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ROLE OF BUSINESS INTELLIGENCE SYSTEMS IN DECISION MAKING SUPPORT IN AN ENTERPRISE. REVIEW OF BI PRACTICAL APPLICATIONS

Summary: The most important role of Business Intelligence systems in an enterprise is the support of decisions at all levels of management what leads to the improvement of competitive advantage of a particular organization. BI environment becomes an integral part of the decision making process. The application of those systems in different areas of business activity for instance in controlling or telecommunication as it is presented has also an impact on the increase of work effectiveness. Data warehouses, OLAP, data mining and reporting help to improve the quality of decision making process and the efficacy of same decisions as well. A Business Intelligence system may also simplify access to business information through the use of information catalogue that documents decision support objects.

Key words: Business Intelligence, decision support, data warehousing.

1. Introduction

Nowadays a competitive advantage of a small, medium size and large company may depend on the application of modern technological solution in those organizations. Data coming from transactional systems are gathered in the data warehouse and transformed into information and knowledge by BI systems and further used as a basis for the support of making a decision. The aim of this article is to present the role which business intelligence systems play in the support of making decisions. The article presents the notion of Business Intelligence systems, describes its key components as data warehouse, data mining, OLAP, reporting tools and benefits resulting from the application of such solutions in almost all areas of company's functionality with special emphasis on controlling area and telecommunication industry.

2. The notion of Business Intelligence

The term of Business Intelligence was first coined by Hans Peter Luhn in 1958 who wrote in his article: "business is a collection of activities carried on for whatever purpose, be it science, technology, commerce, industry, law, government, defense, et

cetera. The communication facility serving the conduct of a business (in the broad sense) may be referred to as an intelligence system. The notion of intelligence is also defined here, in a more general sense, as "the ability to apprehend the interrelationships of presented facts in such a way as to guide action towards a desired goal" [LUHN58]. In 1989 Howard Dresner, later a Gartner Group analyst, popularized BI as an umbrella term to describe "concepts and methods to improve business decision making by using fact-based support systems". BI ties together other closely related data disciplines including data mining, statistical analysis, forecasting, and decision support.

Business intelligence is a business strategy aimed at understanding and anticipating the needs of an enterprise's current requirements. It is knowledge about the enterprise's customers, competitors, business partners, competitive environment, and its own internal operations that gives the management of an enterprise the ability to make effective, important, and often strategic business decisions [PARE07]. Business Intelligence represents a broad category of applications and technologies for providing access to data to help enterprise users make better business decisions. It includes decision support systems, forecasting, reporting, data warehouses, data mart and data stores, data mining, statistical analysis, Extract, Transform, and Load (ETL) processes, Online Analytical Processing (OLAP), reporting, portals, ad hoc queries.

The key of Business Intelligence system is data warehouse. The term data warehouse was first coined by Wilhelm Inmon. He defined it as: "a subject oriented, integrated, time variant and non-volatile collection of data in support of management's decision making process" [INMO96]. The main functions for a data warehouse are to collect, clean and stage the data [RAGS02]:

- Collecting the data means that it probably comes from disparate sources. Different systems may not have the same database management system (DBMS). Bringing the data together in a single DBMS simplifies the subsequent processes of cleaning and staging the data.
- Cleaning the data really means ensuring its integrity, addressing the issues of accuracy and validity.
- Staging the data means moving it to tables that make the data readily available to create data marts or for other reporting systems to draw directly from the data warehouse.

The example of Microsoft Business Intelligence solution shows that data warehouse leverages enhancements in partitioning, manageability and query optimizations to streamline operations and increase performance. Another key component of BI system is OLAP which is an approach to quickly provide the answer to analytical queries that are dimensional in nature. It is part of the broader category of business intelligence, which also includes ETL (extraction, transformation and load of data), relational reporting, and data mining. The concept of OLAP can also be described as the Fast Analysis of Shared Multidimensional Information. Databases configured for
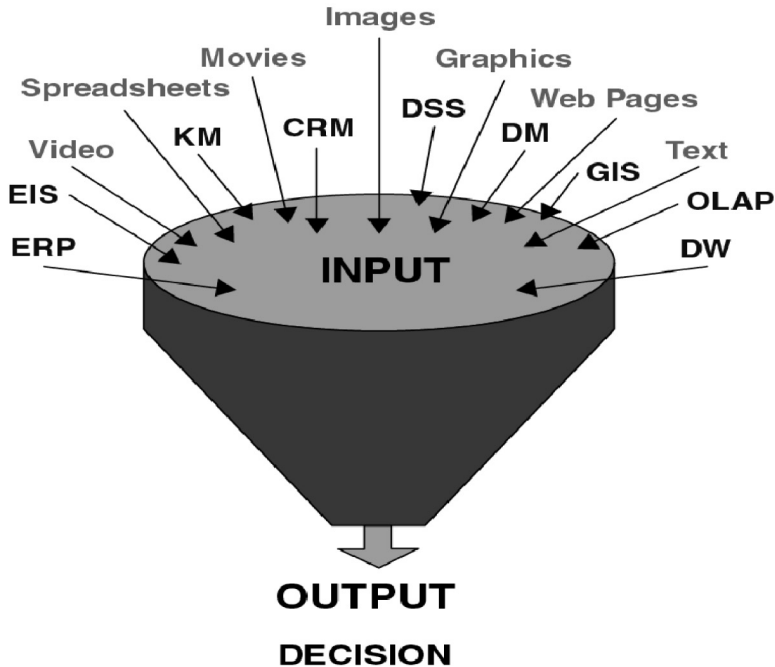
Fig. 1. Generic model of Business Intelligence

Source: [PARE07].

OLAP employ a multidimensional data model, allowing for complex analytical and ad hoc queries with a rapid execution time. The multidimensional characteristic means that an OLAP system can quickly switch among various orientations of dimensions, as well as among various subsets and structural arrangements of a dimension. Due to the multidimensional nature of OLAP systems, the collections of data that they implement are often referred to as cubes. The other crucial component of BI system is data mining which according to IBM definition is: "the process of extracting previously unknown, valid and actionable information from large databases and then using the information to make crucial business decisions". Some of the more popular data-mining techniques are: **association analysis** used to identify the behavior of specific events or processes. It is sometimes called market basket analysis. **Classification** which is the most common use of data mining and looks at the behaviour and attributes of already determined groups. **Clustering** that is a technique that aggregates data according to a predetermined set of characteristics. It can be used to differentiate groups of customers that behave similarly on certain factors within the data. **Regression** for forecasting purposes is one of two forecasting techniques. It uses known values of data to predict future values or future events based on historical trends and statistics [PARE07]. Many important problems in science and industry

have been addressed by data mining methods, such as neural networks, fuzzy logic, decision trees, genetic algorithms, and statistical methods [ZIOR07].

The analysis gains an integrated view of all organizational data as the foundation for traditional reporting, OLAP analysis, scorecards and data mining. Reports deliver the information employees need to make better decisions in virtually any environment. Data Mining explores data, discovers patterns and applies these patterns to daily operations with an easy to use, extensible, accessible and flexible platform [MICR07]. Business Intelligence systems not only support the latest information technologies, but also provide prepackaged application solutions. They focus on the access and delivery of business information to end users, and support both information providers and information consumers. Business intelligence systems support access to all forms of business information, and not just the information stored in a data warehouse [AIRR99].

Business Intelligence systems are fundamental providing business people with the information and tools they need to make both operational and strategic business decisions [MWKI06]. Thanks to application of Business Intelligence in an enterprise it is possible to conduct fast analysis of millions of database records generating annual, quarterly and monthly financial statements and to compare chosen coefficients. Having full information about what happens in the company and in its environment there can be built strategy of the company with the appliance of SWOT analysis, BCG and GE matrix. Business Intelligence systems focus on improving the access and delivery of business information to both information providers and information consumers. They achieve this by providing advanced graphical and Web-based online analytical processing (OLAP) and information mining tools, and prepackaged applications that exploit the power of those tools. The most popular BI tools are Oracle – Siebel Business Analytics Applications, SAS – Business Intelligence, SAP – Business Objects, IBM – Cognos BI, Oracle – Hyperion System BI+ Microsoft — Analysis Services, MicroStrategy – Dynamic Enterprise Dashboards, Qliktech – QlikView, Pentaho – Open BI Suite, Information Builders – WebFOCUS Business Intelligence, TIBCO Spotfire – Enterprise Analytics, Sybase – InfoMaker.

3. Business Intelligence systems in the support of decision making

The process of decision making is connected to the management of an enterprise. It may take place when a decision maker possesses information concerning individual parameters characterizing company's business activity and its environment. Therefore decision is the transformation of one information into the other one. The process of transformation may be done in a different way, depending on the complexity of phenomena requiring decision making as well as the selection of methods and techniques used for the purpose of this transformation. The process of transformation of information is always a part of the decision process. What is more, decisions are made on the basis of available information which is located in decision maker's

mind or in accessible for him IT resources and what is more the quality of information decides about the quality of an undertaken decision [NOWI01].

Business Intelligence systems are used by different enterprises to gain competitive advantage, boost operational efficiency and lower operating costs of a given organization. They have become fundamental for knowledge gathering and organizing for the purposes of business analysis. They are mainly used for supporting the process of decision making, management of company's revenue, customer relationship management, detection of frauds and payroll management of employees etc. Business Intelligence can be used strategically only when it is implemented together with complete support from the top management [NOWI07b].
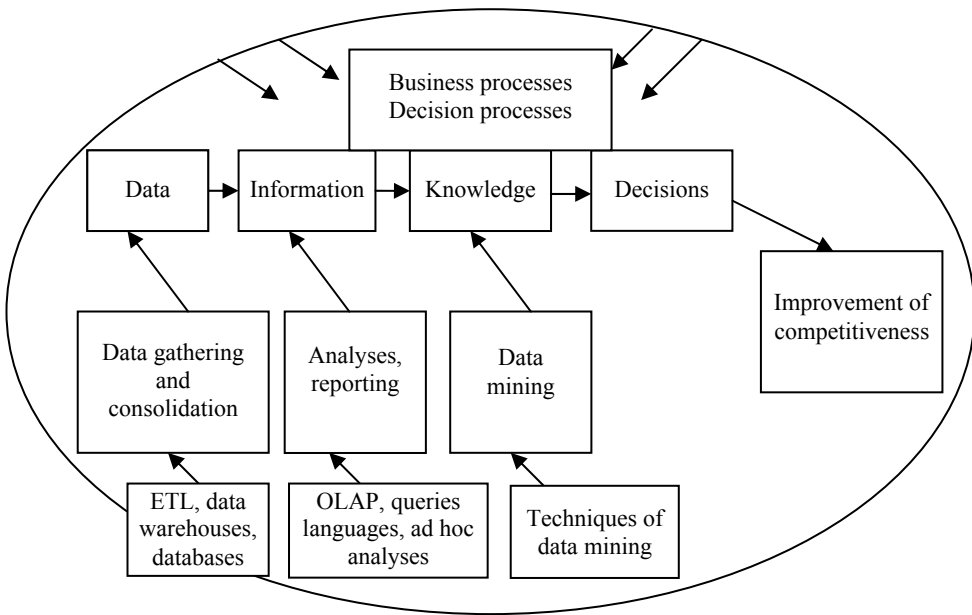

Fig. 2. The place of BI in decision making support

Source: [OlSZ07].

Business Intelligence systems in the process of decision making support decision makers most of all by the transformation of given information into knowledge and the creation of the environment for effective decision making [OLSZ07]. BI systems are applied at all levels of managerial decision in an enterprise.

According to the Microsoft Tech Survey conducted among 171 government and industry officials which rated the most important key capabilities of Business Intelligence solutions the most useful were [MICR07]:
– performance of predictive analysis,
– decision support provision,

– sending alerts when a significant event occurs or certain parameters exceeded,
– trending data provision,
– creation of recurring reports or briefings and dynamically updating the data,
– performance of real-time tracking of metrics or data points,
– provision of data to the right people in a user friendly format/environment.

BI systems are designed not only for data collection, storage and access provision (e.g. corporate portal), but also knowledge management with the use of different analytical tools. Intelligent data analysis in the BI systems is conducted mainly through OLAP technologies, data mining and data warehouse technology as it was previously described [NOWI07a].

4. Practical areas of BI systems application

There exist many practical applications of BI systems in the support of decision making. There is worth mentioning its application in **controlling** in managerial accountancy area where BI tools are used for:
– modeling of different variants of organization development,
– providing information about trends in the company, about results and progress on introduced changes and realization of plans,
– identification of problems and so called "narrow cross sections" and provision of knowledge concerning the way of problems resolving,
– enabling analyses of "the best" and "the worst" employees, customers, products and regions,
– providing analyses about deviations in realization of plans for particular organizational units, persons or indicators.

OLAP is very often used as a tool supporting controlling. Its analytical possibilities are applied in the following way [JANU08]:
– presentation of costs simultaneously in multiple dimensions e.g. type, place, cost and time generation,
– presentation of sales in the valuable and quantitative form, profit and so called margin of financial coverage simultaneously in many dimensions e.g. product, customer, region and time,
– comparison of revenues, profit, costs from different investment centres and with different level of details,
– drill down and roll up of costs according to hierarchy of dimensions,
– consolidation of budget of subkey costs those which are at the lowest levels of hierarchy,
– comparison of planned and real data concerning revenues and costs realized simultaneously in multiple dimensions,
– presentation of dynamics of costs, revenues, position of finance statement.

In the report entitled Poland Enterprise Application Software 2007-2011 Forecast and Vendor Shares the results of the survey conducted by IDC Poland shows that

during the last three years the interest in specialized tools aimed at controlling increased significantly. In 2006 there was noted down 37% more implementations in comparison to the previous year. Most of implemented systems were built in OLAP technology. The leader on Polish market is Eureca which in 2004-2007 implemented most of such systems [JANU08]. The most popular stand-alone solutions in the area of Controlling beside Eureca system designed by Controlling Systems are TETA Controlling, Columb Controlling and Optima Controlling.

In telecommunication industry due to ever changing market conditions business managers need information to anticipate these changes and quickly make appropriate decisions. Decision making in the telecom industry demands high quality intelligence. On the concrete example of Business Objects BI solution telecommunications companies in human resources and finance are now becoming critical to their core business strategy by [BUOB08]:

- **Driving sales and marketing** – in this field sales analysis enables companies to measure revenues, volumes, and margins from an unlimited number of different dimensions such as geography, time, and product category. Marketing professionals can obtain deep insight into customer demographics and behaviour as well. There is also possible here customer segmentation, profiling and customer value management as well where customers' value across time is optimized. Such features as creation, visualization and management of customer segments resulting in more accurate marketing campaigns and an improved ability to target customers are available. Thanks to the application of BI solutions managers are able to track the performance of campaigns over time, and use this tracking to create more effective marketing and merchandising promotions.
- **Increasing customer loyalty** – it allows for online usage and bill analysis. According to the Gartner Group, producing and sending consumer e-bills, they cost just 48% of the cost of paper bills. Moving customer billing to the web will also allow customers to analyze their own bills, identify the top call destinations or phone users, and use this information to aid their own decision-making. In case of customer service and service level reporting companies can provide their customers with critical information such as trouble ticket status, SLA (service level agreement) reporting, and usage history. One of the most significant application of BI is churn analysis. There is proved that relatively small increase in customer loyalty can deliver large increases in profitability. Business Intelligence can identify the patterns that can precede customer churn, allowing businesses to pinpoint customers who are most likely to leave and take appropriate action in advance.
- **Streamlining operations** – in this field there are worth mentioning call centre reporting where it is possible to detect busy periods, look at call waiting times, and take action to ensure that the call centre is running at peak efficiency. The analysis of call data records allows companies to understand how their network is used. It can also help to identify opportunities for new services and calling plans that will increase the number and duration of calls. It is also possible to

detect frauds. For example Business Objects tools can also be used to detect anomalies in calling patterns that could occur due to unauthorized use of the network [BUOB08]. Detecting them quickly and automatically lets companies act in real time to limit the loss of revenue. In case of telecommunication companies data mining is very useful. For instance, the competition between telephone enterprises has created the need for "churn" analysis. A telephone organization that does not act to keep customers and attract new ones will not survive long. Data mining uses algorithms to sift through the huge volumes of information for the purpose of detecting patterns hidden in the data [PARE07].

Taking into consideration the practical application of BI in telecommunication industry there should be mentioned an example of T-mobile company where around 550 people use SAP NetWeaver Business Intelligence (BI) to analyze the data accrued about daily working practices, company finances, network build and other business processes. Managers run extensive data queries to discover new ways to increase efficiency and develop better ways of continuously improving processes. T-Mobile decided to upgrade to SAP NetWeaver Business Intelligence, and take advantage of cutting-edge technology by deploying a new and innovative business analytics appliance – SAP NetWeaver BI Accelerator. It enables customers to analyze large amounts of critical business information, crunching through large volumes of data in a matter of seconds. IBM and SAP have created an easy-to-install solution that enables customers to deploy the BI Accelerator cost-effectively and rapidly: the IBM Systems solution for SAP NetWeaver BI Accelerator, based on the IBM Blade-Center, running on IBM HS20 64-bit Intel Xeon processor blade servers and IBM System Storage [TMOB07].

References

[AIRR99]   Almeida M.S., Ishikawa M., Reinschmidt J., Roeber T., *Getting Started with Data Warehouse and Business Intelligence*, IBM, California 1999.

[BUOB08]   *Business Intelligence for Telecommunications. Increase Profits and Deepen Customer Insight*, Business Objects Company White Paper, retrieved 11.11.2008, http://www.spain.businessobjects.com.

[INMO96]   Inmon W.H., *Data Architecture; The Implementation Paradigm*, Wiley-QED, New York 1996.

[JANU08]   Januszewski A., *Funkcjonalność informatycznych systemów zarządzania. Systemy Business Intelligence*, Wydawnictwo Naukowe PWN, Warszawa 2008.

[LUHN58]   Luhn H.P., *A Business Intelligence System.* IBM Journal (PDF), retrieved on 11.11.2008.

[MICR07]   *Arming Federal Leaders with Microsoft Business Intelligence Solutions*, Microsoft Tech Survey, http://www.microsoft.com/industry/government/solutions/bi.mspx, retrieved 13.11.2008.

[MWKI06]   Mundy J., Warren T., Kimball R., *The Microsoft Data Warehouse Toolkit: with SQL Server 2005 and the Microsoft Business Intelligence Toolset,* John Wiley & Sons, 2006.

[NOWI02]   *Wstęp do systemów informacyjnych zarządzania w przedsiębiorstwie*, red. A. Nowicki, Wydawnictwo Politechniki Częstochowskiej, Częstochowa 2002.

[NOWI07a] Nowicki A., Rot A., Ziora L. *The role of Business Intelligence and Data Warehouses in the management of enterprise. Application in retail trade and insurance companies*, [in:] CITSA 2007 Proceedings, Vol. 1, edited by: Hsing-Wei Chu, Michael Savoie, Yo-Ping Huang, Gloria Moss, International Institute of Informatics and Systemics, Orlando, FL, USA 2007.

[NOWI07b] Nowicki A., Rot A., Ziora L, *The application of Business Intelligence solutions in enterprises. Review of selected case studies in Polish companies*, [in:] Proceedings of The 2007 International Conference on E-Learning, E-business, Enterprise Information Systems and E-goverment EEE 2007, edited by H.R. Arabnia, A. Bahrami, CSREA Press, Las Vegas, Nevada, USA 2007.

[OLSZ07]   Olszak C., *Tworzenie i wykorzystanie systemów Business Intelligence na potrzeby współczesnej organizacji*, AE, Katowice 2007.

[PARE07]   Pareek D., *Business Intelligence for Telecommunication*, Auerbach Publications, New York 2007.

[RAGS02]   Rasmussen N., Goldy P., Solli P., *Financial Business Intelligence. Trends, Technology, Software Selection, and Implementation*, Wiley & Sons, New York 2002.

[TMOB07]   *T-Mobile speeds business intelligence with SAP NetWeaver Business Intelligence Accelerator and IBM* , IBM White Paper, http://ibm.com/solutions/sap, December 2007.

[ZIOR07]   Ziora L., *Application of data mining methods and techniques in the enterprise. Review of chosen practical example,* Prace Naukowe AE we Wrocławiu nr 1150, Wrocław 2007.

ROLA SYSTEMÓW *BUSINESS INTELLIGENCE* WE WSPOMAGANIU PODEJMOWANIA DECYZJI W PRZEDSIĘBIORSTWIE. PRZEGLĄD WYBRANYCH ZASTOSOWAŃ PRAKTYCZNYCH

Streszczenie: Celem artykułu jest przedstawienie roli, jaką odgrywają systemy *business intelligence* we wspieraniu podejmowania decyzji w przedsiębiorstwie. Artykuł przedstawia istotę systemów BI, opisuje kluczowe komponenty tychże systemów, takie jak hurtownia danych, OLAP, *data mining*, narzędzia raportowania. Przedstawiono tutaj również praktyczne przykłady zastosowań rozwiązań BI w kontrolingu oraz w telekomunikacji ze wskazaniem korzyści wynikających z ich wdrożenia.