

# Chapter XII

## Design Science: A Case Study in Information Systems Re-Engineering

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### ABSTRACT

*Recently, many organisations have become aware of the limitations of their legacy systems to adapt to new technical requirements. Trends towards e-commerce applications, platform independence, reusability of prebuilt components, capacity for reconfiguration, and higher reliability have contributed to the need to update current systems. Consequently, legacy systems need to be re-engineered into new component-based systems. This chapter shows the use of the design science approach in information systems re-engineering research. In this study, design science and the Bunge-Wand-Weber (BWW) model are used as the main research frameworks to build and evaluate conceptual models generated by the component-based and traditional approaches in re-engineering a legacy system into a component-based information system. The objective of this evaluation is to verify that the re-engineered component-based model is capable of representing the same business requirements as the legacy system.*

### INTRODUCTION

The objective of this chapter is to show how the design science research approach can be used for applied information systems (IS) research.

Design science in information systems is defined by March and Smith (1995) as an attempt to create things that serve human purposes, as opposed to natural and social sciences, which try to understand reality.

The IS research problem chosen to demonstrate the use of design science is the re-engineering of a legacy system in a financial institution. The vast majority of legacy information systems were implemented using the traditional paradigm. The traditional paradigm consists of modeling techniques used by system analysts including system flow charts and data flow diagrams (DFD) to capture, during the analysis phase, the activities within a system. However, with recent developments, particularly trends towards e-commerce applications, platform independence, reusability of prebuilt components, capacity for reconfiguration, and higher reliability, many organizations are realizing they need to re-engineer their systems. Given the limitations of legacy systems to adapt to these new technical requirements, new component-based systems are required to meet these trends; however, there is a high degree of interest and concern in establishing whether or not a full migration to a more portable and scalable component-based architecture will be able to represent the legacy business requirements in the underlying conceptual model of re-engineered information systems.

To address this concern, the research project re-engineered a sample process to derive a component model from the legacy system and posed the question: Is the resulting component-based model equivalent to the legacy conceptual model?

In order to answer the research question, the project evaluated the conceptual models generated by the component-based and traditional approaches in the re-engineering process in order to verify that the re-engineered component-based model was capable of representing the same business requirements of the legacy system. Design science is used as the central research approach for this project.

The first section provides the background for this chapter. Then, the application of design science in information systems re-engineering is demonstrated by using a case study. Finally, directions of future research are suggested.

## **DESIGN SCIENCE BACKGROUND**

### **Design Science as an Information Systems Research Approach**

The design science approach has a history of providing useful results in the evaluation of constructs and models in information systems (Hevner, March, Park, & Ram, 2004). This is in line with Nunamaker and Chen (1990) who classify design science in IS as applied research that applies knowledge to solve practical problems. March and Smith (1995) define design science as an attempt to create artifacts that serve human purposes, as opposed to natural and social sciences, which try to understand reality (Au, 2001).

### **Fundamental Concepts of Design Science**

March and Smith (1995) outline a design science framework with two axes, namely research activities and research outputs. Research outputs cover constructs, models, methods, and instantiations. Research activities comprise building, evaluating, theorizing on, and justifying artifacts.

*Constructs* or concepts form the vocabulary of a domain. They constitute a conceptualization used to describe problems within a domain. A *model* is a set of propositions or statements expressing relationships among constructs. In design activities, models represent situations as problem and solution statements. A *method* is a set of steps (an algorithm or guideline) used to perform a task. Methods are based on a set of underlying constructs (language) and a representation (model) of the solution space. An *instantiation* is the realization of an artifact in its environment. Instantiations operationalize constructs, models, and methods.

Concerning research activities, March and Smith (1995) identify *build* and *evaluate* as the two main issues in design science. *Build* refers to the construction of constructs, models, methods,

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