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Managerial Aspects of Business Intelligence Implementation

Helsinki Metropolia University of Applied Sciences
Bachelor of Business Administration
International Business and Logistics
Bachelor's Thesis
May 19, 2012

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Title	Business intelligence: Managerial aspects of business intelligence implementation
Number of pages	86
Date	May 19, 2012
Degree	Bachelor of Business Administration (BBA)
Degree programme	International Business and Logistics
Specialization	International Business and Logistics
Instructor	Senior Lecturer, Kaija Haapasalo

In the modern conditions of the dynamic and rapidly changing business environment organizations pursue goals to improve their adaptation capabilities and increase the efficiency of their decision-making process. Due to this organizations implement the Business Intelligence (BI) solutions (reporting, analyzing and forecasting information systems) into their operations. However, the implementation of the BI differs from implementation of a typical IT project due to the fact that business benefits that BI systems provide are intangible and difficult to quantify, companies may face significant problems related to the project planning, cost-benefit analysis, vendor selection, data preparation, employees training and ethical and legal aspects of the implementation.

Current research addresses the managerial aspects of the BI and outlines the importance of the efficient cross-departmental information flow between all parties involved in the project, emphasis on the key business benefits when preparing the cost-benefit analysis of the project and communicating it to the stakeholders, developing long-term partnership relations with the BI vendors, developing continuous and efficient BI employees' training in the context of the daily business tasks of the end-users, ensuring that the corporate IT support staff is involved in the implementation process and understands first and foremost the business needs behind the functionality of the BI solution and emphasizing the importance of the ethical and legal problems such as personal data privacy and consequences of the automation of the decision-making during implementation of the BI systems.

As a result of the current research, managerial aspects of the BI implementation are analyzed based on the secondary research and interviews at the case company. The BI implementation in the case company is assessed and recommendations for improvements are provided. Additionally, based on the secondary research and experience of the case company corrections to the BI implementation process models are suggested and general recommendations for BI implementation are outlined for future references of the organizations.

Keywords	Business Intelligence (BI), vendor, project plan, planning, cost-benefit analysis, employees training, BI justification, IT infrastructure, ethical and legal aspects, BI architecture, business analytics, data mining, OLAP analysis, BI implementation process model, sensitivity analysis, information flow

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List of abbreviations

ANN – Artificial Neural Networks

BI – Business Intelligence

BPM – Business Performance Management

CFO – Chief Finance Officer

CIO – Chief Information Officer

EIS – Executive Information Systems

ETL – Extract, Transform, Load

GPS - Global Positioning System

IC – Information Center

KPIs – Key Performance Indicators

OLAP – Online Analytical Processing

ROI – Return on Investment

SQL – Structured Query Language

SME – Small and Medium Enterprises

PC – Personal Computer

PDA – Personal Digital Assistant

1 Introduction

Dynamic nature of the present business environment requires organizations to quickly respond to external changes (pressures and opportunities) and efficiently adapt their corporate strategies. An efficient decision-making process in business requires a large amount of data, information and knowledge for evaluation and analysis of the possible courses of actions (Turban et al., 2011: 23). Rapid technological development in the database management field during the past decades has allowed businesses to store large amount of historical data which can be used to support the decision-making process by application of the computerized analytical and data processing tools, which are nowadays referred to as business intelligence (BI).

Figure 1 represents a Pressures-Responses-Support (Turban et al., 2011: 26) model which illustrates interconnection between the external factors influencing on the organizations, companies' responses to these factors and tools which support the decision-making process.

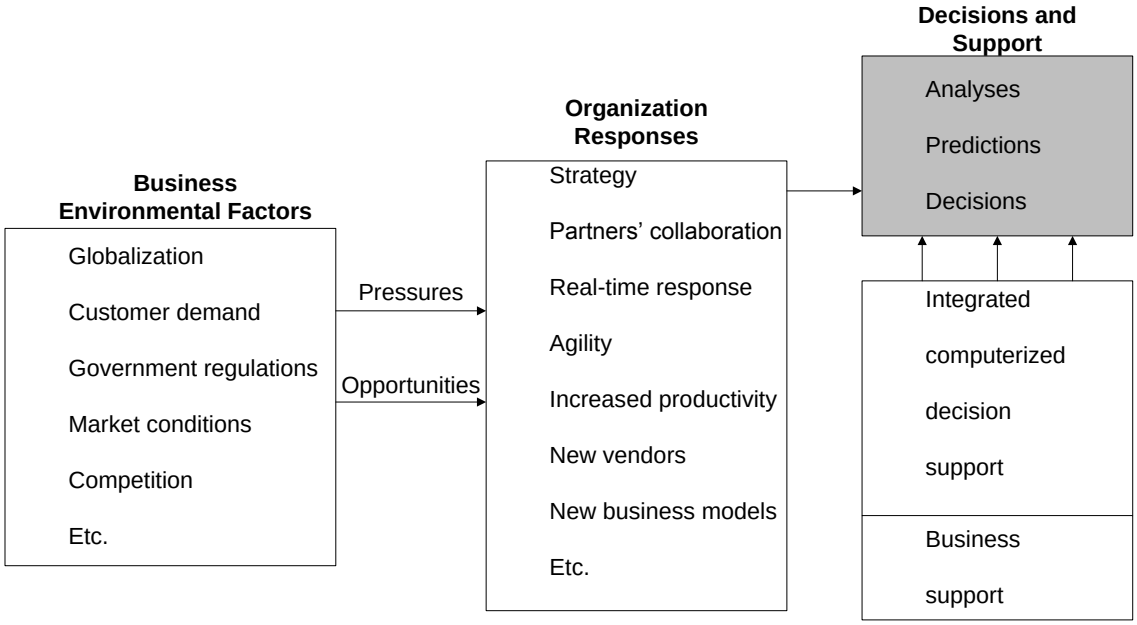

Figure 1. Business Pressures-Responses-Support Model (Turban et al., 2011: 26)

Thus, as a response to the changing business environment organizations adapt their strategy, implement new business models, choose suppliers or vendors, adjust productivity levels etc. However, these decisions require correctly structured and analyzed information in order to increase their effectiveness.

Therefore, in order to be "reactive, anticipative, adaptive and proactive" (Turban et al., 2011: 27) in their responses to the changing business environment, companies often turn to BI tools, the main goal of which is to support the decision-making process based on the relevant analytical data and close in this way the gap between the current and desired performance of the organization (Turban et al., 2011: 28). BI tools can be divided into several groups, such as predictive analytics (data mining tools focusing on forecasting trends), event-driven analytics (provide real-time alerts or warning when the pre-defined event occurs) and operational decision support (support operational, tactical and strategic decisions through, for example, performance dashboards, cockpits, charts, scorecards with key performance indicators, reporting etc.). Relevant types of the BI tools are defined depending on the information needs of the company, complexity of the decision-making process and time-sensitivity of the decisions (from daily operational to quarterly or yearly decisions) (Turban, Volonino, 2010: 453-454).

Thus, the main benefit of BI tools is the fast processing of large amounts of data and transforming the data into the information which facilitates the decision-making process. However, implementation of BI tools is a complex process, during which unexpected issues and problems may arise. Often organizations face problems that refer to the choice of the BI systems of the correct scale and functionality, which arise from poor pre-project research and gaps in understanding of the organization's information needs as well as inefficient information flow between parties involved in the BI project. Data consolidation and standardization, loading to the data warehouse or data mart, which will serve as the repositories of the historical data required for analytical processing, employees' training and involvement in the implementation process, choice of vendor and justification of the BI tools' acquisition are some of many issues which can arise during BI integration and implementation stage.

Thus, current research provides the overview of the modern BI solutions, their evolution and increasing impact on the business processes in the organizations as well as analysis of the managerial aspects related to BI implementation based on already available information and results of the interview at the case company and generates the set of guidelines and recommendations for the BI implementation process.

1.1 Objectives, scope and limitations of the research

The objectives of the current research are, based on the published information sources and interviews at the case company, to: 1) study the evolution and current situation in the field of BI solutions, 2) analyze managerial issues related to the BI implementation stage and 3) apply theoretical models of BI implementation to the case study, evaluate their efficiency and suggest corrections to the existing models as well as generate guidelines and best practices for BI implementation. The current research addresses the following managerial aspects, such as: justification of the business intelligence tool's acquisition, data consolidation and standardization, vendor selection, possible business process reengineering needs, employees' training and empowerment, legal and ethical issues associated with the business intelligence implementation analyzed based on the secondary and primary research (case company interviews).

The research is justified by the fact that various published sources contain disparate information about the BI implementation process and do not provide detailed description of the problems which organizations might face during the integration as well as do not suggest recommendations or guidelines regarding solutions of the possible implementation problems. Therefore, current research aimed to eliminate this gap, consolidate the information related to BI implementation aspects based on the published sources, apply BI implementation theory to the case study, analyze the efficiency of the implementation process at the case company, suggest improvements to the process and based on the theoretical analysis of the managerial aspects and experience of the case company provide general guidelines and recommendations for the BI implementation at large organizations.

In terms of the scope, current research contains four parts: 1) introduction to the field of the business intelligence, analysis of the evolution of the BI tools, their main functionality and role in the decision-making process, 2) secondary analysis of the managerial aspects related to BI implementation, 3) analysis of the efficiency of the BI implementation process at the case company based on two interviews with representatives of the company and 4) as a conclusion overview of the improvements for implementation process at the case company and possible corrections to the existing implementation practices as well as generalized guidelines for more efficient BI

integration in large organizations. The secondary research covered managerial aspects of the BI implementation from various published sources and the primary research (two interviews) aimed to provide an example of how the real company organizes its BI implementation process and how theoretical models discussed in the secondary research can be applied in order to improve the efficiency of this process. Due to the fact that the interviews covered BI implementation at one company, the generalization of the practices of the BI implementation might have not been accurate enough since more case studies are required for this purpose. Thus, the research was limited towards providing the recommendations and improvements for the BI implementation process for the particular company discussed in the case study and generating of the general recommendations and guidelines for improvements of the existing implementation practices based on the experience of the case company.

Possible limitations of the research concerned the validity of the data sources used for the secondary research which included published books, articles and online resources. The main limitation of the secondary research in this case was the difficulty to ensure the quality and relevance of the used sources since they were collected for other purposes than the current research. Besides this, the fact that some of the sources used for the secondary research were published several years ago might have lead to the timeliness problem or irrelevance of the information due to the gap between the period of publication and the date of the current research.

Limitations of the primary research which was based on the structured interview method related to the quality of answers received which were directly dependent on the quality of the questions prepared for the interview. Moreover, the substantial preparation phase was required in order to identify the list of questions for the discussion. Taking into account that the questions were prepared before the interview, there was a high possibility of the "interview effect" occurrence, which means that questions might have not given enough flexibility in the replies of the interviewees creating the interviewer's bias. The research was also limited to the information which was available for analysis during the interview due to the confidentiality issues. Thus, due to the fact that some information about the specific details of the case was not available for retrieving or publishing, it might have also influenced on the accuracy and completeness of the research.

1.2 Research methodology

Current research relates to the qualitative research and includes secondary research (based on the literature review) and the primary research (case company interviews). Based on the information acquired during research of the published works on business intelligence implementation and a case study of a BI implementation project at the large organization, managerial aspects of the business intelligence implementation were identified and recommendations for the case company and general guidelines concerning factors which are needed to take into account when making a decision to integrate such systems were generated.

Secondary sources used for secondary research included published books and scientific articles in the field of business intelligence. Secondary sources were used to define a concept of business intelligence, present the evolution of the business intelligence systems, list most popular business intelligence vendors in order to give the reader a better understanding of the background of such systems as well as of the current state of the industry and outline and analyze the main managerial aspects of the BI implementations. The secondary research represented the initial stage of the research and aimed to provide the background information about the BI field, analyze the current situation in the field and consolidate and analyze the information from the disparate secondary data sources concerning the managerial problems that companies face during the BI implementation stage.

The secondary research was followed by the primary research, which served to provide practical examples of the typical managerial problems of the BI implementation based on the experience of the case company. The case company used for the research represents a large telecommunication organization based in Finland. Company's main field of operation is development and manufacturing of the mobile devices. Due to the confidentially issues, detailed information about the company should not be revealed.

The research method used for data collection during primary research was represented by the structured interview. The structured interview is a fixed-format interview in which all questions are prepared beforehand and are put in the same order for each interviewee. Although this method lacks the free-flow discussion features due to pre-

determined questions, some clarifications in the process of the interview are allowed if needed (Business Dictionary, 2012). The main advantages of the structured interview as the research method are presented in table 1.

Table 1. General advantages and disadvantages of the structured interview as the research method (Sociology, 2011)

Advantages	Disadvantages
– Enables the researcher to examine the level of understanding of the interviewee and provide clarifications to the questions if necessary; – Is easy to standardize as all interviewees are asked the same set of the questions; – Provides a reliable source of the qualitative data; – Is relatively quickly and easy to create, code and interpret; – There is a formal relationship between the interviewer and the respondent, where the latter knows exactly what is required to answer.	– Can be time-consuming if the sample group is large; – A substantial amount of planning is required; – The quality and usefulness of the information is highly dependent on the quality of the presented questions; – The presence of the researcher may influence on the respondent's behavior and way of responding which can lead to the occurrence of the bias; – Pre-determined list of questions might determine in advance what is important and what is not important concerning the topic of the interview.

For this particular research the structured interview research method was selected based on the characteristics of the topic, logistical issues and objectives of the research. Thus, during first stages of the research it was planned to carry out the primary research in the format of the survey with multiple-choice and open-ended questions distributed among several companies. However, in the process of the preparation of the questions it was defined that the current topic requires a thorough study of the BI implementation process, the information for which cannot be obtained through the questionnaire as it requires detailed answers with possible clarifications from two points of view: technical implementation aspects and business goals and project justification. Such information can be only obtained in the process of the discussion, which would have not been possible in case of the survey.

Due to the logistical issues and possibility to perform the face-to-face interview, the case company was chosen among the local businesses present in the Helsinki Metropolitan Area. The choice of the case company was also influenced by the objectives of the research, namely, a possibility to consider larger organizations which have more experience in the BI implementation and which face considerable implementation problems due to the complexity of the organizational structure that influences significantly on the project management issues and information flow.

The structured interviews were conducted based on the questions prepared beforehand, which can be found in the Appendix 2. Questions included in the survey concerned the implementation stage of the business intelligence integration and company's own evaluation of the managerial problems and impacts that were identified during the implementation.

The interviews were carried out with two interviewees involved in one of the BI implementation projects at the case company. The first interviewee represented a head of the BI and reporting integration team at the Corporate Information and Data department of the case company and had the title of the senior reporting manager. The first phase of the interview was conducted as the face-to-face discussion in the company's headquarters office and lasted for 2 hours, followed by the e-mails exchange and phone calls to approve the written results of the interview. Questions covered in the first interview concerned the technical aspects of the implementation and managerial problems associated with these aspects.

The second interviewee represented an employee from the customer care logistics IT department of the company, who was involved in the studied BI implementation project as the process owner from the customer side. The second interview was conducted in the form of the e-mail, in which the interviewee provided detailed answers to the presented open-ended questions. The feedback from the interviewee was received one week later after questions were sent. Aspects covered in the second interview were related to the BI project initiation phase, project justification, organizational changes required, employees' training, project planning and monitoring etc.

The data obtained from two interviews was analyzed and conclusions about the interview results with comparison to the results of the secondary research were presented to the senior reporting manager for approval. As soon as the analysis was approved, suggestions for improvement of the BI implementation at the case company were produced along with the generalized guidelines and recommendations of the BI implementation for large organizations.

As mentioned in the previous chapters, the validity of the data is affected by the fact that not all information about the project could have been revealed due to the confidentiality issues. Besides this, the generalized guidelines and recommendations for the BI implementation that are currently based on the secondary research and a case study with one company might have been more accurate if more case studies / interviews were used for the research.

1.3 Background of the case company and interviewees

The company used for the case study represents a large telecommunications company (further referred as Company A) based in Finland, Helsinki Metropolitan Area, which main field of operations is manufacturing of the mobile devices. More detailed information about the company is limited due to the confidentiality issues related to the public availability of the certain information.

As mentioned in the previous chapter, the interviews were conducted with the 1) senior reporting manager and 2) customer care / logistics manager, a process owner. A senior reporting manager is the team leader of the business intelligence and reporting implementation team at the Corporate Information and Data (CID) department. The team deals with implementation and support of the business intelligence systems and business warehouses throughout the Company A and is formed by the 14 reporting specialists, which are located at the headquarters of the company in Finland, and Indian subcontractors. The customer care / logistics manager is the process owner of one of the BI implementation projects at Company A from the customer side. The customer case / logistics manager belongs to the Logistics IT department which is dealing with the information systems and IT support for the Logistics and Supply Chain Management units of the Company A.

Due to the complex structure and large scale of the organization, the BI implementation projects at Company A involves several parties, which are represented by the 1) end-users or internal customers, 2) intermediate IT support department for the specific business unit and 3) BI and reporting team of the Corporate Data and Information department. Due to this, two interviews were performed with two latter parties involved in the project in order to obtain the full information regarding the BI implementation issues. Detailed description of the case is provided in chapter 4 of the thesis.

1.4 Literature review

The literature used for the purpose of the current research includes published books in the field of business intelligence and information technology for management as well as scientific articles in the same field.

An insightful introduction to the business intelligence concept, which gives the possibility to get acquainted with the topic is provided by Turban et al. (2011), Turban, Voloniono (2010) and Taylor (2007). These books explain the emerging need for business intelligence solutions from the business point of view and give the relevant examples which help to apply the theory to practice. More technical introduction, monologue-like introduction is given by Biere (2003). The disadvantage of this book is that it is oriented more towards IT professionals rather than business readers. However, Biere (2003) provides a very thorough and logical explanation of the evolution of the business intelligence tools and grounds for their emergence due to the technological development. This overview is highly important for the research since it gives a possibility to understand the complexity of such systems and business needs which led to their development and, therefore, can be translated to the modern pressures which are driving companies to implement business intelligence solutions as well.

Research topic and, namely, managerial aspects of the business intelligence implementation requires detailed description of the actual architecture of the business intelligence systems since clear understanding of the system's architecture is essential in order to define what kind of problems may arise during the implementation stage.

Well-written and also schematically illustrated high-level architecture is provided by Turban, Volonino (2010), while a more technical but well-explained and logically structured description is given in an article prepared by Chaudhuri et al. (2011).

The major disadvantage of the books and article mentioned above is that these resources do not provide detailed overview of the modern business intelligence vendors which is a significant omission since without it a full understanding of what solutions are currently available for companies cannot be gained. Therefore, in order to obtain the overview of the modern BI tools official websites of such vendors as Teradata, MicroStrategy, Oracle, IBM, Microsoft and SAP were studied and main solutions provided by these companies were assessed and compared.

Justification of the business intelligence implementation is one of the major managerial issue which occurs when organizations decide to implement these systems. Therefore, in order to be able to justify the solutions, understanding of the real benefits which business intelligence provide should be explained. This information is well presented by Turban, Volonino (2010), Biere (2003) as well as an article prepared by Computerworld (2006). These sources provide a good overview of the main benefits of the business intelligence, explain the driving forces to implement these systems as well as define which types of the end-users bring the most benefit to the organization through utilization of the reporting and analysis.

Finally, the managerial aspects of the business intelligence implementation are discussed in Biere (2003) and Turban et al. (2011). However, these sources provide only brief information about possible problems and do not suggest any recommendations which companies can use in order to avoid or solve such issues. Therefore, additional secondary and primary research on this particular topic aimed to fill the gaps which exist in this area by detailed studying of the published sources and conduction of the interviews with the company which implemented business intelligence solution. As an output of the research recommendations and guidance for the companies concerning implementation stage were produced.

2 Background of business intelligence

2.1 Business intelligence concept

According to Turban et al. (2011: 28), business intelligence (BI) is "an umbrella term that combines architectures, tools, databases, analytical tools, applications, and methodologies". However, as mentioned further by the author, such broad definition might be interpreted differently by different people. Turban further explains that the main goal of the BI is to enable interactive access to the data, manipulate with the data, process and analyze it in order to provide the insightful information for the decision-makers. Chaudhuri et al. (2011) define business intelligence as "a collection of decision support technologies for the enterprise aimed at enabling knowledge workers such as executives, managers, and analysts to make better and faster decisions."

These definitions are supported as well by Taylor et al., (2007: 110), who relates business intelligence to such statements as "better data for improved decision making", "getting the right information to the right person at the right time", "the single version of the truth" etc. All these descriptions can be expressed in the main function of the business intelligence - transform the data to the information which can be evaluated from different prospective by the decision-makers and consequently utilized to support the decision-making process.

The main difference between the traditional databases, which are used in the operational systems, and business intelligence data repositories which are called data warehouses, is that the latter are optimized primarily for the reporting processes besides data storage (Turban, Volonino, 2010: 448). Thus, the implementation of business intelligence systems allows organizations to standardize disparate data, bring it to the single format and by running reporting tools retrieve the real-time information concerning key performance indicators based on which the decisions concerning acquisition, sales, marketing, financing, logistics etc. are made.

As mentioned by Turban, Volonino (2010: 449), the efficiency of the organization's responsiveness to the changing environment depends on two main pillars: trusted view of the information and reporting systems. Thus, traditional operational systems and

databases are not able to provide the decision-makers with the trusted information due to the fact that organizations often use several systems for different departments and, therefore, the data in such systems is scattered and disparate. Moreover, the purpose of such systems is first of all to store the information without providing the users tools to understand and analyze it.

The main problems that users of the traditional information systems face due to the disparate data include the following (Turban, Volonino, 2010: 449):

- receiving the information too late;
- presenting the data on the wrong detail level (greater or fewer detail);
- retrieving of the excess data which is not necessary for the decision-making and which can to some extent even negatively affect the analyzing process;
- inability to coordinate and share the data with other departments of the organization.

Successfully implemented business intelligence systems are able to solve the problems of the data standardization and consolidation and, therefore, provide the trusted view of the information for the decision-makers.

2.2 Evolution of the business intelligence tools

Development of the business intelligence is tightly related to the innovations in the information technology field in general. As mentioned by Biere (2003: 30-41), before 1970s, managers were struggling to access the information they needed for the decision-making process since they were forced to wait for the programming changes and reports. Moreover, it was not possible to access a computer outside of the organization. Thus, all tools for reporting and query were sold to the organizations to be personalized by the IT departments and, thus, required a significant amount of the time and versatile programming skills. However, in the early 1970s some of the vendors started to offer tools which allowed also non-programming users to access and analyze the data. The main disadvantage of those solutions referred to the fact that vendors loaded proprietary data solutions (i.e. data was embedded into the system after the sale and there was no possibility to implement end-user data afterwards) as the relational databases and, hence, standardized formats to store data have not yet been developed. Such data sources were closed and worked only with that particular

vendor's tool; extractions of the data sets were often not synchronized with the customer's actual data; most tools were not able to contain the required data volume; IT specialists were usually required to pull the information from the original data source; these tools required significant investment; consequently the customer could be trapped with the non-efficient tool. However, development of first query-based tools resulted in the learning outcomes (e.g. understanding of how the data should be stored and accessed) and positively influenced on the further development in the field.

The next development milestone was the emergence of so called Information Center (IC) concept in the early 1980s. The idea of such centers was to decrease the lengths of the learning process for query-based reporting systems users (end-users who were standing in between the non-technical users and IT staff) by providing them with the online assistance concerning system's issues. Moreover, ICs also became personal computer (PC) competency centers as the personal computer has just emerged at that time. However, with the development of the spreadsheets, the role of the ICs declined and they have disappeared with time, ruining the settled knowledge centralization in the organizations. The most significant value of these centers was "setting the corporate standards for analysis tools" (Biere, 2003: 40)

Due to the fact that IT cost decreased significantly during this period, the impact of the IT systems on the company's performance started to be more visible. In order to make users being more responsible while utilizing the IT systems (especially those which has a significant impact on the organizations' business processes) end-users were charged with users fees when they were processing data, using reporting or maintenance. However, this practice was not eventually successful since the end-users were not willing to pay for utilization of the tools when they are not able to estimate the real impact of their actions towards the performance of the organization.

Further spread of PC utilization offered a possibility for end-users to analyze the data without possessing outstanding technical skills. However, the problem of efficient data access and data standardization still remained as companies were using electric mixture of mainframes, distributed systems, fixed function terminals, several databases and personal computers for storage and processing of the data which lead to the situation where data was disparate. This issue was solved by development of the

client/server systems. It became clear that keeping the data as it was is creating difficulties for its analysis and, therefore, the reengineering of data into BI-friendly forms was required. Due to this fact relational (entity-relationship model) databases emerged along with the SQL (Structured Query Language) – a query language which allows construction of the queries to retrieve the necessary information. Common standards for SQL for all vendors of the relational databases were created. This made the format in which data was stored and accessed more unified.

The next significant milestone in development of the modern business intelligence systems is related to emergence of the information warehouse – a central repository for data storage.

During late 1980s and early 1990s data processing and manipulation was performed directly in the data warehouse, the access to which was provided to any users. This approach had many negative aspects such as: excess of errors and anomalies in the data which users had to deal with, high complexity and volume of the data since it was pulled from various disparate sources, problem of validating and qualifying of the results, lack of performance etc. However, such practice also brought a positive development and, namely, understanding the need for the metadata. Metadata is the data which is represented by the attributes that describe this data (Turban, 2011: 55) (e.g. metadata for the file can be represented by such attributes as: creation date, author, size of the document etc.). Thus, such development led to several conclusions, such as: all data sources and metadata should be defined, there should be a central repository for users to access the data such as data warehouse or data mart (a more specific repository which is derived from the warehouse to suit end-users needs more specifically (Turban, 2011: 53)).

Thus, a cornerstone in business intelligence development was introduction of the data warehouse concept. According to Biere (2003: 14), the goal of the data warehouse is to create by means of it "a unified, single version of the truth for the data being used for analysis and business decision-making throughout the enterprise". The data warehouse concept is tightly related to the ETL process (Extract, Transform/Cleanse, Load). Due to the fact that data loaded to the warehouse was pulled from different systems and files, it was stored in the disparate formats. Thus, by means of the ETL

techniques, data was extracted from these sources, transformed to the unified format and loaded to the warehouse.

From the terminological point of view, the actual term of "Business Intelligence" was introduced by the Gartner Group in the mid-1990s as mentioned by Turban et al. (2011: 29). However, based on the above presented information, the idea of the reporting systems already existed in the early 1970s being represented by the static two-dimensional reporting systems grouped as the Management Information Systems (MIS). Later in 1980s another concept named Executive Information Systems (EIS) emerged. These systems were meant as the decision-making support for the top-level managers and executives. Some of the functions these systems performed include the following: dynamic multidimensional ad hoc or on-demand reporting, forecasting and predictions, drill down to details, trend analysis, status access, critical success factors (CSFs). After mid-1990s, with addition of some new features, commercial products which offered functions mentioned above appear under a common name of business intelligence. Thus, from the conceptual prospective, EIS transformed into BI. As pointed out further by the author, by 2005, BI started to include also artificial intelligence capabilities meant to facilitate the decision-making process as well as powerful analytical features.

Figure 2 illustrates the evolution of the business intelligence tools starting from the basic querying and reporting, ETL process, introduction of the metadata and data warehouse and data marts concept and more complex decision support systems (DSS) and common spreadsheets (e.g. MS Excel) which all are grouped under the business intelligence concept nowadays.

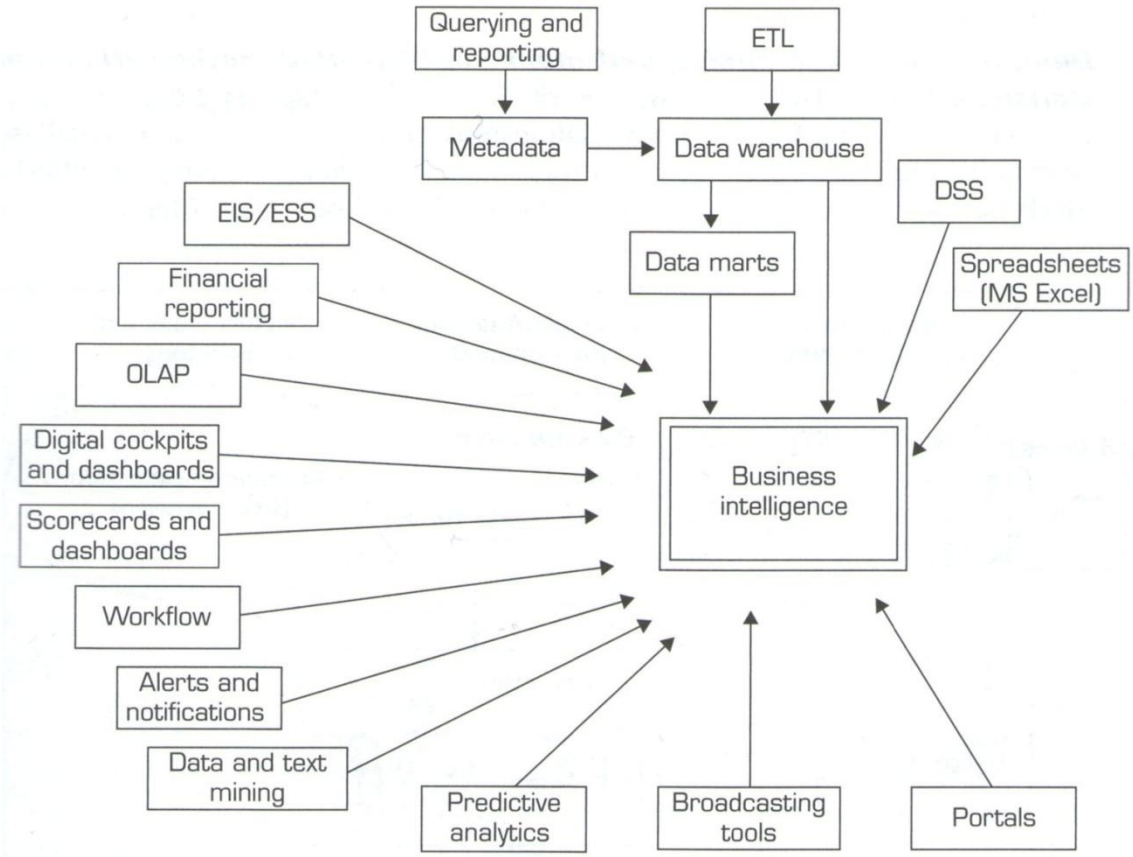

Figure 2. Evolution of BI (Turban et al., 2011: 29)

The diagram also contains the most common features and functions of BI systems such as executive information systems, financial reporting, online analytical processing (OLAP), digital cockpits and dashboards, alerts and notifications, data mining etc. Some of the most commonly used functions will be discussed in the next sub-chapter 2.3.

2.3 Business intelligence tools functionality

The most commonly used functions and features of the modern business intelligence systems are represented in the figure 3.

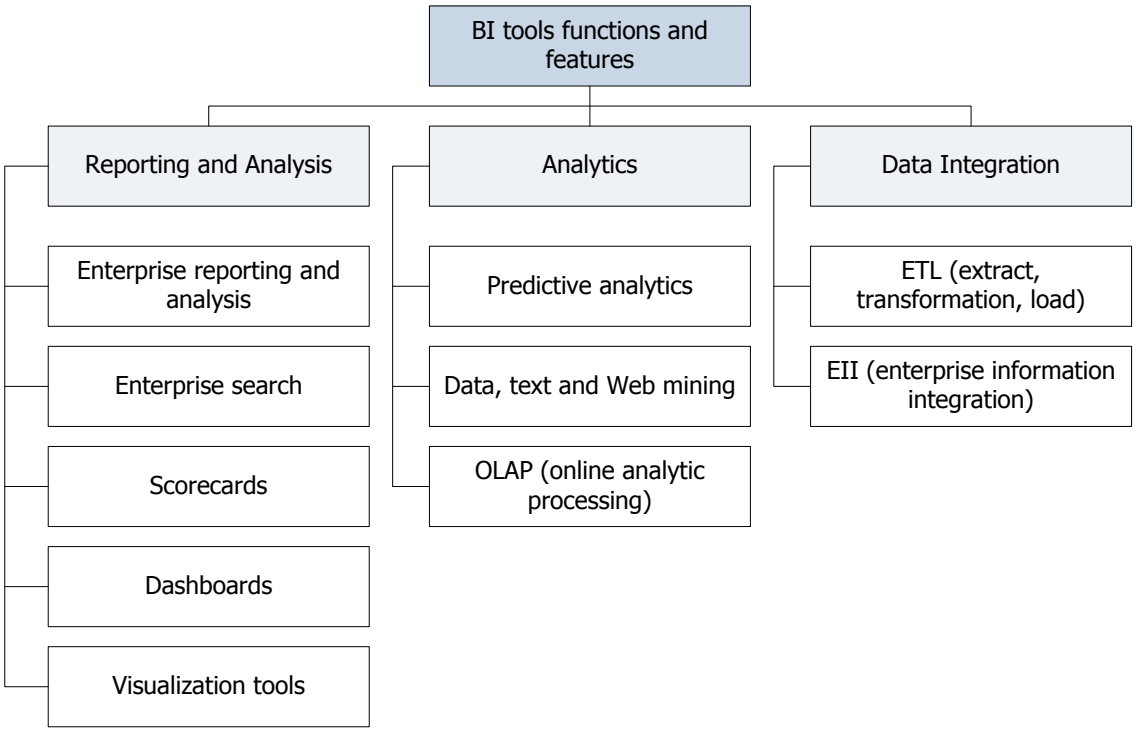

Figure 3. Functions and features of the BI systems (Turban, Volonino, 2010: 450)

As shown in figure 3, BI reporting and analysis consists of the following most commonly used functions, such as: 1) enterprise reporting and analysis, 2) enterprise search, 3) dashboards and scorecards, 4) visualization tools.

According to Turban, Volonino (2010: 456), enterprise reporting and analysis function is realized by the enterprise reporting systems, which provide "standard, ad hoc, or custom reports that are populated with data from a single trusted source to get a single version of the truth". In other words, these systems provide users with the access to the standardized data in the warehouse as well as tools for analyzing this data.

As mentioned by Chaudhuri et al. (2011), at the present moment organizations often require to search for both structured and unstructured enterprise data – perform the enterprise search. Examples of such complex search requests can be search for all information related to specific customers including data in the data warehouse or ERP systems, e-mails, documents, chats etc. Usually such searches are performed based on

the key-word search paradigm. In the figure 4 the most common integrated model of the enterprise search function is represented.

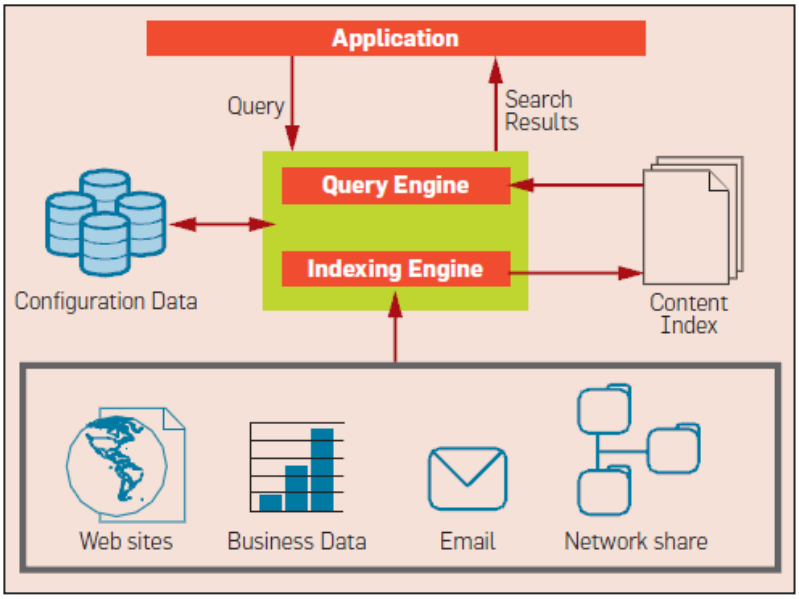

Figure 4. Enterprise search architecture (integrated model) (Chaudhuri et al., 2011)

As pointed out by Turban, Volonino (2010: 457), dashboards and scorecards represent active user interfaces and at the same time reporting tools. Dashboards are mostly used by the top-managers and CEOs as they provide a quick and easy access to the company's main performance indicators. Scorecards (often based on the balanced scorecard methodology) provide access to more specific key performance indicators and are mostly utilized by the middle-level managers for operational or tactical decisions.

Finally, as mentioned by Turban, Volonino (2011: 42), visualization tools often include Geographical information systems (GIS) – systems which are using cartographical data for analysis, dashboards, scorecards, charts as well as multidimensional presentation of the data.

BI analytics is represented by the following features: 1) data, text and web mining, 2) predictive analytics and 3) OLAP (online analytical processing).

Data mining is referred to the process which reveals previously unknown patters in data (Turban, 2011: 155). Structured data is not the only content which can be mined

for patters. Often organizations need to mine the textual data from documents, electronic communications, e-commerce transactions, logs from Internet browsing history etc. It is believed that the main information value organization gets from their unstructured data (Turban, Volonino, 2010: 461). As mentioned by Turban et al. (2011: 161), data mining's goal is to identify four major patterns, such as: associations (co-occurring grouping of things), predictions (based on the past historical data), clusters (grouping of data based on its known characteristics – e.g. grouping the customers based on the demographics, purchasing behavior etc.) and sequential relationships (predicting future events based on similar events in the past, e.g. customers who bought a professional camera might need in future a new spare lens etc.). Besides many of the data mining methods and techniques it is worth to mention the artificial neural networks (ANN), which represent a pattern recognition methodology for machine learning (Turban et al., 2011: 189) and are used in many forecasting and business classification applications in finance, marketing, manufacturing, operations management, information systems, social behavior analysis etc.

Predictive analytics is "the branch of the data mining which is focused on forecasting trends (e.g. regression analysis) and estimating probabilities of future events" (Turban, Volonino, 2010: 451.). Predictive analytics is often used by managers to estimate what can happen in future based on the past historical data. Predictive analytics is based on complex mathematical models and requires a high level of expertise to be created.

OLAP systems are designed to provide end-users with the possibility to perform "ad hoc analysis of organizational data more effectively and efficiently" (Turban et al., 2011: 77). As pointed out further by Turban et al. (2011: 77), "the main operational structure in OLAP is based on a cube concept – a multidimensional data structure (actual or virtual) that allows fast analysis of data". Such structure of the data allows fast and efficient manipulation and analysis of the data from the multidimensional prospective and, therefore, due to this the problem of the slow two-dimensional analysis in relational databases is overcome. Data warehouse or data marts represent the sources of data for OLAP processing. The main operations of the OLAP systems can be defined as following: slice (specification of slices of data via rotation of the cube the result of which is the two-dimensional table) and dice (slice on more than two

dimensions of the data cube), drill down/up (navigation between levels of data from most summarized to most detailed correspondingly), roll up (computing all of the data relationship for one or more dimensions) and pivot (change of the dimensional orientation of a report or ad hoc query page display) (Turban et al., 2011: 78). OLAP servers are implemented using either a multidimensional storage engine (MOLAP); a relational DBMS engine (ROLAP) as the backend; or a hybrid combination called HOLAP (Chaudhuri et al., 2011).

Finally, the last and the most important feature of the business intelligence tools concern data extraction and integration (ETL- Extract, Transformation, Load; EII - Enterprise Information Integration). As discussed in chapter 2.2, data integration is performed through three phases process – ETL, due to which the data is moved from the various sources, disparate data is transformed into structured form and is loaded to the data repository (a data warehouse, data mart or another type of the database).

2.4 Architecture of the business intelligence systems

According to Turban et al. (2011: 30), a typical business intelligence system consists of four major elements, such as:

- data warehouse (used as a repository for data storage);
- business analytics ("a collection of tools for manipulating, mining and analyzing the data in the data warehouse");
- business performance management – BPM (used for monitoring and analyzing organization's performance);
- user interface (e.g. dashboards, scorecards etc.).

As discussed already in the previous chapters, data warehouse is the cornerstone in the business intelligence systems since it serves as the repository of the structured standardized data, suitable for analysis purposes. As pointed out by Turban (2011: 30.), previously data warehouses contained only historical data while nowadays they also store the current data which gives a possibility to provide "real-time decision support".

As discussed in chapter 2.3 business analytics consists of two main types: 1) reports and queries and 2) data, text and Web mining as well as other more complex mathematical and statistical tools (Turban et al., 2011: 30.). Data mining and predictive analytics was described more specifically in chapter 2.3.

Business performance management, which is also referred to as the corporate performance management (CPM), enterprise performance management (EPM) – a term associated with Oracle's PeopleSoft, strategic performance management (SPM) – term which is used in SAP's software, "refers to the business processes, methodologies, metrics, and technologies used by enterprises to measure, monitor, and manage business performance" (Turban et al., 2011: 105). According to Turban et al. (2011: 105) BPM is a concept which evolved from BI and incorporates many of the BI tools. Often BPM is called as "BI + Planning", which means that it includes the whole cycle of organization's management – plan, monitor and analyze – in one package, while BI refers only to analysis of data and predictions.

As mentioned by Turban et al. (2011: 105.), BPM includes three main components:

- Integrated analytical and management processes that address financial and operation activities;
- Tools which allow organizations to define strategic goals, set measuring characteristics for them and then manage performance based on the set goals;
- Core set of processes, such as: financial and operational planning, consolidation and reporting, modeling, analysis and KPIs monitoring which are linked to organization's strategic goals. Often BPM is combined with the balanced scorecard methodology which allows companies to link their strategic goals with the specifically measured key performance indicators in different areas or departments and consequently monitor company's performance according to the set values of the indicators.

Finally, the last basic part of the business intelligence system is the user interface – dashboards or other information broadcasting tools (Turban et al., 2011: 32). As already discussed in sub-chapter 2.3, dashboards provide an overview of the key performance indicators of the company, trends, errors or exceptions by integrating the information from different business areas. They often present the graphs which

compare the actual performance of the company with the planned one providing an overview of the "health" of the organization. Besides dashboards some of the other broadcasting tools may be referred to the cockpits, charts, corporate portals, multidimensional cubes etc. Geographical information systems also start to play a significant role in the decision support (Turban et al., 2011: 32).

Figure 5 presents a high-level architecture of the BI systems with the emphasis on the business performance management and explanation of the end-users roles.

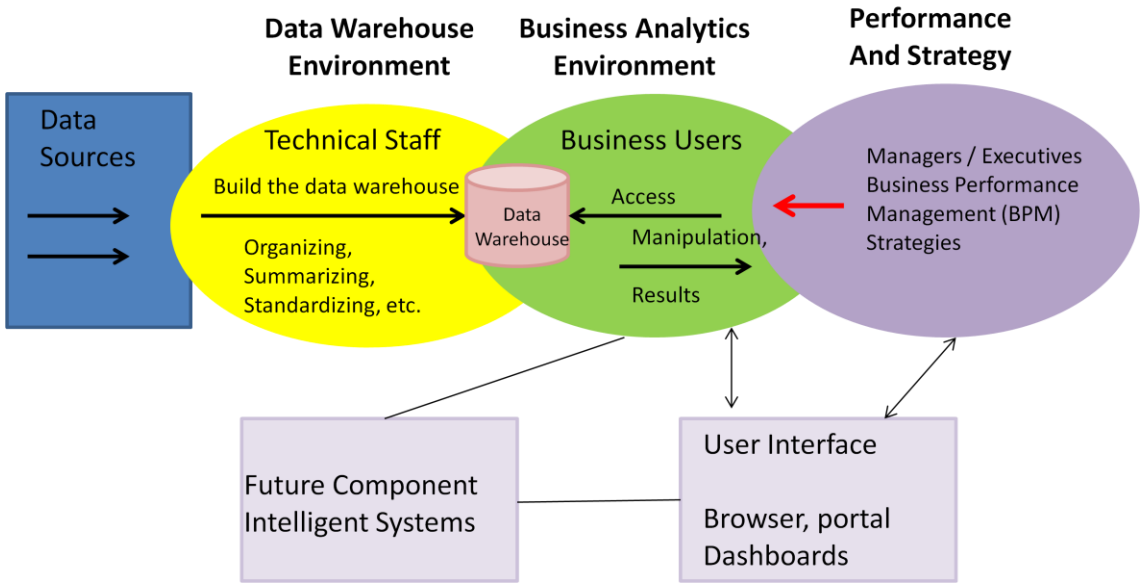

Figure 5. High-level BI systems architecture (Turban, Volonino, 2010: 459)

Thus, data warehouse environment is first of all intended for the utilization of the technical users, such as organization's IT staff, business analytics environment is accessed by the business users who can be represented by the middle managers or operational managers and whose main task is to perform data analysis, run reports and predictive analytics. Performance and strategy area of the business intelligence is represented by the business performance management process which is designed to facilitate the planning and monitoring process of the company's strategy for the top-level managers and executives. Business users access both the data warehouse and analytics tools through the user-friendly interface which may be represented by the dashboards, portals etc.

The actual physical architecture of the business intelligence systems is provided in the figure 6.

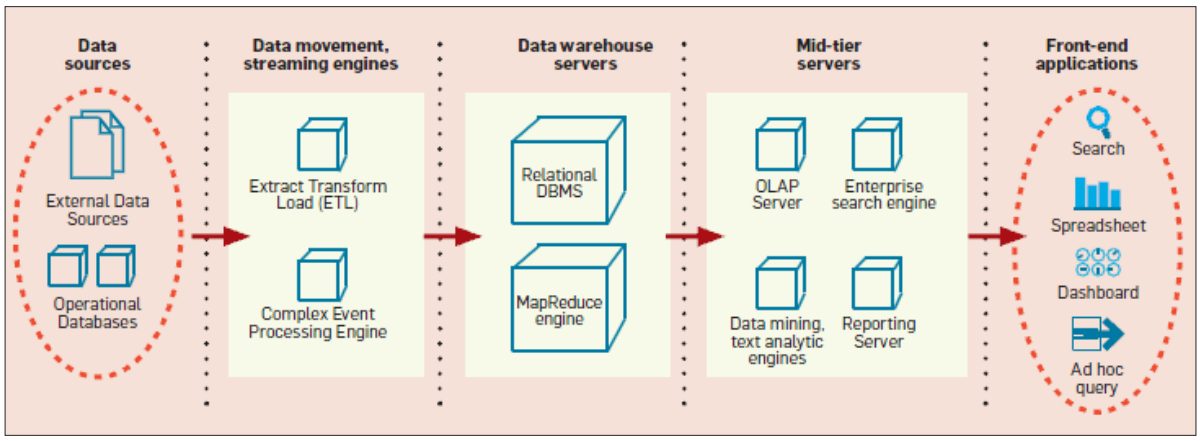

Figure 6. Typical BI system architecture (Chaudhuri et al., 2011)

Most physical components of the BI systems shown in the figure 6 were discussed in the previous chapters. In addition, it is worth to mention that data warehouses besides more traditional options such as relational database management systems (DBMS) can also be represented by MapReduce engine. According to Chaudhuri et al. (2011), emergence of the MapReduce paradigm was triggered by necessity to process large amounts of data with low latency. Originally such engines were used for analyzing of the Web documents and Web query logs; however, nowadays they are also widely implemented for enterprise analytics.

Another component which was not introduced in the previous chapters refers to the Complex event processing (CEP) engines which are designed to support the BI tasks in the real time in order to allow making decisions based only on the operational data (Chaudhuri et al., 2011).

Thus, according to the figure 6, BI systems operation can be described as the following sequence. Data from the external data sources or operational databases is transformed to the unified format and loaded to the data warehouse; alternatively data can be processed by the CEPs in the real time. When the data is processed, it is loaded either into the data warehouse which can be represented by the relational database or MapReduce engine depending on the volume and requirements for data processing. After that on the mid-tier server levels the actual business intelligence analytics is performed, which can include OLAP processing, enterprise search, reporting or data mining. As an output the end-users receive information for the decision-making process in the front-end applications with the friendly user interface. Such applications,

as discussed earlier, can be represented by search tools, dashboards, ad hoc query tools, spreadsheets, digital cockpits, charts etc.

2.5 Business intelligence vendors

At the present moment in the market there are many business intelligence and business performance management solutions offered by various vendors. As defined by Turban et al. (2011: 41), some of the major software corporations which provide BI solutions include Teradata, MicroStrategy, Microsoft, IBM+Cognos+SPSS, SAP+Business Objects, Oracle+Hyperion, SAS etc. As pointed out further by the author, recently there has been a major consolidation due to the fact that larger software companies acquired others in order to complete their product portfolio. Thus, SAP acquired Business Objects, IBM acquired in 2008 Cognos and in 2009 SPSS, Oracle acquired Hyperion. Some of business intelligence solutions provided by each of these vendors are discussed below.

2.5.1 Teradata

According to company's website, Teradata position itself as the world's largest company which is focused "on analytic data solutions through integrated data warehousing, big data analytics, and business applications" (Teradata, 2012). Company provides various solutions to satisfy most common business needs, such as: big data analytics, data governance, data warehouse migration, financial management, tax and revenue management, business intelligence, data mart consolidation, demand planning, SAP integration, Master data management, customer relationship management, data mining and analytics, enterprise risk management etc.

In terms of the business intelligence solutions, Teradata offers an Active Enterprise Intelligence platform which combines two types of business intelligence – strategic and operational business intelligence. Strategic business intelligence solutions provided by the company are designed for planners, financial analysts and marketing managers so that they would have a possibility to "use historical trends and insights to make informed decisions concerning customers, inventory, suppliers, products, and partners" (Teradata, 2012). Operational business intelligence module is designed for utilization

by front-line workers and systems which are involved in making of day-to-day business decisions (e.g. cashiers, customer representatives, call-center agents etc.). Active Enterprise Intelligence platform is delivered through Active Data Warehousing services provided by the company as well as business intelligence solutions of company's partners.

Besides Active Enterprise Intelligence, Teradata also provide Integrated Analytics solutions which include such business intelligence features as (Teradata, 2012):

- Data Exploration - visual data exploration to quickly understand and analyze data within the database;
- OLAP Optimization - built-in multidimensional analytics optimization;
- Geospatial - native in-database geospatial data types and analytics;
- Temporal - native in-database temporal support to manage and update time data and analytics;
- Advanced Analytics- optimized in-database data mining technology from leading vendors, open source, and Teradata;
- Agile Analytics - in-database data labs to accelerate exploration of new data and ideas;
- Big Data Integration - partner tools to analyze unstructured and structured data;
- Application Development - tools and techniques to accelerate development of in-database analytics.

Thus, as it can be seen from the information mentioned above, Teradata's most business intelligence technologies are based on their main product Active Data Warehousing. Therefore, for organizations who decide to choose this vendor for business intelligence implementation, it is essential to use also vendor's warehouse. The main disadvantage of this vendor is lack of the specific information and examples of the tools which can be used for business intelligence.

2.5.2 Micro Strategy

As mentioned at company's website, MicroStrategy is one of the global leaders in business intelligence technology, which provides "integrated reporting, analysis, and

monitoring software that enables companies to analyze the data stored across their enterprise to make better business decisions" (MicroStrategy, 2012).

The company claims that its business intelligence software allows transformation of the organizational data into more structured and understandable information which gives the possibility to increase the productivity, achieve cost-efficiency, increase customers satisfaction, set revenue-optimizing goals and define efficient strategies, monitor trends and detect anomalies as well as forecast opportunities. MicroStrategy's business intelligence software can be run based on the data stored in data warehouses, operational databases, enterprise resource planning (ERP) systems (e.g. SAP, Oracle) and MDX cubes Microsoft Analysis Services, SAP BW, Essbase, and TM1 (MicroStrategy, 2012).

The main business intelligence software offered by the company is MicroStrategy 9, which represents a fully integrated business intelligence platform. Some of most important modules of the MicroStrategy 9 are the following:

- MicroStrategy Intelligence Server which allows grouping all types of the business intelligence applications and running them efficiently on one server;
- MicroStrategy Report Services – a dashboard and enterprise reporting engine which allows running most robust and detailed reports;
- Business Dashboards – provide executive and complete views on organization's key performance indicators;
- OLAP Services – extension of MicroStrategy Intelligence Server that allows faster data analytical processing;
- MicroStrategy Desktop – premier business intelligence development environment for reporting and analytics purposes;
- MicroStrategy Web – web-based reporting and analytical platrofm.

A comprehensive overview of the development, deployment/management and reporting modules of MicroStartegy 9 is represented in the figure 7. MicroStrategy 9 includes three main groups of the solutions, such as: development tools (e.g. Rich Design Environment) required for the developers or IT support staff to implement and manage a BI solution, deployment / management tools (e.g. Unified BI architecture)

for management of the BI solution in the organization and reporting tools (e.g. Dashboards & Scorecards) for reporting and analysis performed by the end-users.

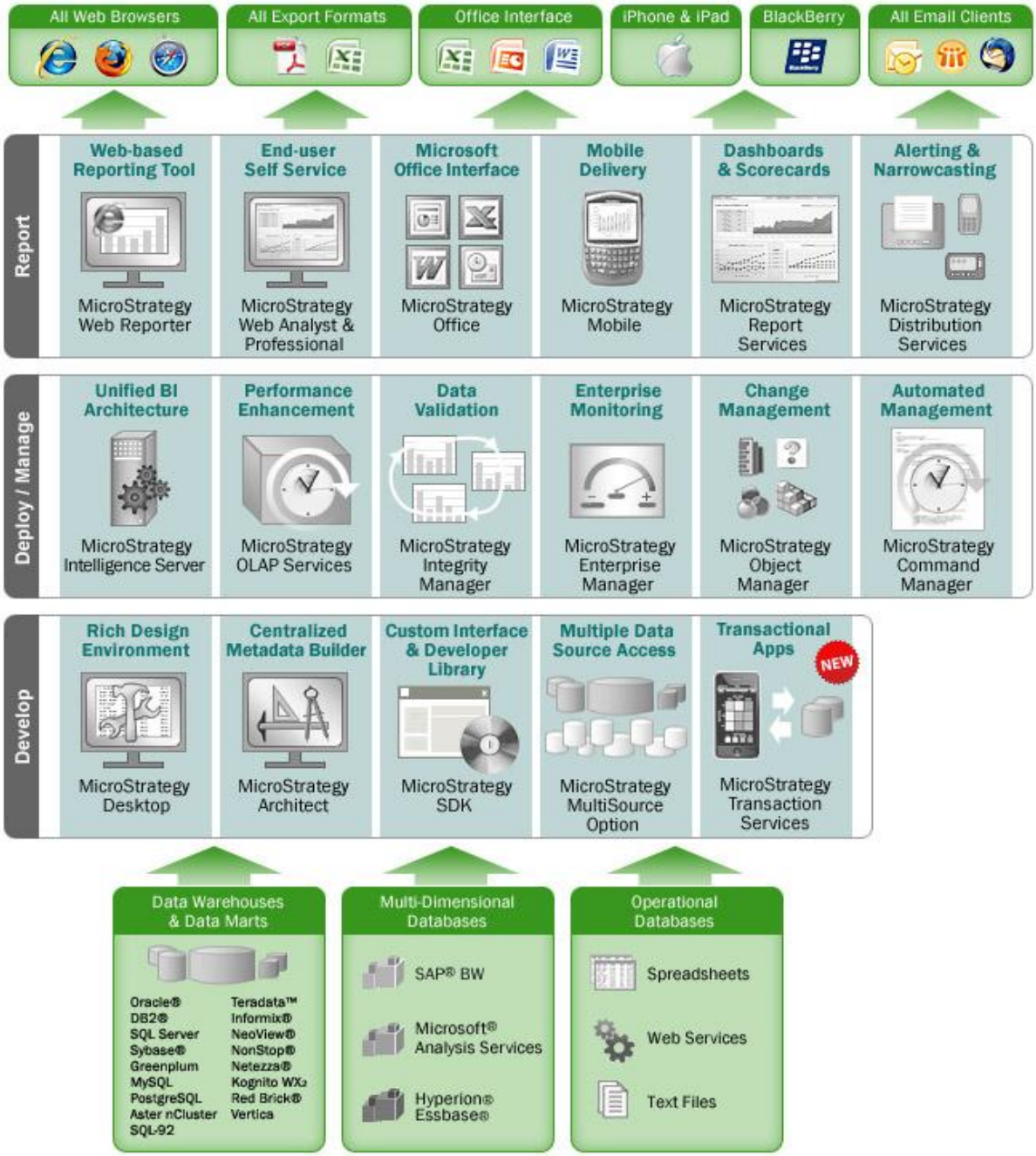

Figure 7. MicroStrategy 9 architecture and modules (MicroStrategy, 2012)

2.5.3 Microsoft

Microsoft uses familiar applications to deliver business intelligence solutions such as Microsoft Office in a combination with MicrosoftPivot and Microsoft SharePoint built on the SQL Server 2012 platform (Microsoft, 2012).

Some of Microsoft business intelligence solutions include the following:

- Self-Service BI – by means of the PowerPivot application it is possible to access data from any source and run reports via Microsoft Excel 2010 or Microsoft SharePoint 2010;
- Managed Self-Service BI – designed to efficiently manage user-created content through PowerPivot IT Dashboards in SharePoint;
- Dashboards and Scorecards – via Microsoft SharePoint Server 2010, it is possible to use dashboards and scorecards with advanced filtering, interactive navigation, advanced analytics, visualization etc. Integration with Microsoft Visio allows display of the live data in the diagrams while integration with Bing Maps gives a possibility to view the data in the geospatial format;
- Reporting – performed through Microsoft SQL Server; Microsoft SQL Azure Reporting also allows to access the data through the cloud;
- Semantic modeling – an integrated business intelligence solutions consisting several BI possibilities, such as reporting, analytics, scorecards, dashboards etc.;
- Advanced analytics – data mining techniques used to define trends, anomalies, perform forecasts and predictions;
- Enterprise Information Management – an integrated tool for improvement of data's quality and master data management;
- Data Warehouse – depending on organization's needs from pre-configured solutions to complex systems based on the massive parallel processing performed by SQL Server Parallel Data Warehouse.

2.5.4 IBM Cognos

One of the main peculiarities of IBM Cognos Business Intelligence is that besides usual BI techniques it also includes planning, scenario modeling, real-time monitoring as well

as predictive analytics in a single platform. The platform can be accessed through the desktop computer, notebook, tablet and smart phone.

Among numerous features of the system it is worth to mention the following ones (IBM, 2012):

- Query and reporting – this feature fits to all user roles in the organizations, from professional users who design one-to-many reports to ad-hoc personalized reporting;
- Analysis – function allows performing basic analysis for day-to-day decisions along with the more advanced predictive or what-if analysis;
- Scorecarding – links strategy to the operational implementation by providing information concerning key performance indicators across the organization;
- Dashboarding – summarizes most important information throughout all departments of the organization;
- Mobile BI – provides secure access to the organizational data from any mobile device enabling users to perform quick decisions;
- Real-time monitoring – allows facilitation of the operational decision-making by providing almost real-time values of the KPIs;
- Extending BI – integrated solutions for Microsoft Office and Cognos Mashup Service;
- Collaborative BI – facilitation of the decision-making for groups and teams through collaborative analysis;
- Statistics – powered by IBM SPSS Statistics Engine allows incorporation of the statistical analysis into decision-making.

Company's website provides insightful information concerning capabilities of the system as well as full documentation and demo versions of every available tool which facilitates system's evaluation for potential customers.

2.5.5 SAP Business Objects

SAP provides both business intelligence as well as data warehouse solutions represented by the SAP Business Objects business intelligence (BI) and SAP NetWeaver Business Warehouse (SAP, 2012) correspondingly.

SAP Business Objects BI provides the following functionality:

- Reporting and analysis – represented by SAP Crystal reports (provides the possibility to build interactive reports based on any data source), SAP Business Objects Analysis, edition for OLAP (analysis of the multi-dimensional data sets), SAP BusinessObjects Analysis, edition for Microsoft (perfoms data analysis via intuitive user interface within Microsoft Office), SAP BusinessObjects Web Intelligence (ad hoc analysis across heterogeneous data online and offline), SAP BusinessObjects Predictive Workbench (prediction of future trends);
- Dashboards – represented by SAP BusinessObjects Dashboards and serves for quick visualization of complex data;
- Data exploration – represented by SAP BusinessObjects Explorer and is used for the efficient search and exploration of the data;
- Mobile – includes SAP BusinessObjects Mobile (provides access to reports, data and analysis from a mobile device), SAP BusinessObjects Explorer (possibility to connect data to maps with the location-based analytics), SAP Event Insight (allows receiving alerts to a mobile device based on real-time data processing);
- BI Platform – represented by SAP BusinessObjects BI Platform (a single platform which integrates available business intelligence tools), SAP BusinessObjects Integration (integrates business intelligence with organization's applications) and SAP BusinessObjects Live Office (integrates business intelligence with Microsoft Office solutions).

SAP NetWeaver Business Warehouse serves as a data repository and improves the data querying and analytics performance if used along with own SAP business intelligence solution.

2.5.6 Oracle solutions

Oracle provides various data warehousing, business intelligence and business performance management solutions, among which it is worth to mention the Oracle Business Intelligence (BI) Foundation Suite and Oracle Hyperion Performance Management Applications (Oracle, 2012).

Some of the main functionality, provided by Oracle Business Intelligence (BI) Foundation Suite, includes the following:

- Enterprise Reporting – delivered by Oracle Business Intelligence (BI) Publisher which allows preparation of the highly formatted reporting documents, including in PDF format;
- Ad hoc query and Reporting – combines both relational and OLAP style analysis and suits for processing data from multiple sources in a pure Web environment;
- Interactive Dashboards – represented by rich interactive dashboards available from Web;
- Scorecard and Strategy Management – allows communicating of the organization's strategic goals across the organization and their monitoring over time;
- Actionable Intelligence – allows exception based decision-making which is achieved through an alerting engine which captures exceptions and provides notifications;
- Integrated Search – performs system-wide search throughout dashboards,
- Analyses, views, prompts, KPIs, scorecards, publisher reports, agents, actions, catalogs and folders;
- BI on the go – provides a quick access to the business intelligence content if the user is not directly connected to the organization's network.

As mentioned before, business performance management is a concept which evolved from the business intelligence and is an essential part of the enterprise's IT infrastructure nowadays. Thus, Oracle Hyperion Performance Management Applications concentrates mainly on the strategy management, planning, budgeting and forecasting for different departments, financial close and reporting (Oracle, 2012).

2.5.7 Comparison of the vendors

Based on the analysis of the vendors provided above, comparison between the functionality of the presented vendors can be performed in order to identify the difference between offered solutions.

Thus, vendors which were considered in the previous chapters provide in most cases similar functionality with minor differences depending on how the vendor positions itself in the field of the business intelligence. Enterprise reporting and analysis is provided by all vendors and is represented as Data Exploration by Teradata; Micro Strategy Report Services and Micro Strategy Web by Microstrategy; Semantic modeling, reporting and Self-service BI by Microsoft; Query and Reporting by IBM; SAP Crystal Reports by SAP; and Oracle Business Intelligence Publisher by Oracle.

Enterprise search is also realized by all vendors and is represented, for example, as Data Exploration by Teradata, SAP Business Objects Explorer in SAP solution or Integrated Search by Oracle. The same concerns the scorecards, dashboards and data visualization tools – all analyzed vendors provide similar solutions in this field. Predictive analytics is represented by most vendors as Advanced Analytics, OLAP Services or Ad Hoc Query and Reporting modules.

Therefore, the functionality of the BI solutions provided nowadays by most vendors is similar except for the insignificant differences or some additional modules, such as, for example, cross-platform integration (access to the BI solution through any device) which is offered strongly by some vendors compared to others (e.g. Microsoft, SAP, Oracle). Taking into account this fact, organizations should define the criteria for choosing a specific BI solution as well as company who will be implementing this solution not based on the functionality or price of the system, but rather based on the specific offer of the implementation company and needs of the organization. More detailed process of the vendor selection is described in the chapter 3.3.

2.6 Benefits of the business intelligence implementation

The main benefit of the business intelligence implementation concerns the fact that organizations are able by implementation of such tools to provide users with the right information to the right people at the right time, which significantly facilitates the decision-making process both on the strategic and operational levels (Turban et al., 2011: 32).

Among top pressures which are driving companies to implement business intelligence solutions it is worth to mention the intentions to increase the customer satisfaction, improve growth strategies, identify process inefficiencies, define the adverse situations in advance and response to them quickly and efficiently, optimize resource allocation. In fig. 8 the percentage distribution between top five business pressures driving companies to implement business intelligence technologies is represented.

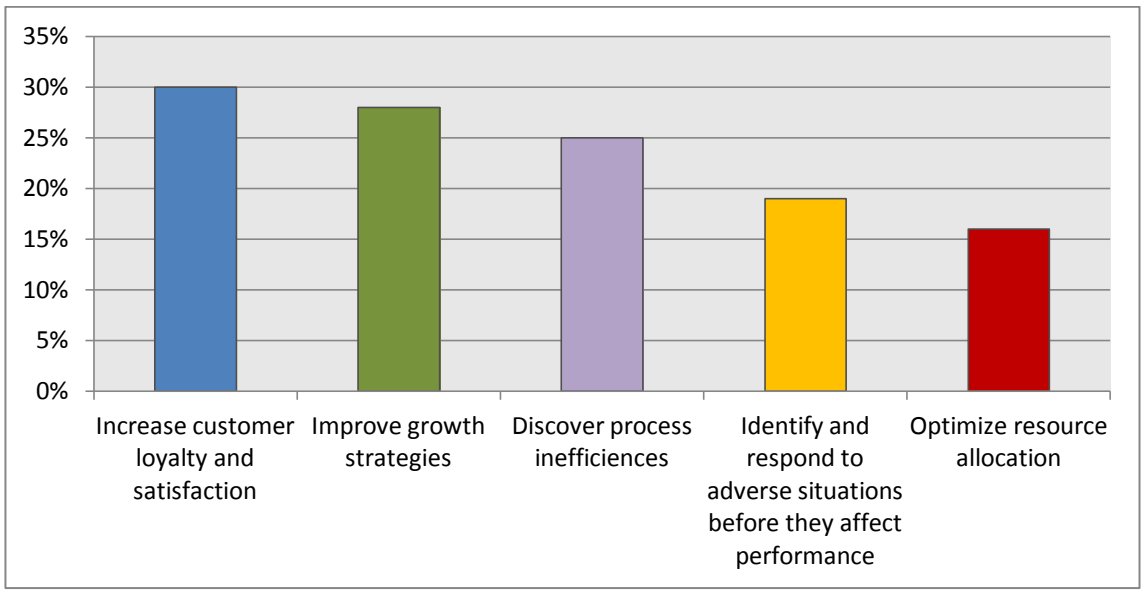

Figure 8. Top five business pressures driving adoption of predictive analytics (Turban, Volonino, 2010: 451)

As mentioned by Martin et al. (2011), successfully implemented business intelligence solutions are able to increase the overall decision-making process as well as increase the efficiency of the business reporting and analysis. The prerequisites for achievement of these benefits are the following:

- the information becomes available;
- data is consistent across the organizational units and stored in the same format;
- data can be easily analyzed through the built-in analytic tools;
- reports are presented in well-structured and user-friendly format.

Another important aspect of the business intelligence systems is that the information can be easily shared and compared between different departments as there are common data formats and standards throughout the whole organization.

Business intelligence solutions benefit not only the business environment of the organization but also improve the IT infrastructure of the company (Martin et al., 2011). This is achieved due to the fact that all organization's applications are being integrated into the common system which makes the IT structure of the company more logical and easier to manage. Moreover, business intelligence end-users self-service empowers the employees who become able to run their own reports at any point in time. Due to this the IT staff is no longer involved into reports' preparation and changing which reduces organization's costs and leads to more efficient utilization of the organizational human resources.

As it is shown in the figure 9, users of the business intelligence solutions can be roughly divided into three categories: heavy analysts, casual and ad-hoc users and consumers.

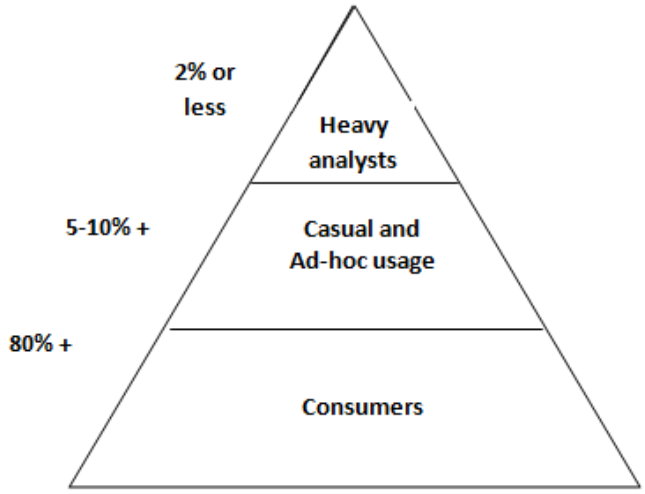

Figure 9. End-user segmentation by technical skills (Biere, 2003: 50)

Thus, heavy analysts are users with the IT background who are able to perform highly technical analysis and, therefore, deliver creative information which will benefit the organization the most. Usually, amount of these users does not exceed about 2%. Casual and ad-hoc users usually include those who can run reporting or create templates and make modifications according to their own requirements. These users are not usually decision-makers, but department's employees who are preparing the information for the employees of the higher hierarchy (refer to about 5 to 10% of the organizational employees). The biggest benefit business intelligence solutions provide to top-level managers, senior department managers or CEOs who account for about

80% of the BI solutions' users. Usually these people do not have significant IT skills and time to learn the tool in details and mainly utilize high-level cockpits and scorecards to get the quick view of the organization's situation for more efficient decision-making.

The most widely used business intelligence tools in the organizations according to Biere (2003: 74) refer to basic query and reporting (up to 80% utilization), OLAP applications account for 5-10% and data mining and other tools less than 2% (see figure 10).

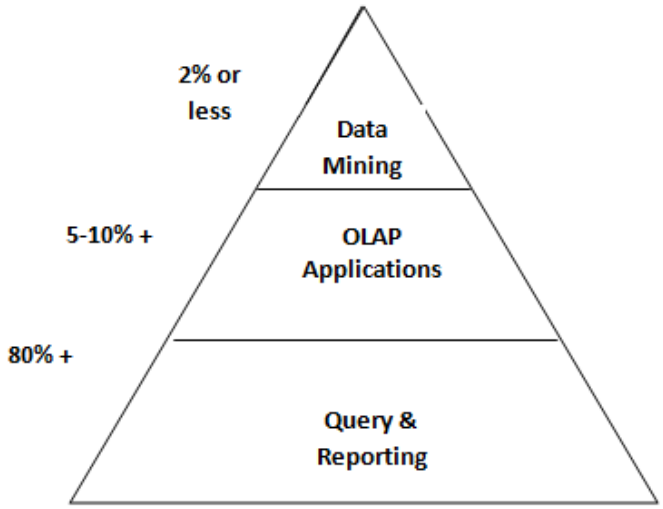

Figure 10. End-user segmentation by products used (Biere, 2003: 74.)

The important aspect to mention is that the level of sophistication of the tool used or technical skills of definite users do not correlate with the impact which business intelligence makes to the business. The impact depends on the fact which users are the decision-makers in the organization. Thus, a CEO might receive a single monthly report based on which an important decision about company's strategy in this or another country might depend (Biere, 2003: 73).

However, the more recent report prepared by Computerworld (2006) with the sponsorship of SAS and Intel states that organizations (especially large ones) also start actively implementing OLAP analytics and more sophisticated techniques as their business intelligence solutions. At the same moment, many of the smaller companies also include Microsoft Excel into this category (see figure 11).

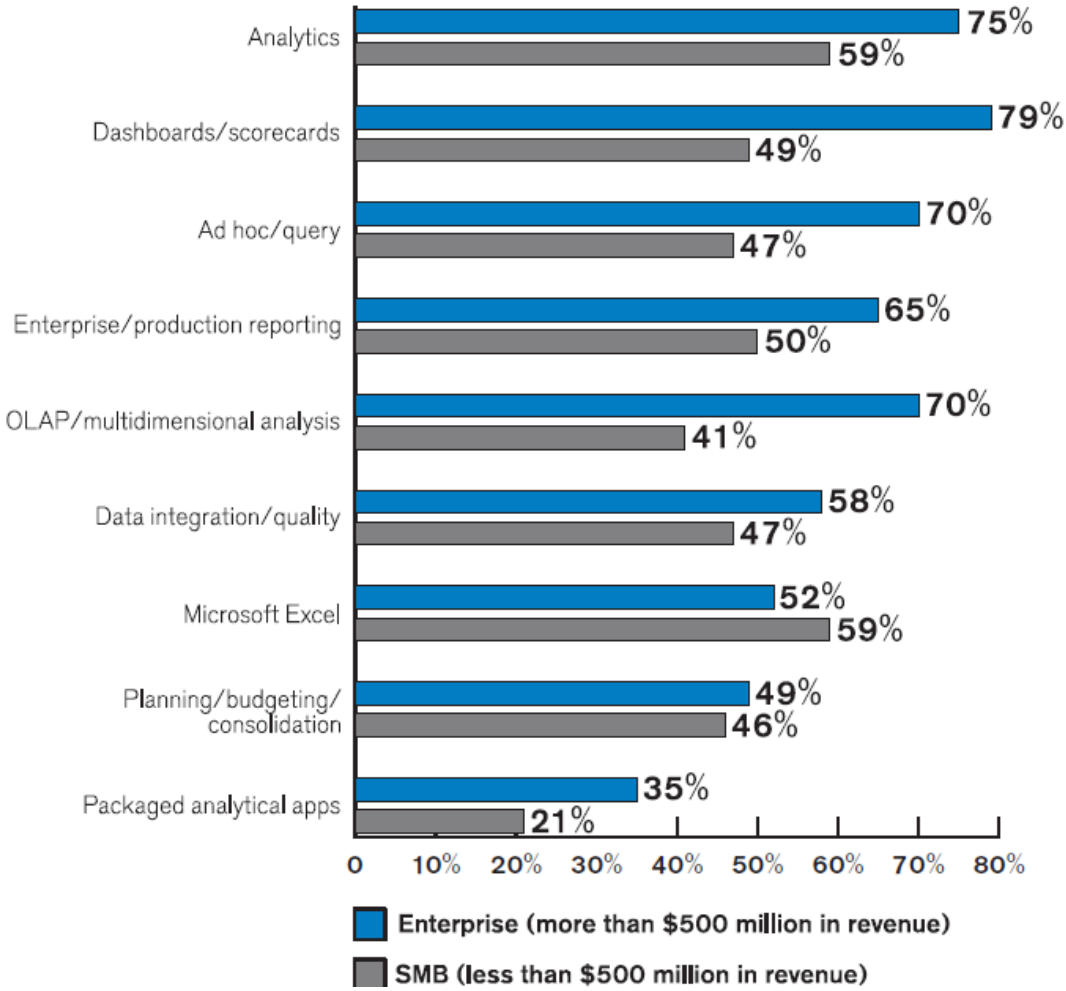

Figure 11. Percentage who consider each software tool part of their BI solution (Computerworld, 2006)

Thus, based on the above mentioned, business intelligence is believed to deliver various benefits to the organizations and most importantly in the way of facilitation of the decision-making processes and increasing the speed of the organizational responses to the changing environment. However, organizations who make a decision to implement such often costly and sophisticated tools might not always understand how exactly this will impact their business since there are no exact ways to measure business intelligence's influence on the decision-making process. Moreover, organizations do not always realize what kind of problems and difficulties might arise during the implementation stage since integration of such complex solutions changes not only the IT infrastructure of the companies, but also their overall business processes.

3 Managerial aspects of the business intelligence implementation

3.1 BI project planning activities

Implementation aspects of business intelligence systems vary significantly depending on the size of the organization and project's constraints such as budget (costs), time and company's internal expertise in the field of business intelligence. Thus, larger organizations, as a rule, make the investments in purchasing of one or several business intelligence solutions and creating dedicated experts to support and manage purchased systems. In the modern conditions the "green field" situation (absence of any similar systems in the IT environment of the organization) is not common. Small and medium enterprises do not tend to use sophisticated BI, considering e.g. Excel (see figure 11) as one of the BI solutions. Therefore, in case of the company's growth and the emergence of the need to implement more advanced business intelligence, the "green field" situation may arise. Such projects are easier to manage since often re-engineering of the whole organization's IT environment is performed and vendor's involvement is significant.

According to Groh (2004), BI project planning and management should correspond to the steps which are presented in the figure 12. Steps from 1 to 7 in the project refer to the responsibility of the organization as they are describing the business needs of the company and goals for the BI solution along with organization's current capabilities and condition to implement BI. Steps 8 and 9 can be performed with the assistance of the vendor or consulting company if the organization does not possess enough technical expertise in the field of the BI, while steps 10 and 11 are related to the cost-benefit analysis which is discussed further in the sub-chapter 3.2.

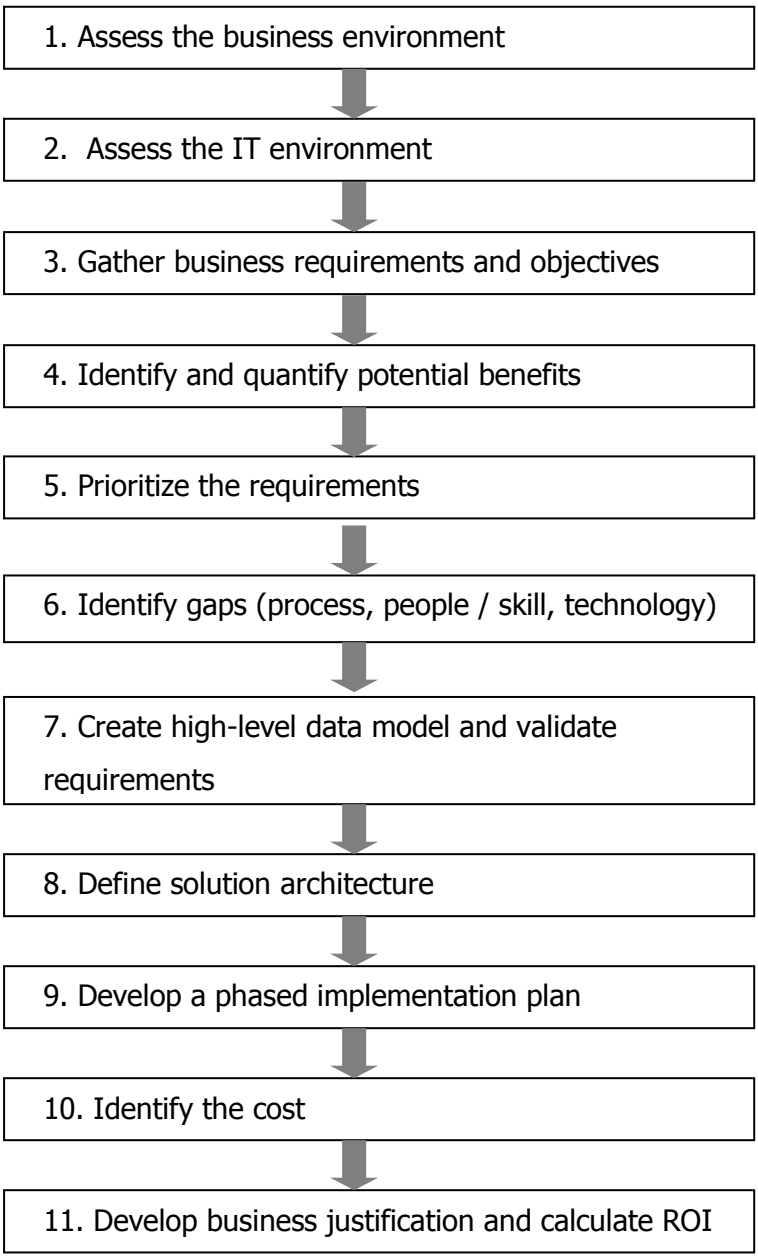

Figure 12. BI project planning and implementation activities (Groh, 2004)

Assessment of the business environment, IT environment, collecting of the requirements and objectives, identification of the potential benefits and prioritization of the requirements highly depends on the feedback from the top-management and experts in the business units where the BI solution is intended to be implemented. Figure 13 provides an overview of the requirements gathering process which are transferred into specific business needs and goals to implement BI solutions.

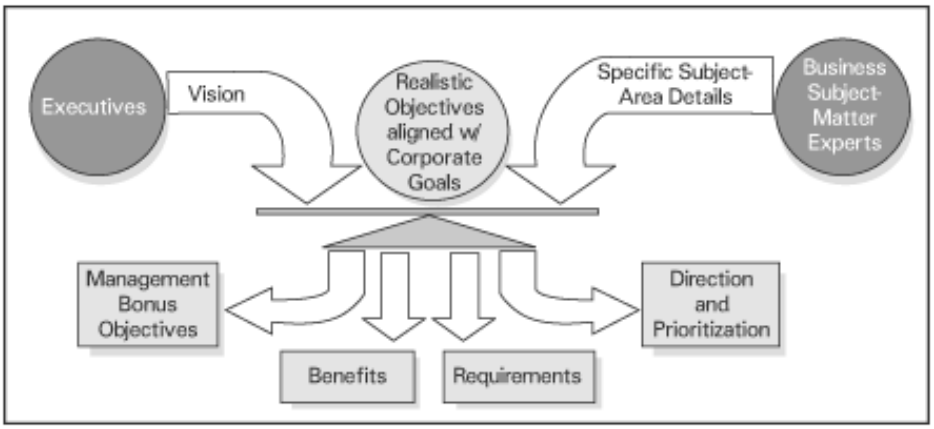

Figure 13. Requirements gathering process (Groh, 2004)

As mentioned by Biere (2003: 124) and supported by the BI project planning flow above, correct formulation of the BI implementation's mission and goals is one of the most crucial aspects of the justification process and it should provide a clear understanding of the reasons to implement BI and its specific benefits to the business processes of the organization. Due to the fact that the value of the BI and its impact on the real decision-making process is elusive and intangible, it is highly important to provide as specific formulation of the goals as possible. Below, two examples of the goals' formulation for the BI project are provided.

The first goal's formulation lacks specific details, realistic estimations and description of how exactly the BI tool will be used to solve organization's tasks.

> Our goal is to produce a series of new reports for the sales and marketing organizations to increase sales and develop more pinpointed and focused efforts to reach new customers. We plan to organize a series of presentations for leading query/reporting vendors to introduce us to their technology. We will award the business to the one that we feel most closely suits our users believe they want (Biere, 2003: 124).

The second example of the goal's formulation and description of the project's flow contains more specific details and is written in a more clear and understandable way.

> Our goal is to produce five new reports that have been agreed to by our sales and marketing organizations for joint use. The source data has been identified and loaded. We have scheduled a proof of concept (POC) for the query/reporting vendors that we have researched and have an interest in pursuing. We intend to

> award the business to the one delivering the critical reports in the most understandable and timely manner during the POC (Biere, 2003: 124).

In order to correctly formulate the goals of the BI project and assess the IT and business environment of the organization managers and initiators of the BI implementation in cooperation with the end-users are recommended to consider the following questions (Biere, 2003: 125-126):

- What new analyses will be provided? Can quantitative or qualitative benefits be assigned to it?
- What is the primary benefit for the BI implementation (productivity, better data, greater sales, fewer expenses)?
- What significant new business function or capability will BI solution provide?
- What is the risk if the BI solution is not implemented? What will happen if the project is not completed?
- Is it a corporate necessity to implement BI solution or is it based on other reasons (e.g. resemblance to the competitor's practices)?
- What is the scope of the project and what is a quantifiable business value that will be delivered?
- Does the company have historical data to be used with the BI tool?
- If the company does not have any historical data at the moment, does it intend to provide a structure and database to serve as the data pool?
- Does the data that the company possesses span into several business areas so that in case of implementing the BI tool for the tasks in one area, it can also benefit across the organization?

The model presented by Groh (2004) is based on the identification of the benefits and requirements for the BI solution which is being implemented. An alternative approach for the implementation's planning is provided by Martin et al. (2011). This approach in the contrast to the BI implementation planning phases provided by Groh (2004) starts the implementation planning process from definition not of the requirements for the BI solution, but key performance indicators (KPIs) for the business processes which are supposed to be covered by the BI solution. This approach also differs from the Groh's model as it emphasized the vendor selection stage and explains how vendor comparison should be carried out in order to choose the vendor that suggests the functionality which suits the company the most. Instead of approval of the BI solution

architecture as described by Groh, Martin also suggests using prototyping which makes the implementation an iterative process aimed for continues monitoring and improving of the BI solution.

Thus, according to Martin (2011), three phases of the implementation are identified (see figure 14).

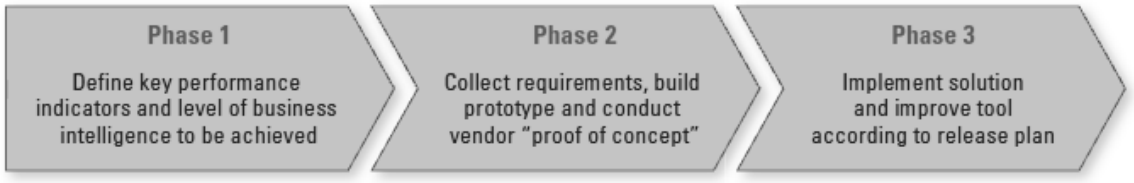

Figure 14. Three phases of the BI implementation (Martin et al., 2011)

It is mentioned by Martin that the BI project should always start with identification of the business requirements, as projects which are based only on the technical requirements often fail.

Thus, during the first phase an organization should identify the key performance indicators (KPIs) expressing the current situation of the company in order to define the reporting needs (see figure 15). The next step is related to assessment of the data availability in order to perform the calculation of required KPIs. As it is mentioned by Martin et al. (2011), condition and availability of the data for the KPIs is one of the major aspects leading to successful implementation of the system.

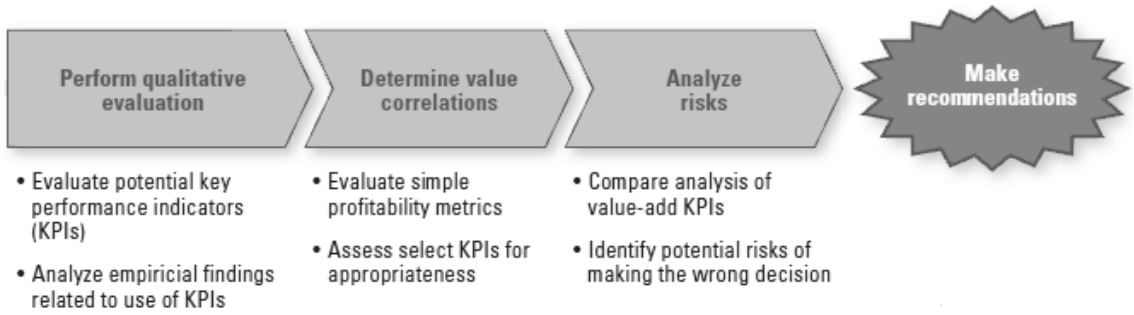

Figure 15. The first phase of the implementation (Martin et al., 2011)

During the first phase organization also needs to define which areas or business units the BI solution will cover – financial, supply chain and logistics, marketing and sales etc. Besides that, the risk assessment should be performed in order to compare the chosen KPIs and define the potential risk associated with the choice of wrong KPIs.

As soon as the first phase is completed, organization is able to proceed to the second phase, the end result of which is approving of the future BI system's prototype (see figure 16).

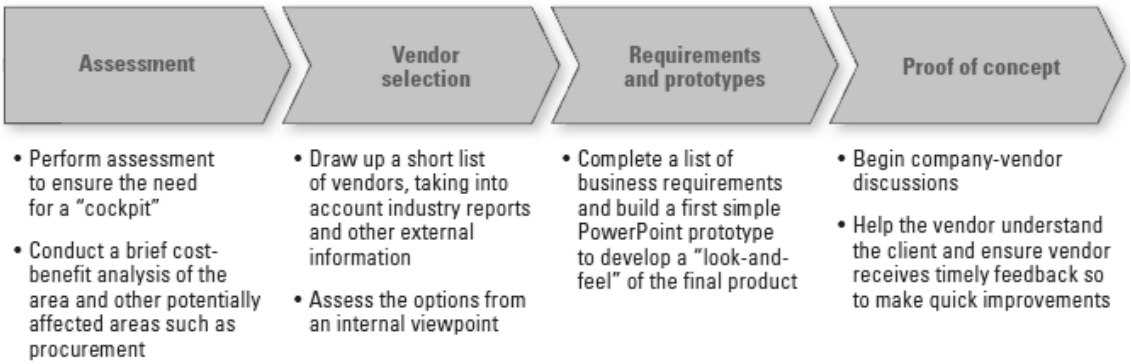

Figure 16. The second phase of the implementation (Martin et al., 2011)

During this stage the justification of the BI implementation is carried out through performance of the cost-benefit analysis of the implementation in a specific area / business unit. According to Martin et al. (2011), vendor selection is free from any specific functional requirements for BI system and is based mostly on the company's IT policies and IT infrastructure. Thus, based on the IT architecture rules, a specific BI solution that fits into company's general requirements, IT strategy and IT landscape can be chosen. When this is completed, requirements gathering task begins, during which the company provides not only the functional requirements but also design and look-and-feel mock-ups of the future reports design and cockpit to the vendor. Based on further suggestions and recommendations of the vendor, the concept of the future BI solution is proved and a third phase related to the technical implementation begins.

As mentioned by Martin et al. (2011) the third phase usually represents a typical IT project. The implementation and results should be achieved fast due to the higher management awareness. Thus, the set of the reporting tools and a cockpit should be provided already during the initial stages of the implementation operating on the limited data set. One of the main aspects in BI projects is preparation of the data which includes not only cleansing and transforming existing data into the unified format, but also establishing organization wide rules for data storage which often includes development of the data architecture, hierarchies, dimensions and formulas. Another important aspect of the successful BI project is close cooperation between the development team and end-users in the business units.

3.2 Justification of the BI implementation

3.2.1 Types of the costs and benefits

Turban (2011: 256) mentions that the cost-benefit analysis is one of the most critical parts in the implementation stage of a business intelligence solution. Nonetheless that some BI solutions are expensive and justifiable only in large corporations, the cost-benefit analysis should be made also in SMEs before committing to any of the BI systems. According to Groh (2004), business intelligence solutions refer to the IT investments which yield the highest returns and require only about two years or less of the total payback time (for 63% of the companies). However, it is also mentioned further by the author that it is more difficult to develop a business case (project plan) for BI initiatives than for other IT investments due to intangible benefits of the BI solutions.

Biere (2003: 125) identifies the following key elements that should be taken into account while calculating return on investment for BI solutions:

- the cost of the software proposed and annual maintenance;
- the cost of the hardware required (new servers, PC upgrades etc.);
- the cost to train the IT staff and end-users (including deployment costs);
- support costs for IT and additional costs;
- the cost to the enterprise while little or no productivity occurring (during the BI testing and deployment phases).

As mentioned by Biere (2003: 127-128.), in the end of the project planning process, organization should document the findings and create a project outline that should cover the following areas (a layout of the BI project outline is attached in the Appendix 1):

- Project information (project name, description, executives and responsible persons, budget and cost owners, scope of the project, key business benefits, total estimated return on investment);
- Vendor and technology cost information (vendor solution proposed, cost and type of the software, maintenance, cost and type of the hardware, total estimated vendor costs);

- IT and support cost information (description of the implementation team, budget, time estimated to implement, estimated cost to implement, estimated ongoing support cost, total estimated IT costs);
- End-user cost information (implementation team, estimated cost of training per user, number of users, total cost of user training, support costs, total estimated user costs);
- Total ROI;
- Total costs;
- Net business benefit.

Groh (2004) suggests an alternative approach to justification of the BI solutions' implementation – dividing BI benefits into quantitative and qualitative. Thus, the author claims that there are two major quantifiable benefits of the BI systems, which are related to decrease of the costs and increase of the revenue. Decrease in the costs can be achieved by increasing efficiency of the business operations. For example, improvement of the marketing campaigns based on the reporting provided by the BI tool – when a roughly estimated cost of acquiring a new customers can be decreased. Increase in revenues is an area with most likely payback of the BI initiatives. This can be achieved through, for example, converting one-time buyers into repeated purchasers due to the detailed reporting and analysis provided by the BI systems.

The author mentions further that some benefits are difficult to quantify, however, despite of this, they should be still included into the business case as they clearly demonstrate how the processes in the organizations can be improved. Thus, some of these benefits may be represented by the following: improved information dissemination, improved information access, improved data quality and feedback from operational systems, improved collaboration between business units.

According to Groh (2004), the cost analysis of the BI project is always more straightforward than the benefit analysis as it is usually associated more with the selected solutions architecture (hardware and software) and the implementation plan, which defines resource and time requirements.

In figure 17 it is described how the cost identification is performed based on the set requirements, priorities, budget constraints, current IT architecture and chosen BI solution architecture as well as based on the phased implementation plan.

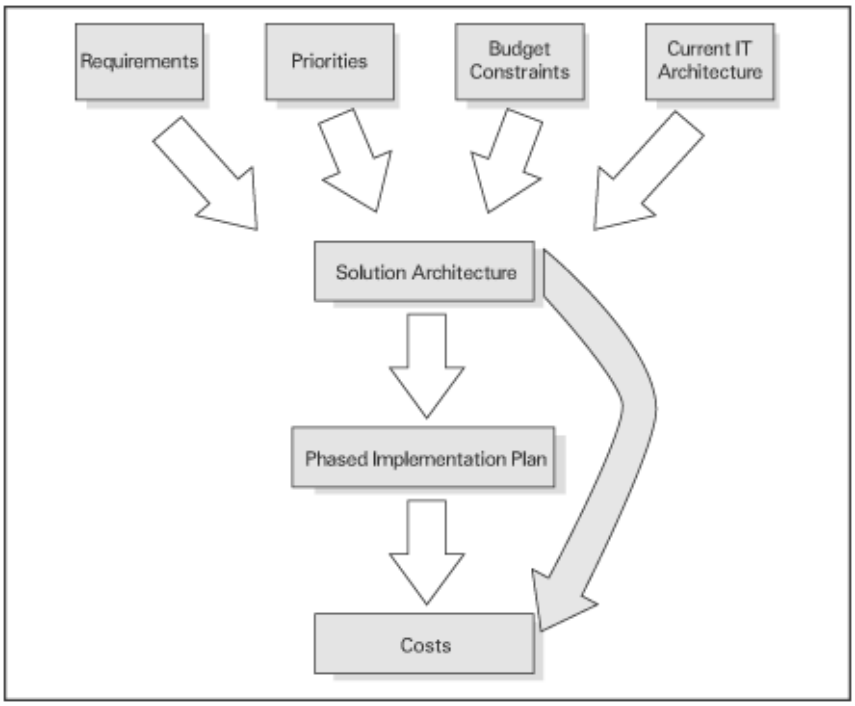

Figure 17. Project planning components and total costs (Groh 2004)

Groh (2004) identifies two cost components – initial and recurring. Initial cost components refer to the cost of the software, hardware, internal and external labor costs and training, while recurring cost components are related to support and maintenance of the BI solutions. Figure 18 shows an example of the format to identify external and internal labor costs based on the roles of the employees involved in the implementation.

	Internal			External		
Required Roles (initial)	Hrs.	Cost Rate	Total Cost	Hrs.	Cost Rate	Total Cost
Project Manager		$ –	$ –		$ –	$ –
Business Analyst(s)		$ –	$ –		$ –	$ –
Technical Lead/Solution Architect		$ –	$ –		$ –	$ –
Data Modeler(s)		$ –	$ –		$ –	$ –
ETL/Database Specialist(s)		$ –	$ –		$ –	$ –
Front-End Tool Specialist(s)		$ –	$ –		$ –	$ –
Stakeholders/Bus. Subj.-Matter Expert(s)		$ –	$ –		$ –	$ –
IT - Network/Administrator(s)		$ –	$ –		$ –	$ –
IT - System/DB Administrator(s)		$ –	$ –		$ –	$ –
Subtotal Labor Costs			$ –			$ –
Total						$ –

Figure 18. Calculation of external and internal labor costs (Groh, 2004)

Training costs should include training for the BI solution's administrative staff as well as training for the end-users.

3.2.2 Financial analysis for project justification

Hopkins (2007) mentions that calculating the value of the BI solution to be implemented is difficult due to the fact that it equals to calculating of the value of the potential information which is unknown – there is some value of the investment, the company has a rough idea of what it is looking for, but the real value of the information and its amount will be determined only after the investment is made. Thus, in the case study that the author is describing, the BI implementation project was divided into smaller cascading stages where every next stage depended on the successful implementation and valuable payback of the previous stage. In this way the investment is easier to justify since the organizations gain their results from the very first successfully implemented stage.

As mentioned by Groh (2004), one of the most common financial tools to calculate the payback of the project is return on investment (ROI). It allows assessing the benefit of the project and comparing its initial cost with the net present value (NPV) of the future gains or savings achieved as a result of the investment. NPV allows determining the value of 1€ one or several years from the date when the calculation is made taking into account the discount rate or investment yield rate for the organization (Groh, 2004).

Besides ROI, the payback period is also widely used to calculate the number of years which are required for the project to compensate the investment. The payback period takes into account the initial investment divided by the NPV of gains and total number of years in the planning horizon (Groh, 2004).

In order to assess different scenarios of project's implementation, the sensitivity analysis can be used. This analysis with the application to ROI allows identification of the gains and risks associated with the project as well as the weighted outcome which should be significantly greater than zero for the project to be worthwhile. The sensitivity analysis usually assesses the probability of the best, medium and the worst cases for the investment and gains or losses associated with these cases (Groh, 2004).

3.3 Vendor selection and data preparation

3.3.1 Platform and vendor selection

According to Howson (2008), tactics for BI implementation and organization – BI vendor cooperation have been significantly changing from the beginning of BI introduction. Previously BI sales of the solution were mostly made directly to the business eliminating a corporate IT department from the interaction. However, nowadays investment in the BI is considered to be more an organization wide investment and, therefore, corporate IT unit is involved in the process due to the expertise and knowledge of the organization's IT architecture and infrastructure.

Howson (2008) mentions that due to the fact that at the moment BI solutions are similar at the surface (in terms of the functionality offered), the key difference between the vendors are represented by their approaches to account management and establishment of the relationships with the organizations. The winning vendor should be "responsive, diligent and should want to understand the customer's challenges, both business and technical – a partner" (Howson, 2008), while the losing vendor can often be "arrogant, unresponsive and disinterested in the project's vision – a problem" (Howson 2008). Thus, a winning vendor should be able to develop partner relationship not only with the business representatives, but also with the corporate IT structure to ensure that both business and technical requirements of the company are taken into account. Howson (2008) suggests some practical recommendations which organizations might follow before and after the purchase of the BI solution.

Thus, before the purchase of BI tools organizations are recommended to (Howson, 2008):

- ask the BI sales person about his experience in the BI field and the industry the organization is in (it is more efficient to cooperate with sales people who have an industry specific knowledge and extensive experience in BI);
- find out how the sales person is remunerated (often sales people are paid on the commission based level after the sale is made which might influence on the quality of the cooperation);

- make clear to the sales person who in the organization makes the investment decision and challenge the expertise of the sales person through cooperation with the business users.

After the purchase of the BI solutions organizations are recommended to:

- schedule the conference calls or site visits in order to discuss the product development, progress and potential problems;
- involve the sales person into internal discussions concerning the impact of the BI solution on the business;
- utilize informal social interaction in order to facilitate the communication and ensure sales person's better understanding of the company's business needs.

As mentioned by Martin et al. (2011) during the BI implementation there is rarely a "green field" situation in terms of the architecture of the BI solution due to fact that it is highly dependent on the organization's general IT infrastructure and landscape. Therefore, choice of the vendor and specific BI solution should take into account these aspects as well. As a rule a software vendor and actual implementer of the BI solution is often the same as only larger companies are able to provide a full business intelligence suite.

Martin et al. (2011) suggests that the best approach to choose the suitable vendor from the short-listed ones based on the market analysis and external reports is to prepare a presentation with the general functional requirements for the BI solution as well as general level architecture of the system. In this way vendors would be able to analyze the requirements, complete them with their suggestions and corrections and provide a proposal with the description of the BI solution.

Figure 19 contains an example of the comparison of current BI solution implemented in the organization and two solutions suggested by vendor based on the following characteristics: implementation design, implementation comments, implementation simulation, transition to the prototype to release I to II, connectivity to data, hardware costs. A circle beside every evaluation describes how fully every aspect is implemented in the current solution and those which are provided by the vendors.

Category	On-board tools	Vendor 1	Vendor 2
Implementation design	• Only static design possible; performance critical	• Through TOOL 1 WYSIWYG the dashboard can be handled	• Possible according to the demonstration; no information given on the interface builder; use of all graphic types possible
Implementation comments	• Use of standard BDS associated with performance issues	• Vendor 1offers functional building blocks for the storing of comments in the SAP BW	• Possible according to the demonstration • Comments can only be used in the machine-three environment
Implementation simulation	• Generally not simulation functionality	• Simulations can be saved; retraction through vendor 1's own functionalities into BW backend	• Possible according to the demonstration; simulations can be saved and retracted into the SAP BW
Transition from prototype to release I to II	• Due to low performance on comments and the illustration of graphs, no usage possible in phases 1 to 2	• Look-and-feel remains the same • Comments and simulation can be executed early	• Look-and-feel remains the same • Comments and simulation can be executed early
Connectivity to data	• Executed on machine one, no export of the cube data needed	• Either DataMart on machine two or WebService on machine one	• According to vendor, it can communicate with SAP BW 3.5 but not demonstrated
Hardware costs	• None	• BOE Infrastructure for LiveOffice and reporting tool (phase2)	• Basic infrastructure on machine one has to be built anew

Full function *Very limited function*

Figure19. Vendors' comparison (Martin et al., 2011)

3.3.2 Data preparation

According to Olszak (2007), the data preparation stage usually follows the vendor selection and precedes the actual implementation and relates to identification and evaluation of the internal and external data sources that will be utilized by the BI systems. Internal resources may refer to the intellectual resources, information technology resources, paper files etc., while external resources may be represented by information provided by customers, suppliers, shareholders etc. During this stage it is important to evaluate the condition of this data and possibilities and approached for its transformation. It is also important to diagnose all information systems that are used at the enterprise from application data to databases and ERP systems.

During the diagnosis it is recommended to take into account the following instructions (Olszak, 2007):

- identify the data in the information systems which is not necessary for the analyses performed by potential BI tools;
- identify relations between data across organization's information systems;
- describe the logical structure of the data taking into account the business processes related to it;

- find data where the errors might be generated due to its inconsistency.

During this stage it may be possible to identify large amount of the useful data that is hidden, e.g. in the Internet resources. This data can be revealed through following manipulations:

- manual searching (when documents are downloaded directly from the sources);
- automatic searching (downloading html documents through specific software);
- querying (using index-based browser search).

After identification and filtering of the data, it is transformed to the homogenous format through ETL technique and downloaded to the data warehouse or a database (Olszak, 2007). However, in some cases BI tool may be only used in the bounds of one department and built based on one specific application. In such situation a BI tool may use the data directly from the application without its transformation or additional processing.

3.4 Employees training

As mentioned by Biere (2003: 47-50.) one of the most important aspects of the BI implementation is related towards employees' training and changing end-users' mindset in terms of the approach towards decision-making process. As the author points out end-users' main goal is to solve data-related business problems by preserving a definite degree of the self-sufficiency during the decision-making process.

The main problem with integration of the BI tools to the daily routine of many end-users is related to the fact that not all of them are technically inclined or have time to learn a tool to the level they need in order to yield a business benefit. Therefore, one of the first aspects that must be defined is the level of commitment, which the end-users are ready to devote towards learning of the tool and completing of the necessary tasks.

As Gibbons Paul (2012) points out that companies often skip the employees' training part – the final step of the BI implementation process. As it is mentioned by the author further companies often ask their vendors to provide training for the BI tools, however,

the main mistake is that the training is performed too early – several months before employees are actually starting to use the tool. Therefore, by the time the staff starts using the tool, they might forget technical details and guidelines.

Moreover, before performing actual training companies need to change employees' attitude towards data sharing and trusting the data generated by the BI tool. This perception should be changed based on the initiatives from the top and encouraging the employees to become more open with the data (Gibbons Paul, 2012).

Another problem related to BI employees training is that often companies fail to set the BI solution in the context of the employees' daily tasks. Thus, employees may be able to understand the functionality and technical characteristics of the tool without having a clear idea how results generated by the tool might impact on the company's performance and efficiency of their job. The same problem is related to the corporate IT support department – while having technical and functional excellence of the implemented BI solution, IT staff might not be able to help the business user to use BI tool in the context of his duties (Gibbons Paul, 2012). Thus, Gibbons Paul (2012) mentions that the most efficient training is two-hours training sessions for groups of business users from the same area during which company's own data is used and graphical representations of the data are explained. Such training sessions must be distributed among the certain period of time during initial stages of the implementation of the BI solution are business users must be given an opportunity to ask questions throughout this period.

Biere (2003) mentions that during the implementation and employees' training stage, organization must take into account several end-user provisions in order to facilitate integration and training processes. Thus, among these provisions it is worth to mention the following:

- Training schedule (it is not recommended to involve "novice" users into initial training stage);
- Users' documentation and sharing strategies (it is important to know how end-users will manage their work with BI tool and ensure that the rest of the involved employees in the enterprise are able to understand that);

- A list of the specific, initial output (it is important to have a specific list of the required output (e.g. outlines of the reports) for every business end-user of the BI tool);
- The support structure and the processes in place (ensure that users understand the process if an issue about support arises and are strictly following the process steps);
- The plan for possible failure (assess alternatives that should take place in case users do not follow the steps related to fixing of the support problems).

3.5 Ethical and legal issues

As mentioned by Turban et al. (2011: 265), business intelligence and predictive analytics can lead to serious issues related to ethics, accountability and privacy. Based on the results generated by the BI tools incorrect decisions may be made which may lead to considerable damage of the company's reputation and business performance. For example, an advice of the expert system may concern unethical or even illegal actions. Besides that, automation of the managers' jobs may lead to massive layoffs.

One of the major legal issues is related to the liability of the results generated by BI tools. Thus, Turban et al. (2011: 265) provides an example of who should be liable if an enterprise goes bankrupt as a result of using BI software:

- The enterprise itself for not testing the BI solution properly?
- Auditing and accounting firms for failing to apply adequate auditing tests?
- Developers who have been preparing and implementing the BI project?

Among other questions referring to the consequences of the BI systems, companies should consider the following before implementing a business intelligence solution (Turban et al., 2011: 265):

- Who is liable for the wrong advice or information provided by an automated BI system if the manager accepts an incorrect diagnosis made by BI and makes a decision which has a negative impact on the employees?
- What happens if a manager enters an incorrect judgment value into a BI system and the result is a large damage to people and/or companies?
- Who owns the knowledge in a BI knowledge base?

- Can management force manager to use a BI system?

As pointed out further by Turban et al. (2011: 265-266), privacy is also one of the important ethical aspects related to BI. "Privacy is the right to be left alone and the right to be free from unreasonable personal intrusions" (Turban et al., 2011: 265). In relation to business intelligence, privacy may be jeopardized in cases of collecting the information about individuals, the web and information collection and in case of mobile networks.

Thus, implementation of the BI solutions may require collecting of the data about individual employees or customers. The Internet in a combination with large-scale databases, data warehouses and social networks has created a totally new dimension for accessing of the individuals' data. In general due collecting of the private data with its matching to the computer information can help organizations to fight the fraud, crime, corporate mismanagement etc. However, on the other hand it can be argued whether it is ethical or legal to collect the private information about the employees or customers.

Nowadays the Internet offers various ways to collect the personal data (Turban et al., 2011: 266):

- by reading individual's social network profile and postings;
- by looking up individual's name and identity in an Internet directory;
- by reading an individual's e-mails, blogs or discussion boards postings;
- by asking an individual to complete Web site registration;
- by recording an individual's actions as he or she navigates the Web with a browser, using cookies or spyware.

Single-sign-on facilities let users enter their account information and passwords once and use it in order to sign in to multiple services. Some experts claim that such services may work in the same way as cookies and impact individual's privacy. Thus, implementation of the business intelligence solutions may also increase employees' concern in terms of privacy of the information. These fears need to be addressed by the organizations during the implementation of any BI project (Turban et al., 2011: 266).

Turban et al. (2011: 266) mentions that many users are unaware that their private information is being tracked through mobile personal digital assistants (PDAs) or cell phone use. For example, some companies are tracking locations of the cell phones via GPS-enabling devices or via transmitting of the information at Wi-Fi hotspots. This data can be used in BI analysis, which is also the violation of the individuals' privacy rights.

Thus, the main ethical issues that should be taken into account while implementing the BI project should include the following (Turban et al., 2011: 267):

- electronic surveillance or tracking;
- ethics in BI design (code of ethics for developers);
- invasion of individuals' privacy;
- use of proprietary databases;
- use of intellectual property such as knowledge and expertise;
- accuracy of data, information and knowledge;
- accessibility to information;
- use of corporate computers for non-related purposes (employees' personal information may be tracked through the Internet and, thus, may have a negative impact to private data of the company);
- how much decision-making should be delegated to computers.

4 BI implementation at the case company

4.1 BI solutions at the case company

At the moment Company A has implemented the following solutions related to the business intelligence:

- Company A Data Warehouse (created based on the solution provided by Teradata);
- SAP Business Warehouse;
- SAP Business Objects (standard, ad-hoc query and analytical tools);
- QlikView (BI tool for in-memory analysis and reporting solutions);
- Cognos (BI tools for reporting, analysis and dashboards based on OLAP technology);
- Tableau (BI tools for reporting, analysis and dashboards, data visualization, interactive dashboard capabilities and BI self-service capabilities).

The figure 20 represents a distribution (intensity of utilization) of the BI tools mentioned at the company. All together the BI tools serve more than 5000 end-users and more than 325 customer applications across different organization's departments.

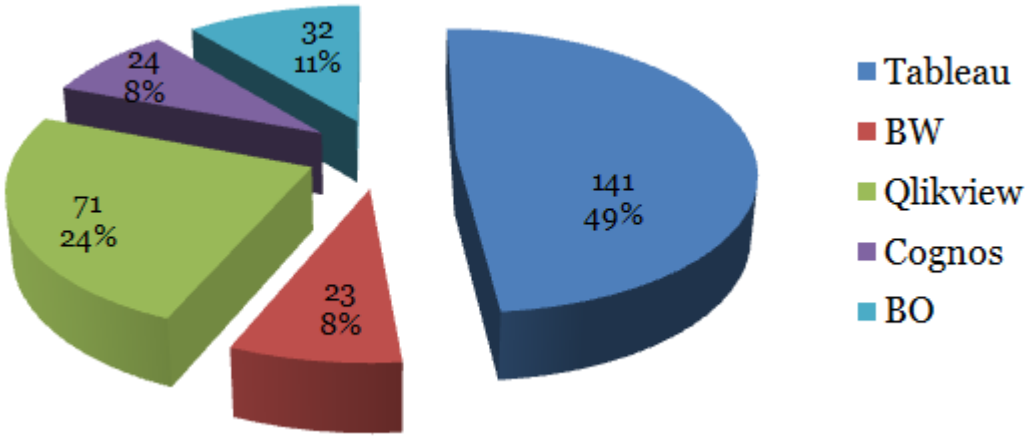

Figure 20. Customer application per BI tool (Company A, 2011)

The reason of utilization of several various BI tools instead of one generic tool is that they all have different functionality and characteristics and, therefore, serve various needs of the organization. In figure 21 the evaluation of the tools based on three

characteristics (enterprise reporting, dashboards, interactive analysis, data exploration and visual discovery) are shown (2 – less developed functionality, 5 – most developed functionality).

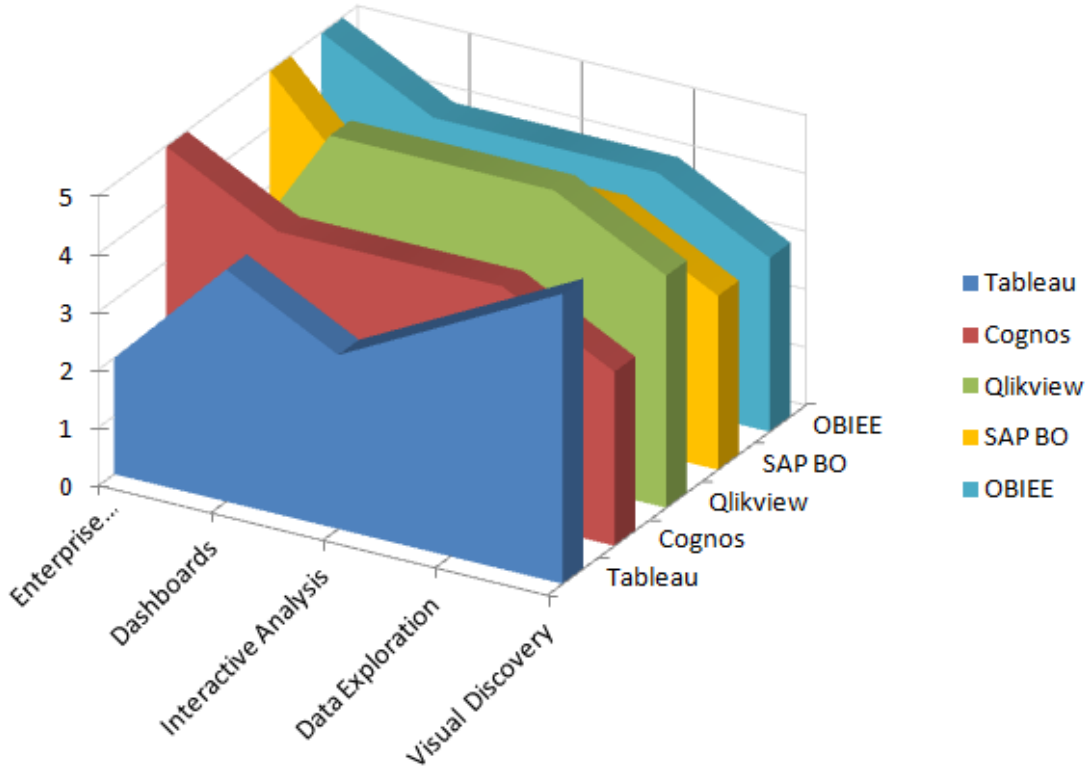

Figure 21. Evaluation of BI solutions' capabilities (Company A, 2011)

Thus, according to the figure 21, enterprise query and reporting is performed to the higher extent by means of Cognos, SAP Business Objects and Oracle solutions (OBIEE, used only in the financial department), dashboards are implemented for most users by means of Qlikview, interactive analysis is mostly performed by Cognos, Qlikview and Oracle solutions, data exploration and search is realized by Tableau and Qlikview and visual discovery is implemented based on the Qlikview as well.

Company A made considerable investments throughout its operation and at the present moment owns solutions listed (including support plans from vendors according to which updates to the solutions are provided automatically). Company A contentiously develops and implements business intelligence projects which are built based on the existing software. Thus, at the present moment there are up to 20 business intelligence projects which belong to the responsibilities of the Corporate

Information and Data department and up to 20 other projects which are run separately in various departments managed by internal IT support staff of the specific department. Financing of the business intelligence projects is performed either in the centralized way or by separate departments which have their own budgets.

4.2 Results of the interviews

During the interview one of the business intelligence projects of the company was analyzed. The project "Point of sale" is related towards development and implementation of the business intelligence solution for the sales and marketing department of the company. The business need behind the project is to develop methods to retrieve the information about sales of the specific product model in various points of sales of re-seller, process this information and apply a BI tool which will help to identify sales patterns dependent on the store's geographical and socio-environmental location. This information will be the basis for the local marketing team to identify the effectiveness of the marketing campaigns performed in this area and modify them in case of lower sales level or other aspects identified by the BI system. The project is carried out in the customer logistics department and capability management department, which serves as the intermediary between the end-users and the implementation team.

Further analysis of the results follows the list of questions which were prepared for the interview and which can be found in the Appendix 2.

At the beginning of the implementation process Company A assessed the business environment and identified the need for the implementation of the new BI solution. Company A collected business requirements and defined the goal for the implementation which represented the aim to establish visibility to inventory and product flows (sell through and sell out) within sales channel. Assessment of the IT environment was not performed beforehand which led to definite complications with the data integration process described further in this chapter.

During the next step, the business justification of the project was made by performing business value estimation based on business owners' (multiple stakeholders) view.

Identification and verification of the qualitative and quantitative benefits was performed during the project's business justification stage. The main impact on the decision-making process and value for the company resulted from the implementation of the BI solutions is improved speed of the decision making and increase of the information transparency access function. The next steps in the implementation planning were related to identification of possible gaps in terms of the people and skills. Thus, project implementation did not require any organizational changes or business processes' re-engineering; changes were related only to the roles and tasks of the involved persons.

The project planning activities included the steering group meetings and discussions where project governance, scope and communication practices were defined as a part of approval of the project's milestones. As soon as the cost calculation was performed, the operational owner/business owner was identified and business benefits (value) were documented. Exception management and reporting and escalation procedures were defined and agreed.

Due to the fact that the BI systems have been already implemented at the company (see chapter 4.1), current project is being built based on one of the already implemented solutions. Thus, the actual data will be processed by one of the systems called Informatica and stored in Conmpany A data warehouse. The business intelligence solution will be developed internally by the employees of the Corporate Information and Data department (BI and reporting team) and built on the basis of the QlikView BI tool.

As mentioned above, the main business need and goal, which were driving a company to implement this business intelligence solution is to be able to generate the information about sales of the specific mobile phone model in order to analyze and adjust marketing campaigns in the local area of the re-seller. Selection of the vendor and specific BI software for the project was performed based on the most commonly used software in the current business unit which is QlikView.

Due to the complex organizational structure of the Company A, there are three parties which are involved in the planning and implementation of the project:

- End-users: business unit's users in another location.
- Customer logistics department: since the project is related towards location information it is labeled as logistics project. Company A has a separate IT department for every business unit (e.g. logistics, marketing and sales, finance etc.), which deals with IT support and projects for these business units. Thus, when there is any need in new IT solution to be implemented, users of the business unit address the IT department of this business unit.
- Corporate information and data department (reporting and business intelligence team): due to the fact that current project is related to business intelligence, customer logistics department is cooperating with corporate information and data department for development and implementing of the project and serves as the intermediary between the end-users of the business unit and actual implementation of the BI solution.

Requirements for the project were collected in the form of the workshop, which was organized with the participation of the customer logistics department which collected business needs and functional requirements from the end-users and a business intelligence implementation team. Customer logistics department introduced the functional requirements and mock-ups (layouts) of the future reporting system to the Corporate information and data department for its consideration and commenting. Definition of the final functional requirements is performed as the teamwork and approved by all parties.

One of the main challenges of the project is to organize the proper data integration since the data which is required for the BI solution is provided by the re-seller. Thus, as it was defined during the working processes of the project, the data will be transferred to the Company A via EDI (electronic data interchange), transformed by the Informatica system and loaded into Company A's data warehouse. The interviewee mentioned that every new BI or reporting project should follow company's guidelines or best practices in order to ensure consistency of the information and the common structure of the reports.

Employees training for the project will be carried out by utilization of the "key-user" method. Thus, one of the users of the business unit (business analyst) where the

project is being implemented will be trained for the developed business intelligence solution. This user will be responsible for the training of other employees in the business unit. Training plan created including training scope, material and target group and other aspects. The issue that the company might face is the ability of business users to participate in trainings due to other, multiple or parallel tasks.

One of the main ethical issues related to the current project, which were mentioned during the interviews, concerns the privacy problem – collecting of the information due to which the identity of the person who purchased a mobile phone can be identified. In order to avoid violation of the privacy, Company A is making a public promise that no personal information will be utilized by the company for any purposes.

Among main reasons of failures of the business intelligence projects the interviewee mentioned as the most important ones cost and time constraints as well as lack of cooperation between the departments. For example, it is important for all parties to understand who exactly is the responsible person for the current project and who possesses enough business related information to give justification to the project, who understands the business goals and impact on the decision-making process as well as the architecture of the BI solutions.

4.3 Assessment of BI implementation at the case company

Current chapter addresses aspects of the efficiency of the BI implementation process at Company A and compares company's practices and problems faced with the common theoretical frameworks of BI implementation planning process and typical managerial aspects of implementation described in chapter 3. The implementation planning process of the BI project at Company A can be best related to the BI implementation framework suggested by Groh (2004), which was described in chapter 3.1. During the first step of assessment of the business environment, the internal customers in cooperation with the customer logistics IT department evaluated the business environment and defined the need for development and implementation of the new BI solution which would help the marketing department to analyze the "point of sale" information related to specific product. However, according to the information provided during the interview, the company skipped the second stage of Groh's model,

which refers to the assessment of the IT environment of the organization. Due to this, during the process of the implementation, company faced problems with transformation of the data from the format provided by re-seller to the standards of the company. The fact that another intermediate system (in particularly, "Informatica") was required to perform the data transformation lead to additional project's costs and increased the time of the implementation. If the company were able to assess own and re-seller's IT environment in the beginning of the project as suggested by Groh (2004), the time of the implementation could have been optimized.

As suggested by Groh, the third step in the BI implementation process should concern collecting of the business requirements and objectives. In case of Company A, the goals for development of the new BI system were set by the top-management, not by the need of the actual end-users of the system. In this situation the decision to implement a BI system for the business function in question ("point of sales") did not take into account a critical analysis of the need for this system by the end-users, who represent the field experts. As a recommendation for further projects it is suggested for the company to implement workshops between management initiating the BI implementation process and end-users as proposed by Groh (2004) in chapter 3.1. This practice will allow determining realistic objectives for the BI system to be implemented and align them with the corporate goals clearly identifying in this way the impact of the implementation of the BI project for current business unit on the whole organization.

Functional requirements for the BI system were collected in cooperation with all three parties involved in the project – end-users, intermediate customer logistics IT department and the BI implementation team, which can be described as an efficient way of collecting the requirements due to the fact that it allows two-way communication between parties. Thus, while representatives of the end-users provide clear set of requirements concerning functionality of the system, the implementation team possesses technical knowledge about feasibility of the BI solution and can advise business users whether their requirements can be implemented. Moreover, the benefit of the implementation team being completely aware of the business requirements (not just of the set of the functionality), allows the team to evaluate the business needs from another prospective and suggest improvements or recommendations.

The main divergence of the BI implementation process at Company A from the model of the implementation process suggested by Groh (2004) refers to the position of the BI project's justification step in the implementation process as well as to the characteristics of this justification. Thus, assessment of the quantitative and qualitative benefits from the BI system to be developed has been performed at the beginning of the implementation which also corresponds to Groh's model. However, Company A completely skipped the process of the cost identification that represents two last steps of the model.

A common practice at Company A is that projects are financed either by the department itself or centrally by the decision of the top-management as it was in this particular case. Thus, department of the end-users possessed a limited budget for the implementation, but did not initiate any cost analysis (as described in chapter 3.2) in addition to the analysis of the benefits. Initiation of the cost analysis could have helped the Company A to identify expected costs of the project and optimize the model of the BI system in order to achieve the most optimal result for efficient return on investment. A possible explanation for skipping of the cost analysis can be referred to the fact that Company A represents a large organization and if the project is financed centrally, it is not trivial to show the clear impact of the particular project on the whole organization. Thus, as a recommendation for further BI projects it can be suggested that the financing of the project could be preferably made on the department level rather than centrally as in this case it gives the possibility to clearly assess the necessity of the BI implementation and define the benefits and investment justification of the BI project. The cost analysis can be performed based on the project outline provided in appendix 1. Application of the sensitivity analysis (mentioned in chapter 3.2.2) could have provided a clear understanding of how critical implementation of this BI solution is and what could happen if the solution is not implemented.

During the planning phase of the current BI project Company A assessed the architecture of the future BI solution by identification of the data transformation needs and choosing of the BI software. The choice of the software as mentioned in chapter 4.1 was made in favor of the most commonly used BI software in the department - Qlikview, one of the multiple systems that the company runs also for legacy reasons.

The fact that company owns BI packages gives it among other advantages also more flexibility and independence from vendors during the implementation. The company should have complemented this process with suggestions provided by Martin et al. (2011), who introduced the vendor selection approach explained in chapter 3.2.1. At the moment Company A is using four BI vendors for its internal operations and the vendor for this particular project could have been chosen based on the assessment framework provided by Martin, rather than based on the fact which vendor is more commonly used in the department. As mentioned in chapter 2.5.7, even though most vendors have similar functionality for their BI solutions, specific functions might be represented better by some vendors and worse by others. A detailed per function analysis could possible allow the company to identify which vendors are more suitable for the project and possibly also re-assess reasons for utilization of the some vendors for other business functions in the same department.

One of the main challenges of the BI projects including the current one refers to the efficient organization of the employees' training process. Thus, as discussed in chapter 3.4, not all of the employees are technically inclined, which might lead to complications related to utilization of the BI tools. As pointed out in the description of the case study, the main approach for the employees' training which are used by the Company A includes assigning a "key" user for a BI system, who is acting as the intermediary between the technical team and the end-users and is able to solve problems related to the usability and technical aspects of the tool. Besides this, Company A also will develop the training material and instructions for the BI system for the current project which will also facilitate the training process. However, it could be recommended for the customer logistics IT department that is responsible for management of the current project to organize seminars or presentations for end-users explaining the need for the new BI solution to be implemented or its general functionality. In this way the end-users will be more prepared to apply the BI solution in their daily work and understand how the efficiency of their tasks could increase with this implementation.

As a conclusion, it is also worth to mention that the company might have used a different approach for the BI implementation and suggested a prototype of the system (a working solution with limited functionality) for the end-users during the early stage of development. This practice could have given the users a possibility to integrate the

system in their daily tasks as soon as possible and for the implementation team to evaluate the reaction of users to the system and address possible problems gradually.

Some of the most significant problems the Company A faced during the implementation is the lack of cooperation, inefficient information flow between parties involved in the implementation process and neglecting of the implementations schedule. Thus, Company A has approved the project planning documentation as well as the milestones of the implementation during steering group meetings. However, during the interview it was not completely clear who is the project manager of the current BI implementation project and who should monitor the process and ensure that the implementation is done according to the schedule. Even though the functional requirements for the BI system have been collected and discussed during team meetings, the technical implementation team did not possess enough information about the business reasons which were leading the company to integrate the new BI solution. As discussed earlier, such unawareness might influence significantly on the quality of the communication between the parties as well as on the choice of the optimal solution.

Another problem refers to the fact that Company A does not have a standard procedure for execution of the BI projects. For example, as mentioned during the interview, cost justification of the project is a selective process and can be skipped depending on the project. However, the main issue with such flexibility is that the company needs to have a concrete algorithm, which would determine what kind of projects require the cost justification and which do not. It could be recommended to set official rules which clearly explain the procedures and actions during the implementation process concerning the cost analysis. For example, it can be defined that only those BI projects, which require significant investment or the implementation of which influences significantly on the decision-making process require cost justification.

Finally, it was mentioned during the interview that the company possesses the set of "best practices" of BI implementation based on the earlier cases, which contain standards for reports and guidelines for implementation. However, for this particular BI project no guidelines or standards were applied. For further projects it could be

recommended to prepare case studies which would contain critical analysis of the "lessons learned" for every BI project implemented.

5 General recommendations for BI implementation

Current chapter suggests general recommendations for the BI implementation based on the published practices and analysis of the experience of the case company. Thus, based on the analysis in chapter 2 it is possible to conclude that the field of BI solutions is not a young industry, but it has developed and transformed considerably over the past decades and had technological advances; this is perceived to continue and will keep on challenging both customers as well as the vendors. There is limited amount of literature concerning the managerial aspects of BI implementation which leaves a considerable room for consulting companies and independent researchers. Managers should systematically track the results from all stakeholders and lessons learned of past projects as well as any industry case studies. The mainstream vendors have been consolidating into large corporations - raising the supplier power especially with regards to SMEs which may find it difficult or costly to implement any BI solutions (i.e. key customizations) that is not part of the standard product offering. These BI tools should however be adapted to business processes of the organization or needs and not vice versa (when due to implementation of the BI solution the re-organization of the business processes of the company is performed). While the "green field" situations of the BI implementation are exceedingly rare and companies implement BI solutions based on the existing IT infrastructure (for example, the Company A), managers should keep an open mind with the business needs versus current capabilities.

5.1 Suggested implementation process model

As mentioned in previous chapters, one of the crucial stages during implementation of the BI solution is the project planning stage. During this stage it is important not only to assess the IT environment as suggested by Groh (2004), but also identify intangible business benefits for the organization and communicate the findings to the management in order to ensure thorough understanding that considerable investments will gradually pay off. In general, the BI implementation process suggested by Groh (2004), which is discussed in chapter 3.1, can be criticized in terms of the sequence of the stages and too general description of the actions, which are supposed to be performed during every stage. For example, Groh (2004) suggests that the justification

of the BI implementation in the 11-staged planning process provided by the author should be done as a last step. However, placing the justification to the last position in the planning process may impact negatively the perception of the top-management concerning the relevancy of the whole project. Management needs to have a clear understanding before proceeding to the technical requirements and details what kind of business benefits the BI tool may bring to the organization, how it can facilitate business operations of the company, how much this could cost to the organization and what is the length of the payback period. Thus, even though cost-benefit analysis is impossible to perform without having at least the rough architecture of the BI solution and expertise required for implementation and vendors' assessment, business benefits and costs of the investments should be addressed first when communicating the results of the project planning to the management. However, it is important to remember that stakeholders, for whom the project planning paper is prepared, may be different. For example, in case if the project plan is presented to the CFO (Chief Financial Officer), costs justification is one of the highest priorities, while if the stakeholder is the CIO (Chief Information Officer), the architecture and implementation aspects are more important.

The implementation planning process suggested by Martin et al. (2001) does not pay enough attention to the division of roles of the parties involved in the implementation process and does not point out on which stage the employees training for the prototype should be carried out. Therefore, in order to combine the benefits of two models, a corrected implementation process is suggested. Users which are involved in the implementation process in the current model are identified as end-users, higher level management and implementation team (internal BI implementation department or vendor). The chart of the implementation algorithm is represented in appendix 3.

Thus, it is suggested that the implementation process is a sequence of 14 steps performed one after another with two possibilities for reiteration on the stage 5 and 12. Besides the sequence of the implementation steps, the model also contains the distribution of the roles among parties involved in the BI implementation process.

During the first stage the end-users or field experts in cooperation with the higher level of management define the need for the BI implementation and set clear goals, which

the BI system is expected to achieve. Further, the end-users as they are most familiar with the business functions of the respective group define the benefits, which the implementation of the BI system will bring to the organization as the whole and to the business unit, where it is implemented in particular. Besides benefits, the field experts also evaluate needs for business process re-engineering (performance of the organizational changes, distribution of the user roles etc.) and assess the risks associated with the implementation of the BI system. The risks can be assessed by means of the sensitivity analysis introduced in the previous chapters.

As soon as the benefits and risks are outlined, end-users / field experts in cooperation with the actual BI implementation team (business analysts, technical staff) collect the functional requirements for the system. In the best scenario requirements should be collected during team sessions organized as the free-flow discussion with the substantial amount of the advanced preparation. As soon as the functional requirements are collected, the BI implementation team chooses the BI system's architecture and evaluates the feasibility of the technical implementation of the system. If the BI system's model based on the current functional requirements and with the chosen vendor / architecture cannot be implemented, the team should return to the stage of the identification of the functional requirements and repeat the same steps. When it is defined that it is possible to implement the system based on the chosen characteristics, field experts and the BI implementation team prepare BI solution proposal, which includes description of the system's functionality, technical characteristics, analysis of the choice of the vendor, action plan of the implementation and milestones. As soon as the proposal is ready, the cost-benefit analysis is performed and return on investment (ROI) for the project is calculated and compared with the disposable budget. For the cost-benefit analysis it is suggested to use the template recommended by Biere (2003), which can be found in appendix 2. Results of the financial analysis are added to the BI solution proposal, which is further being approved by the involved parties and the higher level of management.

Upon approval of the proposal, work on the project is initiated according to the action plan and the prototype of the system is created. Further, the prototype is being integrated into the respective business unit and the employees training is being carried out. It is recommended to use the "key" user approach for training as well as provide

constant support for the end-users by the implementation team. After implementation of the prototype and in the process of the utilization of the prototype by the end-users, the feedback regarding the functionality, technical features, usability of the system and other aspects is being collected by the implementation team. The initial period of the first prototype's utilization is defined by the implementation team. In the end of this period the prototype is being improved based on the feedback of the end-users and technical analysis of the system's work. This stage can be repeated several times until the BI solution is improved to the extent which meets the initial requirements set in the BI solution proposal. When the prototyping stage is completed and BI solution is fully integrated, the permanent "key" user is assigned to the system along with the permanent technical support team.

The final stage of the implementation process should be associated with preparation of the critical analysis of the implementation and creation of the so-called "business case" based on the project. This practice is necessary in order to analyze the problems and issues the implementation team and the end-users faced during the project and file the "lessons learnt" for the future reference. The complete algorithm of the implementation process is provided in appendix 3.

5.2 Other recommendations and guidelines for BI implementation

As was mentioned earlier, in large organizations one of the main problems is to ensure the efficient communication between all parties involved in the business intelligence project across business units. The lack of communication and understanding of the business needs by the IT support department may lead to increased project time as well as to inefficient or not optimal architecture of BI solution or other implementation problems. For example, if the IT support department is informed about the business needs behind the project beyond the functional requirements provided by the end users, it may help to identify bottlenecks or areas for improvement related to functionality, design or layout of the reports. This can positively influence on the cost and time variables of the project as well as increase the efficiency, with which a business unit will be solving tasks with the help of the BI tool.

Cross-departmental expertise is also crucial in the definition and implementation process (to avoid a common problem of poor pre-project research and lack of understanding of the organization's information needs), as demonstrated also by company A emphasizing both the role and the need for close interaction of the corporate IT function as well as business unit-specific experts for data identification, selection and preparation. Thus, from project implementation point of view, managers need to ensure that the gathered requirements and roles of various stakeholders should be made explicitly transparent. For example, Company A runs the risk of much confusion in the case project as such knowledge is not successfully communicated. Therefore, it is recommended for the organizations (especially, for organizations of the large scale) to implement efficient rules of the information flow and in-project communication for all parties involved in the implementation.

All parties involved in the project should carry out detailed project scoping, planning and multidimensional (matrix) vendor analysis. It is suggested that the best vendor should be considered as the one not with the lowest cost, but rather the partner who is most responsive, able and willing to support the project (however, with reasonable costs). Therefore, development of the partner relationships with the vendor should be the priority for the BI implementation as it is one of the most crucial factors in success of the implementation process.

As mentioned earlier the costs for BI implementation is not always trivial to estimate as BI provides intangible benefits. Therefore, managers should keep in mind the benefits as the primary starting point and need to carry out detailed analysis in order to quantify the benefits to the extent that the project can be justified. Even though there are both quantitative and qualitative aspects of the benefits which BI solutions bring to the companies, sensitivity analysis and implementation in cascading steps are good practical tools to help define and verify benefits while managing the risk and cost associated. It is also important to communicate the costs to all parties involved in the implementation process including the corporate IT department if the company owns its BI platforms. Thus, if the internal IT department (BI implementation team) is provided with the cost-benefit analysis (even though the department does not make financing decisions), if this information is processed by them, some more optimal options for the BI system may be found.

No matter how good the system is, it is worthless unless the users know how to use it and actually understand why and how it works to support the business decisions in the context of their daily business tasks. The emphasis on training must not be ignored due to perceived time or skills conflicts. Managers should make it be an ongoing and timely process instead of one-time vendor organized training several months before the BI solution is integrated into daily business utilization. A good practice of assigning a key user that maintains the training process and user involvement is suggested to be implemented by the organizations.

Ethical and legal issues are challenges that managers need to be aware of and track closely especially in global companies, where the operating environments, rules and regulations vary considerably. In current conditions of the global Internet access there is more data available than during past years, which is both a challenge as well as an opportunity depending how this data is retrieved and used by the companies. Ethical and legal aspects concerning automation of the decision-making process and utilization of the automatically generated recommendations and suggestions should be also closely considered by the companies in order to avoid any legal problems in the future. Therefore, it is suggested for the companies to evaluate the consequences of automation of the decision-making which might influence on the business operations. Such evaluation may be performed by means of identification of the benefits and risks of the automation and considering "what if" scenarios (defining critical situations, which might arise from the automation of the decision-making process).

6 Conclusion and analysis of the research results

The main objectives of the current research were related towards performing a detailed overview of the evolution and current situation in the field of BI solutions (in correspondence with the business benefits that these solutions are expected to provide), analyzing most demanding aspects that companies face during the implementation of the BI based on the secondary and primary research (interviews with the senior reporting manager and customer logistics manager at a large telecommunications company) and based on the results of the secondary research and outcomes of the interviews, generate best practices and guidelines that can be used by managers responsible for BI implementation in order to avoid problematic situations during implementation.

As a result of the research process main managerial aspects of BI implementation were identified based on the published theoretical sources. In order to illustrate the implementation process on the real example, a case study with a large telecommunications company was performed and the implementation process was analyzed and assessed in terms of the planning, execution, end-users training and problematic aspects, which occurred during implementation and recommendations for the company were provided. Based on the theoretical overview and the case study, a corrected BI implementation model, a combination of presented by Groh (2004) and Martin et al. (2011), was developed (see appendix 3). Additionally, recommendations concerning organization of the information flow, employees training, identification and prevention of legal and ethical issues were generated.

As mentioned in chapter 1.1, main limitations of the current research refer to the data accuracy problems of the second data sources used for the theoretical overview as well as to the scope of the research. Thus, information collected during the case study limits the possibility to outline general recommendations for the large organizations regarding implementation process due to the fact that only two interviews in one case company were performed. In order to increase the accuracy of the general recommendations, further research can be undertaken and several case studies should be considered. This will give the possibility to compare practices in different organizations between each other as well as with already published cases and make

conclusions concerning similarities and differences of their BI implementation process. Moreover, for further research it is suggested to compare companies operating in different industries and knowledge domains in order to identify whether there are any specifics, which can be attributed to various industries. Moreover, it is suggested to consider organizations of different scale – SMEs in addition to the large companies in order to compare the implementation process and define what kind of aspects in BI implementation are more important for organizations depending on their size. For example, as mentioned in the previous chapters of the current work, smaller companies are more likely to have "green field" situations of the BI implementation and tend to cooperate with the BI vendors more (as opposed to the larger organizations), since they do not possess enough skills and resources in order to carry out the BI implementation process internally.

For possible further research it is suggested to use an unstructured interview as the research method in order to achieve the free-flow discussion, as a result of which additional information can be revealed and managerial aspects of the BI implementation that were not addressed in the current work can be identified. Additionally, for the further research it is suggested to involve BI vendor companies in order to obtain a different perspective of the implementation process and confront it with the perspective of the organizations, which implement the BI solutions in their operations. In this way a complete picture of the implementation process can be achieved. Moreover, further research might consider in more details all managerial aspects mentioned in the current work.

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Appendix 1. Typical BI project outline

Table 2. BI project outline (Biere, 2003: 128)

Project Information
- Project name:
- New project (y/n):
- Description:
- Executive sponsor:
- Budget and cost owner:
- Scope of the project (departments or key business areas):
- Benefits expected from completion (new application, reporting, etc.):
- Checkpoints established? Describe:
- Incremental revenue expected:
- Proof of concept involved (y/n)?
  - If yes, provide details
    - Total estimated ROI:

Vendor and Technology Cost Information
- Vendor solution proposed:
- Cost and type of software:
- Maintenance:
- Cost and type of hardware:
- Maintenance:
- Savings from displaced HW/SW:
  - Total estimated vendor costs:

IT and Support Cost Information
- Implementation team:
- Budgeted (y/n):
- Time estimated to implement:
- Estimated cost to implement:
- Estimated ongoing support cost:
  - Total estimated IT costs:

End-User Cost Information
- Implementation team:
- Estimated cost of training per user:
- Number of users:
  - Total cost of user training:
- Support costs (departmental specialists, etc.):
  - Total estimated user costs:

- Total ROI:
- Total Costs:
- Net Business Benefit:

Appendix 2. Case study questions

Company's information

1. Brief information about the company:
    a. name and field of operations;
    b. size of the company/department/number of users utilizing BI solution;
    c. interviewee's title and role in the organization.
2. Information systems used in the organization (before and after BI implementation).

BI system's justification and reasons to implement

3. Information about the BI solution implemented in the organization.
    a. vendor and type of the system;
    b. BI system's functionality;
    c. organization's departments covered;
    d. data sources used (data warehouse, ERP system etc.).
4. Which reasons lead the company in the decision to implement BI?
5. How the justification of the BI system integration was performed (cost-benefit analysis, assessment of the intangible benefits, balanced score card with metrics for indicators development)?
6. How the vendor selection was performed (several vendors considered)?
7. Was the implementation of the BI solution related to any changes in business processes in the organization (e.g. less employees required for reporting tasks)?

Issues of the BI implementation stage

8. What kind of project planning activities were carried out for BI implementation?
9. Was the prototype of the system prepared?
10. In which way were the information needs for the BI system identified and data sources evaluated?
11. How integration of the data sources was performed? Was the data warehouse implemented in the organization? If not, then why and how the data sources were standardized?
12. Was the data cleaning realized?
13. Was the meta data project carried out? In which way?
14. Were the corporate report standards changed before the BI implementation?

15. What kind of impact on the decision-making process did the implemented BI solution make?
16. How was the employees' training carried out? What are the most active users of the system?
17. Are there any legal issues associated with the work of the BI system in the organization (e.g. promotions are sent to the customers based on the age or gender which may lead to some extent of the discrimination)?
18. What kind of ethical issues are associated with the decision-making process which is based on the information and suggestions provided by the BI system?
19. Based on your experience, please, identify main reasons of the failure of the BI projects:
    a. failure to recognize BI projects as organization-wide projects;
    b. lack of business sponsors with the ability to ensure funding;
    c. lack of cooperation by business representatives from functional areas;
    d. lack of qualified and available staff;
    e. no appreciation of the negative impact of the "dirty data" on business profitability;
    f. too much reliance on vendors (Turban et al., 2011).

Appedix 3. BI implementation process