5-2008

Guidelines for Evaluating Patterns in the IS Domain

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GUIDELINES FOR EVALUATING PATTERNS IN THE IS DOMAIN

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ABSTRACT

Patterns were originally developed in the field of architecture as a mechanism for communicating good solutions to recurring classes of problems. Since then researchers have created patterns to provide guidance and solutions associated with virtual project management, software development and engineering, human computer interaction, and design science research. However, there has been limited emphasis on developing guidelines for evaluating the validity of patterns. In this paper, we propose an evaluation framework for patterns that draws upon the literature associated with patterns, philosophy y of science and research methods. The evaluation framework can be used to validate patterns in a more consistent and rigorous manner.

KEYWORDS
Patterns, evaluation, validity, research methods, philosophy of science.

INTRODUCTION

"When we build something good, when we build a system that works well, we must ask what is it about this that makes it good? Why is it good? What are its essential qualities that will allow us to build something completely different but which is good in the same way." (Alexander, 1965)

Patterns provide a useful way to describe solutions to recurring problems (Alexander 1999; Alexander et al. 1977). They are in some sense analogous to recurring themes, familiar processes, rules of thumb, or standard procedures (Zigurs and Khazanchi forthcoming). Originally created for architecture by Alexander (1964), patterns have been adopted by the IS domain in software engineering (Gamma et al. 1995) and virtual project management (Khazanchi and Zigurs 2006). Developing patterns in a given domain offers something interesting and unique to practitioners and researchers. For practitioners, patterns offer practical and applied knowledge by providing high-level solutions to problems that can be converted into specific best practice implementations (Zigurs and Khazanchi forthcoming). For researchers, patterns can provide a method to synthesize and capture knowledge in a given domain as well as highlight areas for future research. In either case, the pattern needs to be evaluated before it is accepted and used, yet from our reading of the literature that publishes and propagates patterns this critical step is often overlooked.

Therefore the purpose of this paper is to propose a formal approach to evaluating patterns. We propose that patterns can be evaluated using principles adopted from research methodology and philosophy of science.

The rest of the paper is organized as follows. First, we highlight some of the history and literature associated with patterns. Then we propose guidelines for evaluating patterns in the IS domain by synthesizing prior literature on research methods. We offer these guidelines not as the prescriptions for evaluating patterns, but as the starting point for a discussion for better pattern evaluation methods. Finally, we discuss some implications of the framework for practitioners and researchers.

BACKGROUND

> *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 ever doing it the same way twice.* (Alexander et al. 1977, p. x)

The concept of patterns was developed for architecture; however, it was adopted by people within the computing disciplines to support various aspects of the software development process (Beck and Cunningham 1987; Gamma et al. 1995). The idea of creating patterns was embraced quickly in the computer science domain because of its ability to document and replicate successful objects (Price 1999). For example, within the field of human-computer interaction, patterns have been developed to format content, guide users through actions, and present an aesthetic interface (Tidwell 2005). This relationship between patterns and software development lent itself to extensions and applications of patterns to other domains. In virtual project management, patterns were created to address challenges like communication, control and coordination (Khazanchi and Zigurs 2005). Patterns have also been developed for conducting design science research to aid researchers in understanding approaches for finding relevant problems to address, stimulating creativity, and publishing research (Vaishnavi and Kuechler 2007). These examples of developing patterns for different uses show that the IS field has been quite good at creating pattern artifacts.

GUIDELINES FOR EVALUATING PATTERNS

When patterns were migrated from the architecture domain into the IS domain, some preliminary criteria defining the components that must be included to adequately constitute a pattern were established. Those components included: a meaningful name, a problem statement, the context for the problem, the applicable forces and constraints, a solution, one or more examples, the context after the pattern has been applied (which may include side effects), the rationale, a listing of related patterns, and known uses of the pattern (Appleton 2000). Alexander (1979, p. 28) also argued that patterns should have "quality without a name" (i.e., QWAN) in which there is an aesthetic beauty, durability, order, and emotional resonance. He describes this concept as:

> *This oneness, or the lack of it, is the fundamental quality for anything. Whether it is in a poem, or a man, or a building full of people, or in a forest, or a city, everything that matters stems from it. It embodies everything. Yet still this quality cannot be named.*

While QWAN is difficult to describe, we believe there are certain aspects inherent to QWAN that can potentially be evaluated to tell us whether a pattern is good or not. As such, we can propose concepts that can guide researchers in evaluating patterns. Our goal is to achieve QWAN, and the following criteria represent one mechanism to achieve this goal.

Plausibility

The plausibility criteria that we propose is akin to face validity wherein one explores whether the pattern is coherent and sensible within the framework of established domain knowledge (Sproull 1995). Plausibility is initially infused into a pattern through the fact that patterns are higher-order abstractions of "good" solutions to problems embedded in real experiences in a domain. The test for plausibility is an intellectual inspection of the pattern within the context of the domain. Since patterns are descriptions of good solutions to classes of problems that are captured by observation, experience, and through positive and negative examples (Alexander 1979; Khazanchi and Zigurs 2007), they possess a degree of believability that goes beyond mere supposition or conjecture (Khazanchi, 1996). Thus, the better the job of capturing the essence of a solution in a pattern, the more likely we would expect the pattern to produce the desired results (Khazanchi 1996).

Feasibility

By feasible, we suggest that the pattern is viable or that one can implement and operationalize the pattern as it is described; in other words, can I take what a pattern describes and apply it to a problem (Khazanchi 1996). A pattern is of little value if it is not usable. The solution prescribed may be impractical for the practitioner to perform because of policies, regulations, ethical constraints, physical constraints, or some other reason. Referring back to Alexander et al.'s (1977) original pattern language, he suggested that a kitchen in a home needs more light than other rooms. In the "Sunny Counter" pattern, he states that the kitchen counter should be on the south and southeast side of the kitchen with large windows for light. However, a home may be oriented in such a way that it is not practical or possible to install southern or southeasternly windows. It could be that a given pattern is impractical and infeasible in all situations or the pattern could have boundary conditions in which it is sometimes feasible and sometimes not. This should be identified and evaluated for each pattern.

Effectiveness

Our next criterion, that the pattern is *effective*, is in some respects a test of semantics that seeks to assess if the pattern is completely described in language that is understandable (Khazanchi 1996). The goal is to not only address a specific problem, but to also get to the root causes of the problem so that the pattern can apply to other similar situations. Passing this criterion requires the pattern is stated in terms that are correct, comprehensive, complete, internally consistent, and concise. To be effective, the pattern must richly reflect the solution in the reality in which it was developed. Patterns become richer by examining their boundary conditions, and the better those boundary conditions are abstracted, the easier it is to apply the pattern to other similar situations. At the same time, the pattern cannot be so contextually bound that it is not generalizable. In a sense, this criterion seeks to asses if the pattern captures the goodness of the solution in an expressive, yet parsimonious, fashion. The net effect of passing this criterion is that the pattern is transferable; another practitioner can understand and effectively use the pattern.

Pragmatic

Another important criterion for evaluating patterns is that they be *pragmatic* (Khazanchi 1996): is the pattern consistent with the "web" of patterns for the problem class? Because patterns describe a set of solutions for a domain, and the domain encompasses a specific sphere of practice, there should be "connectedness" between the patterns in a problem class. When patterns predict opposite effects for similar situations, they are at odds with each other, and there is a "disconnectedness to" the patterns.

Similarly, if the pattern is too tightly defined it too risks losing its connections with existing patterns in the domain. Passing this criterion helps ensure that the pattern is coherent with extant domain knowledge.

Empirical

Patterns should also have an *empirical* nature. Khazanchi (1996) described how the ultimate test of a concept is having empirical data to corroborate it, and this notion applies to patterns too. Meeting this criterion requires that the developer gather evidence that confirms that the pattern consistently produces the desired effect. In gathering that data the developer should strive to use multi-trait, multi-method (MTMM) techniques (Straub et al. 2004), which is similar to the inter-subjective/inter-methodological criteria advanced by Khazanchi (1996). To fulfill this criterion, the developer should use different measurement techniques at different points in the development and use of the pattern. For example, during the early development phases, the pattern could be conceptually evaluated by recognized domain experts – a qualitative assessment. Then, when the pattern is put into use, precise quantitative measures appropriate for the application domain could be taken. Using different methods at different points in the pattern's life cycle in such a fashion supports the MTMM empirical evaluation of the pattern.

Predictive

Patterns should also be *predictive (Khazanchi 1996).* This criterion is analogous to reliability in that the pattern is expected to yield consistent results. That said, a pattern will not yield exactly the same magnitude of result every time is it applied because the context of application will always be somewhat different, and those contextual factors may dampen or amplify the magnitude. But while the magnitude of the effect will vary with the circumstances, the pattern should produce the same general effect each time it is applied. For instance, if the pattern was designed to improve communication within a virtual team, it should improve communication every time despite the fact that the amount of improvement will vary depending on the team's circumstances. Moreover, patterns are not variance models where more of a pattern necessarily translates into more of a result.

CONCLUSIONS

Patterns are created inductively by observing recurring problems and abstracting general principles or solutions from these experiences. Once we have these solutions in the form of patterns, it only makes sense to close the logic loop by performing deduction. The criteria expressed in this work aid the researcher in accomplishing this goal. These six criteria are not necessarily exhaustive, but they provide a starting point for the evaluation of patterns. We hope they initiate a dialogue in the IS pattern community about the need to more formally evaluate patterns that we develop and propose.

In this paper we've described how patterns have been used in a variety of domains to develop solutions to recurring problems. Previous authors have posited that a crucial component of developing and using patterns is to validate those artifacts. While some standards exist to define what can constitute a pattern, few criteria exist for assessing pattern validity.

In this spirit, we have presented an initial set of criteria derived from scientific method and principles that we believe could be useful in validating patterns. Having, and using, such criteria gives researchers a method for a more formulaic, comprehensive evaluation of the validity and utility of patterns. This type of evaluation, applied in a more consistent and rigorous manner, can increase the level of confidence in a patterns. Furthermore, this type of validation may then improve the use of patterns in practice and help to avoid re-solving recurring problems that occur in practice.

FUTURE RESEARCH

Our intent is to start a much needed dialogue within the IS pattern community on how to actually evaluate patterns. Our next step will be to apply these criteria to existing patterns to see how they hold up in a field application. That study will provide valuable empirical evidence on the applicability and usability of our proposed criteria and may also allow us to convert these guidelines into patterns themselves so that we could then "eat our own dog food" by evaluating our evaluation patterns using our proposed approach. Throughout this work, our goal is to maintain a dialogue in the field to identify better and more inventive methods to evaluate patterns. Along those lines, another future initiative would be to publish our evaluation patterns and then coordinate another study wherein additional researchers apply the evaluation patterns to patterns of their choosing to assess their effectiveness.

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