# Chapter 8.9
# What−if Simulation Modeling in Business Intelligence

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## ABSTRACT

Optimizing decisions has become a vital factor for companies. In order to be able to evaluate beforehand the impact of a decision, managers need reliable previsional systems. Though data warehouses enable analysis of past data, they are not capable of giving anticipations of future trends. What-if analysis fills this gap by enabling users to simulate and inspect the behavior of a complex system under some given hypotheses. A crucial issue in the design of what-if applications is to find an adequate formalism to conceptually express the underlying simulation model. In this paper the authors report on how, within the framework of a comprehensive design methodology, this can be accomplished by extending UML 2 with a set of stereotypes. Their proposal is centered on the use of activity diagrams enriched with object flows, aimed at expressing functional, dynamic, and static aspects in an integrated fashion. The paper is completed by examples taken from a real case study in the commercial area.

## INTRODUCTION

Market conditions increasingly force companies to reduce waste and optimize decisions. This has become not only a critical, but a vital factor for companies. In this direction, *business intelligence* (BI) provides a set of tools and techniques that enable a company to transform its business data into timely and accurate information for the decisional process. BI platforms are used by decision makers to get a comprehensive knowledge of the business and of the factors that affect it, as well as to define and support their business strategies. The goal is to enable data-based decisions aimed at gaining competitive advantage, improving

*Figure 1. The business intelligence pyramid*
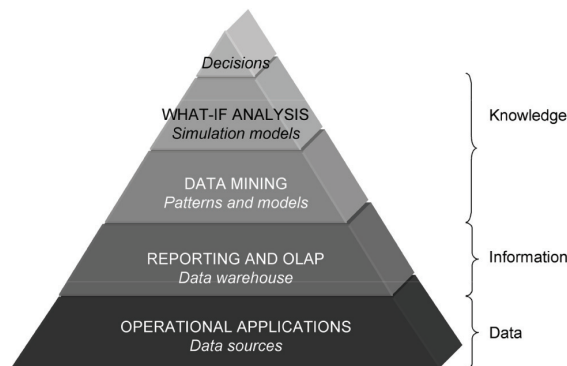


operative performance, responding more quickly to changes, increasing profitability and creating added value for a company (Rizzi, 2009a).

As summarized by the so-called *BI pyramid* shown in Figure 1, BI platforms make it possible for companies to extract and process their own business *data* and then transform those data into *information* useful for the decision-making process. The information obtained in this way is then contextualized and enhanced by the decision-makers' own skills and experience, generating *knowledge* that is used to make conscious and well-informed decisions (Golfarelli & Rizzi, in press).

The BI pyramid demonstrates that data warehouses, that have been playing a lead role within BI platforms in supporting the decision process over the last decade, are no more than the starting point for the application of more advanced techniques that aim at building a bridge to the real decision-making process. This is because data warehouses are aimed at enabling analysis of past data, but they are not capable of giving anticipations of future trends. Indeed, in order to be able to evaluate beforehand the impact of a strategic or tactical move, decision makers need reliable previsional systems. So, almost at the top of the BI pyramid, what-if analysis comes into play.

*What-if analysis* is a data-intensive simulation whose goal is to inspect the behavior of a complex system (i.e., the enterprise business or a part of it) under some given hypotheses called *scenarios*. More pragmatically, what-if analysis measures how changes in a set of independent variables impact on a set of dependent variables with reference to a *simulation model* offering a simplified representation of the business, designed to display significant features of the business and tuned according to the historical enterprise data (Kellern et al., 1999).

**Example 1:** *A simple example of what-if query in the marketing domain is: How would my profits change if I run a 3×2 (pay 2, take 3) promotion for one week on all audio products on sale? Answering this query requires a simulation model to be built. This model, that must be capable of expressing the complex relationships between the business variables that determine the impact of promotions on product sales, is then run against the historical sale data in order to determine a reliable forecast for future sales.*

Among the killer applications for what-if analysis, it is worth mentioning profitability analysis in commerce, hazard analysis in finance, promotion analysis in marketing, and effectiveness analysis in production planning (Rizzi, 2009b). Less traditional, yet interesting applications described in the literature are urban and regional planning supported by spatial databases, index selection in relational databases, and ETL maintenance in data warehousing systems.

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