Chapter 7
A Viewpoint-Based Approach for Understanding the Morphogenesis of Patterns

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ABSTRACT
An understanding of knowledge artifacts such as patterns is a necessary prerequisite for any subsequent action. In this article, as an initial step for formulating a theoretical basis for patterns, a conceptual model of primitive viewpoints is proposed and, by exploring one of the viewpoints, a conceptual model for stakeholders of a pattern is presented. This is followed by the description of a conceptual model of a process, namely P3, for the production of patterns. The workflows of P3 highlight, as appropriate, the interface of patterns to humans and/or machines. The implications of the Semantic Web and the Social Web towards P3 are briefly discussed.

INTRODUCTION
The reliance on the knowledge acquired from past experience can be crucial for solving problems that occur in any development. A pattern is one such kind of conceptually reusable knowledge based on ‘best practice’ that has been found to be useful in different ways. In particular, from their foundations in urban planning and architecture in the 1970s (Alexander, Ishikawa, & Silverstein, 1977), followed by object-oriented software design in the 1980s and the 1990s (Gamma et al., 1995), patterns have been applied in various domains of interest (Rising, 2000). These domains include distributed software architectures, electronic commerce systems, mobile interaction design, security engineering, and use case modeling, to name a few. For novices, patterns have served as means of guidance; for experts, they have served as means of reference.

The purpose of this article is establishing a theoretical basis for patterns for the purpose of contributing to and improving upon the current understanding of patterns. Indeed, such an understanding is necessary for developing means to describe patterns, for managing patterns, and for making appropriate use of patterns. To do that,
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this article identifies basic concerns pertaining to patterns and, by means of conceptual modeling, studies each concern separately. It proposes a conceptual model for viewing a pattern from certain relevant, different but related, perspectives and, by examining one of the viewpoints, proposes a conceptual model for stakeholders of a pattern. These models then form a requisite input to a conceptual model for producing patterns.

The rest of the article is organized as follows. First, the background necessary for subsequent discussion is outlined, and related work is presented. Then, conceptual models for viewpoints of a pattern, for stakeholders of patterns, and for a pattern production process are proposed. Next, challenges and directions for future research are outlined. Finally, concluding remarks are given.

BACKGROUND AND RELATED WORK

This section presents the necessary terminology specific to patterns and a brief analysis of related work.

Basic Concepts of the Pattern Domain

The pattern domain is the universe of discourse for all things related to patterns. The pattern body of knowledge (PBOK) is the set of fundamental concepts, activities, and results that characterize the pattern domain. The pattern concept space or simply pattern space is the collection of basic concepts in the PBOK.

In the last two decades or so, the PBOK has grown and the scope of concepts in it has broadened. There is currently no single source, reference model, or standard for the PBOK. Therefore, for the terminology related to the pattern space, this section relies on selected publications (Appleton, 1997; Meszaros & Doble, 1998; Buschmann, Henney, & Schmidt, 2007) that can be considered as authoritative.

There are a number of members in the pattern space that are of interest. A pattern is an empirically proven solution to a recurring problem that occurs in a particular context. The advantages and disadvantages of patterns have been highlighted (Wesson & Cowley, 2003), a detailed discussion of which is beyond the scope of this article.

A pattern description is a set of indicative statements that specify a pattern. A pattern description, if structured, typically consists of a number of elements. The name element of a pattern is an identifier that often reflects the nature of the solution; the author element gives the identity of the pattern author(s); the context element provides the situation or pre-conditions within which the problem occurs; the forces element provides the constraints that are resolved to arrive at a solution; the solution element provides an abstract, general, and reusable solution to the problem and is shown to work in practice via an examples element; the resulting context element provides the consequences or post-conditions of applying the solution; and the related patterns element outlines any other pattern(s) to which a pattern is related to in some way. At times, the element labels may vary across community, and other (optional) elements, such as those related to metadata, may be included to enrich the description. A pattern form is a prescription of a specific set of pattern elements that are expected to appear in a pattern description. There are a number of pattern forms available (Appleton, 1997; Coplien, 1996), and they are often named after their originators. It is this explicit structure that makes patterns more than a mere collection of problem-solution pairs, and makes them unique and more practical in their applicability among other kinds of experiential knowledge such as principles, guidelines, and heuristics.

A pattern is usually referred to by its name. In this article, the name of a pattern is presented in uppercase in order to distinguish it from the surrounding text.

There are other members in the pattern space that are of interest. An anti-pattern suggests a