

CHAPTER ONE

An Introduction to Business Intelligence

From *Business Intelligence: Making Decisions through Data Analytics*
By Jerzy Surma (A Business Expert Press Book)



© 2011 by Business Expert Press. All rights reserved.

Harvard Business Publishing distributes in digital form the individual chapters from a wide selection of books on business from publishers including Harvard Business Press and numerous other companies. To order copies or request permission to reproduce materials, call 1-800-545-7685 or go to <http://www.hbsp.harvard.edu>. No part of this publication may be reproduced, stored in a retrieval system, used in a spreadsheet, or transmitted in any form or by any means – electronic, mechanical, photocopying, recording, or otherwise – without the permission of Harvard Business Publishing, which is an affiliate of Harvard Business School.

This document is authorized for use only by Ching Yang at University of Wales Trinity Saint David until April 2014.

Copying or posting is an infringement of copyright. Permissions@hbsp.harvard.edu or 617.783.7860.

Do Not Copy or Post

CHAPTER 1

An Introduction to Business Intelligence

1.1. The Origins of Business Intelligence

During the 1970s Herbert Simon, a Nobel Prize winner in economics, was developing his world-famous concept of bounded rationality. He was certainly inspired by an interest in examining the cognitive boundaries of a man following the disappointing results of his own trials concerning the computer stimulation of human decision-making processes.¹ However, the intensive development of computer technologies gave him great hope for building systems to support human activities related to thinking and rational behavior. Those hopes were at least partly fulfilled thanks to the development of business intelligence (BI)—that is, a system that supports managerial decision making in enterprise management in the broadest sense of this word. A distinctive feature of BI is its powerful pragmatism: Out of the broad spectrum of technologies, only those that can be applied to business are selected. The four fundamental sources of information for BI and its tools are as follows:

1. *Statistics and econometrics*, including inter alia statistical theories of pattern recognition, econometric methods, statistical reasoning, and forecasting techniques
2. *Operations research*, including inter alia linear programming, decision theory, and game theory
3. *Artificial intelligence*, including inter alia heuristic search methods, machine learning, expert systems, genetic algorithms, artificial neural networks, and case-based reasoning systems

4. *Database technologies*, including inter alia data modeling, query languages, query optimization, and indexing methods

The application of computers in statistics and operations research resulted in the creation of so-called decision support systems. These systems required the application of formal mathematical models and were mainly based on quantitative data. Simultaneously, they naturally reduced the areas of use and application of computers in modeling real decision-making problems.

Artificial intelligence (AI) faced a much more challenging task. Work on AI was initiated in the 1950s, but to date it has not been crowned with any spectacular success. It was then a lesson in humility for the academic environment and proved how complex and refined human intelligence is. Nevertheless, thanks to those attempts numerous algorithms for supporting real decision-making processes were worked out that go far beyond the capabilities of decision support systems.

Although both AI and decision support systems had a large influence on BI, it was the development of database technologies initiated in the 1960s that was the most important. The development of databases based on the relational data model that allows for the relatively simple interpretation of business data and structured query language (SQL), which was easy to use for those times, proved to be particularly important. Progress in database technologies led to a boom in business applications of enterprise resource planning (ERP), which allows the standard processes of an enterprise to be automatic and well arranged. These transaction data (e.g., expense entering, invoice registering, and recording of bank account transactions or phone call records in a billing system) were soon discovered to be a source of interesting insights into the activities of a business. First, transaction data was aggregated into various reports, which were generated by decision support systems usually by means of SQL. Then techniques derived from decision support systems and artificial intelligence, which could conduct more sophisticated analyses, started to be applied. Those activities, performed at the turn of the 1970s and 1980s, were occasional and originally developed in two areas—namely, in shopping malls² and telecommunications companies.

1.2. BI as an Autonomous Discipline

In the 1980s, business applications became so advanced that a separate discipline of designing and creating databases for business decision support emerged. So-called data warehouses³ and specialist toolsets appeared. Although the term “business intelligence” was first used in 1958 in a paper for *IBM Journal*,⁴ a new sense was imparted to it by Howard Dresner from the Gartner company in 1988. Having analyzed the information technology (IT) market, he referred to business intelligence as to a kind of “umbrella” that covers numerous methods, technologies, and applications oriented to real business decision support in an enterprise:⁵

Business Intelligence is a user-oriented process of gathering, exploring, interpreting and analyzing of data, which leads to the streamlining and rationalization of the decision-making process. Those systems support managers in business decision-making in order to create economy value growth of an enterprise.

Such a definition explicitly points out that BI is an IT management system and, strictly speaking, a third-generation IT management system.⁶ In light of such an understanding of decision support systems, they encompass a broad spectrum of technologies, including the following:

- *Online analytical processing (OLAP) tools.* Software for multidimensional analysis of business data by integration, aggregation, and adequate mode of presentation and visualization of different data
- *Data-mining tools.* Algorithms for automatic analysis of great volumes of data using statistical and econometric methods, as well as machine learning methods that can analyze not only quantitative but also qualitative data
- *Knowledge management tools.* Tools that allow for storage, indexing, and analysis of textual documents and their further linkage with other data

This class of technological systems is based on the data collected by data warehouses—that is, database systems that gather data from various sources and make it readily available to businesses.

In the 1990s, BI became a widely known term among specialists, and on the level of tools, it was a standard offered not only by specialist companies but also by the greatest software manufacturers to enterprises, such as IBM, Microsoft, Oracle, or SAP.

1.3. BI and Company Management

At the beginning of the 21st century, IT technologies were developing extremely rapidly due to sudden Internet developments. Despite the almost total computerization of fundamental business processes, managers still have a fragmentary knowledge of their own businesses and often make decisions intuitively. Simultaneously, confusion caused by the excess of available data and a lack of its organization can be observed. Moreover, errors in data, lack of cohesion, and having a few versions of “the truth” in an enterprise have also led to a lack of trust in the gathered data. All of these factors aided the increased use of BI by enterprises. There are some sectors that already cannot do without such solutions—for instance, telecommunications and banking. The belief that analytical technologies are key tools to gaining a competitive advantage is also clearly visible.⁷ Generally speaking, the successful development of BI contributed to the fulfillment of Herbert Simon’s vision. According to his theories, the tasks managers deal with fall into three categories:⁸

1. *Supervising* the standard activities connected with the management of business processes and subordinates
2. *Solving well-structured tasks (problems)*, that is, programmable decisions that are routine and repeatable and for which strict procedures have been worked out: For these tasks (e.g., establishing a selling price when logistics costs and purchase price are familiar), every single case does not have to be considered individually
3. *Solving ill-structured tasks (problems)*—that is, nonprogrammable decisions that don’t have a cut-and-dried answer—related to new cases in which no pattern of behavior is established, results are

unknown, and there is also no ready-made solution (e.g., a strategic decision about starting up manufacturing abroad)

It should be stressed that at the moment BI is only applied to the first and the second category. The third category is definitely the most interesting one. At present, trials are being conducted in the application of BI methods as solutions for this type of problem. In order to understand the complexity of this issue, let us look at Table 1.1, which describes well- and ill-structured problems.

In formal terms, managerial tasks are decision processes, by which a decision means the selection of one possibility from a set of possible solutions. A BI system can generally support managerial decisions in the following ways (see Figure 1.1):

1. *Providing a decision maker with some information.* This mode encompasses the preparation of adequate information: business reports and outcome from complex analysis.
2. *Proposing managerial decisions.* This approach also includes the possibility of a system making decisions itself.⁹

Making decisions in supervision activities and solving well-structured problems can be supported by providing information and by proposing managerial solutions, while solving ill-structured problems might be supported by BI by their rationalization, that is, by providing the management board of an enterprise with suitable information (see chapter 3). However, proposing managerial solutions for ill-structured problems is not the subject of BI systems' activities.

Table 1.1. Well- and Ill-Structured Problems

	Well-structured problems	Ill-structured problems
Data	Quantitative, specific	Qualitative, unspecific
Knowledge	Mathematic model, algorithm	Experience, heuristics, intuition
Problem solving	• Procedure • Independence from context • Clearly specified, objective goals	• Ad hoc • Dependence from context • Vague, subjective goals

Source: Based on Turner (1988).

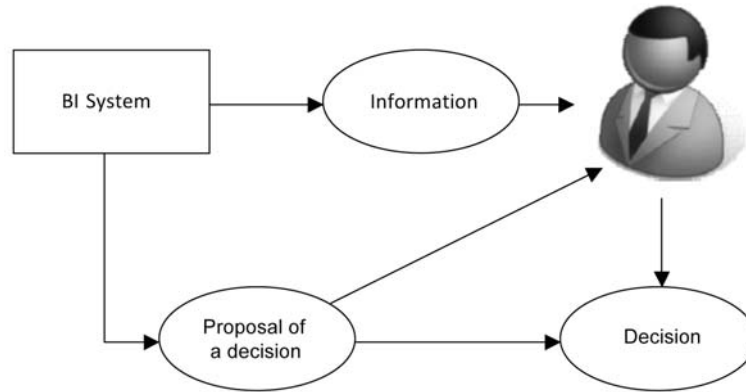


Figure 1.1. Support of managerial decisions by BI system.

Source: author.

1.4. Review of BI Applications in Some Business Areas

Applications of BI in four selected business areas are reviewed in Table 1.2. Each example is backed up by managerial information, which is

Table 1.2. Review of Some BI Applications

Area	Information	Insight	Decision
Customer management	Customer's lifetime value determined by the services provided to the customer	Analysis of the impact of the product portfolio and extra services on a customer's value	Reduction of additional services offered to the least valuable customers in order to reduce their service costs
Sales	History of sales expressed quantitatively and qualitatively according to product groups	Research into the impact of change in product price on the volume of sales	Correction of the prices of specific groups of products
Finance	Unit costs of product manufacturing connected to sales results	Analysis of profitability to specify the least profitable products	Modification of manufacturing process in order to reduce manufacturing costs
Logistics	Information on shipping routes connected to transport costs	Optimization of the routes to minimize transport costs	Modification of the procedure of route and transport selection

Source: author.

given to a decision maker, and solutions, which can be suggested on the basis of the information. Every decision is justified by analyses, which can be conducted in order to obtain certain recommendations.

Case Study 1.1 shows the use of BI concepts to fulfill a company's strategic initiatives. Subsequently, the second chapter of the book discusses the technological aspects connected with building BI systems.

Case Study 1.1

The chain store ALFA (a fictional store) is an important player in the market of discount stores with an ambition to become the leader in its business line. At present, its chain consists of several dozen stores spread across the northeastern United States. ALFA stores have identical exteriors, similar usable floor space, and an almost identical assortment of products: a few thousand indexes of groceries, cosmetics, tobacco, alcoholic beverages, newspapers, and so on. These stores are stocked from a logistics center (central warehouse) located in the center of the sales area (see Figure 1.2). The average customer is a middle-class person who prefers buying high-quality products or a great variety of products at a low price. The ALFA chain has a very effective procurement system, which has built a stable group of suppliers offering relatively low prices, and a selected assortment of ALFA's own brand of products. The chain competes against a few similar chain discount stores and shopping malls by offering low prices and an almost all-day availability of standard product offerings.

ALFA's management board is completely aware that because there is a limited diversification of products, it must focus on low prices and tight cost management to hold on to its competitive advantage. The fundamental strategic aim is to develop more quickly than its competitors (increase in the market share) and to improve its cost position. To realize its strategy, the board has formulated the following strategic initiatives (projects):

1. An intensive growth in market share by the rational selection of new locations and the fast opening of new stores in the chain

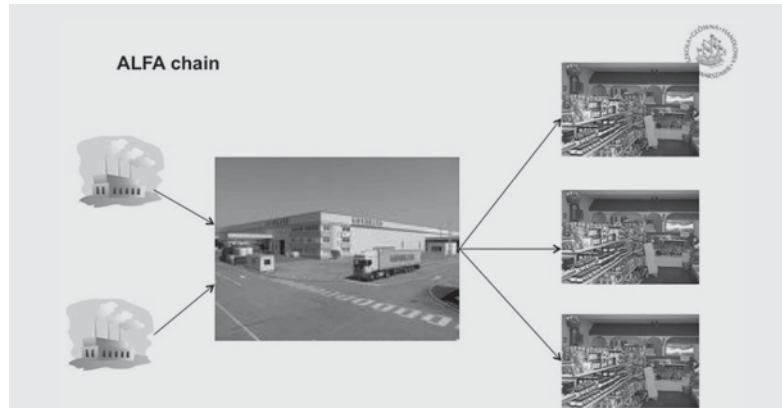


Figure 1.2. *The ALFA store chain network.*

Source: author.

2. An increase in the average sales per store in comparison with competitors (benchmarking) by the selection of suitable product offerings, proper arrangement of products in the stores, and a quick response to changes in demand for individual products
3. Optimal cost management, mainly by a reduction of logistics costs

In taking steps to implement these strategic initiatives, the board was made aware that its management is based on intuition (“following one’s nose”) and that there is no suitable information about the chain store’s performance, which results in an inability to manage it rationally. The following points were discovered:

1. The new store locations were selected in most cases intuitively without taking into consideration knowledge of how chain stores function in similar locations and available demographic data, environmental data, and so on.
2. The board and regional managers get the sales results from all the stores for individual products weekly. A weekly interval in the observation of sales of certain products makes it impossible to respond effectively to radical change in demand in comparison with projections.
3. The managers of the individual stores independently and intuitively arrange products on shelves and use floor space.

4. The divergence between the controlling department and the sales department was found by a calculation of logistics costs. Therefore, those departments give different results regarding the retail margin on a given product when logistics costs are taken into account (a problem of a few versions of the truth).

In order to deal with the aforementioned problems, a consulting company was hired. After preliminary research, it proved that the data registered in ALFA's IT system used are almost complete enough (after suitable processing and by means of some BI techniques) to provide information and support business decisions within the areas specified in Table 1.3.¹⁰ After a suitable analysis of the requirements and an estimation of implementation costs, a strategic decision was made to implement a BI system.

Table 1.3. BI Requirement Analysis Table

Area	Provided information or analysis
Sales	• Quantity (volume) and amount of sales analysis divided into time period, sales region, product category, and so on. • Comparative analyses • Profitability analyses • Comparison with forecast sales • Rankings (e.g., top 25 or bottom 25 of products) • Research into seasonal character of trademarks • Analysis of impact of a price on sales
Logistics	• Analysis of product turnover in a logistics center • Inventory management by analyses of seasonal character of products • Availability of the product (i.e., if it is in stock)
Finance and controlling	• Margin analysis • Profitability analysis (ABC analyses using Pareto's principle)
Expansion (development of a chain store)	• Analysis of locations that connect the location of a store with its profitability
Merchandising	Market basket analysis: • Potential arrangement of products on shelves • Generating packages for promotions • Determining impulse products
Strategy management	• Managerial cockpit and indicators analyses • Comparison with business line (e.g., by making use of market data provided by benchmarking data)

Recommended Literature

Statistics

Aczel, A. (2005). *Complete business statistics* (6th ed.). New York, NY: McGraw-Hill.

Operations Research

Taha, A. H. (2010). *Operations research: An introduction* (9th ed.). New York, NY: Prentice Hall.

Artificial Intelligence

Nilsson, N. (1998). *Artificial intelligence: A new synthesis*. San Francisco, CA: Morgan Kaufmann.

Russel, J., & Norvig, P. (2002). *Artificial intelligence* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Database Systems

Connolly, T. M., & Begg, C. E. (2004). *Database systems: A practical approach to design, implementation and management*. (4th ed.). Reading, MA: Addison Wesley.

Ullman, J. D., & Widom, J. (2007). *First course in database systems*. (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Business Intelligence and Decision Support Systems

Atre, S. (2003). *Business intelligence roadmap: The complete project lifecycle for decision support applications*. Reading, MA: Addison Wesley.

Turban, E., Sharda, R., & Dursun, D. (2010). *Decision support and business intelligence*. (9th ed.). Upper Saddle River, NJ: Prentice Hall.

Turban, E., Sharda, R., Dursun, D., & King, D. (2010). *Business intelligence: A managerial approach*. (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Case Study (Business Analytics for a Chain Store)

Westerman, P. (2000). *Data warehousing: Using the Wal-Mart model*. San Francisco, CA: Morgan Kaufmann.

Internet Resources

“Business Intelligence” on Wikipedia. http://en.wikipedia.org/wiki/Business_intelligence

The Data Warehousing Institute. <http://tdwi.org/>

BeyeNETWORK. <http://b-eye-network.com/>