation to the vice-president. His staff meeting is in a couple of weeks." I agreed but I really didn't understand why the high-level managers needed to hear about design patterns. I thought these were good ideas for developers but that was it. I was so wrong. That presentation brought the purchase of cases of books and training and, eventually, a new position within the company. My good ideas wouldn't have gotten very far without buy-in from upper management.

Acquire high-level managerial support. It is necessary for any activity to thrive and to provide access to resources.

You're an Evangelist or a Dedicated Champion trying to introduce patterns into your organization.

Big-ticket items—training, books, conferences, and visiting gurus—need the backing of higher levels than your own boss.

Brown Bags and enthusiasm can only go so far. Training, books, conferences, and visiting gurus, such as a Big Jolt or Pattern Mentor, will be needed if patterns are to grow. However, resources are limited, since each level of management has authority to spend only in a certain area, whereas very high-level support can make many inroads easier.

For patterns to be successful, very high-level managerial support must be involved, someone who believes in the importance of patterns and will lend appropriate coaching and direction. This high-level supporter must be respected across his organization; otherwise the support could possibly hurt your cause.

Even if everyone subscribes to patterns (unlikely in all but the smallest organizations), the support of high-level management is essential for tools, training, and other support activities.

Little significant change can occur if it is driven only from the top. CEO proclamations and programs rolled out from corporate headquarters are a great way to foster cynicism and distract everyone from real efforts to change.

An analysis of the best technology-transfer practices of a broad cross section of government agencies, research institutions, and national and industrial laboratories identified the importance of the role of *angels*, identifying them as "the high-level executives and patron saints of the organization who carefully project start-up projects and shield them from harm until they mature." [Souder90]

Therefore:

Enlist the support of a high-level manager who has a special interest in patterns and will provide resources and direction to implement company strategies by supporting your idea.

Talk about your ideas initiative with executive leaders as early as possible. Use Pieces of Clay. You don't need full-blown corporate support. That would make it another "freight train," but you need a relationship with the immediate chain of command. If they can't see the link between your new ideas and business results, then you will start to mistrust each other.

By the time symptoms of that mistrust are evident, it's probably too late. The most effective strategy is to invoke curiosity about your efforts—at all levels. [Senge+99:172]

To ensure that patterns have an impact across the organization, the efforts of the Dedicated Champion, the Corporate Angel and the Local Leader must be aligned. When the interests at all levels are in harmony, the paradigm shift to patterns can be made with minimal upheaval and disruption.

If a high-level manager is especially enthusiastic and knowledgeable, the whole process of introducing patterns is eased, since lower-level managers will be more open to directives from the top, especially if a Respected Techie is on your side.

The role of Corporate Angel is similar to Senge's Executive Leader, who is a protector, mentor, and thinking partner. [Senge96]

The Corporate Angel can make it possible to use Big Jolt, have training, and buy Treasures.

The role of Corporate Angel is not an authoritarian one. The upper-level management position should not be used to dictate behavior. Cultural change takes place slowly.

Unlike many theorists of leadership, we do not regard executives as the *sine qua non* of organization change. We do not believe "all change starts at the top" and that "little can happen if the CEO is not on board." We have seen too many counterexamples of significant change started and sustained for some time with little or no executive leadership, and conversely too many examples of aggressive executive leadership that results in little lasting change. But sooner or later executive leadership becomes crucial, especially in sustaining change that can have organization wide, impact. The real role of executive leadership is not in "driving people to change," but in creating organizational environments that inspire, support, and leverage the imagination and initiative that exists at all levels. [Senge99:566]

The pharaoh Akhnaton is a good example of a high-level authority figure who attempted a paradigm shift in Egyptian culture. In paintings from his era the royal family is shown with a new and strikingly different artistic freedom, more natural, lifelike settings—radically different from the stiff, two-dimensional representations of earlier years. At the end of his brief reign, the old paradigm returned. Even a pharaoh, considered to be god incarnate, could not overcome thousands of years of a culture existing inside a single paradigm. [Aldred91]

Top management buy-in is a poor substitute for genuine commitment and learning capabilities at all levels in an organization. In fact, if management authority is used unwisely, it can make such commitment and capability less likely to develop.

Hierarchical authority, as it has been used traditionally in Western management, tends to evoke compliance, not foster commitment. The more strongly hierarchical power is wielded, the more compliance results. Yet there is no substitute for commitment in bringing about deep change. No one can force another person to learn if the learning involves deep changes in beliefs and attitudes and fundamental new ways of thinking and acting. [Senge+99:]

To help keep the Corporate Angel interested, Stay Close and offer the chance for a Royal Audience when an appropriate Big Jolt visitor is planned. Just Say Thanks.

Coplien's Patron pattern [Coplien95] describes the role of a high-level manager who is a development project champion and decision-maker.

This pattern "builds" high-level management support for patterns in the organization.

This pattern was applied successfully in the introduction of patterns at A. The Corporate Angel was the vice-president of product development. He has been a consistent supporter of all patterns activities. His influence has made it easier to bring in trainers and consultants, buy books, and attend conferences.

This pattern has also been used at F. The Corporate Angel has a special interest in patterns and has worked to develop one of the standards as well as setting organization-wide goals.

Originator: Linda Rising

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Corridor Politics

Alias: Prepare Your Victory

The Frenchman Maurice de Talleyrand-Perigord was one of the most important diplomats in Europe during the late 18th and early 19th century. "In May of each year, one of the five Directors—whose name was chosen by lot—vacated his seat. Talleyrand spoke privately with four of the Directors, pointing out to each one how much more secure his seat would be if all five tokens in the lot bore the name of Citizen Director Reubell. ... Talleyrand made a public ceremony of the drawing... When a child pulled a token from the jar and read the name of Reubell, the chosen Director could not object." [Kemske97:156]

Informally work on the decision makers before the decision point. Make sure they fully understand the problem area and the consequences of the decision.

You're an Evangelist or Dedicated Champion facing an upcoming decision that you really care about.

You're unsure of the attitude of all the decision makers. Some of them may not know or understand the problem area. Some may be biased by experience or old ideas.

It's hard to change the decision of a group once it is made. You have a greater chance to reach the minds of individuals before they make a decision.

Therefore:

Informally work on the decision makers before the decision point. Make sure they fully understand the problem area and the consequences of the decision. Attempt to get the approval of anyone who can kill it.

This is known as "lobbying." The fence-sitters, those who are uncommitted on the issue potentially able to vote either way, are your key targets.

Be clear about what you want. Tell a story or example to make the issue real. Tell the truth. Don't distort the facts just to win the vote. It will come back to haunt you later.

Don't be a fanatic—know when to compromise—it may be the best way to get what you want.

Your goal is to build a relationship with the decision maker, so if you win support for your issue, remember to Just Say Thanks. Pay your debts. If someone helps you, remember to help him in the future.

If the decision doesn't go your way, remember, "No permanent friends, no permanent enemies." Some day, on some other issue of importance to you, the decision maker may come through. In the meantime, your task is to prevent a decision maker from being an active opponent. In other words, even if your argument isn't convincing, you may help to turn down the heat on the other side.

To help turn down the heat of skeptics, use Adopt A Skeptic and Fear Less.

Originator: Lise Hvatum

Dedicated Champion

To increase your effectiveness in leading the effort to introduce patterns into your organization, find a way to make your patterns work part of your job description.

You're an Evangelist who has successfully enlisted a Local Leader or Corporate Angel. You believe in patterns enough to make it part of your regular job.

You need more time to devote to introducing patterns into your organization.

Without the pro-active effort of someone whose job description includes the new idea, it can wither and die on the vine. A single, dedicated individual can bring a focus to the activities necessary to maintain a sufficient level of interest in patterns to keep the idea alive.

"A change advocate is an individual or agency whose objective is to promote a change in beliefs, attitudes, and, eventually, behavior in regard to new ideas and innovations. The importance of the change advocate, his attributes, and how he conducts himself, has been established in much of the literature on innovation acceptance and rejection." [Mackie+88:1083]

This role is described by Senge, "those people who 'walk ahead,' people who are genuinely committed to deep change in themselves and in their organizations. They lead through developing new skills, capabilities, and understandings." [Senge96]

Therefore:

Ask for Help from a Local Leader to expand your role of Evangelist to one of Dedicated Champion.

Dedication means: (1) devotion to the cause and (2) time dedicated to the task of 'championing' patterns —in other words, this is part of your job description.

You can start with a small percentage of your time dedicated to working on patterns and expand if there are compelling business reasons. Don't neglect any of your current Evangelist activities. Keeping your enthusiasm, using Personal Touch, monitoring the e-Forum, all these are still important. If you are new to this position. Understand the role of the Evangelist. It is key to getting the new idea going.

The change accelerates when they accept and like you—the Early Majority are quick to get their information from people they like and can relate to. [Rogers95:346]

Now that your job allows time for patterns activities, use A Pattern of Their Own, Ghost Writer, Hometown Story, Pattern Mentor, Big Jolt, Bread Upon the Waters, and Do Food Give away Trinkets and Treasures. Involve Everyone and Sustained Momentum. Just Say Thanks.

To be truly effective, if you do not have one, you will need a Corporate Angel.

In a small organization, the Corporate Angel could be the Dedicated Champion and may be involved with project implementation.

The Dedicated Champion can play the role of Coplien's Gatekeeper (someone who funnels information in and sends information out). [Coplien95]

This pattern "builds" a person who is dedicated to leading the patterns effort in the organization.

This pattern has been successfully applied at A. The Evangelist was able to convince her Local Leader that the patterns initiative was worth supporting. While patterns activity was never her full-time job, there was enough flexibility in her job description to accomplish a lot more than she had been able to do on her own time.

There was a great deal of effort in attempting to get patterns going at W. This would not have been possible without the Local Leader appropriating time for Dedicated Champion.

What allowed us to depart from our normal manner business? For us, the most important element ...was a successful champion who engenders interest in process change. A champion should be a respected developer who is part of the team, known for getting work done and respected for desiring practical improvements. ...I can't stress this enough: when management determines that process must be followed, the pressure comes from outside the group. It is foreign, and team members will likely reject it. If the enthusiasm, however, comes from respected members of the group, developers feel compelled to listen. After all, these people actually know what it's like in the trenches. Once the other team members see real benefits, they'll jump on the bandwagon as well, and the revolution will be well underway. [Roberts00]

Originator: Linda Rising

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Do Food

Turn a patterns class or meeting into a more special event by bringing food into the meeting.

You're an Evangelist or Dedicated Champion who has called a meeting to introduce patterns. Members of the user community are free to attend or not.

A patterns event can be seen as just another ordinary, impersonal meeting or class.

Alexander explains, in Communal Eating (147), that "communal eating plays a vital role in almost all human societies as a way of binding people together and increasing the extent to which they feel like 'members' of a group." [Alexander77:697] Food can turn a meeting into an event. Alexander quotes Thomas Merton on the meaning of communal eating: "the mere act of eating together...is by its very nature a sign of friendship....". [Merton56:126-27]

Having food at a meeting turns it into an event. It helps to make people feel that it is more than just another meeting they are accustomed to attending.

Therefore:

Help to turn a patterns class or other meeting into a more special event by making food available.

Doughnuts and bagels with coffee, tea, and juice in the morning, cookies and soda in the afternoon. Lunch is good at noon.

Ask for Help from the Local Leader or even the Corporate Angel to provide the resources. Organization funding for the food is an important sign to the attendees that the organization supports the patterns effort.

If corporate funding is not available, especially in the beginning of your efforts, you may wish to buy a few cookies -- both your colleagues and management will be impressed that you believe in the idea enough to put your money where your mouth is.

Be sure you have done your homework to understand the role of food in the culture. (When doughnuts were provided at W in the health conscious city of Boulder, Colorado, no one ate them!)

Food puts people in a better mood. If offered in the beginning, it starts the meeting on a positive note. And because everyone likes free food, it can draw people in. It may even help to put people in a more relaxed mood if the topic gets controversial – get a cup of tea or grab a cookie. It can also help to hold people's attention if the meeting gets slow - caffeine and sugar won't hurt!

Apply this solution sparingly or expectations will become too high and when there is no food, people will be disappointed. The food should be seen as a special treat.

Advertise on e-Forum or In Your Space. Tell the Connectors.

You may not be able to Do Food if the corporate culture doesn't accept food in meetings.

While the prospect of free food is nice, Brown Bag can be used when funding is not available.

This technique has been used to draw attendance to information sessions set up to introduce patterns at A.

It was also used at W. (After the experience with leftover donuts, bagels became the food of choice at patterns events.)

A research tradition at B is "Food Place." One department has its own kitchen. Another has the famous espresso room. A food place is a strong addition to this pattern.

Originator: David E. DeLano

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Early Adopter

Ask for Help from co-workers who can serve as opinion leaders early in your efforts to introduce patterns.

You are an Evangelist or Dedicated Champion trying to introduce patterns into your organization. You have a small group of Innovators who support the new idea.

To have more impact in an organization, interest in patterns must extend beyond a small group of individuals. Innovators are excellent gatekeepers for a new idea, but their impact as opinion leaders is limited.

One of the worst ways to introduce a new idea is for it to be dictated by management. People don't like to be told what to do. But, by stirring up interest bottom-up, the users of patterns will push to get them as a part of the organization much more quickly. But you'll need more than just a few outliers to get something significant going.

The Innovator's role as gatekeepers in launching a new idea like patterns is helpful. However, their ability to serve as opinion leaders is likely to have impact only in highly innovative organizations [Rogers95:274]. In most organizations, you need support from those who are known to be more judicious in their decision-making. These are the individuals who are open to receiving information about a new idea, and then make a decision only after a thoughtful evaluation. This allows them to get a reputation as the "embodiment of successful, discrete use of new ideas." They become the ones who are "considered by many as 'the individual to check with' before using a new idea." [Rogers95:274]

Rogers tells us that this group, known as "early adopters" follows Innovators on the normal curve of adopter categories, composing approximately 13.5% of a social system. However, unlike Innovators, their opinion leadership is a key factor in the diffusion process. They are not too far ahead of the Early Majority in their level of innovativeness and risk-taking, and can therefore serve as role models for gaining the approval of this group. This, in turn, will build a critical mass of adopters in the organization. [Rogers95:274:68]

Moore refers to this group as "visionaries," and explains that unlike more enthusiastic Innovators who derive value from the new idea itself, Early Adopters also consider the strategic opportunity it can provide. These rare individuals have the insight to match an emerging idea to a business goal, the temperament to translate that insight into a high-visibility project, and the respect to encourage the rest of the organization to buy into the new idea. [Moore99:34]

Therefore:

Expand the initial group of Innovators into a larger group of people who have the qualities to be opinion leaders for patterns among the majority in the organization.

Look for these individuals in the people who are highly motivated and can see patterns as a strategic opportunity. As visionaries, they are usually open to fundamental breakthroughs rather than simply improvements. [Moore99:34]

Give them as much information and training as possible to convince them of the value in patterns. Use Personal Touch and Pieces of Clay. Encourage them to look to Innovators for information about experiences and the value in patterns.

Because they do not necessarily see value from the innovation itself but rather from the strategic leap it enables, point out the strategic value in patterns to your organization. Use Just Do It to begin to evaluate the usefulness to the organization.

Once they are convinced, Ask for Help in gaining the support of the majority, and possibly a Local Leader and Corporate Angel. Encourage them to do a Hometown Story, lead a Study Group, and/or help with Personal Touch and Adopt a Skeptic.

While Early Adopters are open to new ideas, their decision to adopt does not come as quickly as with Innovators. You have to come down to earth and make patterns real if Early Adopters are going to be interested. This can be hard work.

Gaining the support of this groups helps to decrease uncertainty in others. [Rogers95:264] It calls attention to the benefits of patterns to the majority and, in turn, can lead to high-level management interest. In this way, patterns are beginning to be introduced from the bottom up.

Since Rogers has shown that earlier adopters have more social interconnectedness than later adopters, you may find Early Adopters in those you have identified as Connectors. [Rogers95:273]

This pattern "builds" a group of individuals who can help serve as opinion leaders for patterns in the organization.

Even though the patterns movement at A used the management support of a Local Leader and a Corporate Angel, the focus of the work targeted the development community with the long-term goal of a sustained bottom-up movement

Originator: David E. DeLano

Workshopped as Grass Roots at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped as Grass Roots at PLoP'97 (September 1997).
Shepherded and workshopped as Grass Roots at EuroPLoP'00 (July 2000).
Shepherded as Grass Roots for PLoP'01 (August 2001).

Early Majority

How do you know that you really have a patterns culture? I think I knew that we had passed a significant point when a high-level manager stopped by late one evening. He sat down heavily and began to talk about some problems he was having and then asked, "So, can you think of any patterns to help me?" This was a manager of a large legacy system. Patterns had never really been "pitched" to his project and although anyone could take the patterns

training, most of the interest came from the new OO projects. If this manager was asking for patterns, clearly the majority was being won over.

To begin to realize a commitment to patterns in the organization, seek the support of a majority of individuals.

You are an Evangelist or Dedicated Champion trying to introduce patterns into your organization. You have gained the support of Innovators and Early Adopters.

Gathering the support of Innovators and Early Adopters will spark patterns in the organization, but for patterns to truly have impact, you must obtain the support of a majority.

Your effort to introduce patterns can begin with some Innovators and Early Adopters but will not thrive without a majority. Rogers' Diffusion of Innovation model and Moore's Technology Adoption Life Cycle recognizes the third adopter category, early majority, as approximately one-third of the population. Gaining their support is not as easy as the previous two groups. Because of the great difference between this group and the previous two, [Moore99] shows a gap, referred to as the "chasm". It is necessary to cross this chasm in order to get a new idea into the mainstream.

However, unlike Innovators, this group will not become intrigued with an idea just because it is new and, unlike Early Adopters, they are not visionaries that look at the strategic opportunity an idea offers. Instead, they are deliberate and are interested in how a new idea affects existing operations. They desire evolution, rather than revolution. They follow with deliberate willingness in adopting innovations, but seldom lead. By the time they adopt, they want the innovation to work properly and to integrate well with the current way of doing business. [Moore99:20] [Rogers95:265]

As pragmatists, they look for incremental, measurable, predictable progress and improvement. In their minds, risk is a chance to waste time and money rather than a chance for opportunity or excitement. Before they commit to a new idea, they want to know how other people have fared with it. [Moore99:42]

Because of their deliberate decision-making, it takes effort to win them over but once won, they are loyal and often enforce organization standards that are needed to help the innovation succeed. They are what makes for continuality and the link between the very early to adopt and the relatively late adopters.

Therefore:

Expand the group of individuals who quickly adopted patterns to a more deliberate majority that will allow patterns to gain a strong foothold in your organization.

Spark their interest by showing the visible improvements that can be obtained with patterns. Encourage them to attend a Hometown Story to learn how others have used patterns. Use Personal Touch to show them that the risk is low while the value to their immediate needs is great. Keep in mind that this group is more deliberate and so it takes more time to convince them than Innovators and Early Adopters. Be patient.

Because they are the link to the later majority, Ask for Help with Adopt a Skeptic to help convince this next group of individuals.

Gaining the support of the Early Majority will accelerate the acceptance of patterns in the organization because the 'chasm' has been 'crossed' and the new idea is in the mainstream. In addition, unlike Innovators who usually move from one new idea to the next and Early Adopters who are often see themselves on the fast track, this group tends to be committed long term to their profession and the company in which they work. Therefore, they can offer more stability in the effort to introduce patterns into an organization. [Moore99:58]

This pattern begins to "build" the majority acceptance of patterns in the organization.

Originator: Mary Lynn Manns

e-Forum

Set up a bulletin board, distribution list, or listserver for those who want to hear more.

You're an Evangelist or Dedicated Champion trying to introduce patterns into your organization.

You need to initiate and maintain regular contact with people who might be interested in patterns.

It's hard to get information to everyone. We're overwhelmed by too many ideas and everyone is so busy. But most people will spend a little time each day reading e-mail.

People might not have time to attend every Brown Bag or other patterns event but they like to know what's going on. So they might read a few e-mail announcements before deciding to become more active in the community.

The author of *Community Building on the Web* has observed, "A mailing list is often the best way to get your online community started. If it takes off, you can always add more features and gathering places. You can create a prelaunch mailing list for your founding members, early adopters, enthusiasts, or devotees. You'll get to know some of your most potentially valuable members and let them meet each other, before your member database is set up." [Kim00:30]

Therefore:

Create a publicly accessible electronic, interactive forum. Advertise its existence. Keep it active and growing.

Consider having separate "announce" and "discussion" lists, since some want to actively participate and others want to passively hear what's going on.

This virtual community will help you establish a real one. It will provide a way to identify expectations and goals for your organization and create a consistent definition of your new activity.

If you monitor the medium, you can use this information to convince management that there is sufficient interest to take the next step—management support and the identification of a Local Leader or Corporate Angel.

An e-Forum is one way to Stay Close with individuals, but it should not be the only way. You will also want to use more personal contact with individuals who are key to your efforts.

This pattern "builds" a place to electronically share information about patterns.

The Evangelist at A used a growing e-mail distribution to draw attention to patterns activities. The initial list came from Brown Bag attendees. Later, when training courses were offered, attendees were added to the list. The distribution list was used to advertise pattern news, especially Big Jolt visits. The list made the recipients feel special because they heard about an event before the general population.

The Dedicated Champion at W used a growing e-mail distribution list to send the latest news on patterns events and useful examples of patterns.

Originators: The EuroPLoP 2000 Focus Group on Introducing Patterns into Organizations: Gerhard Ackermann, Frances Evans, Peter Gassmann, Jan de Groot, Pavel Hruby, Klaus Marquardt, Amir Raveh, Linda Rising, Maks Romih, Didi Schuetz, Alberto Silva, Amy Strucko, and Oliver Vogel, with special thanks to Amir Raveh for the idea and capturing the initial version of the pattern.

Workshopped at EuroPLoP'00 (July2000).
Shepherded for PLoP'01 (August 2001).

Evaluation Phase

Gather the Respected Techies and other interested individuals in the organization to have a close look at your new idea and evaluate it for their managers and other developers.

You're an Evangelist or Dedicated Champion, working to introduce a new idea into your organization.

Some managers and developers are supportive but others are reluctant to join in until they have some assurance from a Respected Techie and other respected individuals, that this is really a worthwhile idea.

Managers and developers are overwhelmed by information. They often don't take the time to keep up with the latest and greatest. They have probably been disappointed by the promises of the never-ending stream of silver bullets and have become cynical and reluctant to go along with even the most convincing arguments.

However, they are most likely interested in something that will help make their jobs easier and improve the quality of their products. They just need solid evidence. Usually, managers and developers will trust the judgment of the local guru—the person who keeps up with the latest trends. This kind of person is called a Maven—a reliable source of knowledge.

Gurus are usually those who sit on the front row when you have a meeting about any new technical idea. If these people are also Respected Techies, they can help you influence a much larger audience.

Most managers have a long-term relationship with a Respected Techie. Whatever the Respected Techie says is usually taken to heart by the manager. To convince the manager about a technical topic, you often must convince the Respected Techie.

[Mackie1988] explains that the change advocate may find it necessary to secure the endorsements of a recognized group of technical specialists in the operational area to which the innovation belongs.

Therefore:

Set up an opportunity for the Respected Techies, and other individuals respected by managers, to evaluate patterns.

The names of the people who are on the evaluation team should be those respected by management and developers alike. Get the names of these people from managers or from Connectors—the people who know the right people. Include all the right people. If someone is left out, you could hurt your cause.

Ask for Help. Personally invite these individuals to be part of the evaluation phase for your new idea. Hold presentations, such as Hometown Story, or a special Brown Bag or Study Group for them. Encourage discussion to uncover any areas where the Respected Techies have doubts. Use Corridor Politics to improve your chances of success.

Remember to Just Say Thanks for any support.

If you encounter resistance, use So What's New? and Fear Less.

At A, an evaluation phase was requested by the Vice-President and his staff after an initial presentation on patterns by an Evangelist. Each member of the Vice-President's staff named a Respected Techie for the evaluation team. Innovators who had been involved with patterns from the beginning were also invited to join the team. After a positive evaluation, the management became active supporters of patterns and the word spread throughout the organization that patterns were a good thing.

Originator: Linda Rising

Evangelist

To introduce patterns into your organization, begin by letting your passion for the new idea drive you.

You're part of a software development organization that wants to stay abreast of new technologies. You're excited about patterns. Maybe you went to a conference, read an article or book and, as a result, started learning more. You feel patterns will have value for your organization and you want to spread the word.

You want to get patterns going in your organization but you don't know how to start.

As Ralph Waldo Emerson has said, "Nothing great was ever achieved without enthusiasm" but it's hard to translate enthusiasm into action that has lasting impact. New ideas are always out there—more than we can handle. Even the best ideas still need to be sold. You only have so much time to get your ideas across.

To grow your idea into real change for your organization, be willing to invest yourself in your cause. When you look for possibilities in every situation, you can take advantage of even small opportunities to get your idea across. Don't worry if you don't have an all-

encompassing vision. For any creative project, develop a simple plan of action and experiment with it. Let each stage of the work build on the previous stage. [Senge94:198]

Every example of broad diffusion of new learning practices has relied on the enthusiastic participation of effective internal networkers. They are the natural "seed carriers" of new ideas and new practices. [Senge+00:17]

If you really love people, you want to help them be all that they can be. If you can bring that attitude to your work, and if you can muster the courage and compassion to act upon that love, then you can be effective. [Senge+99:212]

If you have a deterministic view of people—that they come programmed by their genes, there's only a 10% margin of improvement and 20% of them will screw you if they get a chance—then that belief, in itself, will severely limit your ability to lead profound change. On the other hand, if you believe that there's an enormous reservoir of untapped potential in each person, then you will be better equipped to foster a culture of individual growth. [Senge+99:236]

Therefore:

To introduce patterns into your organization, let your passion for the new approach drive you.

To start, tell others. Share your vision. Let them feel your enthusiasm. Learn as you go and be prepared for setbacks.

Give Brown Bags, Plant the Seeds, and set up an e-Forum. Start a Study Group. If you have a well-known contact who will come in to your organization at no cost, bring in a Big Jolt. Do Food at events when you can. Begin to identify Innovators. Try Personal Touch. If you are an author, consider using Bread Upon the Waters. Just Do It. Ask for Help.

If you are introverted or opinionated, you are not going to get anywhere because people are not going to trust you, even if you've got the best data in the world. You need to be a very strong communicator, someone who can build personal credibility. [Alexander01]

It's hard to be a Salesman, Connector, and Maven to make real change. The word Maven comes from the Yiddish—one who accumulates knowledge [Gladwell00:60]. Ask for Help from others who can play these roles. A Respected Techie is a good candidate for a Maven.

An Evangelist is typically an Innovator or Early Adopter. If you are an Innovator realize that people are less likely to trust what you have to say, since Innovators get excited about new things just because they are new. If you are an Early Adopter, you are more down-to earth and will think about how the new idea can help the organization and would be more effective in reaching the rest of the organization.

This is not a role for the fainthearted. The first person to convince is you. If you don't believe in your cause, it will be difficult to sell it to anyone else. Your own determination will be required in the face of resistance. You can also use Fear Less and So What's New? Use Gold Mine if your job description allows it. Just Enough can help you interact with newcomers.

If you are successful in conveying your enthusiasm, a small group of those who also believe in the new idea will support you. These Innovators will help spread the word and ultimately create Early Majority support for patterns. Real impact will require a Local Leader and a Corporate Angel. Be on the look out for possible managerial support. Use Pieces of Clay.

John, a key instigator and leader of a corporate initiative, hit the lecture circuit. He spoke inside the company and out in public, eager to help the rest of their corporate parent learn from his team's experience. An engaging and earnest engineer in his thirties, he had no doubt that the results they'd achieved would provide compelling evidence for anyone.

It didn't work out that way. Many people inside the company ignored John's efforts to tell his group's story. At first, he tried to make his case with greater fervor. He began to blame and resent the corporate culture for being misguided and politically biased against his plant. A corporate executive was asked casually about John. "We think he's made some good technical innovations," said the executive. "But I'm not going to sit through any more meetings with those missionaries."

A few months later, John inadvertently learned of that comment. At first it shocked him a bit. He saw himself as an adventurer, trying to move in pioneering directions. Yet, they apparently saw him as "over the top." At the same time, he had begun some in-depth work on reflection and inquiry skills, and he thought carefully about the assumptions that people were making, on both sides, about one another. His approach and ambiance changed. He became lower key; he began to spend more time inquiring about the needs of the other teams. He became less of an advocate, trying to be right, and more of a deliberately open-minded internal consultant. Today, he visits people in the company only at their request—and these visits, fueled by requests, have become a full-time job that keeps him traveling around the world.

In his classic book *The True Believer*, philosopher Eric Hoffer analyzed the mind of the fanatic. He showed how easy it is for any change-oriented movement to draw people across the thin line from certainty to fanaticism. "At the root of the fanatic's cockiness," wrote Hoffer, "is the conviction that life and the universe conform to a simple formula—his formula." Once people become convinced that they are absolutely right, their minds become closed to the voices of others who disagree.

Zeal and isolation are the most insidious unintended consequences of profound change initiatives. The deeper and more effective the changes that occur in a group, the more easily they can come into conflict with the larger organization. The more people change, the more different they become in their thinking and acting from the mainstream culture. The more they succeed in producing significant advances in practical results, the more potentially threatening they become to others competing with them for management attention and reward. The more personal and business results they achieve, the more arrogant and intolerant innovators can become. Confidence is vital to sustaining innovations, but it can also have a dark side, breeding arrogance and a feeling that "Our way is the only right way." People rarely recognize when they cross this line. [Senge+99:321-325]

The patterns movement at A began with an Evangelist who talked to everyone about patterns and gave Brown Bags. A small group of Innovators supported this early effort and helped identify others who might be interested. An e-Forum was established and ultimately a Local Leader helped identify a Corporate Angel.

Originator: Linda Rising

Workshopped at the OOPSLA "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Fear Less

Identify resistance to your new idea and turn it to your advantage.

You're an Evangelist or Dedicated Champion trying to introduce patterns into your organization. Progress seems to be slowed or blocked by negative influences caused by people in fear of their position.

Some people that are not interested in patterns are introducing noise and gossip. You prefer that they add a positive contribution to the spread of patterns throughout an organization.

New buzzwords and hot topics are always accompanied by a lot of hype. People seem to expect promises of silver bullets. Patterns are a tool, not a silver bullet.

Why does the problem of resistance to innovative products arise? The problem comes about by failure to recognize important human processes involved in innovation acceptance and change. [Mackie+88:1082]

Since the advent of any new system is to some degree disruptive, some resistance is likely to result. [Mackie+88:1083] Every [change agent] complains about it, but if you think resistance is bad, consider the alternative: It's frightening to encounter [someone] who doesn't resist your ideas, because that places the full responsibility on you to be correct at all times. Nobody's perfect; we need resistance to test our ideas. So, the first step in dealing with resistance is to appreciate it. Fortunately resistance is universal. Resistance is like fungus. It doesn't thrive in daylight. Therefore, once you suspect that there is resistance, your next step is to get it out in the open, rather than let it fester in the dark. [Weinberg85:155]

It's difficult to inquire into others' views when you do not agree with them. Our habitual response to such disagreements is to advocate our views harder. Usually, this is done without malice but in the genuine belief that we have thought things through and have a valid position. Unfortunately, it often has the consequence of polarizing or terminating discussions, and leaves us without the sense of partnership we truly want. Try to respond to differences of viewpoint by asking the other person to say more about how he came to his view, or to expand further on his view. Creative outcomes are much more likely. [Senge90:200]

When introducing patterns, you'll have to address fear, both the listener's fear and your own. The listener may fear loss of position or status, or they may fear the loss of comfort, the knowledge that what was true in the past will remain true, that they can work as before. Or they may fear being taken in by hype. This fear will manifest itself as resistance to your ideas.

Your reaction to that resistance is likely to be to advocate your views harder. That, too, is motivated by fear, the fear of looking wrong when everyone's looking at you, the fear that your ideas may in fact be wrong.

The collision of two fearful people leads to impasse. Resistance is not the primary reason why changes fail. It's the reaction to resistance that creates the problems.

No one can persuade another to change. Each of us guards a gate of change that can only be opened from the inside. We cannot open the gate of another, either by argument or by emotional appeal. [Covey89:60]

Yet, Moore recommends that skeptics not be ignored because they "can teach us a lot about what we are doing wrong." [Moore99:54]

Therefore:

Identify any resistance and turn it to your advantage.

Detractors are good sources of information for the problems that may arise with any new idea. Listen to what they have to say. Understanding the reasons for the resistance allows you to use it to your advantage, rather than allowing others to use it against you.

You can also anticipate objections and get ready for that. You can examine the organization's history and culture and determine what issues you should be prepared to answer. It's much better to address those issues when you bring them up instead of waiting for someone else to do it for you.

When communicating with people about new ideas, you don't have to absolutely convince them. Help them see that the story you are telling is "on their side," and therefore worth listening to. It need not align perfectly with their point of view, but show that their point of view is treated fairly, and that they are not cast as an outsider. [Senge+99:332]

As Stephen Covey states, "You can value the differences in other people. When someone disagrees with you, you can say, "Good! You see it differently. You don't have to agree with them; you can simply affirm them. And you can seek to understand. If I were to summarize in one sentence the single most important principle I have learned in the field of interpersonal relations, it would be this: Seek first to understand, then to be understood. This principle is the key to effective interpersonal communication. [Covey89:237, 284]

In presentations, bring up the negative things you have heard or anticipate what your detractors might say. If you don't bring these issues up you are more vulnerable when someone else raises them.

This approach of inviting resistance makes sure that all concerns are heard.

Give resistant individuals extra attention. Use Personal Touch. Show that learning a new approach with patterns does not mean throwing away their experience. Point out how patterns can improve things for them. People like being recognized and receiving special attention.

In some cases, Ask for Help for Adopt a Skeptic.

Be humble in your efforts and compassionate toward imperfections, including your own. While you may like some people more than others in your group, keep in mind that a range of personae lives within each person. The way you operate toward them will elicit the persona you see—the resistor you fear or the best person someone is capable of being. [Senge+99:127] Learn from the skeptic. If they are Respected Techies, use Ghost Writer or help them write A Pattern of Their Own.

Emphasize that "patterns will not solve all your problems." Point to references that point out the difficulties in using patterns, for example, "Patterns: The Top Ten Misconceptions," http://www.research.ibm.com/designpatterns/pubs/top10misc.html

Use So What's New? if resistors do not see any value in patterns because they appear to be so obvious.

Progress in introducing the new idea is not as likely to be dragged down by resistant individuals. Listening to their concerns brings to light the limitations of patterns so that these limitations can be addressed frankly and honestly throughout the organization. Giving these individuals some special attention and validating their concerns may actually bring them around to your side. In addition, others who see you dealing respectfully with these resistors, and even raising objections in advance, are likely to be impressed with you as the messenger of the new idea.

A communication gap can develop that limits any initiative's credibility. As one manger put it, "Many of us were really interested in the new approach, but when we tried to learn a little, all we got was jargon and theory that was pretty hard to make sense of." Innovators who cannot explain themselves effectively to others often end up seen as insular. This lessens their credibility and reduces enthusiasm for the initiative. Usually, innovators are so focused on the changes, they invest relatively little in learning how to help people outside the team understand what they are doing. [Senge+99:325]

There can be many reasons an individual is resistant to a new idea. Some resist because their frame of reference is most often the past – we've always done it this way. Rogers refers to these as "laggards" in the widely known and tested "adopter categorization on the basis on innovativeness" scheme. For more information on "laggards," refer to [Rogers95:265] and [Moore99].

Kerth sees resistance as providing information about a person's thinking process. Resistance to new ideas is very natural and shows that an individual is actively engaged in mapping new possibilities against past experiences. He suggests treating resistance as an invitation to participate in this mapping. [Kerth01:224]

Kerth suggests that someone resists change because he is trying to avoid pain that he thinks will result if the new way is adopted or he is trying to prevent the loss of something positive and enjoyable in his current situation that will be lose if the new way is adopted. Kerth recommends asking questions to better understand the resistance and help the person to move beyond it.[Kerth01:226]

In a medium-sized European organization that facilitates insurance companies, an Evangelist tried to introduce object-oriented approaches. There were signs of resistance at the introduction. Later resistance decreased when the resistors were actively involved in the process.

This approach was also used at A. Any negative comments were followed up one-on-one to hear the detractor's side and to address issues. These issues were always brought up in any subsequent presentations—to deal with problems before they were raised. In some cases, detractors became enthusiastic supporters. In other cases, detractors remained unconvinced but they were no longer as noisy about it.

In trying to introduce XP at a process-intensive company, the group understood what the main objections would be as they tried to sell XP to the management team. Like good lawyers, they prepared anticipated questions along with the answers for their presentation. [Grenning01:28]

Originator: Rob Westgeest

Shepherded for PLoP'01 (August 2001).

Ghost Writer

Capture the knowledge of domain experts who don't write patterns by writing the pattern for them.

You are an Evangelist or Dedicated Champion in an organization building a patterns repository.

A domain expert is willing to contribute to the repository but is not interested in writing, or does not have the time to write patterns.

Patterns capture knowledge from domain experts. It takes a lot of work to write a good pattern, and most domain experts don't have the time. They may not understand patterns, but they are interested in conveying the information.

Ideally, a domain expert should be the pattern author because they have the best knowledge of the domain, but there are several hurdles that must be overcome. The domain experts:

- Need time to learn what patterns are and how to identify and use them
- Need practice at abstracting away detail and writing patterns, and
- Are so tied up in their daily projects that they find it hard to take the first step and actually write patterns. [Beck+96]

Coplien suggests that some people aren't cut out to be pattern writers. However, people who have great ideas but no inclination, time, or talent in writing, can be tapped in a pattern mining exercise and their patterns "ghost written" by someone else. [Coplien00a]

Therefore:

Ghost write the pattern for the expert. Capture the domain knowledge and document that knowledge as a pattern. Ask the expert to review the draft. Iterate through this process until the pattern is mature enough to be workshopped. Keep the expert involved.

Acknowledge the expert as the "author," and acknowledge the pattern writer in an "as told to" line.

The domain expert must be willing to spend time talking with you. If not, the process of writing and iterating through the pattern can take too long or die before the pattern is really finished. Usually you can count on the expert's time for a couple of iterations. Use this time wisely. The expert will lose interest quickly if you keep asking for more time. According to one report, three interviews are required to finish a pattern. [Beck+97]

You should be familiar with the subject area and able to ask intelligent questions. This will keep the experts from getting annoyed at what may be perceived as stupid questions. [Hanmer01]

If you ask good questions, you will discover more patterns, since there will almost certainly be others that are related to the one you are currently writing.

Sometimes the mining interviews can be greatly enhanced by having two experts present. They can then play off each other and probably know the problem/solution space even better than either individual does. [Hanmer01]

Although this pattern allows knowledge of a domain expert who is *not* willing to write patterns to be captured by someone who *is*, it is not as good as having the expert write the pattern. Capture the story in the expert's own words. This will lend an air of authenticity to the solution and make the pattern more credible. The pattern should tell the expert's story.

Take the pattern(s) back into the organization. Most people don't understand patterns until they see a pattern they can viscerally relate to. [Harrison01]

Don't forget to Just Say Thanks to the expert. You may want to give them a Trinket or a Treasure.

This pattern is related to Mercenary Analyst. [Coplien95:213]

This pattern "builds" a person that will write patterns for those who will not.

Many of the patterns in the repository at W were ghost written by the Dedicated Champion who talked with developers willing to share their stories, advice, and best practices.

This is how the patterns effort began at L and "was a big factor in the success of the patterns."

Many of telecommunications patterns at L were mined from experts through a ghost writing process.

At A, the Dedicated Champions were both involved in writing patterns with the help of domain experts. These patterns included design patterns, system test patterns, and patterns for customer interaction.

Originator: Mary Lynn Manns

Shepherded for PLoP'01 (August 2001).

Gold Mine

Combine pattern authoring with another activity that is part of your workload.

You are an Evangelist hoping to become a Dedicated Champion, working in a specialized domain without an established patterns literature.

Patterns currently exist in work products but can't be seen until people understand them.

You have not been officially authorized to do patterns work, so you have little time to spend on writing them. Most of the patterns that people in your organization have heard or read about are from a different discipline or are too high level to be useful to them.

You have access to documentation in your organization. You have noticed recurring information throughout this documentation. You believe this is an opportunity to show the organization that patterns are not something that is beyond their grasp.

Therefore:

Combine pattern authoring with another activity that is part of your workload—"patternize" existing work products.

You may have been using patterns already and just haven't realized it. Many companies encourage employees to document best practices or lessons learned in a freeform manner. Scour this documentation for potential patterns and, with minimal time, extract meaningful patterns from it. If you are not familiar with the content, interview the author of the documentation to gain sufficient context to write the pattern. If possible, name the patterns using corporate buzzwords your colleagues will recognize.

If you are to give a presentation summarizing your findings, use the patterns as you are preparing your notes and presenting some of your results as patterns.

Rewriting documentation as patterns and thinking patterns as you create new presentations or documents will help you refine concepts, improve descriptions, and add extra structure to the information. You may find that patterns allow you to simplify difficult concepts that others have struggled to communicate. This will help to sell the patterns approach to your organization. It will ease the transition to patterns since your co-workers will already be familiar with some of the names and ideas even if they are new to the pattern format and terminology. When you use the patterns in everyday technical discussions, colleagues will naturally absorb the pattern form at the same time that they are absorbing the technical substance of the pattern you are discussing. This will enable a gentle learning curve that may overcome the roadblocks associated with introducing a brand new concept. Use Personal Touch.

This also allows you to avoid making a big deal out of patterns. You will be able to talk about them naturally and in circumstances where the focus is on the content not the form and soon they will be accepted as useful. Concepts that have always been valued will now be seen as related to patterns. Since you are already using patterns, you will be in a better position to justify continued focus on growing the effort within your organization and the associated sponsorship that is required. As a result, you are able to create patterns without compromising your current position.

You will undoubtedly have to deal with those who continue to be skeptical and to obstruct your progress. Some will still see patterns as just a fashionable name for common sense. Others will continue to perceive them as a level of obscurity that does not add value. You will not be able to get your whole organization on board right away, but by leveraging the gold mine of patterns relevant to your industry, you should be well on your way to achieving critical mass. Use So What's New? Fear Less. Ask for Help.

This pattern is one way to Just Do It.

You can continue this effort even after a Local Leader or Corporate Angel has agreed to fund the patterns effort.

This pattern was used at ***D*** *to generate an initial set of patterns. There were a number of valuable concepts with buzzword names that could be documented and catalogued as patterns. When the concepts were presented in a pattern format, co-workers were already familiar with the names and ideas and could see the value in using a patterns approach to structure the material.*

Originator: Frances Evans

Workshopped at the OOPSLA'00 "Introducing Patterns into Organizations" workshop (October 2000).
Shepherded for PLoP'01 (August 2001).

Hero Story

Before starting to write a pattern, have students list their areas of expertise. These become topic areas for patterns.

You're an instructor in a class of students who are writing their first pattern. Some have more difficulty getting started than others.

Students usually struggle with a topic for their first pattern.

Pity the poor students. They learn about patterns for the first time, and before long they are told to write a pattern. They should have participated in a group writing session to at least see the writing process in action, but that is virtually no experience upon which to build.

Even students with experience in using patterns often have trouble writing their first patterns. It can be very difficult to come up with a suitable topic for a pattern. This is particularly difficult in a classroom situation, where the student must "perform on command."

One of the challenges of writing patterns is that when we become expert in an area, we are "through the gate" [Alexander79]: we no longer use our patterns consciously, they have become part of us. So it is difficult to bring them to mind.

Another difficulty is that it is human nature to see others' accomplishments while being blind to our own expertise. In fact, some people don't think they know anything worth writing as a pattern, even though they are quite skilled and experienced.

Therefore:

Before writing patterns, have students list their areas of expertise. These areas become a fertile ground for pattern topics.

The direct approach of asking people for topics they might write patterns about, or even what their areas of expertise are, can freeze some people. So approach it obliquely, by asking people to write down the topics that other people come to them for advice on. Ask them what their favorite areas of work are. Ask them about their hobbies. Ask them what excites them about their hobbies, and perhaps ask them to tell you stories where they felt they were successful. (See War Stories [Harrison99].) Then point out that these are the things of which patterns are made. Emphasize that things they consider mundane may be startling revelations for people without their expertise.

In extreme cases, you can point out that this is simply an exercise to teach pattern writing, so the pattern topic need not be deep or profound.

Have the students write this information down right at the start of class, and post it for all to see. Remind them as you teach them about patterns that the things they wrote down are a source of knowledge they can and should share with others. This also helps the students get to know each other, and begin to build trust. This is important as they move into workshopping each other's patterns. See Workshop as Teacher.

Originator: Neil B. Harrison

Shepherded and workshopped at KoalaPLoP'01.
Shepherded for PLoP'01 (August 2001).

Hometown Story

Encourage and assist individuals in presenting their patterns experiences to others.

You're a Dedicated Champion trying to Involve Everyone.

Those who haven't used patterns are often unaware of those who have used them successfully.

People want to know what successful people are doing. For those who attend, hearing the experiences of respected peers is the next best thing to personally having the experience. "Most individuals will not adopt an innovation without trying it first…to determine its usefulness." [Rogers95:171] Rogers has shown that, "the trial of a new idea by a peer like themselves can substitute, at least in part, for [an individual's] own trial." [Rogers95:171]

You see the same people doing PowerPoint presentations. Others are willing to talk about their experiences, but don't want to take the time to prepare and deliver a formal presentation. Informal, interactive presentations require little preparation and can be just as, or even more effective. Some are more likely to talk about experiences when they can do it in an informal way with little or no preparation. Offering informal opportunities can also help those who are hesitant about speaking in front of a group.

Therefore:

Find individuals who will talk about their patterns experiences.

Encourage them by assuring them that their presentation does not need to be prepared and delivered in a formal way.

Do the legwork necessary to prepare the event and promote it as an informal and highly interactive session. Advertise In Your Space and on an e-Forum.

You do not need a large audience. Small group settings are usually better than large groups for creating an informal, interactive atmosphere. Attendance can be encouraged with Do Food and Brown Bag.

Although you should encourage anyone who has had a positive experience with patterns to do a Hometown Story, Respected Techies and Early Adopters are likely to have the biggest impact on others because they are generally seen as opinion leaders.

Those who are willing to share their patterns experiences with others in the organization will have the opportunity to do so with very little effort on their part. Those who attend the session(s) will see that patterns can be useful to others in the organization and therefore have the potential to be of use to them too.

Remember to Just Say Thanks.

This pattern "builds" an event in which individuals share their experiences with patterns.

This pattern was used at W. Meetings were well attended and filled with discussion.

This pattern was used at A. Patterns success stories were often reported at team meetings. One presenter even went on to give his presentation at OOPSLA.

Originator: Mary Lynn Manns

Shepherded and workshopped at PLoP'99 (August 1999).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

In Your Space

Keep the patterns effort visible by placing reminders throughout your organization.

You're an Evangelist or Dedicated Champion trying to introduce patterns into your organization.

Unless people are reminded often, they may forget about patterns.

Technical people like to be in the know and are willing to get to get to the bottom of anything new. They don't usually take time to periodically look at documents on the web but they'll notice, and are likely to discuss, things that are put in places they frequently encounter in a typical workday.

Rogers tells us that while interpersonal communication is important when individuals are ready to be persuaded about a new idea, more mass media channels that can reach a large audience rapidly are effective when individuals are initially seeking information. [Rogers95:194-5]

"Because members have to have a way to get to know each other, a community can't really exist without gathering places—mailing lists, message boards, chat rooms—wherever a group can come together and talk amongst themselves." [Kim00:29]

Therefore:

Post patterns written in your organization, and other pattern information, on white boards or bulletin boards, preferably in high traffic areas.

A "Pattern of the Week" encourages those who write patterns to display their work and get feedback from others. It will draw attention to the patterns effort and can stimulate discussion from people passing by. These patterns can be "ready for prime time" (the ones that also appear in a repository) or proto-patterns that are not yet in the repository because they still need review. If a proto-pattern is displayed, it should be marked as such. Change patterns on the same day each week (or other time period) so that people know when to look for a new one.

This area can also be used to announce upcoming patterns events, such as a Brown Bag, a Big Jolt, a Hometown Story event, or the formation of a Study Group. Associate your work with the space. Follow-up any queries with a Personal Touch towards building or maintaining a grass roots effort.

Consider building this area in the "public space" in your Work Community [Alexander+77:225] or in your Team Space [Taylor200:627]. This should be a highly visible area, yet pleasing to the eyes of those who display their work and those who will read it.

Spaces in a high traffic area may be easy for people to see but then simply forget as they move on to where they are going. Include an intriguing quote to capture attention. Gladwell speaks of the importance of packaging information so that it is noticed and not forgotten. Referred to the "the stickiness factor," one of the ways to make a message "stick" is to provide ways for the viewers to be more than just an audience of the information, to also allow them to be participants. [Gladwell00:95] When posting a "Pattern of the Week," encourage viewers to give feedback. The ideal space is really one that allows spontaneous feedback, like a white board. However, just posting any pattern may not garner interest. It may need to be odd, unique, or maybe even questionable. Something that sparks conversation can serve to improve the pattern or uncover new patterns. Or, you may want to run some sort of "Jeopardy" area – post a pattern solution and ask viewers for the corresponding problem and forces.

Be creative. A small 'space' can be created at the entrance to your office -- include a comment that says something like "ask me about patterns".

Patterns will stay "in the space," and in the mind of the organization. Those who see the patterns will be inspired and might decide to write a pattern too. Those whose pattern(s) are displayed will see that they are valued by the organization and this may encourage them to write more. The board will also provide the opportunity to discuss and review the pattern.

This pattern "builds" a space where people can go to view the latest pattern information in the organization.

This technique was used at W. A board containing "Pattern of the Week" was placed in a high traffic area. It was a whiteboard with a pen nearby to encourage comments on the pattern.

One Evangelist writes, "In my organization, the disciplines are highly disparate and a new technology simply doesn't garner widespread interest. It is expected that the use of patterns could be useful across disciplines, but it is not really known outside of Architecture and Software Engineering. In Your Space is a way to capture eyes, imagination, and interest in patterns in much the way as Don Olson's HandsInView [Olson98a], *by showing a useful pattern that is not necessarily technical."*

Alistair Cockburn describes an Information Radiator that displays information in a place where passersby can see it. The passersby don't need to ask questions; the information simply hits them as they pass. The information should change over time—this makes it worthwhile to look at the display.[Cockburn2002:84]

Originators: Mary Lynn Manns and Carol Stimmel

Shepherded and workshopped at PLoP'99 (August 1999).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Innovator

When starting to introduce patterns, Ask for Help from a group of co-workers who are quick to take an interest in new ideas.

You're a new Evangelist or Dedicated Champion starting to introduce patterns into your organization.

You know the job of introducing a new idea is too much for one person to do alone. When you begin, you don't want to be standing alone.

You can't get something significant going all by yourself. Even though everyone is busy, there are always a few people who like to know about new ideas. They are among the first to attend Brown Bags and other meetings where new ideas are being introduced.

Peter Senge recommends that you, "seek to establish a community of people, even if it is only a few, who share your interest and want to work together. A small group of genuinely interested and committed colleagues will make a world of difference amid the confusion and inconsistencies that invariably arise in organization wide movements." [Senge90:xxiii]

The often cited work of Rogers tells us that on a normal curve of adopter categories, approximately 2.5% of a social system can be classified as "innovators," those who are venturesome, due to a desire for the rash, the daring, and the risky. They are able to accept a high degree of uncertainty and the occasional setback in new ideas. [Rogers95:264]

The innovator plays an important role in the diffusion process -- that of launching new ideas by bringing them in from outside of the [organization] boundaries. Thus, the innovator plays a gatekeeping role in the flow of new ideas into the organization. [Rogers95:264]

In *Crossing the Chasm*, Moore points out, "There are not very many innovators in any given market segment, but winning them over at the outset of a marketing campaign is key nonetheless, because their endorsement reassures the other players in the marketplace that the product does in fact work." [Moore99:12]

Therefore:

Identify those people who are quick to adopt new ideas. Talk to them about patterns and then enlist their help in sparking an interest for patterns in the organization.

Ask For Help by encouraging them to take the role of gatekeepers, the ones who have the interest and competency for doing an early evaluation of patterns. Help them provide feedback to the organization with Hometown Story and Brown Bag. Listen to their suggestions for appealing to the larger community.

The impact of the Innovators as opinion leaders is highest in organizations that are favorable to change. [Rogers95:274] In other organizations, their opinion leadership may be limited. Rogers notes a fundamental principle of human communication—exchange of ideas occurs most frequently between individuals who are alike. Therefore, the Innovator's interest in new ideas and venturesomeness makes them very open to other Innovators, but may make other, more practical, individuals suspicious of their claims [Rogers95:286,263]. When this is the case, their impact may be more indirect—they become the gatekeepers, the ones who have the interest to learn about new ideas and the ones everyone else deems competent to do the early evaluation and provide some evidence these ideas have the potential to be useful to others [Moore99:32].

Innovators may tolerate something half-baked, but because they are busy they want to see that it is worth their time. While they want to be first to "get the new stuff," they want the truth

without any tricks [Moore99:32]. Make sure you've done your homework before enlisting their support.

You won't feel so alone in what can be an uphill battle to spread the word. Some of the Innovators will help you gain the interest of others, but be careful not to lean on them too much and wear them out. Don't forget to encourage and reward them as much as you ask for help.

Because Innovators take the risks associated with a new idea as it is introduced into an organization, this allows later adopters to avoid these risks and better cope with the high degree of uncertainty. [Rogers95:270]

Look for Innovators in such places as Brown Bags, Study Groups, and Big Jolt presentations. Entice them with Personal Touch. Reward them with Treasure or Royal Audience or Just Say Thanks.

Innovators who are especially enthusiastic may become Evangelists in their own groups.

This pattern "builds" a group of individuals who can help get patterns going in the organization because they are willing to accept new ideas.

The patterns community at A began with Brown Bags that were attended by a small group of Innovators and Early Adopters. These people were invaluable to the Evangelist, since many of them had been with the company for a number of years and could offer suggestions about reaching others in the organization.

A small group of Innovators helped to spread the word about patterns at W.

Originator: Linda Rising

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Involve Everyone

For a new idea to be successful across an organization, give everyone the opportunity to be part of it.

You're a Dedicated Champion, trying to grow the grass roots.

When Innovators and Early Adopters become interested in patterns, it can be tempting to believe that patterns have taken root in the organization. But the support of these two groups of individuals won't give the organization-wide impact needed to sustain patterns in the long term.

Sometimes a group that's interested in patterns can become a clique. When a group focuses on a new idea it's easy to become isolated from the real needs of the organization. It then becomes easy for others who aren't part of the effort to become defensive and withdrawn, and perhaps afraid of not being able to keep up with changing technology.

Although people may be too busy to keep up with all the latest trends, they can become interested if they are given learning opportunities appropriate for their needs. Sometimes they just need to have a chance to feel a part of something new.

Therefore:

Help everyone to feel part of the patterns effort in the organization. Involve people from as many different groups as possible: management, developers, testers, support people, marketing, training.

Use Personal Touch. Hold events such as Brown Bag, Hometown Story, Big Jolt. Let everyone know of the many opportunities that can be enjoyed. Use e-Forum and In Your Space to promote these opportunities. Consider the skeptics with Adopt A Skeptic and Fear Less.

Create a community of learning. The best people thrive in this kind of environment. [Webster95:35]

In this kind of community, learning is an essential part of the organization. Learning is encouraged and there is a lot of active involvement in Study Groups, on-site courses, off-site training and degree programs. People like to learn and are more excited and happy in their work when they have opportunities to continue acquiring knowledge, especially if it is useful for their work.

Everyone, even those who don't want to take a great deal of effort, has the opportunity to become involved in growing and sustaining the patterns culture. The patterns effort will be strongest if everyone, or almost everyone, plays a part in sustaining it. Shared pattern experiences can go a long way to keep others in the organization interested.

This pattern has been successfully applied at A. Everyone in the organization, not just development, was involved in the patterns community: system test, marketing, management, and product development.

This pattern has also been used at F. Presentations have been given to the entire company. The feedback from these presentations has allowed everyone to increase their involvement in patterns.

Originator: Linda Rising

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Just Do It

A letter in the "In My Humble Opinion" column of Fast Company expressed frustration about a company that is filled with people who refuse to try anything new. The author claimed that everyone at her level knew exactly how to save the company, but no on above will let them do it. Seth Godin, Change Agent, responded with the following:

What you're looking for is an insurance policy that will protect you against retribution if your plan goes awry. What you're waiting for is someone way up the ladder to tell you that you can

launch a product or institute a cost-savings plan. You want their approval to free you from risk. That's not going to happen.

Just do it. If you wait for approval, it means that you want someone to cover your backside if you fail. The people higher up on the corporate ladder are well aware of the risk that comes with trusting you and your bellyaching associates. If you and your colleagues screw up after receiving their approval, then it will be your bosses who get into the deepest hot water, not you. [Godin2001]

To prepare yourself for spreading the word about patterns, gather first hand information on their benefits and limitations.

You are an individual contributor to a project—an Evangelist want-to-be, who is motivated to adopt patterns. You are interested in spreading the word to the bigger organization, but you don't have enough experience to effectively evangelize. However, your local group has some perhaps limited tolerance for experimentation.

You need concrete knowledge of patterns, and their usefulness, before trying to become an Evangelist and spread the word to an organization.

New ideas usually incur resistance. You don't want to make a big deal out of something in the organization too soon or people might reject it because it has no internal track record.

Since supporters of the status quo will have plenty of reasons why a new idea shouldn't be adopted, the Evangelist should be able to provide some rationale for patterns. A lack of hands-on experience is easy to attack for opponents. On the other hand, positive hands-on experience is difficult to refute. In addition, understanding the limitations of patterns helps the Evangelist avoid overselling and provide insight into approaches that will work.

Rogers dedicates a complete chapter to the responsibility that the person leading the adoption of a new idea has in understanding its potential consequences. Rather than assuming it will produce only beneficial results, they should be able to predict the advantages and disadvantages of the idea before introducing it to others. [Rogers95:405] He explains that this "trialability" and the observed results are particularly important for grabbing the interest of earlier adopters (such as [Early Adopters]) because, unlike later adopters, they have no precedent to follow and are not surrounded by peers who already talk about the innovation. [Rogers95:243]

Goldfedder writes in *The Joy of Patterns*, "...many organizations [evaluated] the use of objects through small projects to 'prove' the technology. This approach (which I've also seen applied in the last few years to patterns) works fairly well, if the team doing the prototype project is knowledgeable in the correct application of the technology." [Goldfedder01:38]

Therefore:

Gather first-hand information on their benefits and limitations by integrating them into some of your current work and by encouraging your team to do so.

For example, you might incorporate design patterns into design sessions, presentations, system documentation, and code. You may Gold Mine for patterns. You might be able to add relevant pattern references to an existing design document template. Record any benefits and pitfalls of patterns. (Ideally find a way to quantify the benefit, although this is typically very difficult.)

You may wish to Ask for Help from others. Suggest that Innovators in your team use patterns in a software development project. The group may choose to use existing patterns (e.g. Gamma+95, Buschmann+96) and/or may be willing to Gold Mine patterns identified during the project. If a Pattern Mentor is available, enlist his or her help. Try to encourage a Respected Techie to be included in this project. Ask everyone who worked with patterns to document the experiences they have and share this information with others.

The participants will increase their understanding of patterns and be able to apply them to their work; others can see this application and become enthusiastic about patterns. Any patterns that are written from the experience in this project will become effective tools to increase software development productivity in your organization. The project will also provide an opportunity for writing patterns in your organization and create a legacy for other projects.

You will gain experience in using patterns. After using them first hand you will have some lessons learned, some concrete ideas and a Hometown Story to use in a larger process of spreading the word. Nothing succeeds like success. In this industry, everyone wants to know ways of improving their work and is keenly interested in anything that will help them produce better, faster, cheaper.

You might even have created the start of a framework or process that other teams can use as a prototypical example. Once in a while an idea will catch hold and grow quickly in the organization without additional effort.

If your initial efforts are not successful, you will need to reconsider the use of patterns or try again with a deeper insight into their limitations.

You may want to keep everyone informed of the progress in these efforts with e-Forum and In Your Space. Encourage those who take part to later share their experiences with others in a Hometown Story.

*This pattern has been successfully applied in a project at **J**. The participants were novices at object-oriented technologies, but the pilot project produced good practical patterns. These patterns increased the software development productivity by the end of the project.*

*This pattern has been used at **F**. Innovators were involved in a pilot project to refine the new technology.*

*Developers on a project at **W** used the pattern format to write some portions of their project documentation. They did a Hometown Story to explain and show how much easier the documentation was to write and to read.*

*The system engineering organization at **M** was using an old interface development practice (a derivative of a hardware development technique) that did not fit well with object-oriented development approach used for software development. A Programmer Interface Guide (PIG for short—a catchy title really helps) and used to document several interfaces. Even developers outside the group immediately saw the benefit of this approach. A process was written to augment the document, support tools were developed, and the concept was adopted by the entire organization. Without a concrete example, built internally, this infusion of object-oriented programming practice would not have been adopted.*

Originators: Jeff Garland, Rieko Yamamoto and Tadahiro Uehara

Workshopped at the OOPSLA'00 "Introducing Patterns into Organizations" workshop (October 2000).
Shepherded for PLoP'01 (August 2001).

Just Enough

To ease individuals into the more difficult concepts behind patterns, provide them with brief exposure to these concepts in the beginning with resources for them to learn more when they are ready to do so.

You're an Evangelist or Dedicated Champion working to spread the word about patterns in your organization.

There are difficult, complex concepts underlying the notion of patterns that can overwhelm novices.

Concepts such as QWAN, generatively, and even pattern languages cannot be clearly understood in a short period of time. However, individuals should have a grasp on these concepts at some point if quality patterns and pattern languages are to be written in the organization. Providing a thorough explanation of such rather complicated concepts during the time you are first introducing the basics of patterns can put people on the right path to striving for better patterns and pattern languages, but can also risk confusing them and possibly turn them off from the whole idea of patterns.

As Dick Gabriel has said "Alexander could have written a one-sentence definition of a pattern or an essay, but instead he wrote a 550-page book. Because the concept is hard."

Therefore:

When introducing individuals to patterns, give only a brief description of the more difficult concepts. Provide resources for them to learn more when they are ready to do so.

When presenting the basic concepts behind patterns, include some information on more complicated concepts, such as QWAN and generativity. (If doing a presentation, include a slide or two.) Give a brief, simplistic overview, but mention that these topics are much more complicated. Justify that you are merely introducing these important concepts to make them aware but not to overwhelm them with too much detail at this early stage in their learning.

Explain to them that it is alright and probably most realistic to start small and simple, but encourage them to look at these concepts again in the future. Provide references for them to do so and let them know that you are available to help. If you have the opportunity, perhaps in another presentation or informally in a discussion, revisit these ideas that you are merely introducing at this time.

Learners will then be aware of the existence of the difficult to understand concepts in creating quality patterns, and will receive the encouragement and resources they need to look at these concepts again once they have more experience with patterns. They will not be overwhelmed with too much detail at once. Instead, they will request information when they are ready to receive it. They will build their knowledge of patterns as they are ready to do so, after they have a foundation in the basics.

This relates to the approach Alexander recommends for creating a complex building structure, "... build a building in such a way that it starts out loose and flimsy while final adaptations in

plan are made, and then gets stiffened gradually during the process of construction, so that each additional act of construction makes the structure sounder." [Alexander77:963]

This can also relate to how large, complicated software systems are built. We create the foundation for a software system around what we know, what we understand from the analysis, and then add incrementally as we understand more about what the system can and should do.

Those who are enthusiastic about spreading the word about patterns may find that this approach is too slow.

The patterns community appears to be taking this approach in their examining and attempting to understand what a pattern is and what patterns and pattern languages can do for the software industry. John Vlissides seems to agree. He raised the following question during an OOPSLA'2000 panel, "Is it possible to set the bar too high too soon for what a pattern should be?"

Use Personal Touch and Hometown Story.

In the "Introduction to Patterns" course at A, bulleted items on overheads that presented difficult topics were usually covered using this approach. A high-level discussion was initiated that could become deeper depending on questions raised by participants.

When patterns were introduced during workshops at N, the concepts of QWAN and generativity were mentioned as important but were not covered in detail. Attendees were pointed to The Timeless Way of Building if they wished to read more, and the workshop leader mentioned that she was available to answer questions for those who wished to learn more about these and other more advanced concepts.

Originator: Mary Lynn Manns

Shepherded for PLoP'01 (August 2001).

Just Say Thanks

I have a friend who was laid off from a large company where he had worked nearly 30 years. I saw him after his last day and he said that the worst thing about the experience was that no one, not even his boss, had come by to say they would miss him or that they appreciated his work. I thought about my last day when I was laid off at A. I recall a constant stream of people coming by to share a brief story about how something I had done or said had influenced their life for the better—how I had really made a difference for them and the company. I really don't remember sadness on that day but an overwhelming gladness at having had the chance to work in that company with those people and all they did was just say thanks.

To make people feel appreciated, say "thanks" in the most sincere way you can to every individual who helps you.

You are an Evangelist or a Dedicated Champion. Others are helping you introduce patterns into the organization.

People feel unappreciated when they work hard and no one notices.

It's easy to take for granted the people you see and work with on a daily basis. But people are happy and feel their contribution is appreciated with just simple acknowledgement and encouragement. Even when we don't have resources to reward supporters with anything tangible, just an expression of gratitude is worth a lot.

A recent survey of 1,400 chief financial officers shows that a simple thank you can go a long way in motivating employees. When asked what, other than monetary rewards, is the most effective means of motivating employees, thirty-eight percent choose frequent recognition of accomplishments as the best way to encourage staff members. [Accountemps]

As information technology people, we relate well to machines for which courtesy isn't important. So Al Young, a senior research engineer at Novell, cautions us that "we would do well to focus a little more attention on the people skills that will enable us to gain real benefits from the technological process." [Young97]

In Kerth's *Project Retrospectives*, he writes that everyone on a team performs some "heroic act" at one time or another during the course of any project. Because, as a culture, we seem to have lost the inclination to give someone a "high five" or say "great job," those who singly or collectively perform these feats often remain unappreciated. [Kerth01:130]

Yet, in a recent book that collects responses from many different company presidents and CEOs to the following question, "What do you know now that you wish you'd been told twenty-five years ago?" there is strong advice to occasionally stop for a few moments and think about the people to whom you owe thanks and then take the effort to express your gratitude to them. [Edler95:82]

However, in today's fast-paced business world, there often isn't enough time and resources to acknowledge the efforts of these people in large ways. There may not be enough money to buy Treasures for everyone or time in busy schedules to celebrate accomplishments with a meal.

Therefore:

Find everyone that has helped you and just say thanks in the most sincere way you can.

You can do this even if a large amount of time has passed. See if you can hunt down that person to simply say, "Thanks." [Edler95:82]

In addition to a word of thanks, spending a small amount of money can also make a big impression. A card, a morning pastry, a piece of fruit, or a small gift shows that you took an extra step and spent time thinking about the receiver and his contributions.

In *1099*, the magazine for independent professionals, Nancy Austin encourages readers to write thank you notes. She calls it "shoestring marketing" because it is a quick, responsive, cheap, and surprisingly effective way to win friends and influence people. "People remember thank-you notes (and the people who write them) because good ones are so rare." [Austin00]

The author of *Managing Your Career for Dummies*, offers other tips for showing appreciation. He suggests that, when appropriate, one should acknowledge achievements in public, tailor the thanks, spend more time listening than talking, and show people that they are valued by interacting frequently and taking the effort to get to know them. [Messmer00]

A sincere thank you is likely to make such an impression on people that it will be easier to ask for and receive their help again in the future. More importantly, it will remind you that you didn't do it all alone. It will keep you humble and be a real boon for those who've made a difference in your efforts. [Edler95:82]

Among the techniques in his book, *Project Retrospectives*, Norm Kerth describes the "offer appreciations" exercise. This gives project team members the opportunity to give recognition to everyone else, for what each person has accomplished, contributed, or knows, or simply for whom each person is. [Kerth01:130, Loeschen91]

The inspiration for this pattern came from a co-worker at W who expressed extreme frustration because her manager did not say thanks after a long, difficult project was completed. Although she didn't mind working the long hours, she was upset that her manager didn't show appreciation with even a simple thank you to the team.

So many times when "pattern mining," at A, I knew I was taking the valuable time of a Respected Techie. I don't know how many times I just dropped by someone's office to say thanks for the time and say the pattern had been posted. Almost without exception, every one of these hard-boiled, tough engineers would just beam and tell me that it was great to have someone really listen to their stories and then come by and thank them. They said, "We're all too busy to say thanks!"

Originator: Mary Lynn Manns

Local Leader

Enlist the support of first-line management. When your boss lets patterns activity become part of your job, you can truly be effective.

You're an Evangelist, trying to introduce patterns into your organization.

You need attention and resources for your new idea.

You can entice people to meetings with intriguing e-mail messages and Do Food for just so long before you get burned out. It's hard to get people involved unless they think there's a real pay-off. Management support legitimizes things in the workplace.

"We have seen no examples where significant progress has been made without [Local Leaders] and many examples where sincerely committed [Corporate Angels] alone have failed to generate any significant momentum." [Senge96]

Korson and Vijay have made a similar observation, "Site leadership is critical...experience suggests that where the technology will really make an impact across a broader spectrum, versus just a small project, is in those cases where [local] management...takes responsibility for committing the site to the technology...." [Korson96]

Therefore:

Find a first-line manager to support patterns, ideally, your immediate supervisor or boss.

Senge describes this role:"[Local Leaders] have significant business responsibility and 'bottom-line' focus. They head organizational units that are large enough to be meaningful

microcosms of the larger organization, and yet they have enough autonomy to be able to undertake meaningful change independent of the larger organization." [Senge96]

The Local Leader keeps the focus on business results and can commit limited resources to efforts that can show results.

Recent research [Green+00] shows that the degree to which adopting an innovation is voluntary increases both the developers' sense of control of their environment and suggests that the Local Leader should encourage but not mandate the use of an innovation.

Stay Close. If a Big Jolt visit is planned, offer the chance for a Royal Audience.

The Local Leader can also help you find support at a high-level and is your best hope for identifying a Corporate Angel. If the Local Leader is your manager, you can Ask for Help to become a Dedicated Champion.

The Local Leader may play the role of Coplien's Fire Walls (keep pests away) or Patron (project champion and high-level decision-maker). [Coplien95]

This pattern has been successfully applied at A. Two Local Leaders have supported the patterns activities and the work of a Dedicated Champion. The Local Leader was instrumental in opening the door to the Corporate Angel.

This pattern has also been used at F. In a small organization, the Corporate Angel could also be the Local Leader and the Dedicated Champion and may also be involved with project implementation.

The pattern effort would not have been started at W without the budget from the Local Leader to support the Dedicated Champion.

Originator: Linda Rising

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Location, Location, Location

F is located in Campinas in Brazil. A partnering organization is located in Curitiba. Meetings are held in one city or the other, which provides an off-site experience for the other group but the on-site group suffers all the disadvantages mentioned in this pattern, while the off-site group gains all the benefits. The two organizations decided to have future meetings in a third city, to allow both groups to go off site.

To avoid interruptions that disrupt the flow of an event, try to hold significant events off site.

You are planning a half- or whole-day seminar or workshop event, maybe to bring in a Big Jolt speaker and perhaps Do Food, or you are organizing a training course for your company, rather than sending people away to an open enrollment public course.

On-site events allow on-site interruptions and day-to-day distractions to disrupt the flow of the event.

It is natural to assume that events for a company will be held at the company's site, such as in a meeting room or a training room depending on the company set up. This is normally seen as a good use of resources, and presents attendees with a comfortable and familiar environment. However, holding an event that is half a day or longer inevitably leads to breaks, and people will wander off to look at their email or be grabbed by their managers or co-workers to just look at "some small detail." This disrupts the flow of your event—people always seem to end up spending longer with their email than planned, and "some small detail" is rarely a small matter to deal with-- so that people are late, distracted, or even pulled out of the event for a few hours or its duration.

Such disruption reduces the impact of the event, making it seem less special, and perhaps even an obstacle to getting back to some other task that now suddenly seems more important (to someone else, even if not the attendee in question). Even without actual disruption, there is often the feeling that "real work" is a shadow just a knock-on-the-door away.

All trainers and facilitators know that when teaching classes or leading retrospectives in the same location as the attendees' offices, it is tempting for them to get caught in email, scheduled meetings, conference calls, and other happenings around the office. Even when they miss just a small portion of the class or retrospective, it can be difficult for them to catch up.

Distance and separation allow attendees to be more relaxed. They are away from their usual workspace, and because it is no longer as convenient for coworkers to grab them, only genuinely high-priority interrupts will get through. Minor queries and problems will resolve themselves or wait, as will email. The separation can also make the event more special. A new context often makes something stand out more clearly, creating a freer environment, perhaps less constrained by the expectations back at the office. Indeed, sometimes people behave more openly because the perception is that "this isn't really work," and so step out of hierarchy or role.

However, choosing an alternative location should not also introduce inconvenience: People still have children to pick up from school, car pools to organize, squash ladders to climb (or descend), and so on. Choosing a location that is too remote or difficult to get to, rather than just being a stroll or short ride from the office, will probably not be that popular.

Therefore:

Hold significant events of half a day or longer off site but nearby.

A different location, whether a meeting room in a pub, hotel, health club, or at a nearby training company, often means that participants are more focused. They are there for the duration, and are as encapsulated from the worries of work minutiae as the sources of work minutiae are from them—out of sight out of mind. This means that you can expect more focus, with more constructive discussion about the event in the breaks and over lunch, and better personal contact and bonding. There is a sense of purpose to the event that is nurtured by removing it from the usual context of in-house meeting rooms.

Of course, some companies do not have the internal resources for separate meeting or training rooms, which means that they are either completely disrupted—the office is basically "turned off" every time there is a significant event—or the off-site solution is used by default. If the former is the case, an off-site location is still strongly preferred—the sense of a company outing makes the event more fun.

Inevitably, off-site venues will cost more than on-site ones, but such costs can be absorbed more easily when the costs to Do Food, invite in the Big Jolt, or run the training course are taken into account.

A nearby location means that the usual beginning and end of day rituals can continue uninterrupted, and that if interruption during the day is required, it is not a big effort to get back to the office.

As any real estate agent will tell you, the three most important qualities of any property are location, location, location. The same can be said of holding special events for your company, with the observation that the location should be away from the usual office environment. This is old wisdom that applies to training courses, team days, and so on.

The originator was a Big Jolt for a team from a worldwide company in the Midlands. They have instituted team days that are off site in exactly the way described in this pattern. A few years ago a company that I worked for used this pattern to run workshops for a project that I was on. The off-site location was a very nice country manor.

Norm Kerth encourages off-site locations for project retrospectives. He explains the disadvantages with on-site locations: "It may be seen by participants as cheap and therefore unimportant, the site is 'the same old place,' the [event] is easily interrupted, and participants may not prepare as well since they can duck out to look for whatever materials they need at the last minute." [Kerth2001:50]

An early version of this pattern called, Gone to Maui, was created by David DeLano.

Originator: Kevlin Henney

My Gold Nugget

Show students many different patterns to find ones that are most likely to address problems the students have struggled with. Try to find a "gold nugget" for each student.

You are teaching a patterns class.

It's important to get a patterns course started right. You have a class full of people from possibly different backgrounds. The first few minutes of a course is the critical time for catching their attention for the entire course.

To the casual observer, patterns tend to look like "nice simple ideas" or an interesting way to format knowledge. Patterns are much more, but it is often hard to get beyond this simple-looking façade.

Patterns *are* solutions to problems, and they are *proven* solutions, so they are not new. Some may be well known. On the surface, this isn't terribly exciting. Use So What's New?

Patterns tend to be fairly simple ideas. Complex patterns are often broken into smaller patterns. Even more important, patterns belong to pattern languages, and don't stand alone. So a single pattern may look simple and even mundane. But the instructor must use simple patterns when teaching; there isn't time to delve deeply into pattern languages or complex single patterns. Students are just learning the basics of patterns.

Many people's exposure to patterns is limited to the Gang-of-Four patterns [Gamma+95]. But

that view is limited, go beyond it. Show both the practical nature of patterns and the philosophical nature.

When first introduced to patterns, some people are apathetic until they see a pattern that directly relates to their own experience. Then they get excited.

In any class, the first few minutes are the most critical. In that time, you can capture the attention of the class or lose it forever. At the start, students are naturally attentive; they expect to learn something new. It is much easier to hold the attention of the class than to recapture it if you have lost it.

Therefore:

Early on, show students many different patterns, carefully selected to address problems the students might struggled with. Find a "gold nugget" for each student, and capture the imagination of as many students as possible.

Domain knowledge plays a significant role in the motivation of patterns. Bring patterns into the realm of the students' experience and expertise; only then will they catch the vision of patterns. Without that, patterns are just another buzzword.

Certain patterns address problems that nearly everyone experienced in that domain has had; make sure to include them. For example, most OO programmers have had the need for a Null Object [Woolf97]. C++ programmers will relate to patterns of localized ownership in C++ [Cargill95]. Designers of highly available systems will recognize Leaky Bucket Counters [Adams95]. If possible, evaluate the background of the students before the course begins, and select patterns accordingly. Otherwise, pick patterns that are generic, and those that don't require deep domain knowledge.

Introduce these patterns early in the course because they are designed to catch the imagination of the students. Once the light comes on for them, they will be eager to learn all about patterns. Tom Cargill started his classes with the Null Object as his introduction [Cargill97].

As you introduce the patterns, highlight the problem first, and try to relate it to the students. Then explain the solution. The intent is to pique their interest with the problem, a problem they may have had. Then when you introduce the solution, they are ready to understand and accept the associated pattern.

Show parts of a pattern language, so that the students begin to get a feel for how a pattern language is much more than the sum of the individual patterns. Some of Alexander's patterns in "A Pattern Language"[Alexander+77] work well. It was originally thought that pattern languages were too complex to be introduced early, but pattern languages are too fundamental *not* to be introduced early. Use Just Enough.

A closely related pattern is Personal Touch. This pattern differs in that in a classroom, you have several people with different or unknown backgrounds. Present several patterns, and try to hit a problem they have had in the past.

When students see pattern that solve problems they have struggled with, lights go on. They suddenly see the value of patterns, and become excited about them. If they have solved the problem and the pattern shows their solution, they get excited to see their ideas documented. If they didn't solve the problem, then the pattern shows them how to solve it.

You can't always reach every student in every class. Some will just not get excited about patterns.

The essence of this pattern is to find a way to capture the interests' of students. This can also be done in other ways. For example, a class on patterns at W begins with the instructor asking the students what they dislike about documentation they have to read and write. Once their list is composed, the instructor chooses some of the dislikes on the list and briefly explains how patterns could eliminate them.

Originator: Neil B. Harrison

Shepherded and workshopped at KoalaPLoP'01 (May 2001).
Shepherded for PLoP'01 (August 2001).

Pattern Mentor

When a project wants to get started with patterns, have someone around who understands patterns.

You're a Dedicated Champion, trying to introduce patterns into your organization.

A project is interested in patterns but has team members who are unfamiliar with patterns and is therefore unsure about their use.

People want to use patterns on their project but don't know how to begin.

If the project members are willing to introduce patterns into their project, they can study patterns to some extent. However, they might need guidance in applying patterns since they are not necessarily experts.

On the other hand, the number of experts in patterns may be relatively small compared with the number of projects. The experts do not always know about the domain on which the software is being developed, nor have much time to understand the domain.

Goldfedder writes, "Several organizations I worked with initially staffed [a project] with people who had no real understanding of object technology and thus the evaluation showed that objects would not work in environment X. I have seen similar things happen in recent years with patterns. I still recommend the proof of concept starter projects as a training experience but always recommend having an external expert involved in helping to jump start the efforts." [Goldfedder01:38]

Pattern mentors can help provide a balance between encouraging good design practices based on patterns and discouraging overly high expectations of designs based on patterns. Initially, pattern mentors can help developers recognize the patterns that they already use in their application domain and show how they could be reused in subsequent projects. [Beck+96]

Therefore:

Find an outside or intra-organization consultant or trainer to take on the role of a Pattern Mentor to provide mentoring and feedback for the project members.

The Pattern Mentor should use a hands-on approach, work side by side with the team, and let them know that he has struggled with the same problems. This will help open their minds to the new technology. [John Letourneau, workshop contribution, ChiliPLoP'2000] Use Personal Touch to help all team members understand how patterns can be useful to each of them.

The mentor doesn't have to be an expert in the domain. A single Pattern Mentor can support several projects at the same time.

The Pattern Mentor may want to suggest a Study Group to jumpstart the project.

Project members will receive help with patterns and develop confidence in their use of patterns and then be able to help others.

It is best to send the entire team to training together to prepare for the project, as described in Don Olson's pattern, TrainHardFightEasy [Olson98b]. The training could be internal and the trainer also play the mentor role, or the training could be external. In either case, the benefit lies in the shared experience of training together as a team, which not only enables the team to communicate effectively about the new topic but also serves as a team building exercise.

When you encounter resistance to the idea of using patterns on a project, use Fear Less and So What's New?

Introduce complicated topics carefully using Just Enough.

This pattern has been applied to the introduction of design patterns into a software development project at T. In this development, the Pattern Mentor was also a member of the development project.

T is also planning to develop a CASE tool that behaves as a Pattern Mentor for design patterns.

At A, patterns training was available to anyone in the company. In some training classes, the instructor worked as a consultant with teams who were taking the class together. This combination of classroom instruction and hands-on Pattern Mentor was very effective.

B reports the role of a Pattern Mentor as one of their "lessons learned." Jim Coplien says that "the use of pattern mentors in an organization can speed the acceptance of patterns and can help provide a balance between encouraging good design practices based on patterns and discouraging overly high expectations of designs based on patterns. Initially Pattern Mentors can help developers recognize the patterns that they already use in their application domain and show how they could be reused in subsequent projects. Pattern Mentors should also watch that the wrong patterns are not applied to a problem (i.e. people tend to reuse things that they know and the same temptation will apply to patterns, regardless of whether the pattern actually fits the problem)." [Anderson94]

Originator: Junichi Yamamoto

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Pattern Writing Guided Tour

Teach students the structure of a pattern by directing them in writing a pattern as a group.

You have introduced the students to the basics of patterns. Now it is time to move deeper into the structure of patterns.

One of the best ways to gain insight about patterns is to write a pattern. But it is very hard to begin writing a pattern if the student is really new to patterns.

In just about every field, experience is the best teacher. But there is always a bootstrapping problem: the students must learn something about the topic before they can begin to learn about it through experience. This creates a fine line that the instructor must walk.

Patterns have an additional wrinkle that makes teaching them difficult. There is a logical flow of information in a pattern, no matter the form. It begins with a name, then goes from context, problem, forces, to solution and resulting context. This is the logical way to read patterns and the natural way to teach them, but it is not the typical order of writing patterns. Usually you begin with a solution in mind, then derive the problem and other sections. Starting to write with the pattern name is an invitation to writer's block.

It is hard to write poetry—and patterns—on demand.

The meanings of the context and forces sections in a pattern are a bit difficult to grasp. It isn't always clear what information goes in which section. Writers iterate among these and other sections. This is hard to teach, even with examples.

Examples are helpful in almost every teaching situation.

In a typical classroom, the majority of the students will not become pattern writers. In fact, many are likely not natural writers. Both these conspire to make writing a pattern difficult. The experience is still valuable, because it helps the student understand patterns in more depth.

Therefore:

Introduce a well-defined pattern form that illustrates the sections. Teach them the form as well as the typical order of writing by leading them through the process of writing a pattern as a group.

The instructor is a "tour guide," leading students through a typical flow of generating and writing a pattern. The students learn the pattern form by seeing it in action. They see the pattern writing process. You are teaching them more than the sections of the pattern, you are showing them how patterns emerge.

A pattern I use is Body Follows Eyes. First, I describe and demonstrate various solutions in sports: Hitting with power in T-ball; running a slalom course in water skiing; golfing; skiing steep mogul slopes (Hands in View [Olson98a] -- a specialized pattern of Body Follows Eyes). Students may suggest one or two more, for example, target shooting or driving a car. Talk about what all these have in common.

Then I ask them to describe the general solution. I write suggestions on a piece of poster paper titled Solution. Tape the paper (and other sections) to the wall.

I talk about characteristics of a good solution. I then ask what problem this solves. I write their comments, and tell them about problem statements.

I ask, "What makes this a hard problem?" Discuss the forces. I also ask when the solution works, and when it doesn't, thus setting bounds, or context. Discuss characteristics of forces, as well as context. There is often iteration between the context and the forces sections.

About this time, discuss the name of the pattern. Talk about qualities of good pattern names and the suggestions for the name of the pattern.

Talk about resulting context and finish with a sketch and attributions. Now you have a rough first cut at a pattern with something in every section. You might also discuss other possible patterns in the language.

Follow this exercise with an assignment to write a pattern following the above order described above. If they continue to write patterns, they will develop their own style of writing.

This approach has been used with the Coplien pattern form. It would not work as well for teaching the Alexandrian form, where the sections are not nearly as explicit. Students should learn what goes into a pattern, such as problem, forces, and having an explicit form helps them learn. They can convert it to Alexandrian form later if they wish.

Although this pattern has been shown to be helpful, it can't help with the biggest problem that many students face—what to write about. See Hero Story.

After project retrospective sessions at D, they name the lessons learned and write one of them as a pattern.

Originator: Neil B. Harrison

Workshopped at the OOPSLA'00 "Introducing Patterns into Organizations" workshop (October 2000).
Shepherded and workshopped at KoalaPLoP'01 (May 2001).
Shepherded for PLoP'01 (August 2001).

Personal Touch

I often hear frustrated managers declare a particular person a lost cause when someone does not respond in exactly the same way another did to a particular technique. When one manager asked if I agreed that he should terminate a certain employee, I asked the manager to show me his key ring. ... I selected a key and asked, "What does this open?" "The door to my station wagon." "Will it also unlock your wife's car?" "No. Of course not." "Well it's a perfectly good key. We know it works. Why don't you just junk her car and get another one that will open with this key?" [Brown85]

To convince individuals of the value they can gain from patterns, show them how patterns can be *personally* useful and valuable to them.

You're an Evangelist or Dedicated Champion who is introducing patterns into an organization.

Changing a paradigm in an organization really means convincing the individuals in the organization.

Coplien has noted, "Change happens one individual at a time."

Rogers reports that success in securing the adoption of an innovation is positively correlated to the amount of effort in communicating with individuals and the degree in which that innovation is compatible with individuals' needs. Unsuccessful change projects were ones that ignored the needs of users [Rogers95:339-40]. Therefore, "it is the task of the change leader and the change project team to identify and link the needs (and wins) of each stakeholder to the benefits of the project." [PriceWaterhouse95:52]

"Generally individuals tend to expose themselves to those ideas that are in accord with their interests, needs, or existing attitudes. We consciously avoid messages that are in conflict with our predisposition. This tendency is called selective exposure. It has been argued that individuals will seldom expose themselves to messages about an innovation unless they first feel the need for innovation." [Mackie1988:1083]

However, it may not be apparent to everyone how he can use patterns. Information sessions and training will go a long way to arouse curiosity and interest in patterns, but you must do more to ensure that the interest is strong enough to be sustained. Those who see personal advantage in a new idea will move past curiosity and interest toward enthusiasm, creating the momentum needed to stimulate the growth of patterns throughout the organization. People take change personally, so you should help them understand the "legitimate personal wins resulting for them from the changes you envision." [PriceWaterhouse95:51]

Old habits die hard, and often not without special effort. Rogers has shown that, among other things, an individual's perception of an innovation's relative advantage, compatibility, and ease of use has an effect on the individual's willingness to adopt. [Rogers95:250] Regardless of the accuracy of the initial communication, the user's feeling of need for the innovation will be a function of his work experience. It is unlikely that all potential users will have the same appreciation for the operational problem addressed by the innovation. [Mackie+88] Since each of these is unique to each individual, a personalized approach is needed.

Therefore:

Talk with individuals about ways in which patterns can be *personally* useful and valuable to them.

Spark their interest by finding one or more patterns that will help the individual with a work-related problem. To uncover these problems, do a lot of listening, and even consider "eavesdropping" on problem discussions when appropriate. Find out what is important to the individual.

People who are aware of an innovation that promises to meet their needs will likely seek additional information. The degree of information seeking will depend on the intensity of their felt need and the ease with which information can be obtained. [Mackie1988:1085] When you see that someone is interested in further information about patterns, find a comfortable, informal environment for discussion. Use Just Enough. Encourage an interest in pattern writing with A Pattern of Their Own.

People who find something useful are more likely to become excited about it and talk about their "good fortune" with their friends and colleagues. Make a special effort to talk to Connectors and any Respected Techies. They can have the most impact on spreading the word.

Ask for Help from others who are making use of patterns, especially those who are known to and respected by the individuals you are trying to convince. To be most effective, people with

similar interests should be introduced. Rogers points out that "A fundamental principle of human communication is that the exchange of ideas occurs most frequently between individuals who are alike ... Individuals enjoy the comfort of interacting with others who are similar." [Rogers95:286-7]

While finding pattern solutions for individuals can spark their interests, some may end up relying on you too much to solve problems. This can take time away from your primary responsibilities. Create an e-Forum and use In Your Space to help.

Be prepared to accept that some people are not ready to hear what you have to say. When you find this to be the case, use Fear Less or So What's New? You might have to Ask for Help in order to Adopt a Skeptic.

This pattern "builds" a relationship in which the individuals can discuss their personal needs for patterns.

This technique was used at W. When individuals showed interest in patterns, the Dedicated Champion stopped by their office or invited them for lunch or coffee to discuss ways patterns might be helpful.

A began to spread the word about the usefulness of patterns by showing individuals how they could use the GoF patterns. They claimed, "Immediate results, it hooked them in." Innovators also used this approach. Those who were excited early on about patterns seemed to naturally work one-on-one with others on their teams to show them how patterns would be personally useful.

"This pattern is essential to keep any new technology (or process improvement) going." At A, the Dedicated Champion used this during postmortem sessions. When she heard about troubles in a project, she was quick to point out patterns (design, organizational, customer interaction, etc.) that could help.

One consultant used this pattern when introducing patterns to H. He "first figured out what their frustrations were" and then identified patterns that would help ease those frustrations.

This is what shepherds do in the pattern community. They take a personal interest in the work of the person they are shepherding.

One consultant notes that this pattern can also work on a collective level. When he visited P with organizational patterns, it was clear the patterns addressed problems whose perception was widely shared by the team, for example, Firewalls (protecting engineers from requests from marketing for a change in direction.) This pattern, therefore, may be more powerful when you appeal to the pain of a shared cultural malaise.

This pattern is written with the assumption that when first working with any new innovation, most people think about what it can do for them. This was reflected in a comment during the question and answer time near the end of the OOPSLA'00 "Sequel to the Trial of the Gang of Four" panel session. Someone at the microphone said that all he cared about was that patterns "help me do my things faster, cheaper, easier – that will be of value to me as a human."

At one site in a global Fortune 500 company, the new technology group worked hard to become a part of each development team. They attended process and development team meetings, listened for developers' pain and team dynamics, which helped formulate a strategy to use when negotiating changes later. They looked for: opportunities to add value and provide impromptu explanations of the new technology. [Radler+01]

Originator: Mary Lynn Manns

Shepherded and workshopped at PLoP'99 (August 1999).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Pieces of Clay

A manager at G found it difficult to convince another manager of the value of patterns until she mentioned that patterns could be used as a tool in the organization's knowledge management efforts. This was something the second manager could understand. He knew that knowledge management was important. That was enough to convince him that patterns could be of some value in their organization.

To convince the organization of the value it can gain from patterns, tailor your message to the needs of the organization.

You are the Dedicated Champion and have attracted some Innovators. You are using Personal Touch to show individuals how patterns can be personally useful. You also need to show how patterns can be useful to the organization.

While individuals are often intrigued about interesting ideas, organizations are not quick to adopt something that is merely interesting.

When presented in isolation, patterns can appear to be just an interesting idea. The value patterns can provide to an organization are not always apparent. The benefits do not appear overnight, but rather in the long term. Yet, when considering any new idea, management usually wants to see the potential it has for adding value to the organization.

Many ideas are more easily changed by aiming at a group than by aiming at an individual, because as Klein writes, "Ideas confine a man to certain social groups and social groups confine a man to certain ideas." [Klein1961:199]

Rogers speaks of the importance of "matching" a problem from the organization's agenda with the innovation that is being introduced. This begins by defining an organizational problem that creates a need for the innovation, and then restructuring the innovation to accommodate that need. [Rogers95:394]

The organization can be encouraged to adopt something new if it can see how it fits into and improves what the organization already does. Fichman and Kemerer explain, "... organizations are more likely to be willing and able to adopt innovations that offer clear advantages, that do not drastically interfere with existing practices, and that are easier to understand." [Fichman+93:9]

Ideas are selected not just because of their function or fit but because of their form. When it comes to new ideas—packaging matters. Even the best ideas, if not sold to people to get through their filters will have no impact. Internal marketing matters. [Weeks+01:2]

Management wants you to show them that you see their world and can adapt to their needs. They want you to be flexible and understanding, and if you can't be flexible in a particular scenario, they want to know why—and what it would cost to make things flexible. They don't

want you to tell them what they can and can't do. They want you to give them the possible scenarios and the cost of each one, then let them determine where the return on investment is. [Alexander01]

Communicating IT's value and the ROI means showing previous success and providing plainspoken technological education so as to obtain funds and support for new initiatives. You not only have to be able to show [management] that you hit your budget objectives on time, you also have to be able to show them the cost benefits of doing things one way versus doing them another way, and do that at the drop of a hat. Politics plays an important part in these communications. Walter Weir, CIO of the University of Nebraska in Lincoln, says that gaining the confidence of management and thus establishing the value of IT is 70 percent politics and only 30 percent having the right IT facts and figures at your fingertips. [Alexander01]

Pat Sciacca at Lucent advises:

> Particularly in today's market when everybody is tightening belts the only thing that will sell to upper managers are those things that can be executed fairly quickly and will lead to either faster time to market reduction of cost or a proven practice that leads quickly to higher quality.
>
> Therefore, what I now do is to frame any new idea I propose as an outcome that speaks to the manager who will be funding the effort.
>
> I am careful to listen a lot the first couple of times I meet with him or her and then to include the needs that I have heard in the proposal that I make. Then I describe the steps that we can take that will lead to solving the problems that have been articulated.

Therefore:

Mold your message about patterns to the needs of the organization.

Identify and propose ways in which patterns can improve what the organization already does. In other words, persuade them from their point of view. Avoid talking about patterns in a canned, generic way. Rather, show the specific ways patterns can help the organization go where they want to go.

To find the places where patterns can meet the needs of the organization, study the development processes and the business goals and requirements. Consider how patterns can be integrated into and improve the processes and/or can help to meet the business goals and requirements. Then, rather than presenting the general benefits of patterns (such as improved communication, documentation of best practice, etc.) present the specific advantages patterns can offer to the specific organization.

This will allow the organization to see patterns as something that improves what they do, rather than simply an interesting idea that doesn't appear to have a place in the organization.

This pattern relates to a commonly heard piece of advice: Don't sell the technology, sell the business solution.

Although this requires you to tailor the message about patterns to each organization, present a consistent face to all organizations.

Management likes to hear about what organizations are doing, especially if the organization is in the same business, a partner, or even a competitor. If you know of such organizations that are having success with patterns, it will help to include this information in your message too.

If there is an opportunity to do patterns event, use Beyond the Fire House to discover some of the ways the organization may be interested in using patterns.

Thanks to Shawn Dagley, Sales Director at D, for his comment that sparked the idea for this pattern's title. He drew an analogy between a product his company is selling and "pieces of clay" – let's mold [the product message] to where [the customer] wants to go.

Thanks to Russ Stinehour of C for the additional inspiration for this pattern. He said that his clients would be interested in patterns only if it could be shown how patterns can improve the client's existing processes. (He referred to this as the "Meat on the Bones")

At D, patterns have been introduced into the organization by including pattern writing as part of the organization's project retrospective process. The concept of patterns is introduced during the second half of a retrospective event. Participants then record the lessons they learned during the retrospective in pattern form. The goal is to build a pattern repository from the "lessons learned" during project retrospectives.

This pattern was used to spark the interest in pedagogical patterns among the faculty at N. The advertisement for the initial presentation to the faculty appealed to their desire to capture and share practices in teaching and learning with each other. The presentation highlighted this need, and then introduced patterns as a way to capture these practices.

This pattern may be implemented in a Solution Alignment Workshop. An Evangelist at D uses this workshop to determine how to tailor out of the box solutions to meet a customer's requirements. The purpose is to quickly and directly focus the customer on the available solution and their issues relevant to immediate usage of that solution.

The effort to start patterns at A was helped by, in part, by management's awareness that the parent company was using patterns.

Stephen Covey states," To make an effective presentation, you've got to empathize with the listener. You've got to get into his frame of mind. You've got to make your point simply and visually and describe the alternative he is in favor of better than he can himself." After hearing this, one Evangelist went in to make his presentation. He started by saying, "Let me see if I first understand what your objectives are and what your concerns are about this presentation and my recommendation." He took the time to do it slowly, gradually. In the middle of his presentation, demonstrating his depth of understanding and respect for their point of view, a senior manger turned to another manager, nodded, turned back to him, and said, "You've got your money."[Covey89:256, 257]

*The originator of this pattern acknowledges some failed attempts to convince people of patterns because she did **not** use this pattern.*

Originator: Mary Lynn Manns

Shepherded for PLoP'01 (August 2001).

Plant the Seeds

One consultant we know takes patterns books to every OO or UML training course he delivers in industry. They always get a response. In fact he's learned only to bring them out on the last day, or he loses the attention of the participants for the topic at hand. Most often, if consultancy follows, it's on patterns, not UML.

Carry pattern materials (seeds) to plant the idea of patterns whenever the opportunity arises.

You're an Evangelist or Dedicated Champion working to introduce patterns into your organization.

You wish to spark an interest in patterns.

Technical people like to keep up on the latest buzzword and are drawn to sources of information, especially if they can have a close look, take a handout with them or even borrow a book.

Rogers has shown that mass media communication, such as books and other publications, is very persuasive when individuals are in the early stage of a decision, known as the "knowledge" stage. [Rogers95:195]

Therefore:

Carry patterns material (seeds) to plant the idea of patterns whenever the opportunity arises.

This can be a collection of patterns, a supply of articles on related topics, a stack of books. When you give a presentation or attend a meeting, people will be drawn to these "seeds," pick them up, and ask about them. When you tell them the story behind the "seeds," they may become interested in a particular pattern or topic and take a copy of a pattern or an article on the topic, or borrow a book. They may stop by your office later or send an e-mail asking for more information. If they do, tell them a little about patterns (Just Enough) and how they may be useful to them (Personal Touch) and to the organization (Pieces of Clay).

Just having the "seeds" will attract some people. If you refer to the patterns, papers, or books during a presentation, you are likely to spark even more interest. A Study Group might grow out of this special interest.

Be prepared to address skeptics with So What's New?

We're bombarded with URLs for more information than we can absorb. Instead of a list of URLs, having the article to scan and perhaps take along or a copy of a book to consider means that people will see the information you think is important and if it seems useful, they will ask for more. If you do make URLs available, send them by e-mail to save the recipient the trouble of typing it in.

You might be scheduled to give a presentation late in the day. The seeds will attract attention and get conversation going during breaks before you talk. The seeds can also serve as a reminder to the moderator to make sure you're not forgotten!

Don't underestimate the effect this pattern can have. Although the "seeds" usually spark the interest of only a few individuals, they may be one of the Innovators, a Respected Techie, or another key individual that can help you spread the word to others.

Carrying a collection of patterns materials can be problem on a plane. Even in a car, you might have to make several trips to the parking lot or get help unloading material. If books are displayed, you run the risk that someone could borrow one and not return it.

One innovator tried to introduce new ideas by sending books or articles up and down the management chain. Only rarely was that successful. A colleague told him that other people saw his penchant for crediting sources (which he regarded as honesty and humility) as intellectual browbeating. They felt they couldn't keep up the pace of reading, and he was making them feel inadequate. He was encouraged to state ideas as simple, authentic statements, and if anyone asked, he could then provide more background. [Senge+99:347]

Patterns book were brought to a project retrospective session at D. This generated curiosity and questions about patterns among the retrospective participants. (Funny story: One of the participants picked up a PLoP-D book to look at during a break. At the end of the break, he placed the book back on the table and told the other attendees, "You should check out this book – it has a really good ending." ☺)

Whenever one consultant gives a presentation on patterns, a stack of books is always available, both for reference during the talk and for perusing at breaks and after the presentation. People like looking at books. At one talk, a participant said, "Some of my happiest times have been spent with books."

Seeds can take unusual forms. When donuts were leftover from a patterns presentation at W, the Dedicated Champion took them to the Tech Staff. An explanation of where of the donuts came from prompted the Tech Staff to ask questions about patterns (while they were eating the donuts).

Originator: Linda Rising and Mary Lynn Manns

Shepherded for PLoP'01 (August 2001).

Play-by-Play Workshop

At early patterns conferences where writers workshops were going to be heavily used, the conference chairs wondered how to show newcomers what the writers workshops were all about: a handout, a short presentation? Finally, they realized that they could simply hold a workshop with a small number of experienced participants and let the others watch. This was so successful, that it's how all PLoPs begin.

Do a writers' workshop demo. Give a running commentary as students participate.

Students have written their own patterns and are ready to workshop them.

The form (ceremony) of a writer's workshop is a strong contributor to its effectiveness. But for a neophyte, the attention required to execute the ceremony detracts from the attention to the patterns.

The writer's workshop form has become an effective means of providing authors with feedback on their patterns. It balances the need to protect the dignity of the author with the need to improve the work. This balance is achieved partly through the form of the workshop and partly through the culture of the workshop.

The form of the workshop is set up to achieve this balance. The order of positive comments and suggestions for improvement contribute to the balance. Not allowing the author to speak during the workshop contributes to the improvement of the work as well as protecting the author's dignity. This has led to a form that is rigidly enforced but not a simple one. Students have trouble remembering all the steps.

The culture of the workshop is as important as the form. It includes such norms as "gush" to save time, and the moderator's requests to "rephrase that comment as a suggestion for the author." The culture dictates politeness to the author, as the commentator may well be the next author! But culture is really hard to convey in a written description; Coplien's patterns for writers' workshops capture many of the cultural nuances of writer's workshops, but it's difficult to get everything by simply reading them.

Experience has shown that people grasp the form of the writer's workshop pretty quickly after participating in one or two workshops.

Therefore:

Execute a writer's workshop with the students participating, and an instructor giving running commentary. The instructor explains the nuances of the writer's workshop as it progresses.

If the class has two instructors, one can moderate the workshop while the other gives a running commentary. A lone instructor can moderate and comment on the workshop at the same time.

What pattern should you workshop? You can use a student pattern, but it is better to use a pattern prepared just for this purpose. Don't make the pattern *too* good. It must be easy for the students to find both positive aspects and suggestions for improvement and should be short.

If the group is larger than ten, everyone can participate in a single sample writer's workshop. It isn't critical that they all actively participate.

Give an overview of the process before doing the workshop. Jim Coplien's "A Pattern Language for Writers' Workshops" [Coplien00c] gives a description of writer's workshops as they are practiced by the software patterns community.

At the conclusion of the sample workshop, ask students for questions about the process.

There are many nuances of the writer's workshops that generally are not mentioned in formal descriptions. They usually come up in the sample writer's workshop.

This demonstrates the workshop in a way that can never be described on paper. As students participate, questions will occur to them which can be explained before they start workshopping each other's patterns.

At A, this technique was used in all two-day pattern writing classes. Usually one of the students' patterns was chosen. Invariably, one round was enough to show how workshops worked.

Originator: Neil B. Harrison

Shepherded and workshopped at KoalaPLoP'0 (May 2001).
Shepherded for PLoP'01 (August 2001).

Respected Techie

Enlist the support of senior-level technical people who are esteemed by members of the organization.

You're an Evangelist or Dedicated Champion. You may have some Innovators who support your ideas.

The technical community can be reluctant to show interest in a new idea unless it has been certified by other technical people they respect.

People are bombarded with new ideas and are too busy to keep up with the latest and greatest. Many people have others they trust to help evaluate new ideas. Usually these trusted advisors are senior-level people who are respected by everyone. When these people get behind an idea, it's the best approval you can have.

"Reputation is a fundamental aspect of social identity; it helps people know how to interpret each other's words and actions and make decisions about who to trust." [Kim00:109]

Therefore:

Enlist the support of experienced, senior-level technical gurus that are respected by both the technical people and management.

Approach the guru with humility. You're there to learn from them, not educate them about every nuance of patterns. Someone with a great deal of experience has a lot to teach, even if he doesn't know much about patterns.

Gurus usually know about certain projects. Ask them to tell you a story about the project. Have your paper and pen ready if the guru has time to talk or have your calendar handy if you need to come back later. Don't be disappointed if it takes several attempts before you can find a good time for both of you. Offer to take the guru out for coffee. On the way to the cafeteria, give your abbreviated spiel on patterns, ask for a story, and then be prepared to listen. You want to win them over by telling them about patterns (Just Enough) and giving them to the opportunity to be involved in mining patterns (A Pattern of Their Own, Ghost Writer).

The experienced person will probably look at most patterns and not see the benefit of documenting the ideas because they understand most of the solutions. You will need to answer So What's New?

If you're new to the organization, the Innovators can help you find the gurus. It helps if you have a contact, for example, "Charlie (a high-level manager or other guru) said you know a lot about this functional area. Can you tell me about it?" The connection is not to impress the guru but to show that you are impressed that the high-level manager would recognize the guru's expertise.

These veterans can make or break you. If you can convince them that patterns are a good idea, other individuals will at least hear you out. Management, especially upper management, often depends on these well-respected individuals to provide an assessment of potential solutions (Evaluation Phase). Once the Respected Techies are on your side, your battles are half over.

A Respected Techie can also help you win over a Local Leader or Corporate Angel and start you on your way to building the Early Adopters.

A member of the Mont Fleur scenario team reported: "I had had almost no time to prepare. With more time, I would have done my normal thing: reading up on the problem, forming opinions, and coming in with a recommendation. I was effective here because I arrived in ignorance and respect. One of the participants said afterward, "We couldn't believe anyone could be as ignorant as you. We were sure that you were manipulating us. But when we realized you really didn't know anything and you were really there just to support us, we decided to trust you." This was my first lesson: I was much more effective when I gave up the stance of knowing and arrogance and replaced it with one of wonder and reverence." [Senge+99:513]

After an initial presentation had been made to the Corporate Angel and his staff at A, each manager at the meeting was asked to name a Respected Techie to be part of an evaluation team to hear what patterns were all about and make recommendations back to the appropriate manager. The favorable outcome of this evaluation resulted in full management support, including that of the Corporate Angel, and an increased number of engineers who became part of the grass roots.

A Respected Techie at W got other technical people talking about patterns.

Originator: Linda Rising

Shepherded for PLoP'01 (August 2001).

Royal Audience

Arrange for management and members of the organization who have helped with the patterns effort to spend time with a special Big Jolt visitor.

You're an Evangelist or Dedicated Champion using Big Jolt. The visitor has a few spare hours during the day or during the evening before and/or after the day of the visit.

You want to get the most out of a Big Jolt visit.

It's better if the event is more than just a presentation to a large group. Famous people are usually charismatic and can give your cause a boost. If management and other influential people in the organization will take time for a short, one-on-one meeting, that can lead to more interest and support.

Therefore:

Use spare hours or lunchtime during the day or evenings before and/or after the featured presentation to make the Big Jolt visitor available for teams, individuals, or managers that have helped with the patterns effort.

People who are invited to a Royal Audience will enjoy the time spent getting to know a famous person. This can be a "reward" for those who have helped with the patterns effort, such as the Innovators and the Respected Techies and can be a "public relations" opportunity for management who have not yet bought into the idea of patterns. The Big Jolt may also be willing to help the patterns efforts in your organization by taking some one-on-one time with managers who still need to be convinced of the value in patterns. This can lead to sponsorship from a Local Leader or Corporate Angel. This can be a good way to Stay Close.

Be careful that this doesn't backfire. If anyone is upset at not being invited, that can hurt your cause. In addition, don't expect everyone to accept the invitation. It is important that you offered them the opportunity. For those who can't come, it may be enough for them to know that they were invited.

This pattern "builds" an opportunity for people to meet with a Big Jolt speaker.

At A, invitations to join Big Jolt visitors for lunch or an open discussion forum were sent out to Involve Everyone. Free "consulting time" was also announced on the e-Forum. Even when people were unable to attend, they always felt that the opportunity was open to them.

Originator: Linda Rising

Shepherded for PLoP'01 (August 2001).

Shoulder to Cry On

To avoid becoming too discouraged when the going gets tough, make opportunities to talk with others who are also interested in patterns.

You're an Evangelist or Dedicated Champion, working to introduce a new idea into your organization.

When you're struggling alone, it's easy to become discouraged.

Misery loves company but if it's the right kind of company, commiserating can lead to rejuvenation. Getting together with others who share the same or similar problems can often lead to startling solutions. The group dynamic helps everyone become more creative in tackling tough situations.

Research has shown that for certain issues, group support is very helpful. You feel like you're not the only one dealing with an issue, which by itself is useful.

Therefore:

Get together regularly with others who are also interested in patterns. A Study Group and Brown Bag are good ways to do this or just gather informally for lunch or dinner.

A community begins to form wherever people gather with a shared purposed and start talking among themselves. This community provides a confidence boost, a shoulder to cry on when you're discouraged, and a source of helpful suggestions and strategies.

This is a good way to meet Innovators and Connectors within your larger community. Ask for Help from these individuals and remember to Just Say Thanks for any support.

Even if you are enthusiastic about patterns, you will need and deserve a boost now and then, especially if you are trying to sustain the effort (Sustained Momentum). If funding permits, attend a conference where you can learn more about patterns and meet others with whom you can talk about your struggles.

In his book *The Great Good Place* [Oldenberg89], Ray Oldenberg explains the reasons for a "third place"—a local, public establishment that isn't home (the "first place") or work (the

"second place") but a friendly, neutral spot where people gather together to relax and talk and take a break from everyday life.

There are patterns users groups all over the country:
http://c2.com/cgi/wiki?PatternsGroups

The eXtreme Tuesday Club is a group of extreme programmers that meets every Tuesday at The Old Bank of England Pub on Fleet Street. http://www.xpdeveloper.com/cgi-bin/wiki.cgi?XtC

XpMidlands, a group for the exploration of XP for the Midlands in the UK.
http://groups.yahoo.com/group/xpmidlands/

Originator: Rachel Davies
rachel@connextra.com

So What's New?

The first draft of the patterns that became ADAPTOR was delivered to a specially convened design review. The patterns had been developed jointly with some of the company's developers in the previous twelve months. Cannily, DS, the Design Authority, decided to invite some developers who had not been involved in case those who had worked on it were "too close" to be objective. At the end of the presentation DS asked these people what they thought. They were not very forthcoming either way, so DS turned to one of the most experienced men and asked him directly about one particular pattern. He asked whether it was recognizable as something the division did. "Yes. I recognize it. I use it a lot. But, that's what worries me. What does it really add?" At this point a new hire, a junior, spoke up and said, "What do you mean you use it all the time? I had this exact problem last month and it took me nearly two weeks to work out a solution. Do you mean you had the answer all the time?"

When experts believe that patterns don't add value because they are so obvious, welcome their comments as validations of the patterns while showing the value of patterns to novices who don't have the same experience as the experts.

You are an Evangelist or Dedicated Champion trying to introduce patterns into your organization.

For experts, patterns add no value because they are so obvious.

Patterns are "discovered not invented," so experienced people will be using patterns without knowing it. For them best practice is standard practice, and any pattern might look like common sense at best or trivial at worst. On the other hand, there will be people for whom the pattern is genuinely new as a solution to a recurring problem.

Patterns are abstract and tend to appear simplistic, but their complexity appears in the relationships to other patterns in a domain-specific pattern language.

Genuine masters of their trade, by definition, already use the best patterns BUT best practice needs to be articulated if a culture of design is to be created.

No one knows everything. Even experts can improve. In an experiment, teams of leading heart surgeons from five New England medical centers observed one another's operating room practices and exchanged ideas about their most effective techniques. The result? A 24% drop in their overall mortality rate for coronary bypass surgery = 74 fewer deaths than predicted. These surgeons were all trained and presumably experts since they were "leading heart surgeons" but simply by observing, they were able to improve. [Davenport+98, xiv]

Therefore:

Welcome comments such as, "This is the way I do things already," as validations of a pattern, but emphasize the value of the pattern for novices who don't have the experience of experts.

Use Personal Touch to illustrate the usefulness of patterns, even to experts! Show these experts what patterns can offer them and the less experienced people who work with them.

Ask for Help from the experts in passing the word about patterns to novice colleagues who still need to learn the best practices captured in the patterns.

Point out to the experienced people that their comments serve as validation of the patterns as best practice. Celebrate comments from individuals such as the Respected Techies and target them as sources for pattern mining. Encourage them to write A Pattern of Their Own, or use Ghost Writer to help them capture their knowledge. Establish a learning relationship with these masters.

When trying to get these masters interested in patterns, keep in mind their vast amount of experience that is likely to affect their perception of patterns. Rogers cautions against the "empty vessels fallacy" in which those attempting to introduce an innovation often assume that potential adopters are blank slates who lack relevant experience with which to associate the innovation. Therefore, those introducing patterns must understand individual's prior experiences before explaining how patterns offer them an advantage. [Rogers95:240-1]

Originator: Alan O'Callaghan

Shepherded for PLoP'01 (August 2001).

Stay Close

Once you've enlisted the support of key individuals, make sure they don't forget about you.

You're an Evangelist or Dedicated Champion working to introduce patterns into an organization. You've captured the interest of key individuals throughout the organization.

Your key supporters might forget about the patterns activity.

We're all bombarded with information. New ideas are always out there—more than we can handle. It's like the old saying, "Out of sight, out of mind."

Support for patterns depends on the continuing awareness of management and other key people, but their support can lapse. Since there's always something important going on and critical decisions to be made, your message will be lost if you don't step up and call attention to your contributions.

On the other hand, you don't want to make a pest of yourself and overstay your welcome. Some are always anxious to hear more about the latest and greatest technical innovation; others less interested. Beware of hype and buzzword overload.

Rogers cautions that one cannot assume that when individuals decide to adopt an innovation, they won't reverse their decision. Rather, individuals seek reinforcement of their decision and may reverse it especially if they do not find answers to their questions. [Rogers95:20]

Senge suggests building a relationship with leaders in which you can casually but continually make them aware of progress in small ways. [Senge+99:172]

Therefore:

Stay in touch with the key individuals who are your supporters.

This means talking to management even when you don't need anything. A lot of people make the mistake of talking about projects only when they need funding. As a result, the immediate association management makes is that you're there to talk so you must need money. [Alexander01]

Also Stay Close to the Innovators, Early Adopters, Respected Techies, Local Leaders and Corporate Angel. An e-Forum can help you do this.

Keep your messages timely and interesting. Don't overwhelm them with too much that is distracting or they will ignore you. Be sensitive to the individual tolerances—especially of managers—for new information. You can loose your support if you are viewed as a pest. Present all information in a helpful manner.

If you have used Bread Upon the Waters, make your supporters aware of the publication. If a Big Jolt visitor is of special interest to your supporters, it would be helpful to offer them a Royal Audience.

It is also important to Stay Close when you are working to sustain the momentum (Sustained Momentum).

At A, a company-wide, electronic bulletin was sent out several times a week with important notices for everyone in the company. Everyone read this bulletin. Important patterns activities were always advertised and patterns publications mentioned. This kept patterns news in front of everyone, but especially management.

Originator: Linda Rising

Shepherded for PLoP'01 (August 2001).

Study Group

Form a small group of colleagues who are interested in a specific topic as a next step for newcomers to learn about patterns or a good way for those familiar with patterns to continue learning.

You have an interesting book you'd like to read or an interesting topic you'd like to know more about but there are no resources (time or budget) for a course or tutoring.

There may be little or no money for formal training.

When you read any book by yourself, what you get out of it is limited by your own perspective and experience. When you read a book in a group setting, you can take advantage of a variety of backgrounds and expertise.

More formal independent study has its own difficulties. *The learner relies on* a technical interface, videotapes or broadcast classes, and little social interaction. As a result, *the learner* goes through material in isolation with no chance for discussion or timely questions.

The lecture method has been described as "a way of getting material from the teacher's notes into the student's notes-without passing through the brain of either one." [Weinberg+99:1] This isn't the best learning environment, especially for adults, who want to extract useful information that can apply to their daily work.

As Rogers points out, early adopters of an innovation are often frustrated with its initial complexity and the inability to fully understand written documentation. The value of a group in overcoming obstacles such as these has led to the formation of many types of user groups. [Rogers95:243]

Therefore:

Form a study group of no more than eight colleagues who are interested in exploring and studying a common topic.

If resources are available in your organization, you might get your company to buy books or lunch. Meeting over lunch works well because it's usually a time when most people are free. Use Brown Bag. Eating together helps build good group interaction and bridges the work environment and the learning environment.

The intense experience of internal or external training has been compared to drinking from a fire hose, while study groups allow a more reasonable pace. Each week a chapter or topic is covered and while each participant must have prepared, a facilitator leads the group, a role each participant plays in turn. The facilitator must spend a little more time to steer the group through the material but this is a burden that can rotate through the group. The result is maximum learning with minimal time invested.

According to [Rising+98] this approach is not only fun and effective but also low cost. Even when companies buy lunch for eight participants, as well as individual copies of a book, the cost per learner for a 12-week study group is less than $200, while internal or external training costs can run from $800 to nearly $2000 per learner.

A Study Group provides adults with a genuine educational experience, focusing on topics the learners have chosen. They allow timely, convenient scheduling and a sense of ownership of the learning path. However, they are not appropriate for all learning and will not necessarily work for every learner. Study Groups should be considered as part of the total organizational learning plan for any organization.

For more information about setting up a Study Group and one company's experience, see [Rising+98]. Also see *Knowledge Hydrant: A Pattern Language for Study Groups*. [Kerievsky]

This pattern "builds" an opportunity for individuals to explore and learn about patterns.

There are patterns discussion groups all over the country that meet regularly to cover a book on patterns.
http://c2.com/cgi/wiki?PatternsGroups

Study groups were effectively used at A and allowed employees to learn about a variety of technical topics. Many of these are described in [Rising+98].

Individuals at G went through two days of patterns training and then formed a study group to continue their learning. They chose to go through the GoF patterns first.

Originator: Linda Rising

Shepherded for PLoP'01 (August 2001).

Sustained Momentum

Sometimes we think of introducing ideas as planting a seed. If this really is an appropriate metaphor, then even the most black-thumbed among us realizes that without water, sun, and a source of nourishment, even the best seeds will die. The seed and the young plant that springs forth will need attention to keep it alive and growing. Sometimes we forget how important this on-going support is—for all living things.

Take a pro-active approach to the on-going work of sustaining the interest in patterns in your organization.

You're a Dedicated Champion or a pattern supporter, trying to Involve Everyone and grow the grass roots.

There's always a danger that when some success is evident, it's easier to just rest on your laurels and stay within your comfort zone. But without pro-active efforts, any new idea can wither and die on the vine.

It takes work to maintain interest. It will not survive unassisted. Failing to reinforce the benefits of patterns runs the risk that excitement and interest will fade, especially when people get busy with other things.

Even when a new idea has been accepted and used, people require periodic confirmation to reduce the possibility that they will discontinue their use [Rogers95:20; Chew+91].

As Price Waterhouse notes, "Newton's Third Law was never so true: An object at rest tends to stay at rest until acted upon by external forces. … Stakeholders need continuous invitations to become involved, continuous reassurances that they will get their wins" [PriceWaterhouse95:60].

Therefore:

Take a pro-active approach to the on-going work of sustaining the interest in patterns in the organization.

To do this, the Dedicated Champion and all pattern supporters should:

- Ask for Help. Find Connectors and Respected Techies.

- Be aware of outside events and call them to the attention of the organization. Keep the e-Forum and In Your Space up to date and topical. Have Brown Bags and Do Food when you can.
- Start a Study Group on a patterns topic.
- Read new literature and send along important information to appropriate people. Your continuous learning is an important part of this effort. You must keep your knowledge up to date. Plant the Seeds.
- Attend conferences that allow opportunities to learn new things about patterns and to network with others interested in patterns and share successes/failures. Always look for a Shoulder to Cry On.
- Bring in a Big Jolt, and consultants.
- Encourage and provide opportunities for those who use and/or write patterns to share their experience with others. Use Hometown Story and Bread Upon the Waters.
- Lead pattern mining sessions to keep the repository growing. Use A Pattern of Their Own and Ghost Writer.
- Don't avoid skeptics. Work with them. Use Fear Less and So What's New? Ask for Help to Adopt a Skeptic.
- Always remember to Just Say Thanks.
- Stay Close to all the key individuals.
- Use Shoulder To Cry On to help keep your enthusiasm.

These activities will keep the patterns effort in the mainstream, reinforcing individual decisions to use and/or write patterns. Members of the organization will have a sense of keeping up with the latest and greatest, even when they are too busy to take advantage of everything that is offered.

Those who are not yet involved with patterns are given reminders of what others are doing and the benefits that can be gained. Management of the Dedicated Champion is also reminded that the work is useful and of interest to the organization.

This pattern has been successfully applied at A. The Dedicated Champion did all the things in the suggested list and more. Resting on your laurels means the technology will not move forward.

Originator: Linda Rising

Workshopped at the OOPSLA'96 "Introducing Patterns into the Workplace" workshop (October 1996).
Shepherded and workshopped at PLoP'97 (September 1997).
Shepherded and workshopped at EuroPLoP'00 (July 2000).
Shepherded for PLoP'01 (August 2001).

Treasure

To recognize individuals' special efforts with patterns, give them something they value.

You are a Dedicated Champion trying to introduce pattern in your organization. You have resources to obtain rewards for supporters of new ideas.

People who give special effort to promoting a new idea, such as patterns, should be recognized in a special way.

"Things" are important! You attach significance to objects of value that are given to you sometimes because of who gives it to you and the circumstances under which you received it.

Treasures go beyond identification with a group; they signify achievement or a level of commitment, like the badges that scouts receive for exhibiting learned skills or attaining predetermined goals.

Therefore:

Give supporters of patterns something they will value.

Examples include books, shirts, opportunities to publish, special recognition for their contribution. Expensive items are not necessarily Treasures. The recipient has to attach value to the item and associate it with the topic.

The Treasure should recognize special effort, such as:

- A Pattern of the Week/Month that is posted In Your Space.
- Presentation of a pattern or use of a pattern in a Hometown Story.
- A publication (Bread on the Waters).
- Participation in a pilot project [Just Do It].
- Help with Personal Touch or Adopt a Skeptic.
- Leadership in a Study Group.

To avoid any hard feelings, make sure that the reward is not too valuable and that it is given for some kind of effort. When it's not appropriate to give a Treasure, a Trinket is appreciated.

There is a fine line here between maintaining a certain amount of exclusiveness in owning a Treasure, and being too exclusive. If there are too many treasures, they may become Trinkets. Too few and they create an atmosphere of exclusion. Anyone should be able to obtain a treasure if they meet the qualifications.

This pattern is not about having an expensive incentive but one way to build a community.

Sometimes a Treasure can be given away as a prize in a drawing.

Pattern books were Treasures at A. Some people saw more value in the books than others. Some even returned books. They saw the value in the book but didn't identify strongly with the topic and wanted someone else to have the book.

At A, an Evangelist received a framed piece of paper from the patterns community. It cost nothing but their time but it meant a lot. It was peer recognition for something special—an extension of Just Say Thanks.

In I, special recognition is given (if there is a winner) to an Employee of the Month. The winner is nominated by peers and receives a coupon for a free dinner. The most enduring piece is the write-up of the nomination, which appears in the company newsletter.

At A, copies of patterns books were given as prizes to pattern writers whose patterns went through a writers' workshop and were then updated. The patterns were then posted on the internal patterns repository.

In many sales departments giving prizes to motivate people is common practice.

One company selects an "employee of the month" is regularly elected due to some strange stuff or funny mistake he/she did. This prize is taken as part of the fun in the company and not taken to upset people.
With this prize, all employees tell each other about the mistakes they make and while laughing about these mistakes, all discuss how to avoid them.

Joe Bergin has written a similar pedagogical pattern Gold Star that says students should get praise for what they do well.
`http://csis.pace.edu/%7Ebergin/PedPat1.3.html#goldstar`
His compiler course is seen as very difficult, so he publishes the Gold, Silver, and Bronze Medal winners each semester:
`http://csis.pace.edu/~bergin/compiler/CompilerAward.html`

Originator: David E. DeLano and Nicolai Josuttis

Shepherded for PLoP'01 (August 2001).

Trinket

I collect the name badges from conferences I attend and hang them on the walls of my cubicle. They remind me of the conferences I have attended, the many friends I have met at the conferences, and the things I have learned. They are not Treasures because they aren't worth anything. So I'm not afraid that someone will take them in the middle of the night.

To keep a patterns event alive in a person's memory, hand out a small token that can be identified with the topic being introduced.

You are an Evangelist or Dedicated Champion trying to get people interested in patterns.

People may be enthusiastic about a topic when it's presented, but the enthusiasm quickly wanes as they forget tomorrow what excited them today.

Our brains can only hold so much; today's information will be quickly replaced by tomorrow's information. However, something special can call attention to a particular topic. Reminders of the event can help retain information and can connect the topic with a group of people, for example, the patterns community.

Therefore:

Hand out a small token that can be identified with, and will remind people of, the topic being introduced.

Examples of trinkets are magnets, buttons, coasters, cups, pencils, or a set of bound notes, a "quick reference" printed on special paper, or copies of patterns or articles. Don't just give more URLs. Some creative insight is needed to come up with Trinkets that are useful for forming a link, to jog the memory of the event.

When people know you have purchased these Trinkets or made the copies of the special references, both your colleagues and your management will be impressed that you believe in your idea enough to support it. A copy of an article or a pattern doesn't take a lot of effort but it shows the attendees that you cared enough to spend a little of your time to make their lives easier.

The monetary value of this Trinket need not be high—it doesn't need to be a Treasure.

People who identify with the topic will keep their Trinket, often prominently displayed, as a symbol of their support of the topic. Initially, this identifies the group of people to each other, helping to create a critical mass. Over time, the Trinkets serve as a constant reminder to re-visit the topic.

However, we all know what it's like to have another toy that just clutters up our space. Don't be disappointed if some people dispose of the Trinket—not everyone will appreciate them, and those who don't "get" the topic will be less inclined to keep the them around. They will get cleaned out over time, and this is okay.

The distribution of too many Trinkets reduces their effect—don't get carried away.

Do Food and Brown Bag can draw people to a meeting. A Trinket can create a lasting memory of the meeting.

Several trinkets have been used over the life of patterns introduction at A. Writers Workshop reference cards were given to people who attended Writers Workshop classes.

Any good salesman knows the value of giving away Trinkets. Even after a sale is made, a Trinket is invaluable for maintaining a good customer relationship and often results in more sales.

Attendees at a PLoP conference usually take a tangle of yarn home with them—a piece of the web that was woven in the last game at the conference. It reminds them of the connections they have with the people in the patterns community.

One consultant has a foldable card that he gives out at his training sessions. He says that there is not only benefit for the receiver of the trinket, but also to the giver. The consultant feels that he gives a bit of himself away with the card.

A group of human factors experts introduced new techniques by conducting short usability tests at their own workstations. They gave chewing gum as a thank-you gift. [Radle+01]

At our poster session at OOPSLA 2001, we gave "Good Job!" stickers for participants' badges if they drew a picture of any pattern we had displayed on our poster. The sticker was just a Trinket but it got their attention, many who said they couldn't draw were convinced by the ridiculously small sticker and it meant they had to read every pattern, looking for one that spoke to them.

Originator: David E. DeLano

Workshopped at the OOPSLA '00 "Introducing Patterns into Organizations" workshop (October 2000).
Shepherded for PLoP'01 (August 2001).

Whisper in the General's Ear

I noticed that a particular manager was always absent from my patterns presentations. He always had a good excuse but I think he was avoiding the subject. His people never came to any of my training classes. I stopped by his office, "I know you're too busy to come to my presentations. I understand that. I'm willing to get together one-on-one, any time, and I'll answer any questions you have." He was caught. He fumbled with his calendar. "Hmm, not much time. I do have an open slot but it's at 7 a.m. next Friday. That's probably too early for you (he was hoping)." "I jotted down the date and said, "Great! Thanks for your time!" I stopped by the day before and said, "See you tomorrow!" On the date, we spent a good half hour and he seemed relived that my idea wasn't just some new OO thing but really did apply to his area. He never became an enthusiastic supporter but he never spoke up against it and his people came to my training classes.

Managers are sometimes hard to convince in a group setting, so set up a short one-on-one meeting to address any concerns.

You're an Evangelist or Dedicated Champion working to get management support for your new idea.

A high-level manager is not a supporter and shows every sign of blocking progress. He hasn't been convinced by presentations you've made.

Progress in convincing people in an organization of a new idea depends, in part, on support from the Early Adopters, but to have resources for books and training, you need management support.

Because accountability is always centralized and flows to the top of organizations, executives feel an increasing need to know what is going on, while recognizing that it is harder to get reliable information. That need for information and control drives them to develop elaborate information systems alongside the control systems and to feel increasingly alone in their position atop the hierarchy. [Schein96:15]

Managers are overwhelmed by new ideas and are reluctant to head blindly down new paths without some justification. You can't push a manager in a new direction but you can gently show the benefits of a new way of doing business that will reflect well on those who are successful with the new approach.

Many managers aren't that interested in technical details. In a group situation their attention span is much less than it is one-on-one.

Therefore:

Set up a short one-on-one meeting to address any concerns.

Be advised that Whispering in the General's Ear might look like "Back-room Dealing" to outsiders. Your best defense against this is to be open and straightforward. Remember that your goal is to build trust with the manager. This will take time. The manager who needs this kind of special attention is likely insecure or has been burned by false promises; it will take patience and great strength of character on your part to face these obstacles.

It's human nature to want to save face in front of a group. Thus, save any politicking to outside the meeting. Encourage the manager to Ask for Help to understand technical details—this might have been embarrassing for him in front of others. Politics is all about communication. Educate the manger about technology in a manner that doesn't talk down or overburden him with too many technical details. [Alexander01]

Don't worry about who will get credit for the introduction. Whether or not the boss then takes credit is a matter of personal style. Give the manager credit for the idea or for supporting the idea.

Say exactly what you know and what you can do to help. Don't exaggerate what your technology can do. Nothing can hurt you more than overselling something, [Alexander01] just play the Evangelist role and let your natural enthusiasm show.

Use Pieces of Clay. Be ready to say something about the costs and benefits of adopting this approach if you are asked for this information but don't overwhelm the manager with data. Most managers don't care if you're using an Oracle or an Access database. It's not important to them. But they want to know about the overall project plan, the approach, the milestones, and the progress. Tailor the information appropriately to the management audience. [Alexander01]

Once you have the manager's support be sure to Stay Close so he won't forget your topic.

David Pottruck, the number-two executive for Charles Schwab Corp., frequently clashed with his boss, Larry Stupski, at top-management meetings. Whatever Stupski proposed, Pottruck tended to oppose. Most of the other executives sided with Stupski, the senior of the two. Pottruck made two big mistakes: He failed to recruit other people to his cause (Corridor Politics), and he disagreed disagreeably. He was almost forced out of the company. Then he met with Stupski and proposed a solution: He would never publicly argue with him again. He might disagree, but he would do so only in private. By questioning his boss behind closed doors only, he got his ideas into the room and kept the power struggle out of it.

I had lunch with my boss today to discuss a new program we are trying to add to our department. My boss suggested that we see her boss before the committee meeting to make sure he understands exactly what we are trying to do, so that we will have his support during the committee meeting.

An Evangelist once had a boss who was hard to convince in a group meeting (darn near impossible!). He would move forward on an issue during a meeting only if he had all the information and all his doubts removed before the meeting. He rarely asked questions during the meeting. So, when an upcoming meeting would have an issue that was important, the Evangelist would meet with him before the meeting and address all his questions and concerns one-on-one.

Originator: Linda Rising

Workshop as Teacher

After writing their first patterns, have students writers' workshop each other's patterns.

The students have written their first patterns. Obviously, they still have a lot to learn about patterns.

After writing their first patterns, students need individual feedback about what they have written. Otherwise, the writing experience will have limited educational value.

The first pattern that you write is usually not very good. Pattern writing is hard, and takes not only practice, but regular correction and feedback. You want to get students off on the right foot.

But in a class setting, it is impossible for you to critique each student's work. It takes too much time. If you could take the patterns home and review them overnight, that would help, but the feedback should be personal and immediate. General feedback to the entire group can be no more than superficial.

Students need to do more than write one pattern. They need to look at other patterns. They need guidance on what to look for—what are good characteristics of patterns, and what aren't.

Students can learn from each other.

In music instruction, a student practices, but still needs regular feedback from a master. Periodic master classes, where students listen to and critique each other are also valuable.

Therefore:

Have the students writers' workshop each other's patterns.

Actively guide these writer's workshops. Teach the form of the workshop by participating in the workshop, and showing by example the kind of comments to make. This teaches the students not only about how to participate in writer's workshops, but also what to look for in patterns.

Students can workshop as many as ten papers in a day. At first, the instructor will have to lead the group by the hand, but soon, students may take turns at moderating sessions. (See Master and Apprentices [Alexander+77].)

Keep the group size to seven to ten people. Otherwise, students will not have sufficient opportunity to participate. This is true of non-student writer's workshops as well. If the class is too large, it should be split into two or more workshop groups, each with at least one instructor.

Students will learn how to conduct workshop and by examining each other's patterns, the students learn more about patterns. They see what works and what doesn't work. They do it all under the watchful eye of the instructor.

Workshops introduce students to many of the important aspects of the patterns culture. Students are not just hearing about the culture, they are living it for a short time.

Since nearly all the students will be new to writer's workshops, use Play-by-Play Workshop to introduce them to the procedure.

This was an effective technique for two-day pattern writing classes at A.

This pattern was an important part of the two-day pattern writing workshops we taught at G. It's most effective when members of the group are part of the same development team. The patterns they write can be understood by everyone and the problems they solve are readily applicable back in the "real" world after the class is over.

Originator: Neil B. Harrison

Shepherded and workshopped at KoalaPLoP'01 (May 2001).

Shepherded for PLoP'01 (August 2001).

External Pattern References

Body Follows Eyes. In almost any activity, if you want to go somewhere, simply look there.

Communal Eating. Give every institution and social group a place where people can eat together. [Alexander+77:696]

HandsInView. Skiers should always keep their hands where they can be seen. [Olson98a]

Leaky Bucket Counters. To handle transient faults, keep a counter for each failure group. Initialize the counter to a predetermined value. Decrement the counter for each error or event and increment it periodically (but never beyond its initial value). If the leak rate is faster than the fill rate, then an error condition is indicated. [Adams95:555]

Master and Apprentices. Learn something by helping someone who really knows what he is doing. [Alexander+77:413]

Mercenary Analyst. Have a professional documenter remove the burden of creating documentation from developers. [Coplien95:213]

Null Object. A surrogate for another object with the same interface, but the Null Object does nothing. [Woolf98:5]

Patron. Give the project access to a visible, high-level manager, who champions the cause of the project. [Coplien95]

Team Space. To maximize people's productive time at work, allow team members to own their space and to use if for everything from decision-making to social events. [Taylor200:627]

War Stories. Include real-life experiences in a pattern to make it come alive. [Harrison99]

Work Community. To create a feeling of community in the workplace, build small clusters of workplaces that have their own common area. [Alexander+77:222]

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Appendix D: Matching of Factors to Patterns

Each of the forty-six patterns was matched to the fifteen factors in the following way:

1) *A Pattern Of* Their Own: Help individuals play a role in the patterns effort in your organization by mentoring them through *the process of* writing a pattern of their own.
This pattern recognizes the influence of:

- providing training for individuals (P13 – training)
- teaching individuals how to create an patterns repository in the organization (P14 – patterns repository)

2) Adopt a Skeptic: Pair those who have accepted patterns with those who have not.
This pattern recognizes the influence of:

- making use of opinion leaders to convince skeptics (P11 – opinion leader)

3) Ask for Help: Since the task of introducing patterns is a big job, look for people and resources to help with your efforts.
This pattern recognizes the influence of:

- seeking help for those leading the patterns effort (none)

4) Beyond the Fire Hose: Take time near the end of a patterns event to plan what to do next with patterns in the organization.
This pattern recognizes the influence of:

- seeking help for those leading the patterns effort (none)

5) Big Jolt: To give more visibility to the patterns effort, invite a well-known person to do a presentation.
This pattern recognizes the influence of:

- using a speaker that will attract attention to provide visibility for the patterns effort in your organization (P5 – visibility)
- providing information about patterns (P13 – training)

6) Bread Upon the Waters: To gain credibility for patterns inside your organization, have your patterns work published in an external source that is recognized by your colleagues.
This pattern recognizes the influence of:

- improving the image of the person(s) that are trying to spread the message about patterns (P7 – image)

7) Brown Bag: Use the time when people normally eat lunch to provide a relaxed atmosphere for learning about patterns.
This pattern recognizes the influence of:

- making use of the time when people normally relax for lunch to provide some visibility for patterns (P5 – visibility)
- provide information about patterns (P13 – training)

8) Connector: To help spread the word about patterns, seek help from people in your organization who know and connect with many other people in the organization.
This pattern recognizes the influence of:

- building patterns from the bottom up, rather dictating from the top-down (P8 – choice to use)

9) Corporate Angel: Acquire high-level management support. It is necessary for any activity to thrive and to provide access to resources.
This pattern recognizes the influence of:

- acquiring high-level management support for patterns (P10 – champion)

10) Corridor Politics: Informally work on the decision makers before the decision point. Make sure they fully understand the problem area and the consequences of the decision.
This pattern recognizes the influence of:

- building support for the patterns effort before a decision is made that affects it (none)

11) Dedicated Champion: To increase your effectiveness in your efforts to introduce patterns into your organization, find a way to make patterns work part of your job description.
This pattern recognizes the influence of:

- giving one or more person(s) the formal support and recognition to lead the patterns effort in the organization (P12 – change agent)

12) Do Food: Turn a patterns class or meeting into a more special event by bringing food into the meeting.
This pattern recognizes the influence of:

- give more visibility to a patterns events (P5 - visibility)

13) e-Forum: Set-up an electronic bulletin board, distribution list, or listserver for those who want to hear more.
This pattern recognizes the influence of:

- making use of the place when many people spend the majority of their work day to provide some visibility for patterns (P5 – visibility)

14) Early Adopter: Ask for help from individuals who can serve as opinion leaders early in your efforts to introduce patterns.
This pattern recognizes the influence of:

- building patterns from the bottom up, rather dictating from the top-down (P8 – choice to use)
- making use of individuals who can serve as opinion leaders (P11 – opinion leader)

15) Evaluation Phase: Gather the Respected Techies and other interested individuals in the organization to have a close look at your new idea and evaluate it for their managers and other developers.
This pattern recognizes the influence of:

- using opinion leaders (P11 – opinion leader) to obtain support from management and other developers (P10 – champion)

16) Evangelist: To introduce patterns into your organization, let your passion for this approach drive you.
This pattern recognizes the influence of:

- creating the role of an informal change agent who is driven by an interest and excitement for patterns to lead the patterns effort (P12 – change agent)

17) Fear Less: Identify resistance to your new idea and turn it to your advantage.
This pattern recognizes the influence of:

- skeptics' ability to influence express and influence opinions in your organization (P11 – opinion leader)

18) Ghost Writer: Capture the knowledge of domain experts who don't write patterns by writing the patterns for them.
This pattern recognizes the influence of:

- creating a patterns repository with ghost writers who write patterns for those who will not (P14 – patterns repository)

19) Gold Mine: Combine pattern authoring with another activity that is part of your workload.
This pattern recognizes the influence of:

- creating a patterns repository with individuals who integrate this work with their other work (P14 – patterns repository)

20) Hero Story: Before starting to write a pattern, have students list their areas of expertise. These become the topic areas for patterns.
This pattern recognizes the influence of:

- teaching people about patterns (P13 – training)
- teaching people how they can add to the organization's patterns repository (P14 – patterns repository)

21) Hometown Story: Encourage and assist individuals in presenting their patterns experiences to others.
This pattern recognizes the influence of:

- giving visibility to the patterns effort in the organization (P5 – visibility)
- providing information about patterns (P13 – training)
- making use of the those who have a positive image in the organization to transfer information to others (P7 – image)
- giving those who have not yet tried patterns an opportunity to consider others trails as a substitute for their own (P4 – trialability)
- providing individuals with the results they can realize from patterns (P6 – result demonstrability)

22) In Your Space: Keep the patterns effort visible by placing reminder throughout your organization.
This pattern recognizes the influence of:

- keeping continual visibility for the patterns effort (P5 – visibility)

23) Innovator: When starting to introduce patterns, Ask for Help from a group co-workers who take an early interest in new ideas.
This pattern recognizes the influence of:

- making use of individuals who are the most innovative (P9 - innovativeness)
- building patterns from the bottom up, rather dictating from the top-down (P8 – choice to use)

24) Involve Everyone: For a new idea to be successful across an organization, give everyone the opportunity to be part of it.
This pattern recognizes the influence of:

- building patterns from the bottom up, rather dictating from the top-down (P8 – choice to use)
- spreading the visibility of patterns throughout the organization (P5 – visibility)

25) Just Do It: To prepare yourself for spreading the word about patterns, gather first hand information on their benefits and limitations.
This pattern recognizes the influence of:

- providing the opportunity to try out patterns (P4 – trialability)

- providing individuals with the results they can realize from patterns (P6 – result demonstrability)

26) Just Enough: To ease individuals into the more difficult concepts behind patterns, provide them with brief exposure to these concepts in the beginning with resources for them to learn more when they are ready to do so.
This pattern recognizes the influence of:

- providing training to individuals (P13 – training)
- showing individuals that patterns are easy to use (P3 – ease of use)

27) Just Say Thanks: To make people feel appreciated, say "thanks" in the most sincere way you can to every individual who helps you.
This pattern recognizes the influence of:

- recognizing the contributions of those who help with the patterns effort (none)

28) Local Leader: Enlist the support of first-line management. When your boss lets patterns activity become part of your job, you can truly be effective.
This pattern recognizes the influence of:

- gaining the support of management (P10 – champion)

29) My Gold Nugget: Show students many different patterns to find ones that are most likely to address problems the students have struggled with. Try to find a "gold nugget" for each student.
This pattern recognizes the influence of:

- showing individuals how patterns can be compatible in their own work (P2 – compatibility)
- providing training for individuals (P13 – training)

30) Pattern Mentor: When a project wants to get started with patterns, have someone around who understands patterns.
This pattern recognizes the influence of:

- providing training for individuals (P13 – training)

31) Pattern Writing Guided Tour: Teach students the structure of a pattern by directing them in writing a pattern as a group.
This pattern recognizes the influence of:

- providing training for individuals (P13 – training)
- teach individuals how to create an patterns repository in the organization (P14 – patterns repository)

32) Personal Touch: To convince individuals of the value they can gain from patterns, show them how patterns can be *personally* useful and valuable to them.
This pattern recognizes the influence of:

- showing individuals how patterns provide a relative advantage to them (P1 – relative advantage)
- showing individuals how patterns are compatible with their work style (P2 – compatibility)

33) Pieces of Clay: To convince the organization of the value it can gain from patterns, tailor your message to the needs of the organization.
This pattern recognizes the influence of:

- showing individuals in the organization that patterns are compatible with their needs (P2 – compatibility)

34) Plant the Seeds: Carry pattern materials (seeds) to plant the idea of patterns whenever the opportunity arises.
This pattern recognizes the influence of:

- providing visibility for patterns (P5 – visibility)

35) Play-by-Play Workshop: Do a writers' workshop demo. Give a running commentary as students participate.
This pattern recognizes the influence of:

- helping individuals learn how to write good patterns (P13 – training)
- teaching individuals how to create an patterns repository in the organization (P14 – patterns repository)

36) Respected Techie: Enlist the support of senior-level technical people who are esteemed by members of the organization.
This pattern recognizes the influence of:

- making use of opinion leaders in the organization (P11 – opinion leader)

37) Royal Audience: Arrange for management and members of the organization who have helped with the patterns effort to spend time with a special Big Jolt visitor.
This pattern recognizes the influence of:

- gaining the support of management (P10 – champion)

38) Shoulder to Cry On: To avoid becoming too discouraged when the going gets tough, make opportunities to talk with others who are also interested in patterns.
This pattern recognizes the influence of:

- the need for those leading the patterns effort to acquire help (none)

39) So What's New?: When experts believe that patterns don't add value because they are so obvious, welcome their comments as validations of a pattern while showing the value of patterns to novices who don't have the same experience as the experts.
This pattern recognizes the influence of:

- showing how patterns provide a relative advantage to individuals (P1 – relative advantage)
- using the comments of those who validate the patterns because they have used them to show the results of using the patterns (P6 – result demonstrability)

40) Stay Close: Once you've enlisted the support of individuals, make sure they don't forget about you.
This pattern recognizes the influence of:

- keeping patterns visible to individuals (P5 – visibility)

41) Study Groups: Form a small group of colleagues who are interested in a specific topic as a next step for newcomers to learn about patterns or a good way for those familiar with patterns to continue learning.
This pattern recognizes the influence of:

- providing training for patterns (P13 – training)

42) Sustain Momentum: Take a pro-active approach to the on-going work of sustaining the interest in patterns in your organization.
This pattern recognizes the influence of:

- proactively working to keep the patterns effort alive and well (none)

43) Treasure: To recognize individuals' special efforts with patterns, give them something they value.
This pattern recognizes the influence of:

- recognizing the contributions of those who help with the patterns effort (none)

44) Trinket: To help keep a patterns event alive in a person's memory, hand out a small token that can be identified with the topic being introduced.
This pattern recognizes the influence of:

- keeping patterns visible in the organization (P5 – visibility)

45) Whisper in the General's Ear: Managers are sometimes hard to convince in a group setting, so set up a short one-on-one meeting to address their concerns and to offer them the opportunity to announce the new idea as their own.
This pattern recognizes the influence of:

- gaining the support of management (P10 – champion)

46) Workshop as Teacher: After writing their first patterns, have students writers' workshop each other's patterns.
This pattern recognizes the influence of:

- teaching individuals how to create good patterns (P13 – training)
- teaching individuals how to create an patterns repository in the organization (P14 – patterns repository)

Appendix E: Patterns Used by Groups in Role Plays

Pattern	C1	C2	C3	C4	U1	U2	U3	U4	Total
1		X				X			2
2	X	X		X	X				4
3	X		X	X				X	4
4									0
5			X	X				X	3
6									0
7	X	X	X	X			X	X	6
8		X	X						2
9					X	X	X	X	4
10									0
11	X							X	2
12			X		X	X			3
13				X	X		X	X	4
14	X			X		X			3
15							X	X	2
16	X		X			X			3
17	X			X					2
18	X		X			X			3
19						X			1
20									0
21		X							1
22			X						1
23		X		X					2
24	X								1
25	X	X		X	X	X		X	6
26						X			1
27				X	X	X			3
28	X								1
29		X							1
30				X		X			2
31								X	1
32	X	X		X	X		X		5
33				X		X		X	3
34	X		X			X	X		4
35				X				X	2
36	X	X			X				3
37			X						1
38						X		X	2
39			X						1
40	X		X	X			X		4
41			X		X	X		X	4
42	X			X		X		X	4
43									0
44									0
45						X			1
46									0

C = conference participants
U = university participants

Appendix F: Memo Used in University Role Play

Memo

To: Patterns Program Proposal Teams

From: Gary Berosik

Date: 5/23/2002

Subject: Patterns Program Proposal Presentations

[Somewhat tongue-in-cheek....]
This memo is to inform you that you are scheduled to present your recently suggested proposal for a software "patterns program" within our organization. Since our company has significant, growing software products and assets that generate at least half of our three million-dollar annual revenue, our recent, brief discussion on this subject caught my interest. However, I came away from our discussion much confused about the "patterns" concepts you mentioned.
Because of this, please be prepared to have your team present and explain your proposal in a more formal fashion to me and my management team (the remainder of the class) during the final class of the OO Patterns and Architectures course.
Because of limited time, and the fact that several teams will be giving similar proposals on the same day (your team, it turns out, is not the only one with "good ideas"!), please adhere to the following guidelines:

- Limit your presentation to 20 minutes, allowing for up to 10 additional minutes of time for questions and answers.
- Explain your program, its motivation, scope, and anticipated benefits, costs and risks for our organization. In short, you should explain the concepts of your program, and why the company should consider its implementation in the coming fiscal year(s).
- You need NOT develop a full ROI analysis at this time. However, your proposal should make a convincing business case for the suggested program. Because of this, some rough estimates of costs, benefits and risks should be included. If, after your presentation, the management team determines that the company should proceed with your proposal, you will be asked to add complete details to your business case before moving forward.

As you know, I am personally inclined to pursue such a program, if it is as beneficial as you suggested in our previous discussions. However, this is not the case with the remainder of the management team. In addition, I (and the remainder of the management team) need to understand all aspects of your proposal fully before the project can be formally endorsed and funded.
Regardless of the outcome, I would like to express my appreciation of your proactive and creative support for our company.
Sincerely,

Gary Berosik

Appendix G: Guidelines

General Guidelines

GG1: *An organization's efforts to show the relative advantages to individuals in their work and demonstrate the results in patterns is likely to have an influence on increasing the general use of patterns.*

GG2: *An organization's efforts to make innovative individuals aware of patterns, show the relative advantages, demonstrate the results and offer opportunities for individuals to use patterns on a trial basis are likely to have an influence on increasing the number of individuals who use patterns only in their own work. In addition, an organization that does not have an installed process for the use of patterns, but requires patterns to be used is likely to have an influence on increasing the number of individuals who use patterns only in their own work.*

GG3: *An organization's efforts to make patterns visible in the organization, to show how patterns are compatible with work style, and to provide an opinion leader for patterns are likely to have an influence on increasing the number of individuals who use patterns in design-sessions or other team-oriented tasks.*

GG4: *An organization's efforts to establish a patterns repository and to demonstrate the results and the relative advantages of patterns is likely to have an influence on increasing the number of individuals who write patterns for their organization.*

GG5: *As organization's efforts to demonstrate the results in using patterns and the relative advantages of using them is likely to have the largest influence of the fifteen proposed factors on increasing pattern use.*

GG6: *Individuals that use patterns are more likely to use them in their own work than they are to write patterns or use them with others.*

GG7: *Any of the following is likely to play a part in the organization's ability to increase the perception that patterns offer a relative advantage: the perception that patterns are easy to use, the perception that patterns are compatible with work style, the perception that the results in using patterns can be demonstrated.*

GG8: *Any of the following is likely to play a part in the organization's ability to increase the perception that the results of patterns can be demonstrated: the perception that patterns offer a relative advantage for individuals and the perception that patterns are compatible with work style.*

GG9: *Any of the following is likely to play a part in the organization's ability to increase the perception that patterns are compatible with work style: the perception that patterns offer a relative advantage to individuals, the perception that patterns are easy to use, the perception that the results in using patterns can be demonstrated.*

GG10: *Any of the following is likely to play a part in the organization's ability to increase the visibility for patterns: a champion, a change agent, an opinion leader for patterns, a patterns repository, an installed process for patterns. However, the visibility of these factors may also play a part in increasing the perception that the use of patterns not voluntary in the organization.*

GG11: *Any of the following is likely to play a part in the organization's ability to establish an installed process for patterns: a patterns repository, a champion for patterns, an opinion leader for patterns, visibility for patterns in the organization.*

GG12: *Any of the following is likely to play a role in the organization's ability to build a patterns repository: mandated pattern use, an installed process for patterns, a change agent, an opinion leader, a champion.*

GG13: *Individuals that consider themselves innovative tend to understand the results of using patterns, to come from organizations with an installed process for patterns and to try out patterns before using them in their own work.*

GG14: *Any of the following is likely to play a part in the organization's ability to encourage individuals to try out patterns: patterns training and encouraging innovative individuals.*

GG15: *Any of the following is likely to play a part in the organization's ability to provide an opinion leader for patterns: the visibility of pattern in the organization and the existence of a champion.*

GG16: *Individuals introducing patterns into organizations appear to emphasize the following: provide patterns training, make patterns visible in the organization, encourage opinion leader(s), show how patterns are compatible with work style, and provide opportunities for individuals to try out patterns before using them in their own work.*

GG17: *Individuals introducing patterns into organizations do not appear to emphasize the following: install a process for using patterns, show that patterns are easy to use, accentuate the image of those who use patterns, and make innovative individuals aware of patterns.*

GG18: *Acquiring help could have an influence on the effectiveness of the person(s) introducing patterns.*

GG19: *Maintaining a proactive, on-going effort for patterns could have an influence on the use of patterns.*

Operational Guidelines

OG1: *An organization should demonstrate the relative advantages of patterns to individuals.*

OG2: *An organization should offer opportunities for individuals to try out patterns before using them in their own work.*

OG3: *An organization should show that patterns are useful to innovators.*

OG4: *An organization should allow time for innovative individuals to learn about patterns.*

OG5: *Management in an organization should find an appropriate level of support for patterns that will help the effort rather than give the impression the use of patterns is being mandated.*

OG6: *An organization should overcome the misperception that there is no need for patterns in software engineering by showing individuals and teams how patterns can apply patterns to the problems they are trying to solve.*

OG7: *An organization should find effective ways to make patterns visible throughout the organization without creating the impression of pressure or hyperactive marketing.*

OG8: *An organization should identify many different types of opinion leaders to help spread the word to others about patterns.*

OG9: *An organization can use a patterns repository to stimulate pattern writing and thus sustain the general patterns adoption process.*

OG10: *An organization should help individuals understand pattern descriptions.*

OG11: *An organization should help individuals to see the costs as well as the benefits of using specific patterns and to understand that a pattern is not used as an "out of the box" solution.*

OG12: *An organization should create ways to help individuals locate the patterns they need for the problems they are trying to solve.*

OG13: *An organization should teach patterns in the context of where they are relevant to the work individuals are doing.*

OG14: *An organization should make managers aware of patterns.*

OG15: *An organization should address the concerns of management that patterns have too much risk and have unknown long term benefits.*

OG16: *An organization should encourage managers to support opinion leaders and others who building the grass roots effort for patterns.*

OG17: *An organization should consider establishing a change agent to provide a consistent force in creating and keeping interest in patterns.*