Chapter XII

Mapping UML Techniques to Design Activities

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INTRODUCTION

Over the years, the information system design process (Gero and Kazakov, 1996; Goldschmidt, 1997; Guindon, 1990; Jeffries et al., 1981; Parnas and Clements, 1986) has been investigated using a variety of perspectives. Researchers have examined cognitive aspects of design (Goldschmidt, 1997; Guindon, 1990; Guindon, Krasner, and Curtis, 1986; Rowe, 1987; Sen, 1997), design strategies (Adelson and Soloway, 1988; Batra and Antony, 1994; Guimaraes, 1985; Jeffries et al., 1981), and reuse tasks (Sen, 1997). A variety of modeling techniques, such as the entity-relationship model (Chen, 1976), data flow diagrams (Gane and Sarson, 1979), and object-oriented models (Booch, 1994) have also been developed to document the artifacts generated during the design process. Increasingly, the object-oriented design paradigm and related modeling techniques have been the choice of system designers. It is reasonable to expect that these modeling techniques (proposed to document the design *products*) will assist or at least not hinder the designer behaviors (that is, the *process* of IS artifact design). The expectation has, however, not been subjected to investigation.

In this contribution, we focus on behaviors that designers exhibit during actual design sessions and investigate how these behaviors are supported by the *de facto* standard for object-oriented modeling, the Unified Modeling Language (UML) (Booch, Jacobson, and Rumbaugh, 1999). We focus on three core UML techniques: use cases, class, and sequence diagrams. To observe behaviors employed

and modeling techniques used by IS designers during actual design sessions, we collect and analyze verbal protocols. Mapping the two provides us with preliminary conclusions about the convergence between the modeling techniques and design activities. The objective of this contribution is, thus, to answer the following questions:

- *How do designers use the core UML modeling techniques during actual design sessions?*
- *How does their usage of modeling techniques map to different designer behaviors?*

The paper is organized in six sections. In the next section, we review the three core UML techniques and discuss prior research on designer behaviors. Following this, we develop an expected mapping of design behaviors to these three UML modeling techniques, informed by prior research on object-oriented design. The next section outlines the research methodology followed. The data collected is summarized and analyzed in the next section, which provides several interesting observations and possible interpretations. We conclude with a discussion of implications for research and practice and an outline for future work.

PRIOR WORK

In this section, we provide an overview of core UML modeling techniques: use cases, class diagrams and interaction diagrams and discuss prior research on designer behaviors and processes.

Object-oriented Design and the UML

Object-oriented design (Booch, 1994) brings the idea of multiple representations to IS design (Booch et al., 1999, Firesmith, Henderson-Sellers, Graham, and Page-Jones, 1998). Unlike other disciplines (e.g. architecture), where multiple representations (e.g. blueprints, vertical sections or scale models) have been available for representing the artifact to be constructed, IS design has been restricted in the past to using single, simple representations (e.g. entity-relationship diagram or data flow diagram) focusing on different isolated aspects. The multiple perspectives provided by the object-oriented design paradigm and the associated modeling techniques have, for the first time, provided IS designers a tool-suite necessary to adequately and properly capture and represent the inherent complexity of the underlying IS artifact.

A rich array of modeling methods and techniques is available today to support the representation of object-oriented information systems. The most comprehensive, Unified Modeling Language (UML) by Rational (Booch et al., 1999), consists of a suite of more than seven modeling techniques that support different design perspectives. The meta-model of UML shows how these perspectives complement one another to ensure internal, logical consistency. Of these, three are considered core to object-oriented modeling (D'Souza and Wills, 1999) - use cases, class diagrams and interaction diagrams (a fourth, state transition diagrams are necessary for real-time systems).

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