TAMPERE UNIVERSITY OF TECHNOLOGY

ANTONS PONOMARJOVS

BUSINESS VALUES OF BUSINESS INTELLIGENCE

Master of Science Thesis

Prof. Mika Hannula has been appointed as the examiner at the Council Meeting of the Faculty of Business and Technology Management on May 15, 2013.

ABSTRACT

TAMPERE UNIVERSITY OF TECHNOLOGY
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Management of big organizations cannot be imagined without enterprise applications, such as ERP, SCM, and CRM. Nowadays, almost every company owns various software solutions provided either by internal IT departments or third party companies. The amount of data stored in these systems increases at a rapid rate. As a result, the most common challenge companies are facing in the current competitive business environment is a management of its own data. Thus, companies are looking for solutions, which could enable them to efficiently manage their data and to make effective data-driven decision. In their opinion, the goal of business intelligence is to transform large volumes of data stored in relational databases into meaningful business information, which could help companies improve their performance. Thus, business intelligence is supposed to be a universal solution for this issue. However, many companies still do not understand the real meaning and value of business intelligence. As a result, many companies have difficulties with creation, capture, and maximization of business value.

This thesis was conducted in close cooperation with Digita Oy. Digita Oy is one of the leading companies in wireless and digital solutions. Digita Oy has several information technology solution and started implementation of business intelligence solution aiming to improve its business performance. However, at the moment, company cannot see any significant business value of implemented solution. Thus, the goal of this thesis is to find possible ways to capture and maximize business value of business intelligence in a case company. This thesis suggests extending existing methodology with actions required to capture and maximize business value of business intelligence. These actions should be oriented on solution integration into managerial and operational processes, alignment with the organization's strategy, as well as, focus of the whole project should be shifted from technological to business development.

PREFACE

This paper discusses the concept of business intelligence and its business value. Business intelligence provides vast of benefits from implementing it, however, it has also numerous costs. Unfortunately, many managers do not have clear understanding of business intelligence concept. As a result, quite often companies overpay for solutions, which do not bring significant business value. This paper allowed me to link my industry-hardened technological background with newly obtained knowledge in business management and conduct a comprehensive study, analysis, as well as, suggests actions, which company should take in order to improve business value of business intelligence.

I would like to thank my supervisor Prof. Mika Hannula for the critical analysis and guidance during the development of the study, Heikki Isotalo, Business System Manager, Kalle Luukkainen, Multimedia Director, and Pekka Vartiainen, ex-CIO of the Digita Oy for ideas and feedback provided during the meetings. Also I would like to give special thanks to Kari Koskinen and Marcus Celvin, Service Managers from Affecto Finland Oy for their support in this study.

Antons Ponomarjovs

Helsinki, August 2013

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ABBREVIATIONS

BI	Business intelligence
CIO	Chief Information Officer
CMDB	Configuration management database
CPU	Central processing unit
ERP	Enterprise resource planning
SCM	Supply chain management
CRM	Customer relation management
DW	Data warehouse
IT	Information technology
ROI	Return on investments
ROA	Return on assets
NPV	Net present value
TDWI	The Data Warehouse Institute

1. INTRODUCTION

1.1. Background

The wide use of computers resulted in an understanding of a need to perform various tasks related to analysis of collected information with a goal to gain new knowledge. In the 1990s most of enterprises invested in enterprise applications (such as ERP, SCM and CRM) and in connectivity between partners via global network (Williams and Williams, 2003). Nowadays, almost every company has own management information system provided by own IT department or third party IT service supplier. Today, management of banks and enterprises cannot be imagined without information storing, processing, analysis, dependency and rule determination, risk and trend forecasting. According to Ranjan (2008), the most common challenge companies are facing in the current competitive business environment is a management if its own data. The ability of company to filter data and convert data into information in order to make right business decision is crucial for any modern company. Depending on company's size or business area the amount of potential data may vary from few megabytes to terabytes, petabytes or even exabytes of data.

Business intelligence project can be considered successful if the end product serves its predefined purpose and provides business value to the consumer. Business intelligence solution could provide value by increasing revenues, by reducing costs or both (Williams and Williams, 2003). However, even nowadays companies still report about failures of business intelligence projects. Due to various project organization, management and requirement analysis issues, business intelligence and data warehouse projects are costly and do not serve its purposes. In quite many cases, business intelligence solutions are used improperly or even not used by end users due to imprecise data, inconvenient use, low business value and lack of trust from the users side. Even if projects are finished in time and in budget, without strong business drivers and without an alignment with company's strategy and goals, business intelligence solutions may result in failures (Moss and Atre, 2003). Such situation is known as project management success; however, it is project's failure (Munns and Bjeirmi, 1996).

Thus, it is vital for every business intelligence project to think about real business value it brings to the company. At the same time value of business intelligence is difficult to estimate. One company may find possible bottlenecks or faults in existing process and get instant benefit from business intelligence solution. However, other company may consider solution useless until the moment they find a new trend, which will lead company to the new profits.

1.2. Problem of the study

Popularity of business intelligence and number of projects is increasing rapidly nowadays. Gartner Group (2013) in their report states that the business intelligence market will remain one of the fastest growing technology markets and it will grow annually by 7% until 2016. According to Bucher et al. (2009), already since 1960s information technology is developing to support organizations with right information and in the right time. Technological solutions are targeted on keeping competitive advantage of the companies and enabling them to stay ahead of competitors. However, still business intelligence implementation projects are limited to technological implementation and do not bring that amount of business value it can actually bring.

Services provided by business intelligence and information technology companies are mostly oriented on creation of business intelligence assets, such as reports, dashboards, etc. based on customer wishes and requirements. In the last years, such services focused mostly on data warehousing activities. Thus, Williams and Williams (2007) state that organizations should go beyond technical implementation of business intelligence and capture the real value of business intelligence as it is shown in Figure 1.

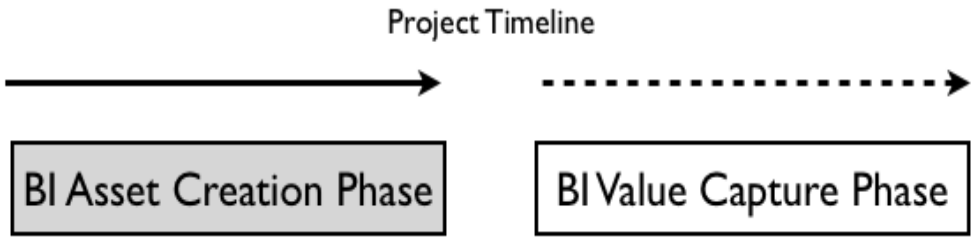

Figure 1. Two phases of BI implementation (Williams and Williams, 2007).

First phase of business intelligence includes design and technical implementation of business intelligence, as well as, required project management activities. Second phase is oriented on process engineering and change management activities required to integrate BI solution into management and operational processes in order to increase revenues and cut costs. It was always considered that second phase is duty of business and management experts. Thus, technology service providers quite often ignore it. Moreover, quite often there is a lack of business and managerial knowledge among technical experts and vice versa, business people understand the data, but they are not able to work with heavy and complicated business intelligence tools. Finally, organizations often do not recognize the need for business process change in order to capture business value of business intelligence. All these issues lead us to the objective of this thesis discussed in the following section.

1.3. Objective of the study

As it was discussed in previous section, companies usually succeed with business intelligence asset creation, but forget about its alignment with company's processes. Much attention is given to technical development and project management activities and not that much attention is given to actions required to integrate this solution into managerial and operational processes that would lead company to reduced costs, increased revenues or both.

Case company has started an implementation of business intelligence solution as an internal project, which was initiated by company's own IT department. However, solution in its current state does not bring business value to the case company. Thus, the objective of this study is…

> *…to extend existing business intelligence implementation process with actions required to capture and maximize business value of business intelligence.*

In other words, this study tries to capture and maximize business value of business intelligence in a case company by extending existing business intelligence methodology with the actions required. These actions should be oriented on solution integration into managerial and operational processes, alignment with the organization's strategy, as well as, focus of the whole project should be shifted from technological to business development.

1.4. Overview of the case company

Digita Oy is a pioneer in wireless and digital solutions. Digita employees are modern technology experts and are actively involved in developing standards. Digita's organization covers the whole Finland and offers high quality service 24 hours a day. Digita's clients include television and radio broadcasting companies as well as mobile and broadband operators. Total company employs about 400 workers. There are few information systems implemented within the company. The company's information systems include such solutions as finance management, travel and personnel management, fault report, map services and some other minor systems. These systems store data about company's employees, inventories, and operations. In 2008, the idea of data warehouse and business solutions arose within the company. The main need for business intelligence solution was to provide reports for controllers and management of the company. In the following 4 years vast of reports was developed. Company uses internal information sources to prepare managerial reports and make operational and finance decision based on its own data. However, existing implemented reports do not satisfy current end-user needs. Most of the users still prefer to get an access to the data and prepare report by themselves. In other words, by now investment in business intelligence did not bring any significant return on investments.

1.5. Scope of the study

The area of business intelligence is wide and it includes various definitions and approaches to business intelligence. Thus, it is crucial to identify clear scope of the study. In this thesis scope is defined by clear usage of business intelligence and framework definitions, as well as, by their appliance for company case.

Business intelligence has vast of different definitions, which are discussed in details later in this paper. The definition used in this thesis states that business intelligence is a managerial concept, which usually utilizes modern information technologies to gather, analyze, and share information required for taking effective business decisions in order to improve business performance. The sources of information can be both internal and external. However, in terms of the company case only internal sources are utilized.

Finally, the framework developed in this thesis does not include any company specific attributes. Thus, it is not limited by one organization and can be utilized by any project and company other than case company.

1.6. Structure of the thesis

This master's thesis is logically split into five chapters and includes introduction, theoretical background, research methodology, empirical study and conclusions. The structure of the thesis is illustrated in Figure 2.

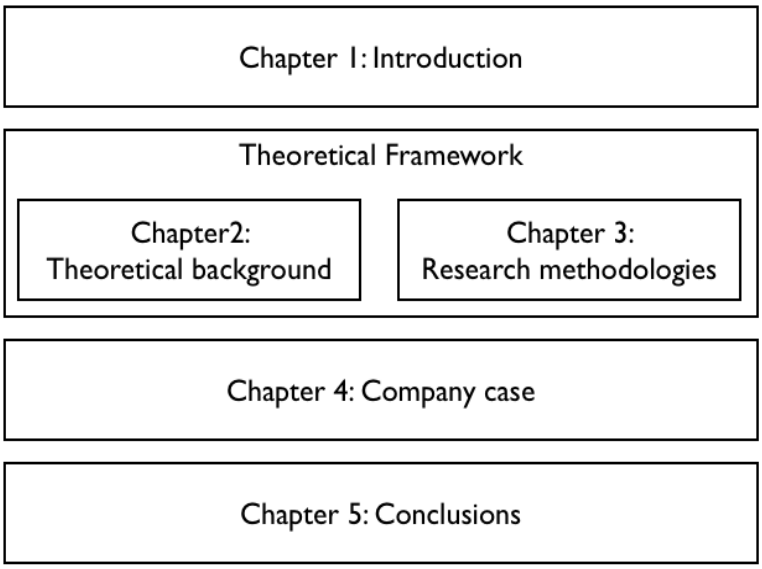

Figure 2. Structure of the master's thesis.

Chapter 1 serves as introduction and it discusses the background, problems and objective of the study. Chapter 2 serves as a theoretical background for the study. It sequentially defines business intelligence, implementation process, and related

technologies. In this chapter business value of business intelligence is examined as well as its measurement techniques and related issues are discussed. Despite this, Chapter 2 introduces business process re-engineering concept, which is crucial for the study. Discussed theories are summarized and lead to value-oriented framework creation.

Chapter 3 discusses research methodologies and data gathering methods available for management research. This chapter describes the process, validity, and reliability of performed empirical study. Chapter 4 represents the practical application of developed framework for capturing and maximizing business value of business intelligence in the real case company. Finally, Chapter 5 summarizes and discusses key results of the thesis. Ideas for further investigations are also discussed in Chapter 5.

2. THEORETICAL BACKGROUND

Chapter 2 represents the theoretical background for the study. Theoretical background is based on review and analysis of various relevant information sources. This chapter logically flows from main concept definition to complex business intelligence implementation approaches, as it is show in Figure 3.

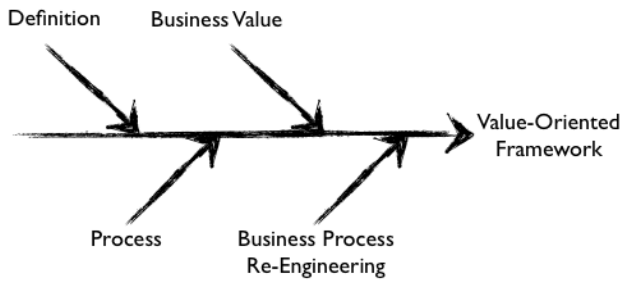

Figure 3. Sequential analysis of concepts in Chapter 2.

As it can be seen from chapter's flow visualization this chapter has several theoretical inputs, which lead it to the value-oriented framework creation. Developed framework is discussed in the last section of this chapter and it is applied and proved in the empirical part of this thesis.

2.1. Business intelligence

The first section of this chapter explains the difference between data, information and knowledge terms. Second section introduces history of business intelligence concept and its development along with the information technology. Both – technical and non-technical aspects are discussed in this section. Finally, various business intelligence definitions are summarized and BI concept is defined in the scope of this thesis.

2.1.1. What are data, information, and knowledge?

Business intelligence is hardly tied to data, information, and knowledge concepts. Thus, it is crucial to understand meaning of each of them, the difference between them and their features. In the literature sources various definitions for data, information, and knowledge can be found (Pirttimäki, 2007). Data is usually considered as a lowest level concept when knowledge is most broad concept. In this thesis, the most classical definitions of all three concepts are used.

Clarke and Rollo (2001) define data as set of objective disconnected facts existing outside any context. Data can be anything numbers, roman numbers, binary codes, dates, etc. The same data can mean different things in different contexts. Data should be

categorized, analyzed, summarized and put into some specific context in order to become information and to make some sense for the receiver. Thus, information is a structured relevant data put into some context, which has some specific meaning for the receiver (Thierauf, 2001). However, what is information for one group of people can be data for other and vice-versa. As a rule, information is associated with a decrease of uncertainty in an existing choice, the answer to any given or implied question. Information can be further developed into knowledge by establishing connections, applying comparisons, insights and experiences.

Knowledge can be defined as fixed and tested in practice information that can be reused by people to solve tasks (Davenport and Prusak, 2000). Clarke and Rollo (2001) see knowledge as information linked with insights, intuitions, judgments, and some applied values. The knowledge is highly subjective and not necessarily codified. Some knowledge is easy to codify and some not. By utilizing knowledge it is possible to create new knowledge. It's hard to transfer knowledge between people as it is linked to previous experiences. In some cases knowledge represents true facts and therefore it is a reliable basis for action.

Moreover, Nonaka and Takeuchi (1995) classify knowledge into two categories: (1) explicit and (2) implicit knowledge. Explicit knowledge exists in codified form and is usually transmitted through formal systematic language. Explicit knowledge is easily transmittable and storable. Unfortunately, only small amount of knowledge is in explicit form. On the contrary, tacit knowledge is embodied knowledge, which exists in a personal form. It is quite subjective and more experience based. It can be expressed as mental models. However, it is possible to transfer tacit type of knowledge, but it is very difficult. Tacit knowledge is most widely spread form of knowledge, thus, trying to rediscover the knowledge of an employee who is not working in a company anymore can take long time and be really costly (Bagshaw, 2000).

In turn, one of the ways to classify information is to classify it by information source, information type, and information subject (Pirttimäki, 2007). This three dimensional model is shown in Figure 4.

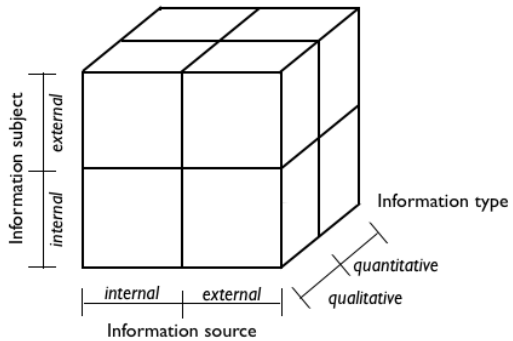

Figure 4. Business information classification (Pirttimäki, 2007).

Information type describes the form of information – either it is quantitative or qualitative. Information subject is related to the subject information describes. In other words, information may relate to company's internal or external environments. Finally, information may come from internal or external sources.

It will be seen further in thesis that proper definition of company's information needs is crucial for business intelligence implementation, utilization, and whole performance management process in general. However, next section will briefly introduce the history of business intelligence.

2.1.2. History of business intelligence

The term "business intelligence" historically is strongly connected to the information technology. Thus, it is important to take an insight into history of information systems development and to understand reasons for business intelligence concept appearance. The history of appearance of different information systems' concepts can be seen in a timeline on Figure 5.

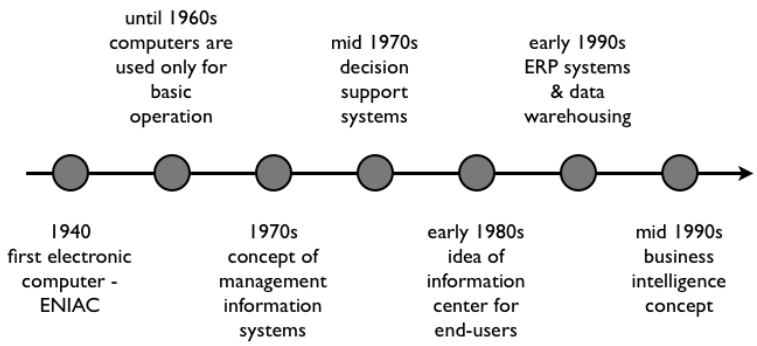

Figure 5. History of information systems.

The first successful electronic computer, the ENIAC, was created in late 1940s (Pfaffenberger and Barber, 2001). However, until 1960s computers were used for transactions processing, record-keeping and accounting (Chow, 2010; Bucher et al., 2006). Computer at this point of time were huge machines and only technical departments were able to deal with them. In other words, business side people were not able to access data stored in these information systems. Thus, with time business department started to wish to access this data stored in databases in order to make informative reports (Biere, 2003).

In the 1970s, concept of management information systems arose and computers systems roles were extended with informative report creation functionality (Chow, 2010). This new role allowed business departments get access to data though basic predefined reports. However, with getting access to predefined report end-users realized that it is not enough with these reports to make successful business decisions and in the mid-1970s, decision support systems appeared (Biere, 2003; Chow, 2010). These systems

were able to provide end users with managerial and ad hoc reports, but still all these reports required assistance from technical departments and business users were highly dependent on IT specialists.

In the early 1980s, there was high development in the area of microprocessors and first personal computers started to appear (Pfaffenberger and Barber, 2001). These developments opened an era of end users. Now business users could have their own personal computers to work with information systems and idea of information center was born (Biere, 2003). Information center is set of tool that allows end users access and process data with small or without assistance from technology departments.

At the same time, it was noticed that executives of companies do not use available reports directly. For this reason, according to Chow (2010), executive information systems were created to provide executives with easy access to analysis of business performance, key performance indicators, competitors' information, and other information require for making strategic decisions. Moreover, with development of artificial intelligence application to business information systems, such systems, as expert and knowledge management started to appear (Chow, 2010).

Through all these year of information systems' existence, they were implemented to support specific functional areas, however, as organizations become more complex and diverse in the global context, it becomes nearly impossible for organizations to implement their global business concepts without enterprise integration (Lee et al. 2003). Managers require information from different departments around the company in order to make important strategic decisions. Thus, in the early 1990s, two distinct system integration approaches were developed - ERP and data warehousing - each with different integration purposes (Lee at al. 2003). ERP is organization-specific form of a strategic information system that integrates all facets of a firm, including its planning, manufacturing, sales, resource management, customer relations, inventory control, order tracking, financial management, human resources and marketing - virtually every business function (Chow 2010). The advantage of ERP systems is one common interface for all computer-based daily operations and their tight integration (Figure 6).

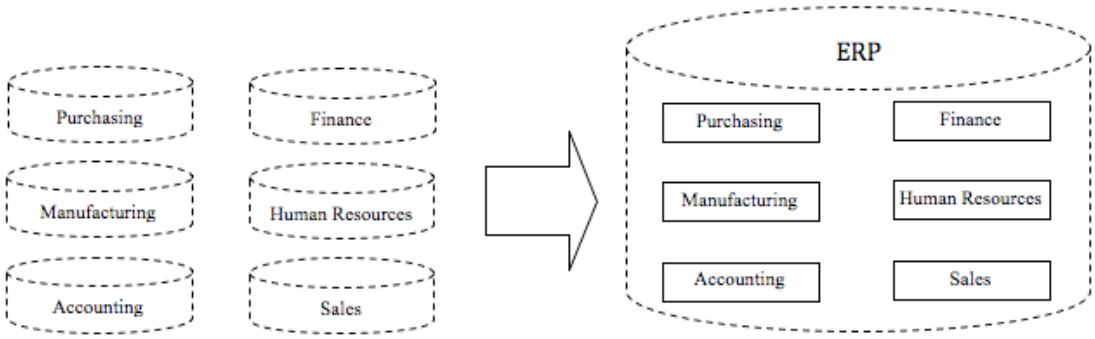

Figure 6. The ERP integration.

However, data warehousing systems focus on informational integration to support decision-making. According to Inmon (2002), data warehouse is a subject orientated, integrated, non-volatile, and time variant collection of data in support of management decisions. The information in data warehouses is populated by so called ETL (Extract, Transform, Load) processes, which extract data from one or more data sources, clean, transform and load into integrated target (Figure 7). The information in data warehouse is stored in a way that allows successful use of this data for advanced reporting.

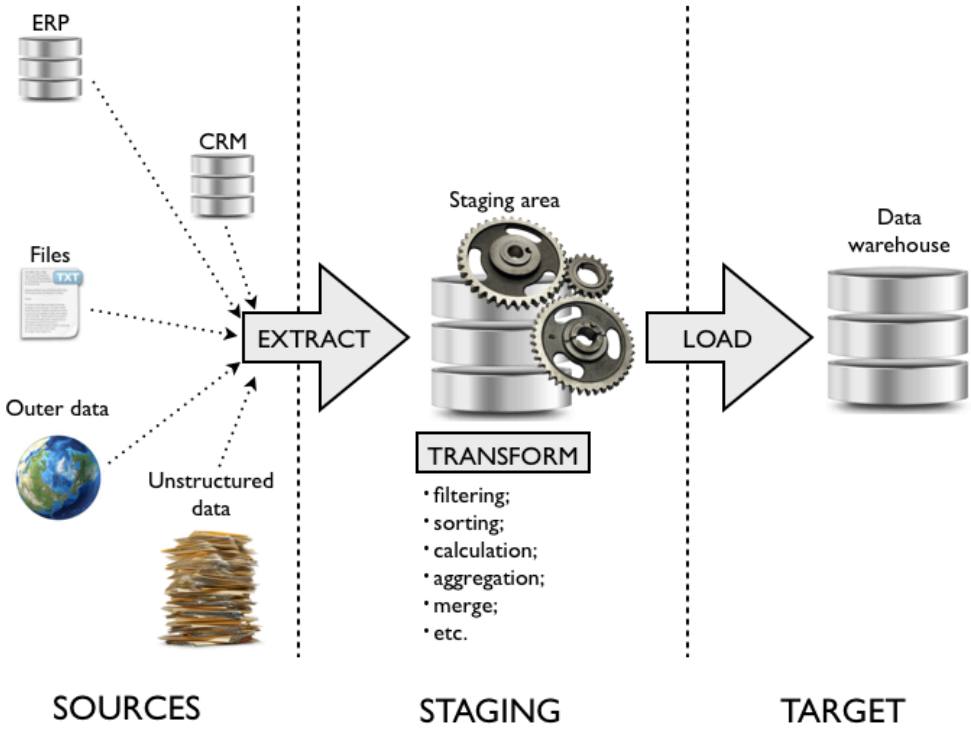

Figure 7. Data warehouse and ETL processes.

Finally, in the mid-1990s, business intelligence concept was created in response to significant development in the IT industry and rapidly growing demand for IT support in business (Moss and Atre, 2003). According to Bucher et al. (2009), Gartner, Inc. was the first to use term "business intelligence" for the first time in 1996 and since this time it was used by various stakeholders, including software companies, consultants, and scientists.

It is obvious that information and its use became key factors of company's success in today's rapidly changing business environment. Along with fast changing conditions and rapidly growing amount of information it is crucial to provide right information to the right persons at the right time (Bucher et al., 2009). Two main trends in information system can be seen. First, information systems try to provide easy access for business people to the information and minimize their dependency on technical departments. Second, business decision involve information from inside and outside the organization, thus, information systems develops toward the big integration system that would contain all the information require for the successful business management.

2.1.3. What is business intelligence?

Nowadays, major companies in various industries are storing huge amounts of operational information in their data storages. All these companies are still data-rich, but information poor, as this data is good for operations, but not for analysis or decision making. Therefore, Ray (2008) states that nowadays, organizations have to develop a culture of collecting, processing and sharing knowledge in order to keep up with competitors and beat them. Thus, business intelligence, in their opinion, is supposed to be a solution for this issue. The goal of business intelligence is to transform large volumes of data stored in relational databases into meaningful business information, which could help companies improve their performance. Unfortunately, term business intelligence is mostly associated with technology; however, business intelligence originally is not a technical term. Business intelligence is more generic term than just single product, which can be bought and installed to solve all company's problems. The following two sub sections present and discuss both technical and non-technical definitions of business intelligence provided by various authors.

2.1.3.1 Technical definition of business intelligence

As it can be seen through the history of information systems since Gartner, Inc. (2006) used term "business intelligence", this term was used mostly in a technological context. Nowadays, many companies associate business intelligence with an IT solutions and set of tools for data extracting, transforming, cleansing, distribution. Table 1 summarizes few popular technical definitions of business intelligence provided by popular authors.

Table 1. Technical definitions of business intelligence.

Definition	Source
Business intelligence is an umbrella term for a broad range of analytical tools and solutions for data gathering, integration, and analysis, as well as, providing an access to the processed data in a way, which will enable business users to make better business decisions.	Adelman et al., 2002
Business intelligence is not an isolated stand-alone technology or application; it is a set of products that include both analytic tools and the required business information.	Buskard et al., 2000
Business intelligence is a batch of applications that enables active and passive delivery of information to the right users and in a right time.	Kalakota and Robinson, 2001
Business intelligence is a generic term for a set of technical applications, software, and tools, which enables efficient and effective processing of business	Raisinghani, 2004

information.	
Business intelligence is a set of IT applications that utilizes technology for reporting and data access, along with analytical software, in order to help organizations make decisions.	Davenport, 2005
Business intelligence is not a product or application. It is a technical architecture and set of operational and decision-support databases that ensures simple access to business data for the stakeholders.	Moss and Atre, 2003
Business intelligence is a collection of both applications and technologies for gathering, analysing and distribution of large amounts of data in an effective manner that enables companies to make better business decisions.	Cook and Cook, 2000
Business intelligence is a set of tools that focuses on technologies, providing gathering, proceeding, analysis, and dissemination of information, but not on the processes	Petrini and Pozzebon, 2008
Business intelligence is managerial concept used to describe technologies that allow gathering, analysing, and providing access to organization's information in order to enable business users to make more effective decisions.	Wu et al., 2007
Business intelligence is a collection of tools, techniques, approaches and IT solutions that helps managers to have better understanding of current business situation.	Rouhani et al., 2012

As it can be seen for the table above, business intelligence is highly associated with IT industry. The terms used in various books and publication fully relate to the tools, applications, and software providing companies with better access to data enabling them to make better business decisions. Thus, technical definition of business intelligence can be summarized as follows:

> *Business intelligence is a set of tools, applications, and technologies for gathering, processing, analyzing, sharing, and distribution of relevant business information from internal and external sources that enables companies to make more effective and efficient business decisions.*

Nowadays, it is crucial for every company to be able to collect, analyze, and disseminate right information and in a right time in order to make effective data-based business decisions (Hedgebert, 2007). Business intelligence tools support numerous

activities such as data analysis, decision-making support, data mining, data warehousing, and dashboarding. According to Loshin (2003), the main goal of business intelligence software is to utilize massive amounts of data in order to help enterprises to gain competitive advantage. Thus, business intelligence technologies include various tools for data extraction, cleansing, transformation, analysis, as well as, reporting, dashboarding, and presentation of information.

The next subsection discusses the non-technical definitions of business intelligence. These definitions are more generic and are more oriented on managerial processes than technologies.

2.1.3.2 Non-technical definition of business intelligence

In the previous sub section various technical definition of business intelligence were discussed. However, some authors introduced concept of business intelligence before the Gartner, Inc. For instance Gilad and Gilad (1986) define business intelligence as a managerial concept to manage information in order to produce knowledge for operative and strategic decision-making. Table 2 summarizes few popular non-technical definitions of business intelligence provided by recognized authors.

Table 2. Non-technical definitions of business intelligence.

Definition	**Source**
A main purpose of business intelligence is to automate and integrate as many operations as possible in order to provide analytical tool-independent data for stakeholders. Moreover, business intelligence aims for transformation of environment from reactive to data to proactive.	Ranjan, 2008
Business intelligence is a managerial concept or a managerial tool, which is used to manage business information in order to enrich and create new up-to-date knowledge and intelligence aimed for more effective operative, tactical, and strategic decision-making.	Gilad and Gilad, 1986
Business intelligence is process of gathering and analysing of information about competitors, customers, markets, modern technologies, and social trends.	Ghosal and Kim, 1986
Business intelligence is an analytical activity that converts raw data into valuable, relevant, useful, and strategic knowledge and intelligence.	Tyson, 1986
Business intelligence is a process of collecting the	Collins, 1997

information on competitors, customers, and markets by legal means in order to enhance decision-making.	
Business intelligence is a managerial tool, which includes monitoring of activities in the external business environment.	Miller, 2000
Business intelligence is combination of company's operational data, information, and knowledge targeted on gaining competitive advantage by making better decisions.	Prior, 2004
Business intelligence is a process focused on gathering of external and internal information, as well as, on prediction of market changes. Business intelligence is a must have process for efficient decision making.	Sawka, 1996
Business intelligence is a set of concepts, approaches, methods, and process, which enable effective and efficient utilization of business information in a operational, tactical, and strategic decision making.	Brackett, 1999
Business intelligence is a legal tool for examining possible options for actions and strategic changes.	Waters, 1996
Business intelligence is not just a management methodology or an enabling modern technology. Business intelligence is continuous cycle oriented on enterprise performance management. Companies use this cycle for setting goals, measuring success, and analysis of developments.	Vitt et al., 2002
Business intelligence is an analysis of business information within the context of key business processes that leads to better decision making and taking better actions, which in the end result in improved business performance.	Williams and Williams, 2007
Business intelligence is a schematic approach oriented on creation capture, dissemination, sharing and usage of knowledge required for company to compete effectively.	Foo et al., 2007
Business intelligence is systematic and well-organized process focused on acquisition, analysis, and dissemination of external and internal information required for business activities and for decision making.	Lönnqvist and Pirttimäki, 2006

As it can be seen for the table above, business intelligence can be considered as a complete managerial concept or a set of managerial processes, approaches, and methods. IT provided tools could be used within these processes to support business intelligence activities. However, technology is just a small part of the business intelligence. Thus, non-technical definition of business intelligence can be summarized as follows:

> *Business intelligence is a managerial concept or a continuous cycle oriented on creation of new up-to-date knowledge and intelligence aimed for more effective operative, tactical, and strategic decision-making, as well as, taking actions resulting in an improved business performance.*

To summarize, nowadays, technology is integral inseparable part of business intelligence. However, business intelligence is not just about technology, it has much wider and broader context. In the next subsection definition of business intelligence is concluded and business intelligence is defined in terms of scope of this thesis.

2.1.3.3 Business intelligence definition concluded

In the previous two sections both technical and non-technical definitions of business intelligence were discussed. Technical definitions are narrowed to modern technologies, tools, and application when non-technical definition is a wider broader concept. O'Dell and Grayson (1998), states that modern IT technology provides vast of tools and applications that enable fast and easy sharing of knowledge among teams and teammates, however, not all business intelligence solutions require implementation of IT.

According to Rouhani et al. (2012), there exist three main groups of business intelligence definitions. These three groups have slightly different focuses and scope:

1. Managerial definitions focused on management processes;
2. Technical definitions focused on IT tools and applications;
3. Enabling definitions focused on business value creation possibilities enables by proper use of information.

In this thesis managerial and enabling definitions were combined in one group, which are non-technical definitions. Rounhani et al. (2012) have studied 85 articles related to definition of business intelligence and concluded that number of technical definition is approximately one third from the total amount of definitions. The approximate distribution of definitions can be seen in the pie-chart shown in Figure 8.

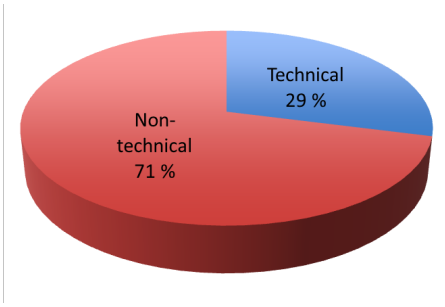

Figure 8. Distribution of BI definitions (adapted from Rouhani et al., 2012).

Figure 8 shows that less than third of definition describe business intelligence as a technical concept. Most of the definitions are non-technical business or managerial concept where technology plays supporting function. Thus, in this Master's thesis business intelligence is defined as follows:

> *Business intelligence is a managerial concept, which usually utilizes modern information technologies to gather, analyze, and share information required for taking effective business decision in order to improve business performance.*

IT tools will have business intelligence's supporting function in this thesis. However, available tools and applications will be discussed and described in the following sections in order to provide better understanding of the role modern technologies play in business intelligence implementation and utilization.

2.1.4. Benefits and costs of business intelligence

Business intelligence provides vast of benefits from implementing it. According to Bartlett (1998), benefits of business intelligence could be achieved through the improved business processes, which involve implementation of information systems and use of tools for data acquisition, integration, analysis and dissemination. Therefore, Gartner Group (2006) states that utilization of such processes may bring a significant improvement in visibility within business environment. Moreover, Sharma and Djiaw (2011) consider that implementation of business intelligence and its alignment with operational, tactical, and strategic goals may lead company to gaining a competitive advantage.

Ranjan (2009) consider information the second most important resource after people. Thus, if company makes business decisions based on precise and up-to-date information it can significantly improve company's performance. According to Ranjan (2009), utilization of business intelligence may have the following benefits:

- Elimination of guesswork and enabling companies to make data-based decisions;
- Communication enhancement between different departments due activity coordination;

- Company's ability to respond quickly to changing market and finance conditions;
- Customer experience improvement by timely response to customers' problems and requests;
- Decision-making acceleration;
- Improvement of the overall performance of the company.

According to Business Objects (2007), goal of business intelligence is to convert company's data into valuable knowledge and knowledge into profit. Business intelligence is able to bring the various benefits to businesses. These benefits are grouped by Business Objects (2007) in three main categories:

- Cost reduction
    - Improvement of operational activities;
    - Elimination of report backlog and delays;
    - Ability to negotiate more beneficial contracts with customers and suppliers;
    - Ability to find root causes of various issues and take actions according to situation;
    - Ability to identify waste of resources and increased inventory costs;
- Revenue incensement
    - Provide more precise information to stakeholders;
    - Ability to improve strategies by using enhanced marketing analysis;
    - Support of sales force with detailed, precise, and up-to-date information;
- Customer satisfaction's improvement
    - Ability to make more efficient decisions working with customers
    - Ability to react and adapt company's actions immediately according to the customers;
    - Use of factual information instead of assumptions.

However, KPMG (2000) conducted a survey of 423 companies around the world. In this survey KPMG identified various benefits brought by business intelligence implementations. Many of identified benefits overlap with previously mentioned ones and are listed below (KPMG, 2000):

- Improved decision making;
- Improved dealing with customers;
- Flexibility to key business issues;
- Enhanced employee skills;
- Improved productivity;
- Sharing and following best practices;
- Increased incomes;

- Reduced expenses;
- Increased market share;
- Creation of new business opportunities;
- New product development.

Moss and Atre (2003) in their book identify five benefit categories of business intelligence. These categories are shown in Figure 9.

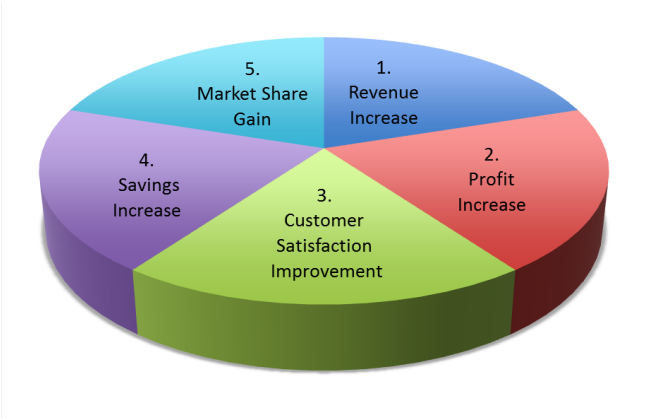

Figure 9. BI benefit categories (Moss and Atre, 2003).

According to Moss and Atre (2003), all business intelligence benefits shall fall within these five categories. First, revenue increase category may include such benefits as identification of new niches or markets, new business opportunity recognition. Second, profit increase may take for of better customer targeting, proper market monitoring, identification of under-performing resources and inefficiencies. Third, customer satisfaction can be reached by improved understanding of customer needs. Fourth, increase in saving can be reached by identification of resource waste. Finally, market shares could be gain through identification of those customers who are excluded from the existing competition.

Gessner and Volotino (2005) states that business intelligence benefit is ability to enable companies to monitor and manage customer transaction in order to identify required changes in company's activities, as well as, identify opportune time for making best possible offer for the right customers in the right time. Customers are one of the most critical factors for the company's success (Ranjan, 2009). Customers are vital for company's existence. Thus, it is important to have all the required information on customers and serve them well.

To summarize, all benefits can be split into 6 main categories they refer to. These categories are customers, decision-making process, market, new business opportunity, performance and resources. However, costs can be split into software, hardware, staff, and development costs. More detailed information can be seen in Table 3.

Table 3. Benefits of business intelligence.

Benefit	**Source**
Business intelligence improves ability to monitor and manage customers, ability to understand customer needs, ability to better target customers, ability to react and adapt actions according to customers, as well as, customer experience.	Ranjan, 2009; Business Objects, 2011; KPMG, 2000; Moss and Attre, 2003;
Business intelligence improves decision-making process, by providing precise up-to-date information, eliminating guesswork, backlog, and report delays.	Ranjan, 2009; Business Objects, 2011; KPMG, 2000
Business intelligence improve business strategies due to enhanced market analysis, as well as, allows to support sales forces with precise up-to-date information, quickly respond to market changes, identify niche markets, and increase market share.	Ranjan, 2009; Business Objects, 2011; KPMG, 2000; Moss and Attre, 2003
Business intelligence allows identifying new customers who are excluded from current competition, along with new product and business opportunities.	KPMG, 2000; Moss and Attre, 2003
Business intelligence improves visibility within business environment and allows reducing costs, increasing profits, gaining competitive advantage, improving communication, employee skills, company's performance as well as, allows finding root causes of various issues, sharing best practices and tools, negotiation of better contracts.	Barlett, 1998; Gartner Group, 2006; Sharma and Djiaw, 2011; Ranjan, 2009; Business Objects, 2011; KPMG, 2000
Business intelligence improves company's ability to identify waste of resources, increased inventory costs, and other underperforming resources and inefficiencies.	Business Objects, 2011; Moss and Attre, 2003

The table above summarizes main benefits of the business intelligence solution. Many publications and books are related to benefits of business intelligence, but not that many sources list business intelligence implementation related costs. The significant costs for business intelligence are related to technical implementation of business intelligence. Madsen (2010) has designed the most probable scenarios for technical implementation of the business intelligence and has evaluated them taking into consideration software and service prices provided by various vendors. However, Gartner (2013) conducted a statistical analysis based on real companies' expenses. Both Madsen (2010) and Gartner (2013) came almost to the same cost distribution over three years. The distribution of total cost of ownership in three years period is shown in Figure 10.

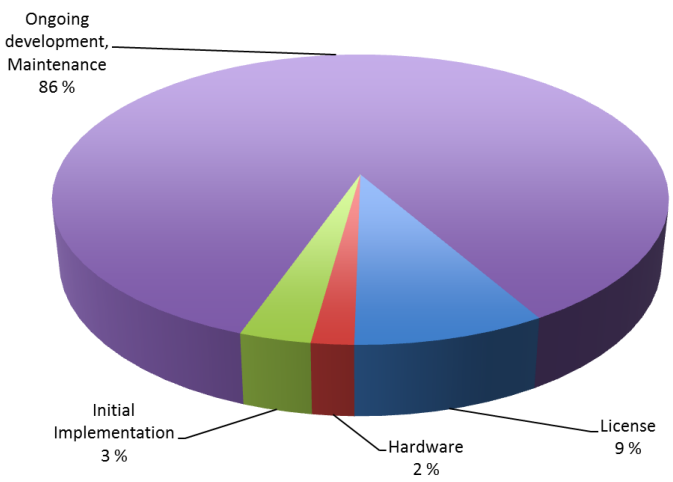

Figure 10. Distribution of BI costs over 3-year period (Madsen, 2010; Gartner, 2013).

Most costly component of business intelligence is ongoing development and maintenance. However, hardware, license and initial development all together are just 14%. Maintenance includes fixing of issues, monitoring, backups, etc. Thus, companies may think on reducing costs of these activities. Most common costs are summarized in Table 4.

Table 4. Costs of business intelligence.

Cost	**Source**
Business intelligence requires investment into hardware, such as servers.	Gartner, 2013; Madsen, 2010
Business intelligence requires investment into software, such as tools, applications, and licences.	Gartner, 2013; Madsen, 2010
Business intelligence biggest expenses are related to solution initial implementation, on-going development, and maintenance.	Gartner, 2013; Madsen, 2010
Business intelligence solution implementation requires investment into business process redesign. Moreover, business intelligence solution implementation has cost of disruption.	Gartner, 2013; Madsen, 2010
Business intelligence requires investment into human resources, such as salaries, wages, travel expenses, trainings.	Gartner, 2013; Madsen, 2010

The tables above summarized main benefits and costs of a business intelligence solution. The next section will introduce the process for business intelligence implementation.

2.2. Business intelligence process

In the previous sections business intelligence concept was discussed and business intelligence was defined in the scope of this thesis, as well as, business intelligence costs and benefits were analyzed and listed. This section will focus more on business intelligence implementation and utilization process. First, business decision-making model will be introduced. Second, information management cycle will be discussed. Third, generic business intelligence process will be defined. Finally, some critical success factors for business intelligence will be listed and discussed in the last subsection.

2.2.1. Decision-making model

It can be seen that main goal of business intelligence is to improve decision-making process. Thus, it is important to analyze decision making model and identify those steps where business intelligence could add value.

The decision making research has a long history. Thus, many publication devoted to this topic can be found. One of the popular models for decision making in business was described by Thomas and Schwenk (1984) decades ago and can be seen in Figure 11.

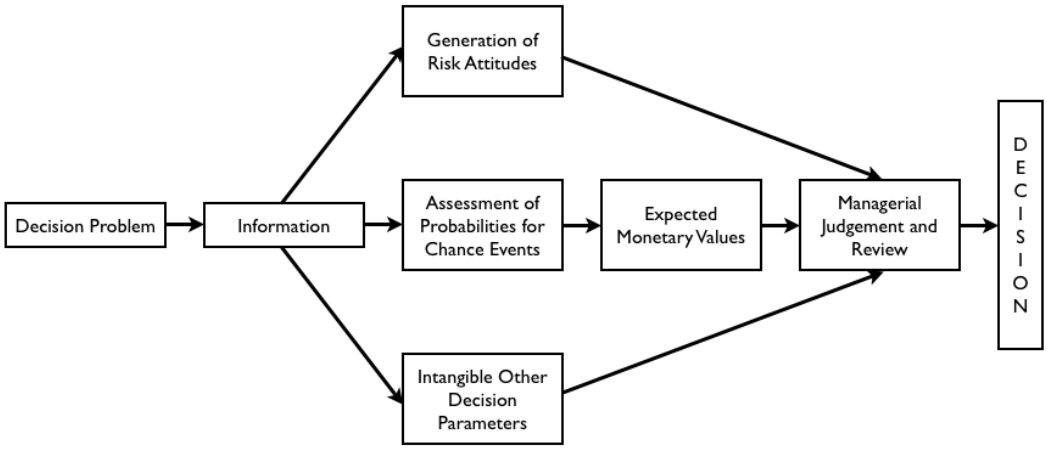

Figure 11. Decision analysis process (Thomas and Schwenk, 1984).

Reynolds (1995) states that in order to define which business decisions are made and what are information needs, every company should start with the identification of its business processes. Thus, the decision-making process starts with a problem analysis and clear definition. When problem is defined, information on defined problem and possible solutions is collected. In this step information may come from various sources, both – external and internal. The result of this step is a list of potential solutions. These solutions are analyzed in the following steps, which are conducted simultaneously. First, risks for every option are analyzed. Second, possibilities for chance events are estimated. Chance events are those events that may happen due to implementation of

one or another option. Third, all other intangible parameters are evaluated. Moreover, expected monetary values, such as implementation costs, possible profits, and ROI are forecasted. Before the actual decision is made, managers apply their own experiences and know-hows and judge about different options. Even if some options seem better than others managers may have own experiences and tacit knowledge that will lead them to choosing option different from the best one. Finally, combining collected and analyzed information with managers tacit knowledge decision is made.

It can be easily seen from decision-making model (Figure 11) that information gathering and analysis plays a crucial role in a decision making. These are exactly those steps where business intelligence can add value and improve decision-making process.

2.2.2. Information management cycle

As it was mentioned in the previous section, information gathering and analysis plays a significant role in a business decision making. Thus, information management is essential part of decision making and enterprise performance management. The information management cycle was introduced by Choo (Figure 12) and is discussed below.

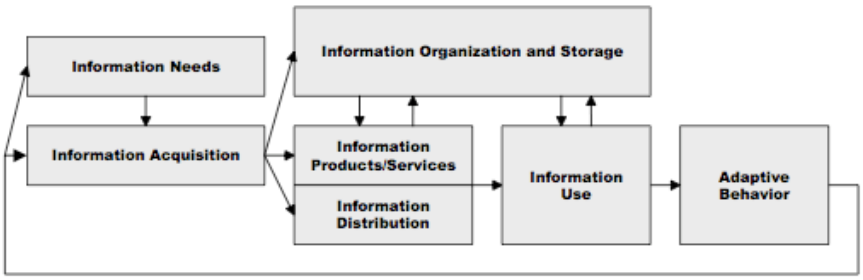

Figure 12. Information management cycle (Choo, 2002).

According to Choo (2002) information management cycle starts from the most right step called adaptive behavior. Choo illustrates that information is created by organization actions. These actions are conducted within organization itself or may interact with other organizations and systems in order to adapt the environment and to create new information. In the first real action step, information needs, an organization should analyze and find out what kind of information and what information is required to solve existing problems and to make successful decisions. Information needs are defined both by situation-determined contingencies and by subject-matter requirements.

According to Choo (2002), the next step is required information acquisition. Information acquisition is a complex function that defines the way to get information needed for solving problems and decision-making. There are many different sources of information both inside and outside the organization. This step is hardly influenced by definition of information needs step and its goal is to find a way to get all the

information defined in previous step (Choo, 2002). At the third step of Choo's (2002) information management cycle, information is organized and stored. According to Choo (2002) the organizational memory is created at this step. The organization memory is storage of all organization's knowledge and know-how. In the next step, organized and stored information is put into form that makes this information available for required persons in the organization. Then this information is distributed to all required persons and only to them.

Finally, it the last step of cycle, acquired information is used for solving real business problems, making decisions or identifying problems, selecting alternatives etc. Therefore, the gathered information and knowledge have to be applied to practical problems and decision-making efficiently. According to Choo (2002), new insights and knowledge about complicated problems, situations, and organizational learning are achieved by widespread information sharing. When the whole iteration of information management cycle is finished, new problems and information requirements are defined. The whole cycle repeats continuously improving company's performance with very next iteration.

Decision-making model and information management cycle concepts, discussed in the last two sections now lead thesis to the business intelligence implementation and utilization process definition. The generic business intelligence process is introduced in the next section.

2.2.3. Business intelligence process

There are different business intelligence processes discussed in the literature. For instance Herring (1993) considers following steps as a guideline for implementing new business intelligence solution:

1. Identification of key users and possible use cases of the business intelligence;
2. Analysis of current business intelligence activities;
3. Design of business intelligence solution based on information available and current business intelligence activities;
4. Analysis, design and implementation of information collecting, processing and analysis processes.

This process describes business intelligence in a really high level. From various publications and books it can be concluded that business intelligence implementation processes may differ from publication to publication; have some different specific steps or details. However, most of them have common main steps and can be generalized in one cycle (Pirttimäki, 2007). Generic business intelligence process model is shown in Figure 13.

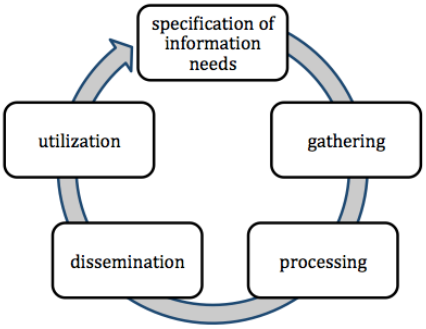

Figure 13. Generic business intelligence process (Pirttimäki, 2007).

The process is illustrated as a continuous cycle. Same as decision-making and information management processes, business intelligence process starts with situation analysis and more precisely with specification of information needed. Then required information is gathered and processed. The processed and analyzed information is later on disseminated to the stakeholders and is utilized by them.

However, as information technology plays a significant role in business intelligence nowadays, there are also technical business intelligence process models. For instance Kimball et al. (2008) introduce his model for implementation of business intelligence solution. Kimball's business intelligence implementation model is shown in Figure 14.

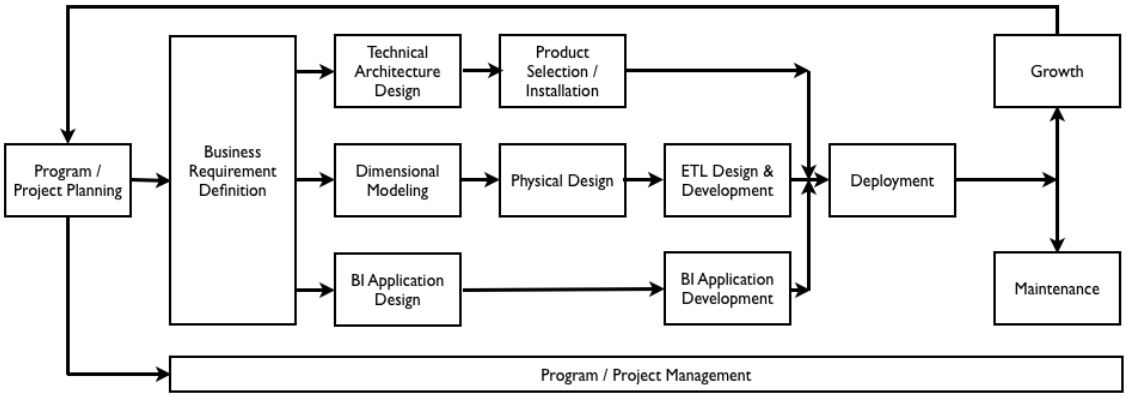

Figure 14. Kimball's business intelligence implementation model (Kimball et al., 2008).

The model starts with traditional business intelligence or data warehouse project planning. Then follows process similar to the waterfall model where all steps are conducted sequentially. After project planning follows detailed and thorough business requirement analysis and definition. Only when all requirements are identified and specified follows design and modeling phase, which is split into three logical parts. First part is related to technical architecture and vendor selection process. Second part is related to the database and data warehouse model design, as well as, design and implementation of data processing processes. Finally, third part is about business intelligence application design and development. In this model Kimball et al. (2008) define business intelligence as reporting and dashboarding application built on data

warehouse. The Kimball's models last steps are maintenance of implemented model and analysis of solution's growth possibilities. New growth opportunities may initialize a new business intelligence project. It is important to mention that all steps in this model are conducted along with a project and program management.

Nowadays, big popularity gets business intelligence pathway method. Its popularity is increasing quite fast mostly due TDWI who implements most of its trainings and business intelligence certification utilizing business intelligence pathway approach (TDWI, 2008). Business intelligence pathway method is illustrated in Figure 15.

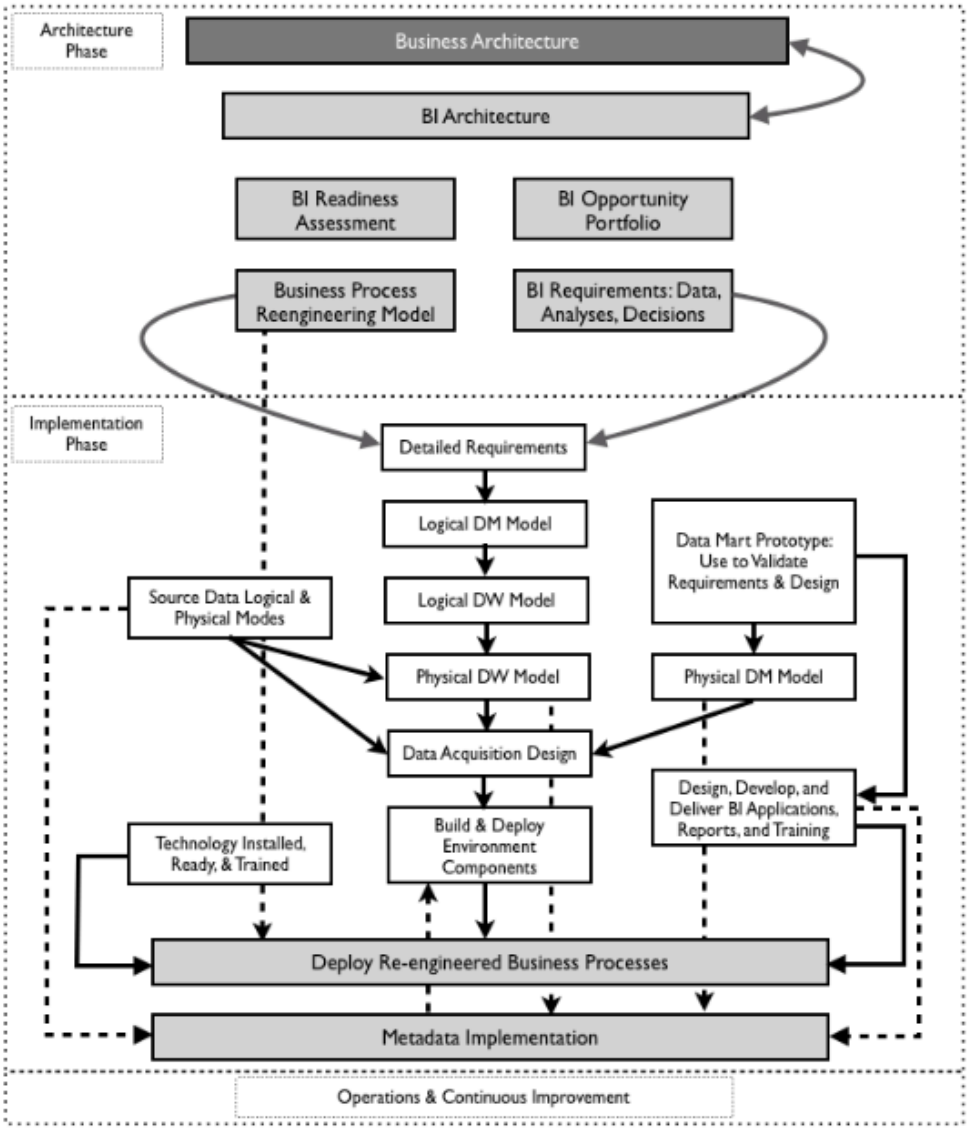

Figure 15. Business intelligence pathway method (Williams and Williams, 2007; DecisionPath Consulting, 2010).

Pathway method originally was introduced by DecisionPath Consulting group in 2004 (DecisionPath Consulting, 2010), however, Figure 15 is a summarized and adapted model by Williams and Williams (2007). The solid lines in this model mean process

flows, but dashed lines are metadata flows. The introduced model consists of three phases. First is architecture phase, which is followed by implementation and later on by operations and continuous improvement phases.

Architecture phase contains all the actions oriented on current situation and problem analysis. In architecture phase, current business situation is analyzed and generic business architecture is created. It is important to note four actions conducted in this phase and oriented on maximizing business value. First, business intelligence readiness assessment evaluates organization's readiness and ability to implement valuable and qualitative business intelligence solution. Second, business intelligence portfolio contains and stores all analyzed and available opportunities for maximizing company's profits, minimizing costs or both. Third, business intelligence requirement is focused on identification and definition of business decisions made by company, the decision-making process and data required for it. Finally, business process re-engineering is aimed on "as-is" analysis of existing business processes and "to-be" design of re-engineered processes. The goal of process re-engineering is to change existing business processes in order to use business intelligence solution in a proper way to maximize its value. However, business process re-engineering concept, as well as, business value of business intelligence in this model is introduced in a high level. Thus, these two concepts are investigated and discussed in the following sections of this thesis.

Implementation phase of pathway method contains a lot of complicated technical steps which are not in scope of this thesis. However, this phase contains important step called deployment of re-engineered business processes. After solution is implemented and users are trained it is important to ensure effective and efficient use of business intelligence by proper business processes. Solution users should see and realize how exactly business intelligence solution may be used in their actions and optimize their work.

Finally, operations and continuous improvement closes the pathway approach model. This phase is oriented on maintaining the implemented solution, as well as, continuous improvement of both technical solution and business processes in order to maximize business value.

The business intelligence process was introduced in this section. However, following the process is not that simple and business intelligence projects quite often results in failure or does not bring any business value. Thus, next section will introduce and discuss critical success factors of business intelligence projects and how to cope with them.

2.2.4. Critical success factors

Business intelligence process introduced in a previous section describes the process of implementation and utilization of business intelligence solution. However, introduced model does not guarantee the success of business intelligence project. In most cases, project is considered as successful if it is finished on time, within the budged and within predefined scope. However, such project still may not bring any business value.

As business intelligence utilizes information technologies intensively, successful IT project is one of the critical success factors of business intelligence. However, according to The Standish Group (2010), in 2010 only 33% of all information technology projects were successful, 26% were unsuccessful and 41% were challenging. The statistics are based on answers of 365 respondents, who provided information on 8380 applications and projects. These companies and projects had different size and type. This statistics are hardly criticized by IEEE (Eveleens and Verhoef, 2010), who states that Standish Group consideration of successful and unsuccessful project does not differ those project, which are underestimated and overestimated, as well as, as those which are finished but does not bring any value. Standish group calls project successful if it is finished on time and planned time's and budget's relation to the real one is more or equal to 1. In turn, unsuccessful are all unfinished projects.

For business intelligence projects, involving data warehouse implementation, such statistics is a reason for disputes already for many years. However, according to research conducted in 2007 around 63% of all data warehouse and business intelligence project were successful (Scott, 2007). In this research took part 586 respondents and around 73% of those has more than 10 years of experience in IT area. Half of respondents were developers or designers. The research was made in a form of e-survey and was conducted within 1 week.

As it can be seen both mentioned statistics are imprecise and quite subjective. Moreover, it is impossible to make judgment about real project execution and assessment quality. However, these statistics provide general understanding about project implementations and shows that there is quite large percent of failure project.

As business intelligence projects nowadays are highly dependent on information technology, it is crucial to secure IT project success. Thus, it is important to identify critical success factors for business intelligence implementations. According to Adelman and Moss (2002), there are various critical success factors for business intelligence implementation, such as:

- Expectation communication to the users;
- Ensured user involvement;

- The project has a good sponsor;
- The team has the right skill set;
- The schedule is realistic;
- The project has proper control procedures (change control);
- The right tool have been chosen;
- Common data definition;
- Well-defined transformation rules;
- Properly trained users.

Listed factors cover main reasons of business intelligence project failures. First, business intelligence implementation team should be able to tell end-users what they will be getting and when. These things include performance, availability, functionality, and various other system features. Second, end-users should be involved into implementation process as they are the ones who will work with this solution. Third, the sponsor should be person with good connection, able to manage resources and budget. Fourth, team should get the right mix of business and technical skills. Fifth, one of the most common failure reasons is unrealistic schedule. Sixth, project manager should be able to control and manage scope of project as in business intelligence there always will be scope changes. Seventh, business intelligence solution success is highly dependent on the chosen tools and vendors. More expensive tool is not always the best choice. Tools, solutions, and applications should be chosen according to company's needs. Eight, there should be defined common vocabulary for terms as various departments may use different words for same objects. Ninth, business intelligence has consolidated and integrated data from various source systems. Thus, transformation and load rules should be well defined in order to deliver information users are waiting for. Finally, in order to get maximum out of business intelligence users should be trained to work with chosen tools and implemented solution.

However, Cervone (2006) noted, the most common reasons of business intelligence project failures:

- Insufficient top management and end-user involvement;
- Misunderstanding the requirements due the lack of skills;
- Failure to manage end user expectations.

Cervone's failure reasons overlap with Moss and Atre critical factors of success. However, Cervone (2006) stresses out the importance of top management and user involvement into analysis, design and implementation process. Moreover, lack of business knowledge and skills leads developers, who are technology consultants by nature, to misunderstanding of requirements. As a result, vast of inaccuracies, misunderstanding and lack of communication leads to the failure of user expectation management.

However, Stoll (2004) identified four key elements ensuring successful business intelligence. First, there should be dedicated team, which believes in a project. Second, end-users and management should be educated and trained to understand benefits and principles of business intelligence. Third, business intelligence implementation and utilization takes time, thus, all stakeholders should have patience. Finally, end-users should participate in survey before and after business intelligence implementation in order to point out the success of business intelligence.

In turn, Fuld (1993) considers the following three basics principles as a key for a business intelligence success:

1. Business intelligence should be built on the company's real information needs and resources and not by following ideal book model;
2. Company should understand the value of business intelligence and allow employees involved into implementation of business intelligence to spend some time on data analysis;
3. Management should enable employees to use produced intelligence effectively by providing them with required knowledge.

In order to do so managers first should determine what information is required and what information is used by employees. Moreover, they should identify and list all the internal information sources, as well as, information sources available outside the company. When these steps are taken, managers cans tart thinking of choosing vendors and software packages.

Moreover, Williams and Williams (2007) stress out the importance of business opportunity analysis. Seeing and recognizing opportunities are one of the crucial factors of company's growth (Black and Gregersen, 2003). Heinonen et al. (2011) also states that opportunity recognition is a fundamental step in the whole business process. Moreover, Emblemsvåg and Kjølstad (2002) consider that companies primarily fail due loss of opportunities, but not from taking wrong actions. According to Morris (2005), opportunity is a mixture of circumstances, which leads company to the acceptation or rejection of options.

All business opportunities should be listed and prioritized. One popular tool for listing and analyzing business opportunities is SWOT analysis (Piercy and Giles, 1989). However, Agarwal et al. (2012) states that SWOT analysis does not fit modern business needs, as it is only a snapshot of current strengths and weaknesses matched with current opportunities and threats. Moreover, Williams and Williams (2007) suggest a tool for business opportunity prioritization shown in Figure 16.

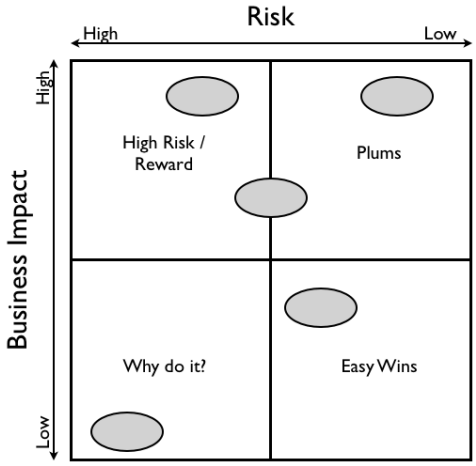

Figure 16. Business opportunity evaluation framework (Williams and Williams, 2007).

Prioritization can be reached by evaluation of positive business impact and possible risks caused by implementation of business intelligence solution. In order to evaluate business impact it is crucial to understand company's business strategy, goals, objectives, and core business processes. It is important to know right business intelligence tools and solutions, which could improve these processes. In this case, business impact can also be called business value. In other words, business opportunities are compared by business value they can bring to business. Business value and its measures are discussed in more details in the following sections of this thesis.

In turn, analysis and management of risks enable identification, assessment, and control of company risks (Halliday et al., 1996). Risks are potential problems, which may happen in future (Cervone, 2006). Most of the projects are focusing on identification, assessment and minimization of risks related to the project implementation. However, there might be also other risks related to business itself. For instance, how implementing one of the application features will impact company's performance or which business opportunity company will miss by not implementing it. These risks are also important and should be taken into consideration. Halliday et al. (1996) also states that analysis of business risks is important and it should be performed at all three levels – strategic, tactical, and operational. Drucker (1986) counts that risk management is completely about being proactive, as successful companies focus on opportunities rather than on current problems. In other words, companies identify, evaluate future risks and choose proper strategies beforehand.

According to Halliday et al. (1996), risks should be prioritized and appropriate security procedures should be chosen. In order to do so, risks should be measured. Risks can be measured by using two dimensional model shown in Figure 17.

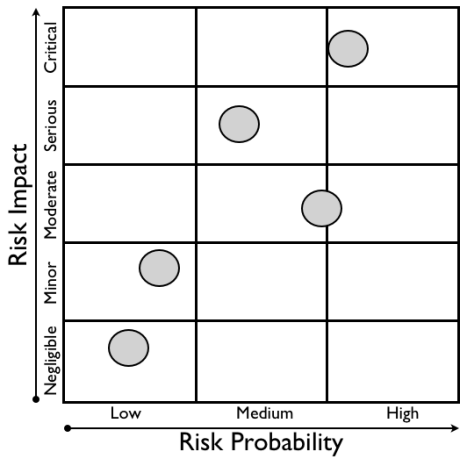

Figure 17. Business risk evaluation framework.

The first dimension in this model is risk impact suggested by Lansdowne (1999). Risk impact can be classified as critical, serious, moderate, minor, and negligible. The second dimension was suggested by Kendrick (2003). This dimension is risk probability and it can be classified as high, medium, and low.

The next section introduces the concept of business values of information technology and business intelligence. Issues related to measurement and capture of business value are discussed as well.

2.3. Business value of business intelligence

Business value term is mentioned in a various publications in a high level. However, to maximize business value of business intelligence it is crucial to understand this concept in detail. Thus, this section discusses business value, its measures, and capture methods.

2.3.1. What is business value?

Most of managers within IT departments wish always the best for their companies; however, they end up focusing too much on the process, documentation, and software instead of delivering business value (Matts and Pols, 2004). Moreover, according to Symons (2006), most of IT managers are required to demonstrate tangible results and improve the business value brought by IT investments. Also IBM (2011) states that various level managers should be able to measure business value in order to optimize it, as well as, identify and plan improvement actions. At the same time Business Objects (2007) insist that managers constantly suffer from misunderstanding the real value of IT, lack of knowledge in business value measurement, and are not able to follow their progress towards defined objectives. Unclear definition of business value and it measures is one of the major issues in IT departments (Cronk and Fitzgerald, 1999). Thus, it is important to understand and define business value of business intelligence.

According to Lyly-Yrjänäinen et al. (2010), business value is the difference between total cost of investment and total gain from investment. However, Porter (1998) states that value is result of the whole chain of operations and activities. Every activity and operations adds some value. Total value of all these operations and activities is greater than total costs. Thus, company gets some value. Porter's value chain shown in Figure 18. In this chain information technology solution plays supporting role. In other words, the goal of information technology is to support those critical primary business activities.

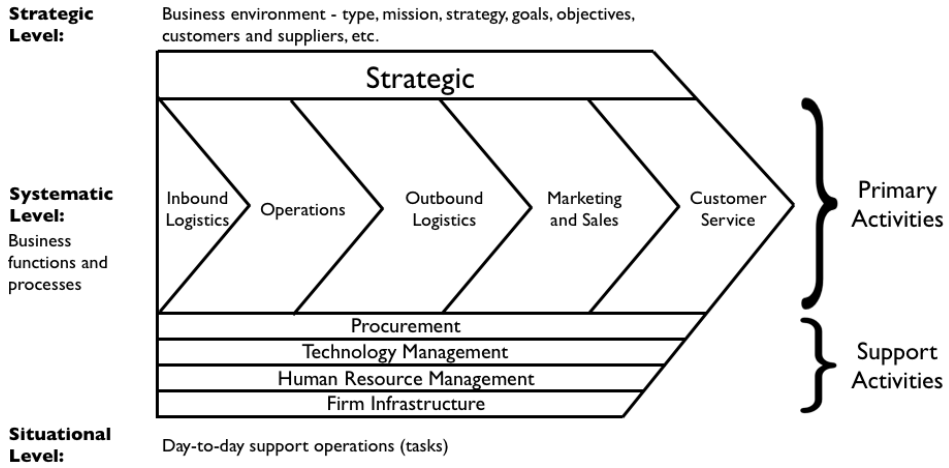

Figure 18. The organizational value chain (Porter, 1998).

In the classic economic theory business value is defined as an investment, which results in the increase of net present value of the after-tax cash flow related to the investment (Williams and Williams, 2003). In other words, IT creates business value when it increases company profits or reduces costs (Matts and Pols, 2004). Until the 90s, there were no convincing facts proving that IT brings any business value and improved performance, as relationship between IT investments and business value was unclear (Soh and Markus, 1995). Therefore, first attempts to measure and quantify business value of IT appeared. Early quantitative measures were focused only on financial perspective of one single system, but there usually is more than one information system within one company. As a result, these measures were extended with concept of IT contribution to organization performance. However, these new concept were also limited to the financial perspective and were mostly focused to ROI and ROA measures (Cronk and Fitzgerald, 1999).

According to Symons (2006), usage of financial measures is a significant improvement comparing to not measuring business value of IT, however, measuring business only from financial perspective has a serious flaws. First, there are various measures and approaches, such as ROI, ROA, NPV, etc. Second, these measures are based on pure mathematical estimates and number of assumptions. Third, quantitative measures fail to measure intangible benefits provided by IT. Finally, they don't take into consideration

the future opportunities of IT solutions. Thus, with understanding the fact that it is hard to identify and isolate IT influence on the company cash flows, measures were replenished with qualitative measures, such as, user satisfactions and systems conformity to predefined requirements and goals (Cronk and Fitzgerald, 1999).

Cronk and Fitzgerald (1999) conducted a study, in which they reviewed various definitions and measurement approaches of IT business value. After review, Cronk and Fitzgerald (1999) provided own definition of business value of IT:

> *Business value of information technology is the sustainable value added to the business by IT, by single system or set of systems, considered from organizational perspective, relative to the resource expenditures required.*

In other words, business value consists from two major parts. One component is all values that can be expressed in monetary values. Second component is all these values that cannot be measured in money and have only subjective evaluation. These two complementary parts are illustrated in Figure 19.

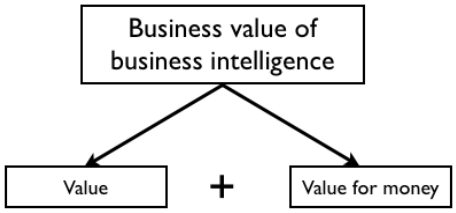

Figure 19. Business value of BI (adapted from Cronk and Fitzgerald, 1999).

As it can be seen from figure above, business value of business intelligence consists of monetary values and intangible subjective values, such as customer satisfaction. As it was already mentioned monetary value of business intelligence is hard to evaluate as it is almost impossible to isolate it from other business operations. However, there are plenty of measures and measure dimensions for both value parts. Business value measurement approaches and related problems are introduced and discussed in the following chapter.

2.3.2. Business value measurement and related problems

As it was discussed in the previous section, it is really hard to measure business value of information technology and business intelligence particularly. This section discusses popular value evaluation approaches, as well as, discusses issues related to these methods.

Holt and Elliot (2002) state that economists use cost-benefit analysis developed decades ago for evaluation of business value. This approach was applied to many different activities including evaluation of business value of information technology. Linn (2010)

agrees that cost-benefit analysis may be useful when companies are deciding on making big investments. According to Boardman et al. (2005), generic cost-benefit analysis includes following steps:

- List business opportunities that require investment;
- List possible stakeholders;
- Select proper measurements and evaluate costs and benefits of every investment;
- Forecast possible outcomes of costs and benefits;
- Evaluate net present value of each opportunity;
- Take a decision about making or not making an investment.

However, it is not easy to follow this process and evaluation method. According to Rouhani (2012), business intelligence can bring many benefits; however, business value of these benefits is not always clear. Moreover, as it was discussed earlier in this thesis, it is difficult and sometimes impossible to evaluate and represent benefits of business intelligence as monetary values. Thus, it is hard to compare benefits with costs, which can be measures in monetary values. Irani and Love (2001) states that information technology is one of areas where traditional evaluation techniques usually make no sense and does not bring any satisfactory result as most of benefits are strategic and almost always are not quantifiable. Tayyari and Kroll (1990) as well note that information technology bring vast of intangible benefits and costs that cannot be associated with any monetary values. Hannula and Pirttimäki (2003) also prove that measurement of business value of business intelligence is an important task, but it is extremely difficult to conduct it. Despite this, Rouhani (2012) states that only few companies are able to measure and actually measure value of business intelligence.

In turn, after analysis of business value definition, Cronk and Fitzgerald (1999) split business value of business intelligence into two parts – monetary values and qualitative values. They suggest using traditional financial measures for monetary values along with qualitative measures for intangible benefits of business intelligence. These traditional financial measures are as follows:

- Return on investments (ROI);
- Net present value (NPV);
- Payback period.

First, return of investment is a performance measure used to evaluate the affectivity and efficiency of an investment (MicroStrategy, 2008). Evaluation of ROI requires knowing the total costs of investments and obtained business value. The ROI is expressed in percent. The return on investment is calculated using formula (1).

$$ROI = \frac{(Total\ gain\ from\ investment - Total\ cost\ of\ investment)}{Total\ cost\ of\ investment} \quad (1)$$

Second, net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. This measure is used to estimate the profitability of potential investment and can be calculated using formula (2).

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0 \quad (2)$$

Where t is time of cash flow, r – the discount rate, C_t – the net cash flow, $-C_0$ is minus the initial investment. Net cash flow as well requires both estimated cash outflow and estimated cash inflow, which is hard to estimate.

Finally, payback period is period of time required to recover the total cost of investment. For the projects with equal annual income payback period can be estimated using the formula (3).

$$Payback\ period = \frac{Total\ cost\ of\ investment}{Annual\ cash\ inflow} \quad (3)$$

These three measures are the commonly used for evaluation of monetary component of business value. However, Cronk and Fitzgerald (1999) also stress out the importance of qualitative measures, which can be split into three categories:

- System dependent;
- User dependent;
- Business dependent.

First, system dependent measures are used to estimate value brought by implementation of system. The example of such measures is accuracy, response time, downtime, timeliness, etc. Second, user dependent values are those value brought as a result of user characteristics. For example, user attitude and skills, which affects the use of system. Finally, business dependent measures estimate the value added to the company by the aligning system with company strategy and goals. This value can be measured by estimating company's effectiveness in achieving its business goals.

In turn, Adelman and Moss (2002) suggest a whole list of measures of success of business intelligence:

1. Return on investment;
2. Solution is used;
3. Solution is useful;
4. Project is delivered on time;

5. Project is delivered within the budget;
6. Improved user satisfaction;
7. Additional requests for data warehouse functions and data;
8. Business performance-based benchmarks;
9. Goals and objectives are met;
10. Business problems are solved;
11. Business opportunity is realized;
12. Solution has become an agent of change.

This list includes both qualitative and quantitative measures. First, return on investment already discussed in this section is used to estimate monetary value. Second, solution should be used and bring some useful value to the company. Third, also project management metrics are important for project success - project should be delivered on time and within the predefined budget. Fourth, users who are using implemented solution should be satisfied with it and interested in it. They should constantly request new functions and data in order to develop and improve the solution. Fifth, solution should enable company to improve its business performance indicators, help to meet objective and goals, solve existing business problems, and provide company with new business opportunities. Finally, business intelligence solution should become as an agent of change and enable company's transformation to the predictive information-based way of business management.

As it can be seen business value of business intelligence is hard to evaluate. Moreover, total cost of ownership is not limited only with initial investment, as maintenance of business intelligence constantly requires additional investments. Next section discusses the ability of companies to capture business value. The ways of capturing business value and its maximizations are introduced as well.

2.3.3. Capture of business value

Sharma and Djiaw (2011) state that improving productivity of an organization is one of the biggest challenges companies face today. Companies are switching from industrial economy to a data, information and knowledge based economy. Unfortunately, most of companies willing to implement business intelligence end up with implementing information management solutions (Sharma and Djiaw, 2011). In other words, companies fail to implement full potential of business intelligence and produce simple solutions for processing, automation, data storing and management of their business information. Gartner Group (2013) states that currently companies utilize only 43% of potential given by information technology. According to Ranjan (2008), the goal of investment in business intelligence is to change company's environment from reactive to proactive along with automating and integrating as many processes as possible, as well as, to provide stakeholders with right access to important business information.

Moreover, Gangadharan and Swamy (2004) point out that business intelligence is much more that enterprise resource planning, supply chain management, customer relation management, reporting, decision-support, and data mining systems. Sharma and Djiaw (2011) state that business intelligence is quite often confused with IT systems. For many organizations business intelligence seems as plug-and-play out of the box solution (Kaplan, 2007). As it was discussed in business intelligence definition section, technology plays supplementary role into the whole business intelligence concept. Thus, it is a main reason why simple technological implementation does not bring awaited business value.

This leads to the question how to capture and maximize the business value of business intelligence? Wu (2000) states that support from management and business operations are crucial for the business intelligence success. According to Ranjan (2008), success of business intelligence is hidden in the integration of business processes and information technology. Kaplan (2007) found out that companies nowadays are under increasing pressure of adapting their existing processes for proper use of data, information, and information technology solutions. These facts along with business value measures, business value implementation issues and critical factors of business intelligence success allow identifying few ways of business value capture and maximization:

- Ensure end-users and management involvement through the whole implementation process;
- Choose team with proper skills in business and technology;
- Train users how to use implemented solution;
- Choose proper technology and vendor;
- Reduce labour costs during maintenance phase;
- Thoroughly analyse business pains;
- Finnish project in time and within predefined budget;
- Re-engineer business processes.

All there ways are widely discussed in the literature. However, most of them are more related to project management techniques and already have wide discussion in literature. One of the approaches to address most of the project management issues is agile data warehousing (Ponomarjovs, 2012). In turn, this thesis focuses more on business intelligence process and its steps crucial for business value capture and maximization.

The concept of business process re-engineering already was mentioned in various publications and approaches but it is discussed only in very high level concepts and definitions. Thus, business process re-engineering is chosen as step required for gaining maximum from business intelligence and is discussed in the following sections of this thesis. This concept allows to adapt company's processes in order to aligns business intelligence solutions with company's strategy, capture and maximize business value.

2.4. Business process re-engineering

Business process re-engineering became one of the most popular topics among business managers and technology experts in early 90s (Choi and Chan, 1997). According to Martin and Cheung (2005), more than half of huge enterprise information technology projects do not reach even half of potential business value. Martin and Cheung (2005) also state that it is crucial for every company to continuously improve its information technology solutions and business processes. Moreover, for companies who already implemented various information technology solutions there is opportunity to capture business value by re-engineering and improving existing business processes (Riley, 2003). Thus, the following section focuses on a business process re-engineering, which is aimed on effective use of business intelligence and capturing value from its implementation.

2.4.1. What is business process re-engineering?

Many companies think they can get business value out of information technology project simply by implementing solution. However, Lee et al. (2011) insists that in order to get maximized business value of information technology it is necessary to align implemented solution with company environment and business processes. Thus, business process re-engineering is a key concept for business value capture and maximization.

According to Choi and Chan (1997), around 88 per cent of managers conducting business process re-engineering projects were able to implement business process re-engineering as a redesign of existing business processes. However, for many managers business process re-engineering concept is associated with business downsizing, layoffs or basic process automation. Around 54 percent of senior executives have wrong understanding of business process re-engineering (Choi and Chan, 1997).

Before defining business process re-engineering concept it is important to understand what is business process. Hammer (1990) defines business process as a full complete collection of task and activities performed by company in order to fulfill customers' requirements. Similarly Childe et al. (1994) defines business process as a structural and logical organization of human resources, materials, and procedures into tasks and activities aimed at producing end products or services. Now when business process is defined the concept of business process re-engineering can be introduced.

According to Hammer (1990), business process re-engineering is absolute rethinking and cardinal redesign of existing business processes in order to achieve significant improvements in crucial key performance indicators, such as, speed, quality, and costs. However, Armistead et al. (1995), who considers organization as a set of business processes, defines business process re-engineering as a process aimed on achieving

extreme improvements in business performance by use of resources in a way which enables capture and maximization of business value, as well as, minimization of cost-causing activities. Thus, it can be concluded that business process re-engineering is …

> *… cardinal rethinking and redesign of company's existing business processes in order to significantly improve business performance, as well as, capture and maximize business value.*

According to Homa (1995), companies in average may have three to ten core business processes. All other processes are minor and play only supporting roles. The main idea of business process re-engineering is to change core and supporting processes in order to improve business performance. Performance measures can be also quantitative and qualitative. Typical measures of business performance are speed, costs, profits, and quality.

Development of technology and increasing number of information technology projects pointed out a need for business process re-engineering for proper and more effective use of available solutions. In other words, proper use of right technologies may improve performance of business processes. Thus, one of the most popular areas of business process re-engineering is the role of technologies in business process re-engineering (Choi and Chan, 1997).

Business process re-engineering seems to be a key for business process improvement. However, there are still unsuccessful business process re-engineering projects, which do not bring improved business value (Choi and Chan, 1997). According to Champy (1993), around 70 per cent of companies fail in improving business performance by business process re-engineering approach due bad and unclear understanding of this concept.

2.4.2. Business process re-engineering and IT

The business process re-engineering unleashes the huge potential of modern information technologies (Gant, 1992). However, according to Choi and Chan (1997), managers quite often confuse business process re-engineering with information technology projects and forget about processes, human resources, products, and services. In other words, they only automate existing process by implementing IT systems. Therefore, such inaccurate process leads companies to creation of stand-alone systems for automatization of specific localized department operations. Choi and Chan (1997) state that this is happening due to lack of a complete corporate view at the available business information. All this causes urge need for business process re-engineering in order to capture potential business value of IT systems.

In order to achieve extreme improvement in business performance and maximize business value of information technology, management of the companies should rethink and clarify the role of information in their business (Choi and Chan, 1997). Managers should analyze the information flows along the business processes within the organization and identify these places where information technologies could bring real business value. In the re-engineering process, operations required to accomplish some predefined goals and methods to implement them should be identified (Choi and Chan, 1997). After these two things are identified re-engineers should think on opportunities and benefits of implementing information technology solutions through the chosen processes. Moreover, companies should be willing to put adequate budgets into information technology developments (Bashein et al., 1994). The process of business process re-engineering is discussed in more details in the following section.

2.4.3. Business process re-engineering approach

Business process re-engineering approach is a process as well. According to Choi and Chan (1997), business process re-engineering process is mainly based on the following steps:

- Conduct a "to be" situation analysis;
- Conduct "what-how" analysis and identify possible benefits of IT appliances;
- Establish redesigned process model;
- Simulate and evaluate re-designed processes;
- Implement new re-designed processes;
- Refresh company's objectives and goals.

However, Vakola and Rezgui (2000) represent business process re-engineering approach as a cycle. The approach is presented as a cycle of successive steps and is continuous process (Figure 20).

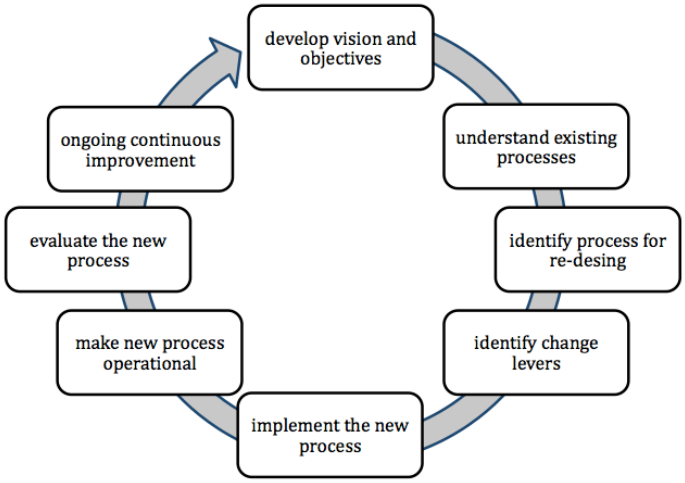

Figure 20. Business process re-engineering process (Vakola et al., 1998).

The cycle includes eight consecutive steps. First, the vision or "to be situation" is designed and objective for re-engineered process are established. Second, existing processes are analyzed and understood. Third, possible processes for re-design are identified. Fourth, levers such as implementation of information technology solution are identified. Fifth, new re-engineered processes are implemented and introduced within the company. Sixth, new processes are evaluated. Finally, processes are constantly monitored and continuously improved.

As it was mentioned in a business process re-engineering cycle (Figure 20), new processes should be always evaluated. Process evaluated allows re-engineers measure improvement and processes effectiveness. Thus, next section discusses the way of business process evaluation.

2.4.4. Business process re-engineering evaluation

It is important to evaluate and measure business processes in order to identify needs for meaningful re-engineering. According to Morris and Brandon (1993), business process re-engineering is usually measured with cost savings, revenue increases, quality and customer service improvements, user satisfaction, time reduction or combination of these measures. Valoka and Rezgui (2000) suggest evaluating business process re-engineering taking into consideration four different aspects:

- System functionality;
- System efficiency;
- User friendliness;
- Technology.

First, system functionality aims at evaluation how new re-engineered process supports functional requirements identified in third step of business process re-engineering process. New re-engineered process should ensure all same functionality as original process. Second, system efficiency aims at measurement how new re-engineered process solves identified problems. New re-engineered process should solve original process' issues. Third, user-friendliness measures the level of interaction between users and processes. These measures include such measures as process friendliness, access to required information, data processing, etc. Finally, technological measures aim at evaluation of technology involved into re-engineered process. It is measured with system shutdowns, network problems, lack of data, cleanness of data, etc. To sum up, these measures evaluate ability of new re-engineered process to support all required functions in an effective manner, which is user friendly and supported by technology.

The second chapter of this thesis discussed concept of business intelligence, its costs and benefits, its implementation process, as well its business value and its measures.

Moreover, concept of business process re-engineering was introduced. This theoretical research leads thesis to creation of business intelligence implementation framework, which is aimed at business value capture and maximization. This framework is introduced in the next section of this thesis.

2.5. Business intelligence value-oriented framework

Technological solutions may support and automate business processes, assist in daily work, but no technology will bring high business value without it alignment with company's goals and objectives (Clarke, 2001). Thus, it is crucial to ensure business intelligence technological solutions alignment with company's strategy. In other words, it is not enough with technology implementation. This chapter introduces business-value oriented framework for implementation business intelligence. Framework is a combination of various theories and approaches. Business intelligence value-oriented framework is shown in Figure 21.

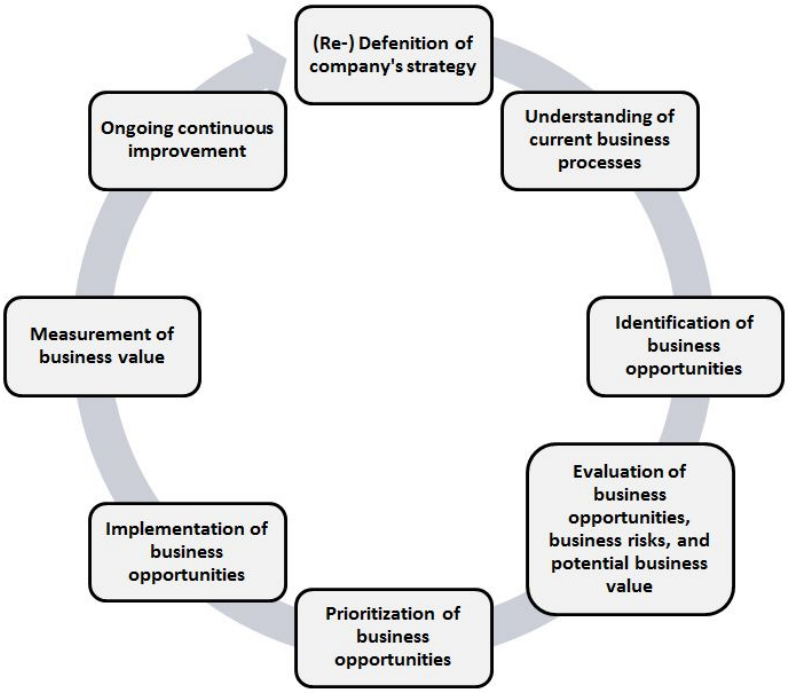

Figure 21. Business intelligence value-oriented framework.

This framework describes the business implementation process. The process as cyclical as it follows the idea of continuous improvement. The whole process starts with the definition or re-definition of company's objectives, goals, mission, vision, and strategy according to external environment and internal strengths. Defined strategy serves as input for the next step that is oriented on analysis of existing business processes and degree to which these business processes support chosen strategy and contribute to reaching selected goals and objectives.

Analysis done in first two steps of this framework leads to identifying of business opportunities. It is important to note that business opportunities do not always involve business process re-engineering, implementation of business intelligence and moreover technical solutions. However, framework developed for this thesis implies only those business opportunities, which involve implementation of business intelligence. Further, each opportunity is studied and analyzed in more details and evaluated utilizing business opportunity and business risk evaluation frameworks. Such aspects as business intelligence readiness and available data are also taken into consideration in this step. In other words, it is important to prevent company from wasting time on solutions, which company is not able to implement due to lack of data or technological limitations. Moreover, in this step potential business value of business intelligence is estimated. In the following step business opportunities are sorted and prioritized according to its values, resulting into prioritized business opportunity backlog.

The prioritized business opportunity is transferred to the business opportunity implementation step. Implementation step includes set of smaller business intelligence implementation cycles (Figure 22).

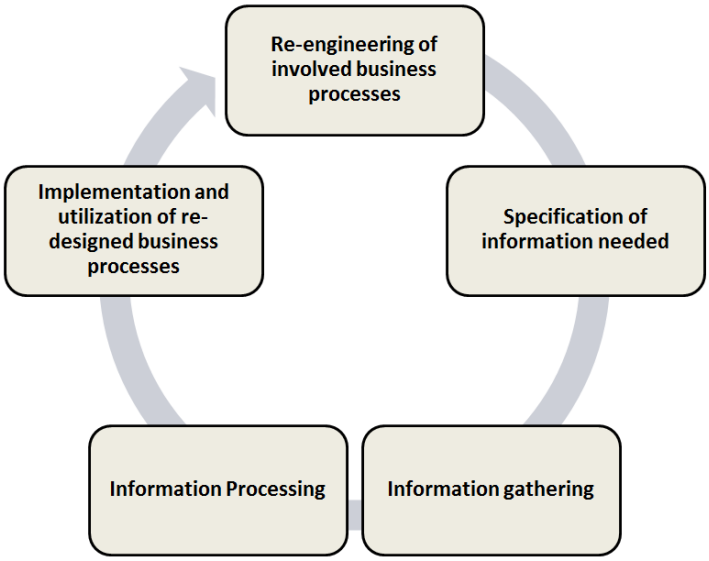

Figure 22. Business opportunity implementation step.

Implementation cycle starts with identification and re-design of business processes involved into business opportunity implementation. Business process is redesigned in order to support established strategy in more efficient ways. In business process, technology serves a lever. From the redesigned business process it becomes clear what kind of solution is needed. Thus, next team is to specify information required for the business intelligence solution. Later on specified information will be gathered and processed. The last step of business opportunity implementation cycle is implementation and utilization of re-engineered business process. In other words, re-engineered process is put in practice and is followed by involved persons.

After business opportunities are implemented their business values are measured and compared to the previous values in order to monitor progress. Business value measures include both quantitative and qualitative measures of business intelligence value, as well as, measures of re-engineered business process. Finally, implemented business opportunities and re-engineered business processes are monitored in order to improve their efficiency and effectively or to align them with re-defined business strategy.

3. RESEARCH METHODOLOGY

Research is a process of obtaining new knowledge or increasing existing knowledge by systematic and methodical investigation or enquiry (Amaratunga et al., 2002). Redman and Mory (1933) defined research as schematic process of gaining new knowledge. However, Oxford Advanced Learner's Dictionary defines research as detailed and carefully conducted investigation aimed at finding new facts (Turnbull et al., 2010).

In turn, research methodology is an approach of systematical research issue solving (Kumar, 2008). Methodology defines how research is conducted. Methodology does not define only methods for conducting the research, but also explains the logic behind the use of every particular method, approach or technique. In other words, methodology explains why researchers choose one tools over others and ensures that research results can be evaluated by researcher conducting research, as well as, by others.

This section of thesis describes the common approaches and methods for managerial research available in literature. Figure 23 shows the structure of this section.

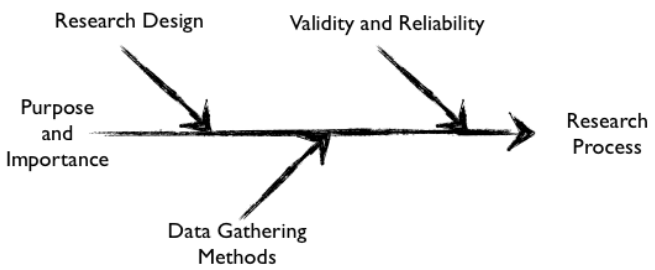

Figure 23. Structure of third section.

The goal and importance of research serves as a trigger for the whole process. It is followed by such inputs as research design, data gathering methods, validity and reliability of study. These inputs leads thesis to choice of research approach and methods suitable for this thesis and implementation of chosen methods in a real life study.

3.1. Research purpose and importance

According to Soni and Kodali (2012), research is usually aimed at new theory building or verification of already existing theories. The theory building focuses on observations, classification and defining relationships between existing theories and practices (Carlile and Christensen, 2004). In turn, verification of theories is testing of new theoretical hypotheses by use of empirical data (Lunenburg, 2011).

To the some extent this thesis is aimed on verification of combination of existing theories. This thesis was triggered by issues or "business pains" of the case company. The purpose of this thesis can be specified as combination of existing theories with a goal to create framework aimed at solving concrete business pains and apply it to the case company. Moreover, empirical study conducted within this study is focused on analysis of business pains, choosing right theories and subjective evaluation of results with a goal to verify suggested framework.

The importance of this study is hidden in case company's disappointment with its investments in the business intelligence solution as it did not bring awaited results. Thus, company was ready to support research in order to get maximum of their current business intelligence implementation and bring solution to the completely new level. Moreover, such kind of research has never been done within particular case company. This fact, from one side, made study more complicated as company was not familiar with concepts; on the other side, the results of this study may bring real value to the case company. Finally, the outcomes of this study are believed to provide case company with a tool for getting maximum value from existing and potential business intelligence implementations.

3.2. Research design

Currently there are various attempts to classify research approaches. Research approaches are classified from different points of view and different strategies they implement to answer research questions. In managerial and economics literature are discussed such management research types as:

- Theoretical or empirical;
- Deductive or inductive;
- Qualitative or quantitative.

First, research can be either theoretical or empirical (Simon et al., 1994). Theoretical research approaches issues in question via various theoretical constructs (Näsi, 1983). Empirical study is based on gathering empirical data, followed by analysis and reporting of results and conclusions (Minor et al., 1994). According to Moody (2002), empirical research as process can include the following steps:

- A definition of the research questions or problems;
- A review of existing theories and literature;
- The construction of hypotheses;
- The gathering of data required for answering research questions;
- An analysis of obtained results;
- Conclusions and implications.

Second, research can be either deductive or inductive (Heit and Rotello, 2010). Deductive research, referred also as “top-down” research, proceeds from more broad to more specific and narrow theories. Inductive or “bottom-up” research is an opposite concept focused on moving from specific observations to more generic and broader theories.

Finally, research may be categorized as qualitative or quantitative (Curall and Towler, 2002). Quantitative approach follows strong academic traditions and it is focused on numerical data that represents concepts and opinions in form of numbers analyzed using statistical methods (Amaratunga et al., 2002). Qualitative approach is more oriented on gathering data through interviews, observations and analysis of gathered data through qualitative data analysis methods (Bryman and Bell, 2007). Moody (2002) lists the most common quantitative and qualitative methods:

- Quantitative methods
    - Experiment;
    - Survey;
    - Historical data;
- Qualitative methods
    - Case study;
    - Action research.

Quantitative methods include experiment, survey, and historical data analysis. Experiment is focused on application on threaten and measuring the results. Survey is more oriented on asking questions in different forms. Historical data research is oriented on search of patterns and links in historical data. Case study research is done by observing conducted in real world settings with a goal to put researcher into the situation and get a holistic understanding of the phenomena. Finally, action research is an application of idea in practice, result evaluation, and further idea modification.

3.3. Data gathering methods

Definition of a research method is an initial stage of any management research. It is crucial for analysis to choose right method or its combination, which will suit established research goals. Thus, it is important for researcher to have good understanding of each of available methods in order to choose combination, which will provide him accurate results. Gummesson (1999) in his study introduces five research methods:

- Using existing materials;
- Questionnaire surveys;
- Qualitative interview;

- Observations;
- Action science.

First, researchers can use existing materials such as books, journals, documentations, specifications, diagrams, statistics, and videos. However, these materials were not created for research purposes and may contain irrelevant imprecise information (Gummesson, 1999). Though, existing materials can be useful tool in combination with some other research method. Second, questionnaire surveys are questionnaires with list of questions targeted on selected group of people. According to Gummesson (1999), this method can be used to evaluate attitudes, experiences, opinions, and preferences of chosen group of people. However, in case of poorly constructed questions such approach can result into highly biased data.

Third, qualitative interviews are the most commonly used method. Gummesson (1999) states that interviews are usually open-ended, as researcher may ask questions both about facts and opinions. In interviewing approach attention is also paid to non-verbal signs, because there are possible inaccuracies due to poor recall of reflexivity, as people may say what interview wants to hear (Gummesson, 1999). Fourth, observations may serve yet another source of information. Observations cover events in the real time and helps to get an understanding of current processes, as well as, it bring an insight on interpersonal behavior and motives (Gummesson, 1999). In spite of various benefits, observations is time-consuming method, which can also result sometimes in low reflectivity, as people might behave differently when they are observed

Finally, the concept of action science (or action research) is reserved for the situations when researchers assume the role of change agents of the processes and events they are simultaneously studying. In contrast to the mainstream researcher who is serenely detached, the action researcher is deeply involved. Applied to the study of business corporations and marketing, the action researcher can be a person who is both an academic researcher and either a marketing practitioner or an external consultant, a consumer or a citizen (Gummesson, 2001).

3.4. Validity and reliability

Validity and reliability are crucial attributes of any research. Validity is a measure of test's ability to measure phenomena it claims to measure (Hammersley, 1990). Ihantola and Kihn (2011) differ two kinds of validity: internal and external validities. Internal or contextual validity refers to the accuracy of results. External validity refers to generalizability and transferability of research results. In other words, external validity reflects how results of research obtained using one group can be transferred to the other group. In turn, reliability of research refers to an extent to which chosen measures are

compatible with thing they have to measure (Ihantola and Kihn, 2011). It means the degree of trust in chosen measures.

To ensure internal validity of this study various sources of information are used. For this study were used such resources as different theory sources, interview with various people in the organization, as well as, the intranet of case company. External validity is kept to some extent as well. Despite the fact that study was performed in one particular company, the results of this study can be applied to other companies with minor modifications. This can be done due fact that research does not utilize any specific unique attributes of case company. Moreover, this study is reliable as all interviewees are the professionals within the company, who works in this business already for several years and know their business and company well.

3.5. Chosen research strategy

This thesis is based on a study conducted within the industry. Study was performed during authors working period within Digita Oy. The goal was analyze existing solution for business intelligence within Digita Oy and find the possibilities of its improvement in order to maximize business value. Research strategy shown in Figure 24 was chosen for this research.

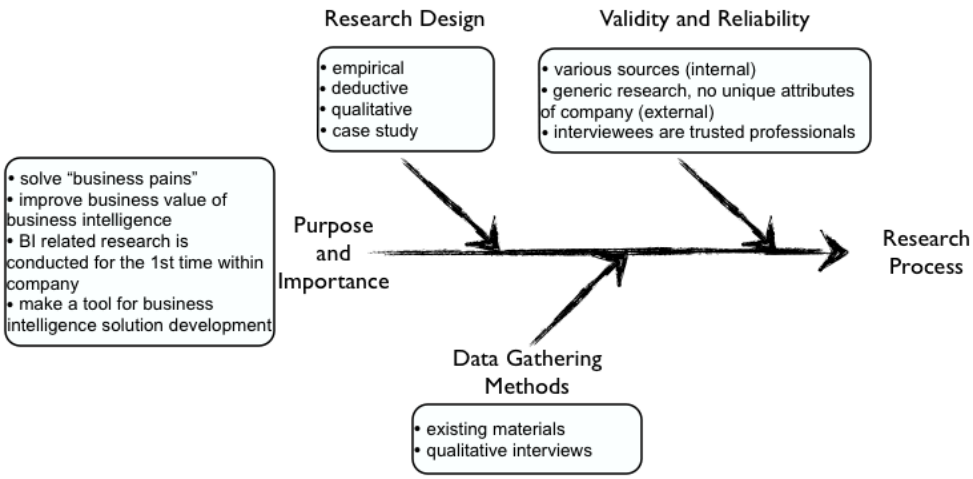

Figure 24. Chosen research strategy.

As it can be seen from Figure 24 the study conducted in this thesis was aimed at solving real company's business pains. The focus was on improvement of current business value of business intelligence by providing company with a tool for further business intelligence implementation. This study was important as such investigation was not conducted within this company before.

In order to accomplish this study, it was decided to conduct empirical, deductive, qualitative research, based on case study. This study is empirical as it is based on

gathering empirical data, followed by analysis and reporting of results. Therefore, study included following steps: definition of the research problem, review of existing theories and literature, construction of framework, application and prove of the framework in a real-world company, and conclusions. Deductive means that study gradually narrowed from the whole generic business intelligence area to discussion on business value of business intelligence. Study is based on qualitative research as it is more oriented on gathering data through interviews, observations and analysis of gathered data through qualitative data analysis methods. Finally, case study research is done by observing conducted in real world settings with a goal to put researcher into the situation and get a holistic understanding of the phenomena.

Data gathering methods used in this research are existing material analysis and qualitative interview. In case of this study such resources as intranet, documentations, marketing materials, and specifications were used. Qualitative interviews were conducted together with company employees. Interviews were 45-60 minutes long and questions listed in Appendix 3 were used for interview. Results were recorded and analyzed. List of interviewed employees can be seen in Appendix 1.

Finally, validity of this study can be proved by use of several sources. Moreover, this study does not involve any specific attributes of the company. Thus, results of this study can be applied to other organizations as well. Therefore, reliability is ensured by involvement of trusted industry professionals and experienced company's employees into research process.

3.6. Research process

As it was mentioned before in this thesis, this paper is based on research conducted with Digita Oy. The collaboration between author and Digita started in March 2012, when author started his career within Digita as Business intelligence analyst. The complete research process is shown in Figure 25.

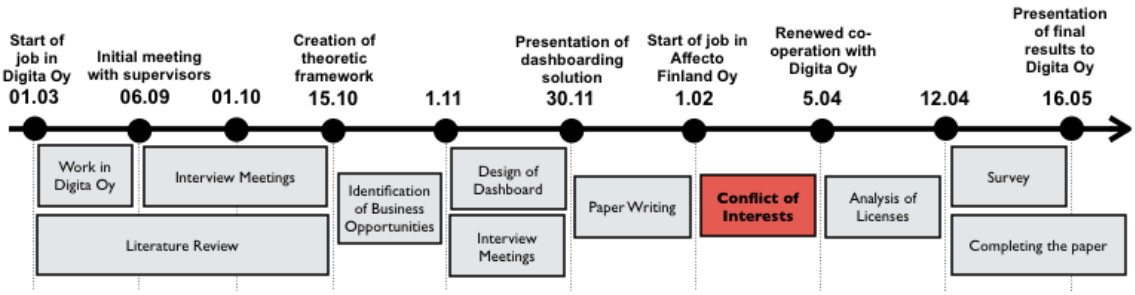

Figure 25. Timeline of the research process.

As it can be seen from Figure 25, the process has started on 1.03.2012 when the author of the thesis joined Digita as Business intelligence analyst. During summer time author was reviewing business intelligence related literature and getting familiar with company

and its business processes. During this period of time company's business intelligence related issues were identified. These issues triggered this thesis and provided author with a company case. On 06.09.2012 first official meeting with supervisors took place at the Digita premises in Helsinki, Finland. During this meeting all sides agreed on topic, objective, scope, and structure of the thesis. After this meeting following 1,5 months were completely dedicated to literature review and framework creation. It is important to note that most of qualitative interviews were conducted within these 1,5 months as well.

On 15.10.2012 theoretical framework was created based on literature review and qualitative interview sessions. Thus, following 1,5 months were spent applying developed theoretical framework for Digita case. During last two weeks of October sever business opportunities were identified and it was decided to focus only on two of them – dashboard for production controllers and license cost reduction. First, it was decided to proceed with dashboard at the same time analyzing different options for license cost reduction. During dashboard design stage, few meeting with production controllers were held. The demo of dashboard was presented on 30.11 and it got quite positive feedback, however, it was decided to conduct survey a little bit later, when users will be familiar with a new solution and will have constructive feedback.

On 30.11.2013 author quit his job at Digita due to organizational changes. From one side, it gave author plenty of free time for writing paper. From other side, it was not clear if it is still possible to continue with Digita case. Situation became even more complicated when author started new job at Affecto Finland Oy as Consultant. Affecto is one of the companies consulting Digita on business intelligence solution. Thus, this thesis could be a conflict of interests. Luckily, in April all sides agreed on continuation of this case study.

On 5.04.2013 author had a meeting with a Business system manager at Digita with a goal to discuss licensing issue, survey, and conditions of finalizing the thesis. Licenses were analyzed in the following two weeks. Luckily, Affecto was able to provide author with great support and information on dealing with licenses. Finally, survey and finalization of the paper were conducted in the late April-May of 2013 and the final presentation of results was help on 16.05.2013.

Despite the numerous challenges, author was able to accomplish everything planned before. Moreover, challenges arose in this research process made it even more interesting and brought a lot of experience for the author.

4. CASE: DIGITA OY

This section of master thesis introduced case company Digita Oy. First, company, its organization, and business processes are introduced. Company's existing information technology and business solutions are discussed as well. Second, the need for change is identified and business intelligence business value oriented framework is applied in order to design and suggest possible solution.

The following chapter is written in compliance with business intelligence business value-oriented framework. The approximate compliance of chapter sections to the corresponding framework steps is shown in Figure 26.

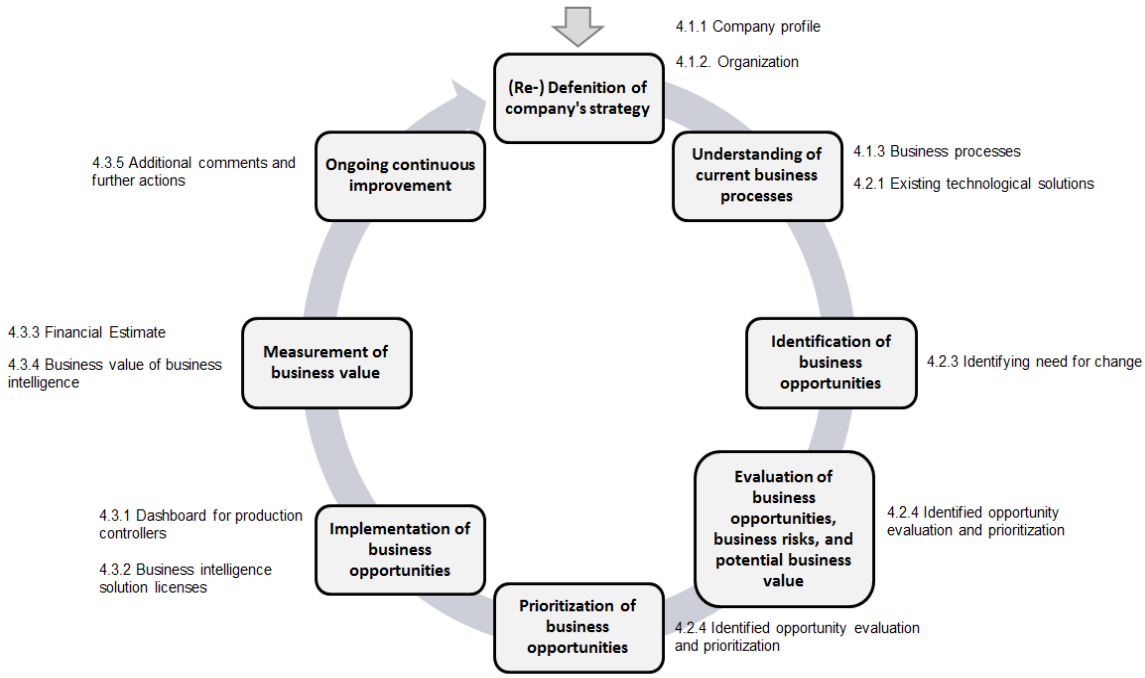

Figure 26. Compliance of business value-oriented framework and chapter four.

The Figure 26 demonstrates that some steps include more than one section of this chapter and some steps are split among several sections of this chapter. There is no clear separation of process steps in thesis. However, in practice it was followed as it was defined in the theoretic part of this thesis.

4.1. Digita Oy

Digita Oy is one of the leading companies in wireless and digital solutions in Finland. Digita has several information technology solution and started implementation of business intelligence aiming to improve its business performance. However, it is important to understand company, its business, and existing solutions in order to suggest any improvements.

4.1.1. Company profile

Digita is a wireless communications network operator, which manages the terrestrial radio, TV and mobile TV networks' broadcasting stations and masts. Digita's customers include television and radio broadcasting companies, as well as mobile and broadband operators. Company is responsible for transmission and broadcasting of national networks, as well as, for maintenance of the radio and television stations. The company's turnover in 2011 was 91 million euro.

Digita is a former YLE's Distribution Technology (*YLE:n Jakelutekniikka*). YLE's Distribution Technology is YLE's wholly owned subsidiary incorporated in 1999. YLE is Finland's national broadcasting company, owned by Finnish state.

In November 1999, YLE made an agreement with Sonera to sell 34% of Digita's shares. It was agreed to sell first 20% of the share immediately for 180 million Finnish marks and the remaining 14% later on for the price based on Digita based on current cash flow. However, Finnish Competition and Consumer Authority (*Kilpailuvirasto*) banned this deal. Finnish Competition and Consumer Authority approved the deal but imposed the condition that Sonera should apply for permission for digital TV broadcasting. Sonera did not accept these conditions and, as the result, deal was cancelled.

In December 2000, YLE sold 49% of the Digita shares to TDF Group for 141 million euros. TDF Group by that time was a subsidiary of France Télécom. The deal included an option to purchase up to 90% of shares later. In July 2003, YLE sold 41% of shares more to TDF Group for EUR 133 million, but in January 2005, TDF Group bought the remaining part of Digita shares. Digita was sold to obtain funds for broadcasting of digital television and radio. In total, YLE earned about 300 million euro from Digita sale.

In August 2012, Digita was sold to the First State Investments. First State Investments is the international arm of Colonial First State Global Asset Management (CFSGAM), the specialist asset management business of the Commonwealth Bank of Australia. CFSGAM is one of the largest Australian-based investment managers with offices in Sydney, Melbourne, Auckland, London, Edinburgh, Luxembourg, Paris, New York, Hong Kong, Singapore, Jakarta and Tokyo and has €118 billion in assets under management as at 30 June 2012.

Under new ownership, Digita will now develop its business as an independent company. As the owner of Finland's most extensive broadcasting network, Digita seeks growth by investing even more in its network and services for television and radio companies, as well as, for mobile and broadband operators. The new Digita's logo is shown in Figure 27.

Figure 27. Digita's new logo (since December 2012).

Nowadays, Digita's broadcasting network covering the whole country comprises 36 major stations, 151 sub-stations and dozens of transmission link stations. The example of broadcasting towers can be seen in Figure 28.

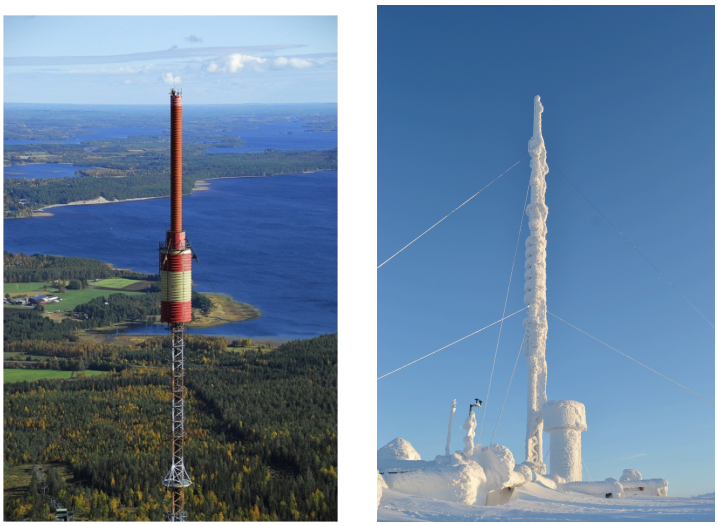

Figure 28. Television and radio broadcasting towers

(Vuokatti on the left, Ylläs on the right).

Moreover, Digita's competent personnel construct transmission and data connection technologies, as well as, other necessary technical solutions required to its customers. Solutions are designed and created in close cooperation with customers. Digita transmits

television programmes in its digital terrestrial networks. Digita is also responsible for the broadcasting operations of several commercial radios, including Radio Nova. In addition to radio and television operators, various electronic communication companies utilize Digita's services. Digita's services are available everywhere in Finland. Company is responsible for transmitting radio and television programmes to every home in Finland.

Digita's Network Management centre, located in Helsinki, maintains and controls the functioning of the broadcasting network and the technical quality of all broadcasts 24 hours a day. Digita has been granted a network-operating license, which allows it to optimize the use of network capacity between the television channels and to offer available capacity for other uses and applications.

Taking into consideration Digita's significant market power Finnish Communications Regulatory Authority (*Viestintävirasto*) has ordered Digita to charge their customers the fee based on costs. Digita almost has a monopoly in television and radio broadcasting. In 2011 Digita made a profit 24.2 percent of net sales. Finnish Communications Regulatory Authority checks the profit every year and ensures that Digita's pricing is cost-based and that the return on invested capital is within predefined limits.

Currently, DNA and Anvia have received permits television network operations. DNA and Anvia broadcast high-definition content. DNA has its own masts and Anvia use Digita's masts.

4.1.2. Organization

After Digita was acquired by First state investment, company's organizational structure had minor changes. However, company still has clearly defined organizational structure. The current organizational structure of Digita is shown in Figure 29.

In the left side of the organizational chart is the managing director of the company. The current managing director is *Sirpa Ojala*, who is a member of board of directors as well. Managing director is assisted by various assistants. The middle column in organization chart represents Digita's departments. Each department has its own role and implements specific function contributing into achieving company's strategy. Bigger departments may have two or more subdivisions.

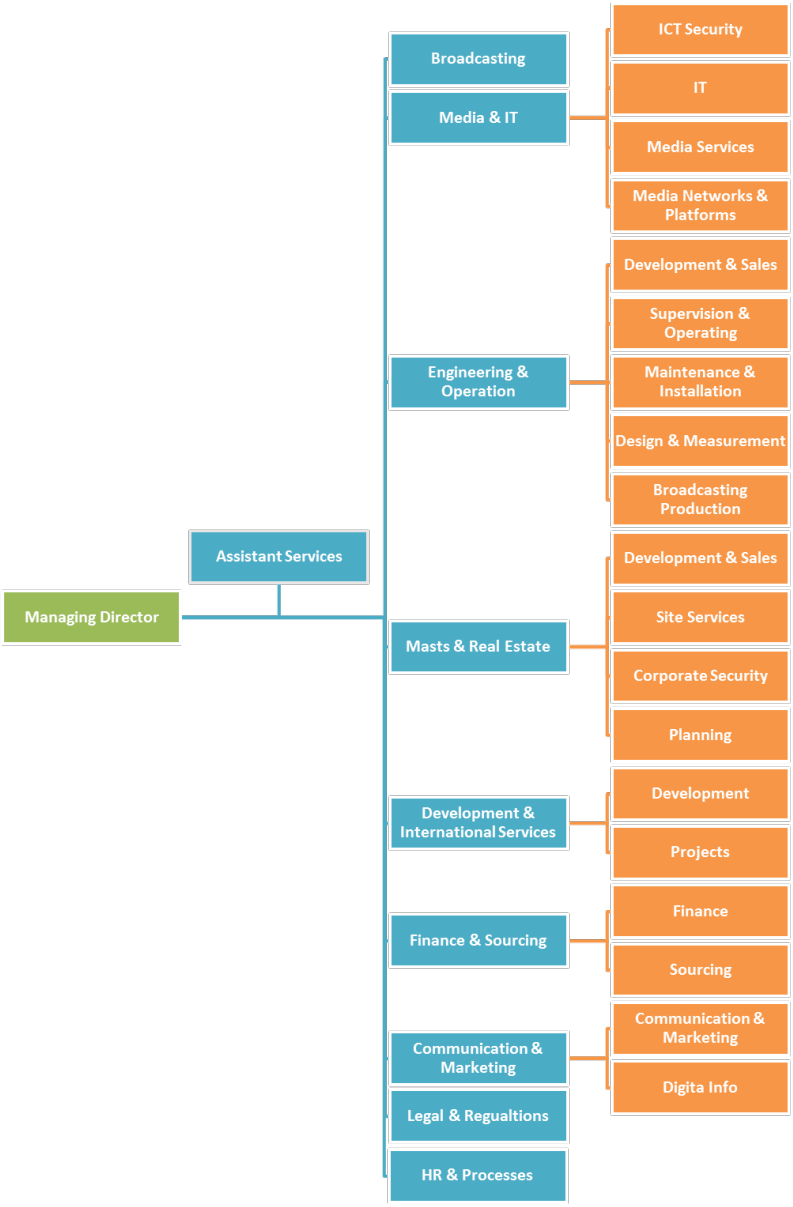

Figure 29. Digita's organizational structure.

However, the company's organization will change dramatically due to upcoming re-organizational changes. It is planned to split company into two parts. The new company Digita Networks Oy will be established and will take care of all the masts and real estates, as well as, all supporting and maintenance operations. Digita Networks will be the owner of already existing Digita. However, Digita will become a small company, which will maintain contracts with the current Digita customers and will be buying services provided by Digita Networks. Thus, Digita will become some kind of retailer distributing Digita Networks services.

4.1.3. Business processes

As it was discussed in theoretical part of this study, according to Homa (1995) company usually has from 3 to 10 core business processes. Other processes play a supportive role. In case of Digita's business the core process is maintenance of television and radio broadcasting masts. This business process is illustrated in Figure 30.

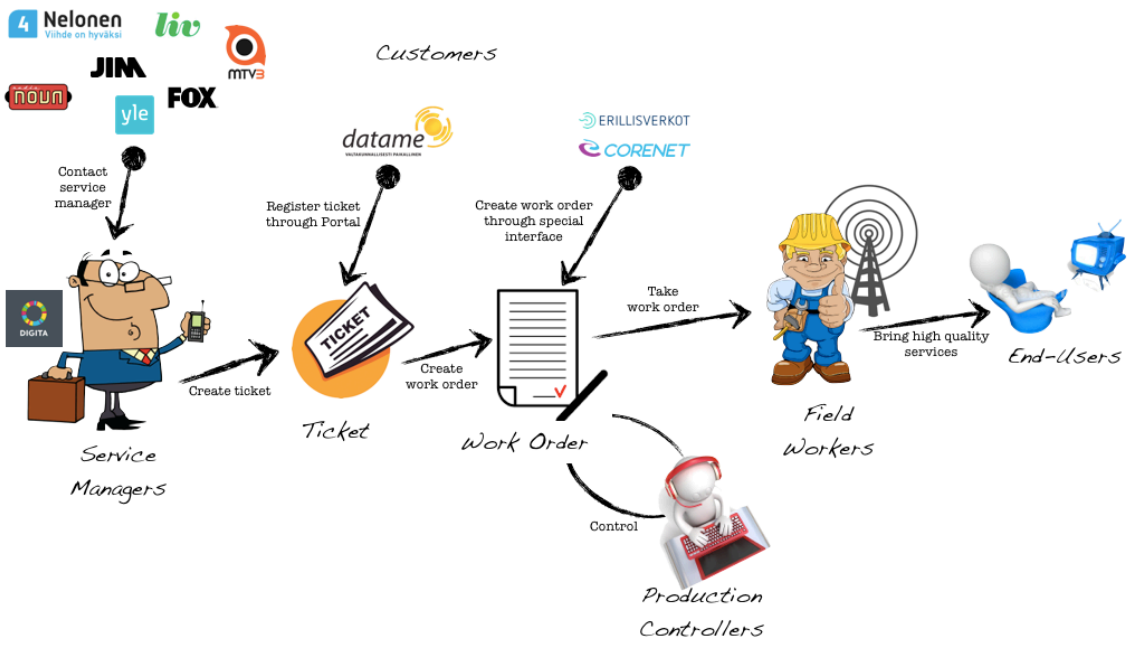

Figure 30. TV and radio mast maintenance business process.

The process is initiated either by Digita's customer either by production controllers. Production controllers may plan and register maintenance works or planned outages. However, customers may create problem or change tickets. Most of the customers have to contact service managers in order to report change request or problem ticket. Service managers evaluate priority, category and impact of the request and create a ticket if needed. However, it is planned to provide online portal for one of the customers to open tickets by itself.

Based on ticket work order can be created. Work order is a signal for action. In case of complex and big change requests, tickets can be split into tasks and work order can be created for each task. However, here as well is an exception. Two customers at the moment are able to create incident work orders by themselves through the special interface. Work orders are controlled by production controllers, who continuously monitor cost, payment and work load information. Currently, production controllers use a vast of report, which are modified and transformed by each controller himself.

Work orders can be accessed by field workers using either computers or mobile devices. Field workers take order from prioritized list in their production area and travel to mast

to perform required actions. As soon as word done, field workers report spent and travel time, amount of mast work done, and resources used.

The whole this process provides end-users of radio and television with high-end services without major outages and issues. Almost each step of this process is supported by technological solution. The next section introduces the set of technologies and systems utilized by Digita.

4.2. Analyzing existing business intelligence solution

The company has implemented various information technologies for supporting its business operations. This subsection discusses solutions already implemented in Digita, estimates its approximate business value, and identifies those places where changes, improvements or new functionality is required.

4.2.1. Existing technological solutions

The business process of Digita may seem simple, however, behind this process there is a complete set of technologies supporting this process. The biggest and major information systems available in Digita are listed in Table 5.

Table 5. Existing technical solutions in Digita.

System	Description
Service Manager	Service Manager is a service management and quality control solution provided by Hewlett Packard. Service Manager application is used for management of incident and change tickets. Currently, there is an on-going project aimed at implementation of configuration management database (CMDB) within Service Manager. Configuration management database is a centralized repository of information related to all the components of the broadcasting infrastructure.
PaJa	PaJa is a system for work order management. It provides access interfaces for both computers and mobile devices. This system is primarily used by field workers, who take orders and report work done. As well, production controllers use this system to monitor costs, incomes and quality.
TIHA	TIHA maintains all the information on site service usability. It contains information on all available sites, services and its availability (on-air times, blackouts).
FINA	FINA is a core of finance management. System contains all information relevant to finance, such as payments, purchases, employee wages, revenues, material expenses, etc.

Travel	Personec Travel is a travel management system provided by Aditro. Primarily system is used by field workers to report their travel times and expenses.
Planmill	Planmill Project is a time & expense management system. Its primary goal is to manage field and mast work hours reported by field workers; however, everyone in organization utilizes this system and reports his working hours and absences.
Vipunen	Vipunen is a name of data warehouse database. Data warehouse is utilized mainly for 3 purposes: • Side service usability reporting, service hierarchy; • Activity-based management or costing; • RTVA (Radio and TV broadcasting quality assurance) reporting.
GIS	GIS is geographical information system. This system is publicly available through Digita's homepage. System itself is a map of Finland containing information on all masts, their coverage, outages, and planned maintenance activities.
RTVA	RTVA is a radio and television quality assurance system. Radio and television broadcasts are recorded in order to monitor quality. System contains such information as planned and acquired translation, its size and quality.
PaHa	PaHa is a system for storing information collected from the broadcasting devices in order to
Tamara	Tamara is a name of system aimed at budget planning and forecasting. System is primarily used by finance controllers.

The listed solutions are implemented utilizing vast of technological solution provided by various vendor. Company currently has few contracts with consulting companies, who maintains implemented solutions. Almost all mentioned systems to some extent are involved in a Digita's core business process. The use of these information systems in the core process is illustrated in Appendix 2. However, as this thesis is focused on business intelligence issues the business intelligence solution and its business value are discussed in more details in the following section.

4.2.2. Current business value of business intelligence

Business intelligence was initiated as an internal development project in 2007. However, after initial designers and developers left company in 2011, solution was developed and supported by the consulting companies. Interestingly, that in 5 year time solution still is small, limited to reporting capabilities, and data warehouse is not really utilized. However, in this section current situation is investigated and discussed in more details.

To estimate the current value of business intelligence in Digita was decided to conducted research. First, in order to analyze what existing solution consist of it was decided to learn more about solution by reading existing documentations and conducting action research by running and utilizing solution. Second, to estimate the real value for business it was decided to conduct face-to-face interview with the solution's end-users.

The existing solution includes data warehouse and reporting portal. The data from various sources is load to data warehouse. Variety of tools from different vendors is used to implement current solutions. Summary of already available tools and technologies is shown in Table 6.

Table 6. Existing technical solutions for business intelligence solution.

Category	**Technology used**
Source Databases	Oracle DB, MS SQL Server, Solid DB
Data Warehouse	Oracle DB
ETL Processes	Informatica, MS SQL Server Integration Services
Reporting Portal and Reports	IBM Cognos BI
Planning	IBM Cognos Planning

The problem with such wide set of tools is that some of them are duplicating each other functionality (Informatica and MS SQL Server Integration Services). Each technology utilized within Digita for business intelligence requires quite expensive license, however, company is not getting maximum from this technologies due to incomplete solution design and user needs that are not requiring use of such advanced technologies.

In order to analyze value of current business intelligence solution, whole chain of face-to-face interviews was conducted. These interviews included meetings with such persons as Chief Information Officer of company, Business System Manager, and end-users of solution, which includes employees from different departments within Digita. The result of the interview showed that current solution to some extent automated the reporting creation process. However, quite big part of user still has to work with excels modifying reports and building own charts. Despite the fact there are 2000 reports ready for use.

Moreover, from the interviews with end-users it was possible to feel some distrust and disappointment with current solution. The one of the negative factors was that even users now have access to data they are still highly dependent on IT department of company. Despite this, users do not really have understanding of possibilities of business intelligence and ideas for future development, which can be summarized as insufficient end-user training and informing about possible solutions and features. From

discussion it also became clear that there is whole set of unsolved business issues and unrealized business opportunities.

There are two tools for data loads in data warehouse, which has similar functionality. At the same time data warehouse in Digita is used only for 3 purposes:

- Side service usability reporting, service hierarchy;
- Activity-based management or costing;
- RTVA (Radio and TV broadcasting quality assurance) reporting.

Side service usability reports are focused on usability and availability of each service in all the sites. This part of solution provides vast of reports to different Digita departments, as well as for some Digita's customers. Activity-based management or costing is used to prepare actual, budget, and forecasting reports for the financial department. Finally, an RTVA part is a really basic solution for preparing radio and television broadcasting quality reports. To sum up, implemented data warehouse functionality and data load processes are quite basic. Moreover, data warehouse and data loading tools capabilities are not used much in Digita.

To sum up, the current business intelligence solution is incomplete and there is whole set of unsolved business issues and unrealized business opportunities. Thus, it gives room for improvements. The next section identifies some of business opportunities and introduces cases where business intelligence solution could bring real value for the business users.

4.2.3. Identifying need for change

Concluding previous section, there is already established technological solution of business intelligence in Digita. However, there is disappointment and lack of interest from the end-user side mostly caused by incompleteness of current solution and lack of knowledge about potential solution improvements. Current solution is nothing more than access to data for business users and some report automatization. The data warehouse is not utilized much as well. The return on investment from such project is not high, as obtained benefits are hardly compared to implementation and software purchase costs of chosen tools. To improve this situation it is crucial to identify areas of improvements. It was decided to identify one business opportunity and implement a demo of business intelligence solution in order to demonstrate capabilities of potential solutions and raise an interest from business side.

The previous sections of this thesis were oriented on analysis of current situation and processes of company. This section of thesis follows a theoretical framework provided by the theoretical part as well. Thus, this subsection is focused on identification of

business opportunities, which will be analyzed and evaluated further in the thesis. It is important to note that this thesis is aimed only on identification and implementation of one business opportunity, when in real life as much as possible business opportunities should be identified, estimated, prioritized, and those bringing real business values should be implemented. Together with company it was decided to proceed with business opportunity of creation analytical dashboard, which would contain all critical key performance indicators, controllers use in their daily work. The primary goal of this business opportunity implementation is to provide production controllers with the reliable tool and build trust and interest for potential development of the existing solution.

However, as it was discussed in this thesis before, business value is difference between total costs and total benefits of business intelligence implementation. This means, cutting costs is one possible way of business value maximization. Thus, in addition to implementation of the chosen business opportunity, company's existing costly tool set will be analyzed (Figure 31).

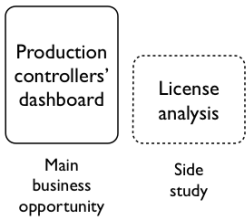

Figure 31. Identified business opportunity and a side study.

Understanding, of required software and licensing strategies is a complicated task for companies who are not specializing in business intelligence software. There are plenty of other vendors providing tools with the similar functionality. In Digita's case, company is not using any of bought tools to the maximum extent and there are some parts of business intelligence solution implemented using tools from other vendor. In terms of customer value it can be defined as company is not taking advantage of provided perceived customer value (Figure 32).

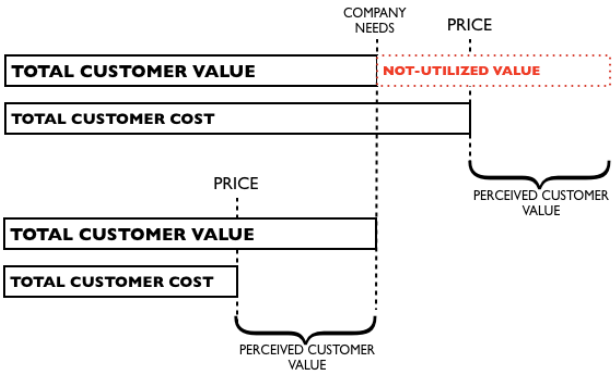

Figure 32. Customer value of software (Ponomarjovs, 2013).

According to Lyly-Yrjänäinen et al. (2010), total customer value is sum of all monetary values of benefits. However, the sum of all costs product or service costs is a total customer cost. The difference between total customer value and total customer cost is a perceived customer value (Lyly-Yrjänäinen et al., 2010). The main reason why companies choose costly products, which do not fit their need perfectly, is related to buyer's pure knowledge in this area. Usually, managers are expert in their core industry but do not have a clear understanding of the product they need and their real needs.

Even licensing analysis does not involve any business intelligence implementation and process re-design, it still can be considered as business opportunity aimed on cutting costs of business intelligence implementation and maximizing business value of business intelligence. Moreover, switching from one tool to another may trigger a whole project and various changes in processes and solution. However, choice of proper tools and related costs should be analyzed more carefully.

To sum up, in this section business opportunity and supplementary licensing issue were identified. Further in thesis, licensing analysis will be addressed as a business opportunity. Both, licensing analysis and primary chosen business opportunity, are discussed in the following sections.

4.2.4. Identified opportunity evaluation and prioritization

Following the defined framework for business value capture and maximization this section evaluate and prioritize identified business opportunities. The evaluation of business opportunity starts with evaluation of business risks or threats. These threats are situation that may happen if company will not implement identified business opportunity. Threats were identified during the interview with stakeholders and are summarized in Figure 33.

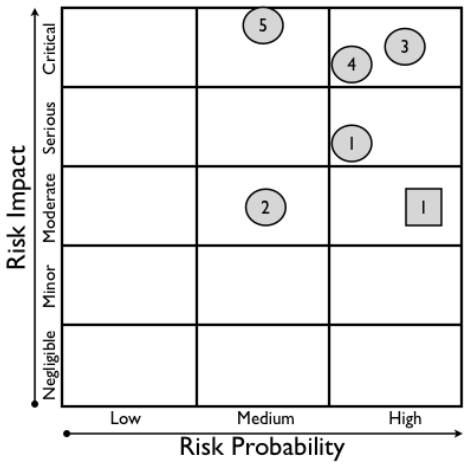

Figure 33. Evaluation of business risks.

Business risks for both business opportunities are summarized in a Figure above. Circle-shaped risks are related to production controllers' dashboard opportunity when square-shaped risks are related to licensing issue. Estimated business risks serves as one of the inputs for evaluation of business impact. Business impacts along with risks are summarized in Figure 34.

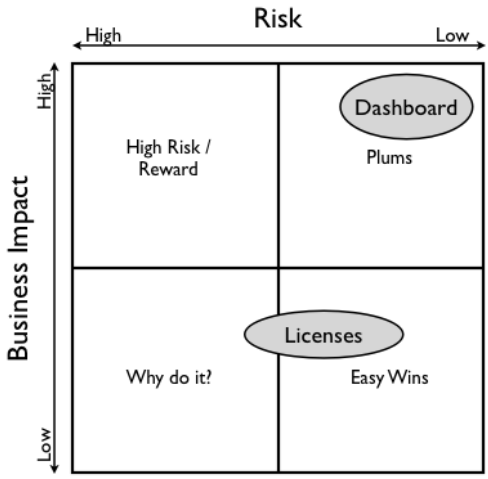

Figure 34. Evaluation of business impacts.

The identified business opportunities are classified into different groups based on their business risks and business impact. Following the framework business opportunities should be prioritized based on its ratings. However, in case of this thesis, we had identified only one primary business opportunity related to controllers' dashboard and supplementary opportunity focused on licensing issue. Thus, there is no need to prioritize these two opportunities and they will be analyzed in parallel further in this thesis. The next section of this thesis conducts a more detailed analysis of opportunities and its possible solutions.

4.3. Towards maximizing business value

From the previous subsection it becomes clear that there is still room for improvement in Digita. Thus, this subsection introduces more detailed requirement analysis and suggests possible solution for identified improvement opportunities. Solutions are estimated from both financial and qualitative sides in order to measure business value of suggested improvement.

4.3.1. Dashboard for production controllers

In the previous section a need for a tool for product controllers that would allow them to monitor costs, work amounts, and total performance in their production areas was identified. In order to design solution which could help them to perform all these action, it is necessary to analyze their daily routines and identify those most important key performance identifications.

The way for requirement analysis and gathering was interviewing production controllers themselves. There were 5 meetings in total. The meetings with production controllers from other Digita offices were conducted utilizing video conferencing capabilities. Every meeting was 60-90 minutes long, which allowed concentrating on issues during whole meeting.

The important thing of the requirement process was documenting of analyzed information and requirement. After each meeting results were documented into specification document, which was reviewed by production controllers and business system manager before the next meeting and commented in the meeting itself. Specification of the tool contains really basic description of dashboard, it tabs, and charts included into each tab. This specification serves as an official documentation of this project.

First meeting was devoted completely to analysis of production controllers daily routines. The typical business process for production controller within Digita can be seen in Figure 35.

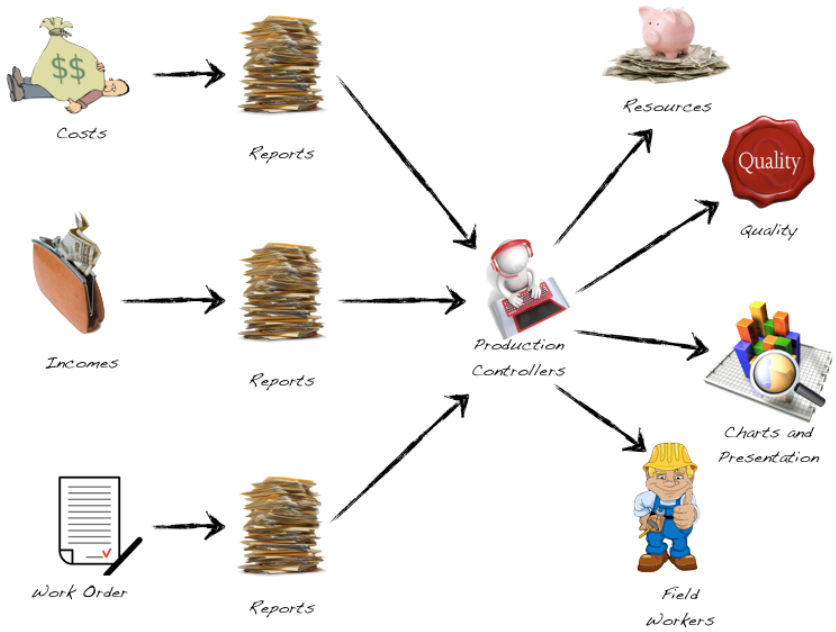

Figure 35. Work of production controllers.

In their daily work production controllers run and analyze vast of reports providing them with information on open, in-progress, and closed work orders, material use and other costs reported by field workers, as well as, information on received payments from customers. Reports have different structures, level of granularity, and are located in different locations, as they come from different source systems. Based on received reports production controllers build own charts, presentation and make an analysis in

order to control field workers, their work loads, quality of work, as well as, use of resources. This process is time and resource consuming for the production controllers.

This section suggests two possible solutions for identified and analyzed business opportunities. First solution is related to development of dashboard for product controllers, which would allow them to monitor key performance indicators. Second solution is focused on cost reduction and solution license optimization.

As it was mentioned before, together with company it was decided to proceed with business opportunity of creation analytical dashboard, which would contain all critical key performance indicators, controllers use in their daily work. To learn more about production controllers work, requirements they have, key performance indicators (KPI) they use series of interviews was conducted. Based on interviews and obtained information the potential improved business process for production controllers was designed. Re-engineered business process of production controllers' work is illustrated in Figure 36.

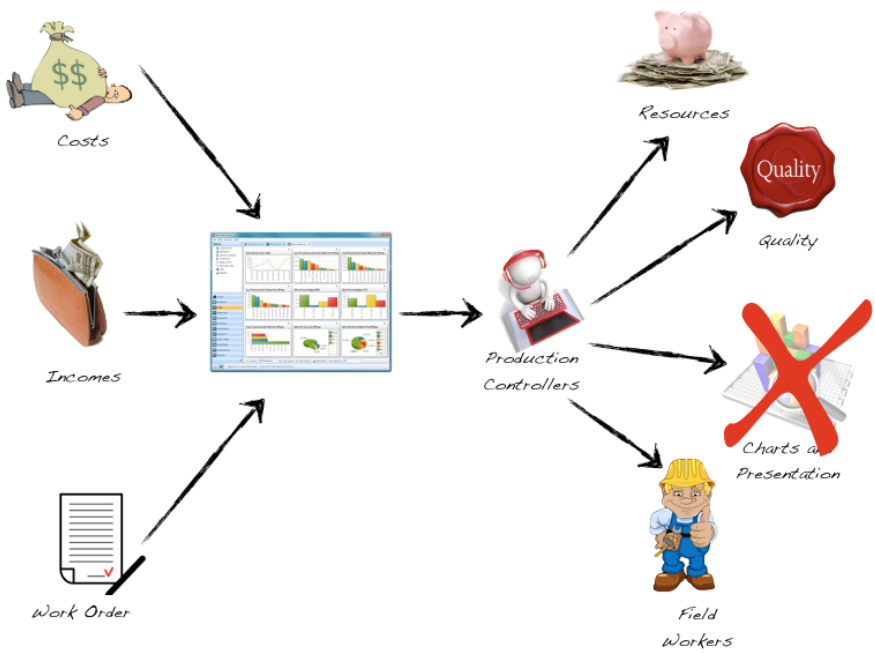

Figure 36. Re-designed work of production controllers.

This process at a glance may seem same as original one. However, in redesigned process production controllers have one centralized tool and source of all the necessary information. This tool allows production controllers save time and concentrate on their main duties. The dashboard for production controllers can be seen in Figure 37.

Figure 37. Dashboard for production controllers.

The information is gathered from various systems and summarized in the dashboard shown above. The dashboard contains all the necessary key performance indicators and charts required by production controllers. Thus, there is no need for controllers to build own charts as any of charts included in dashboard can be easily saved to the computer.

The demo of the dashboard included into re-designed project was also implemented within this thesis. The demo already included all the necessary information; however, it was running on top of operational databases. This has advantages and disadvantages. Disadvantage of running dashboard on top of operational data sources is slowing down other systems and low performance of dashboard, as these sources are not meant for execution of complicated queries and calculations. In turn, advantage of such approach is that dashboard always shows up-to-date information in real time. After the demonstration production controllers gave their feedbacks and came up with ideas for further development, which were summarized in specification and planned to be included in the further versions of product. However, to estimate business value of implemented solution it was decided to give some time for user to get used to this dashboard and later conduct a survey of production controllers. The survey and its results are discussed later in thesis in section 4.3.4.

4.3.2. Business intelligence solution licenses

Second question, which was raised in the preliminary interviews, was choice of development tools and environments. Existing licenses are costly; however, tools are not used to its maximal extent. Moreover, it was concluded that there are plenty of other vendors, whose tool would satisfy company's needs. Thus, current license expenses should be analyzed and minimized if possible. The current license expenses are summarized in Table 7.

Table 7. License costs for current tool set.

Item	Quantity	Unit Price	Discount Price	Extended Amount
IBM Software				
IBM Cognos Business Intelligence Administrator	2	2850,00	2295,00	4590,00
IBM Cognos Business Intelligence Business Analyst	15	297,00	297,00	4455,00
IBM Cognos Business Intelligence Business Author	6	297,00	297,00	1782,00
IBM Cognos Business Intelligence Consumer	107	183,00	183,00	19581,00
IBM Cognos Business Intelligence Professional	6	686,00	683,00	4098,00
IBM Cognos Business Intelligence Recipient	30	68,52	57,00	1710,00
Informatica				
Informatica	1 CPU with 4 Cores	?	?	9100,00

The table summarizes the most recent license prices provided by IBM and total license expenses spent for licenses last year. The initial license required for acquisition of listed tools is not listed here. The costs listed in table are annual feels Digita should pay in order to utilize these tools. Cognos licensing costs are dependent on number of users, who will use business intelligence solution. These users are split into different user groups and each group has right for specific tools and functionality. In other words, the more users will use business intelligence solution and the more advanced functions they will need, the more costly licenses will be. At the moment Digita annually pays 36216,00 euros for Cognos Business Intelligence tools and 9100 euros for Informatica data processing tool. This results in 45315,00 euros annually. However, with company growth number of users may increase, which will result in increase of business intelligence solution license costs.

Issues with costly licenses can be solved by switching to tools provided by other vendor. Currently company is overpaying for tools they do not use to the maximum extent. In the previous section it was estimated that company spends 45312.00 euros annually for software licenses. This thesis suggests migration to Microsoft business intelligence tools as Digita already has Microsoft databases running and utilizes some of Microsoft tools. For instance, data collection and load processes for Planning system are

already implemented with Microsoft data integration tools. Moreover, Microsoft tools support all the functionality currently implemented by IBM Cognos tools and can easily replace them. However, more detailed cost analysis should be conducted in order to evaluate feasibility of this option.

For evaluation of Microsoft business intelligence solution's license costs was used Microsoft license advisor (Microsoft, 2013) available online. Following instructions step by step and filling in required field it is possible to get an approximate cost of required licenses. The process requires taking two main decisions. First decision is related to the package of tools and services, which can be standard, business intelligence, and enterprise. For companies like Digita with 250 employees and more Microsoft suggests taking Enterprise package. License for Enterprise package is dependent on number of CPUs and cores per CPU. Second decision is related to software assurance. Software assurance is a specially designed set of services that includes helpdesk support, software updates, fixes, etc.

In this thesis, estimates were done for Enterprise package with and without software assurance. The estimates are based on assumption that company will use one server with 1 CPU and 4 cores. The both licensing options are shown in Table 8.

Table 8. Microsoft business intelligence licensing options.

Item	**Number of CPUs**	**Cores per CPU**	**Total Amount**
Microsoft Business Intelligence			
SQL Server without Software Assurance	1	4	20891,51
SQL Server with Software Assurance for 36 months	1	4	36562,43
Software Assurance extension for 36 months	1	4	15670,92

The Microsoft licensing options are listed in table above. Microsoft business intelligence is a part of SQL Server product, thus license for this product is mentioned in item column. It is suggested to take option with software assurance, as this option ensures various services provided by Microsoft. To conclude, utilization of Microsoft BI for Digita can result into initial payment of 36562,43 euro and after 3 years they would pay 15670,92 euro every 3 years.

The IBM Cognos Business intelligence price for current number is 36216,00 + 9100 = 4531616,00 euro / year (IBM Cognos Business Intelligence and Informatica costs is included). Thus, Microsoft business intelligence really can save money (Figure 38).

Figure 38. IBM Cognos BI and Informatica versus Microsoft BI license costs.

The Figure 38 shows a difference between license costs of two solution providers. However, there are also other costs related to license change. The biggest cost is switching cost. In other words, changing from one tool to other Digita will have to re-implement whole existing solution with new tools. Luckily existing solution is not that big. Moreover, company has contracts with two consulting companies. These companies could do all the implementation works. Another option would be to hire internal business intelligence specialist who would take care of the whole solution. However, good option also could be to use consultant for designing and establishing initial implementation, but for further implementations and improvements hire business intelligence specialist.

The difference in license costs is obvious, but finance controllers are the ones who should approve such important decisions. They usually operate with such terms as ROI and payback period. There both term were discussed in a theoretic part of thesis. In this chapter both measures are estimated. First, it is required to identify total cost of investment and potential cash inflows. In case of cost cutting cash inflows will be money saved or the difference between value costs. Table 9 summarizes investments and cash inflows relevant for changing software vendors.

Table 9. Forecasted investments and cash inflow related to migration.

Year	**Investment**	**Cash inflow**
Year 1	-36562,43	45316,00
Year 2	0	45316,00
Year 3	0	45316,00
Year 4	-15670,92	45316,00
Year 5	0	45316,00
Year 6	0	45316,00

Now based on identified investments and cash inflows it is possible to calculate payback period. From table it can be seen that initial investment will be covered already in 2 years. This means investment will payback before Software Assurance extension investment. Moreover, Software Assurance investment is smaller than the difference between Microsoft and Cognos licensing costs. Thus, investments in Software

Assurance will always payback within 1 year. Second, return on investment from this investment is calculated below:

$$ROI_3 = \frac{(135948{,}00 - 36562{,}43)}{36562{,}43} = 2{,}72 \quad (4)$$

$$ROI_6 = \frac{(271896{,}00 - 52233{,}35)}{52233{,}35} = 4{,}21 \quad (5)$$

The calculations above show return on investment for 3-year (4) and 6-year (5) periods. In fourth year Digita should invest into Software Assurance again in order to have maintenance services. ROI for three years is positive and already quite high. Moreover, ROI is growing with time. Such good finance indicators may serve as a good reason for the planned change. However, before taking final decision more detailed analysis should be performed. Taking into consideration complexity of software purchasing process and various factors that should be taking into account it is hard to judge on switching from one software vendor to another. Purchase of software products is concerned with plenty of other direct and hidden costs. Even if license comparison shows significant cost reduction the outcome of switching could not bring significant cost reduction or even bring new additional costs.

This section estimated financial value of license change. However, this section did not include any estimation of qualitative benefits. Next section of this thesis discusses evaluation of qualitative component of second business opportunity discussed in this thesis – product controllers' dashboard.

4.3.3. Business value of business intelligence

This section analyzes business value of dashboarding solution provided in this thesis. For the analysis of business value was designed a small survey which was distributed to the key users of solution. The survey (Appendix 4) is based on critical success factors of business intelligence mentioned in previous sections of this paper. This survey was conducted 4 months after the presentation of dashboard demo. Thus, all respondents had time to get familiar with solution and realize positive and negative parts of it. The average results of this survey are listed in Table 10.

Table 10. Results of production controllers' survey.

Question	**Average rate (1-10)**
How often do you use provided solution?	7
How useful is provided solution for you?	6
Are you satisfied with the solution provided?	7
Do you have any improvements in mind?	Yes

Is implemented solution aligned with the company strategy and mission?	8
Are predefined goals and objectives for solution met?	7
Does this solution provide you with improved approach of doing your daily job?	8
Is this solution solving business problem that triggered implementation of this solution?	4
How would you evaluate performance of this solution?	6
How would you evaluate availability of this solution?	7
How would you evaluate user friendliness of this solution?	7
Do you have any ideas on development of a new tool which could support you in your work?	Yes

Survey shows quite good results taking into consideration that provided solution is just a demo of the potential solution. Therefore, this survey allows finding issues already at demo stage and include changes and improvement in the final upcoming solution. Despite fact, that provided solution is just a demo it is already in use and production controllers use it in average 3 times per week. They consider it useful, overall level of satisfaction is quite high, solution is aligned with company strategy well and main objectives for solution are almost met. However, provided solution does not solve the root problems which have triggered the need for this dashboard. At the current stage it is only automation of various production controllers' tasks. Thus, more detailed interviews and analysis are required on this issue. From the technical side solution is stable and reliable. It is available all the time online; however, there are some minor performance issues. Dashboard design is intuitive and user-friendly.

The most important founding of this survey is that user became more active and interested in business intelligence solutions. They have seen possibilities and demo implementation. After presentation of demo and few month of its intensive use majority of product controllers have ideas on improvement, additional functionality, and also ideas for new solutions that would support them in their work. All of them are ready to share experience with other colleagues from other departments within organization to raise their interest for the potential improvements and implementation within their units.

4.3.4. Additional comments and further actions

The research and investigation conducted in this Master thesis provided company with two potential solutions, which could improve business value of business intelligence solution. Moreover, fully functional demo of dashboard for production controllers was created. Demo was presented to the production controllers and got positive feedback. Demo itself covers almost all predefined functionality and is utilized daily by its end-users, but still it requires some improvements.

Two solutions provided in this thesis improved business value of business intelligence solution within Digita Oy. However, there is still room for improvement. Few of potential improvements are listed below:

- Report cleanup and reorganization;
- Utilization of data warehouse;
- Hiring of internal business intelligence professional.

Company has around 2000 stored in its reporting portal. Most of the reports are demo reports, test reports or copies of existing reports. After filtering out those reports which are hidden from end-users, are test reports or various copies of existing reports, number of reports reduces to around 500. This number is still large for such small company and obviously not all of these reports are used. Thus, report audit was established in order to monitor use of reports and identify reports, which are not used, are used rarely, and those used frequently. After data on report use will be collected reports should be sorted out, key users should be identified and report portal cleanup should be performed in order to lighten system and make it less confusing for user by reducing number of useless information.

Also data warehouse system should be utilized more than it is utilized now. With a large number of stand-alone systems, data warehouse may provide great opportunities for data analysis. Therefore, it can improve performance of reporting and reduce system load on operational systems. Moreover, now when users are satisfied with newly implemented solution and have an increased interest in business intelligence solution is a perfect time to work with them and design new potential solutions.

Finally, along with upcoming company's organizational and strategic changes demand for new reports and analytics will increase. Thus, it may be reasonable to hire a business intelligence professional. Business intelligence professional could replace existing contracts with consulting companies, take care of business intelligence solution and its strategic development, and minimize business intelligence related costs.

5. CONCLUSIONS

5.1. Business intelligence value-oriented framework

This thesis discusses the various concepts of business intelligence – starting from definition to business impacts business intelligence may have. In first sections of theoretical background precise definition of business intelligence as given and scope of this term is established. The second section of theoretical background discusses and introduces several business intelligence implementation processes oriented more on implementation of sol ution than on business value capture.

The crucial element of this study is third section of theoretical background where business value of business intelligence is discusses. This section in detail discusses issues and approaches related to measurement of business value. Comprehensive analysis of business value is necessary in order to track the improvements of business intelligence solution, as well as, provide trustful data for analysis of the business intelligence related investments.

The fourth section of theoretical background introduces the business process re-engineering concept. At first sight it may seem that that this concept is not relevant to the business intelligence study. However, this concept in a generic level was mentioned by various authors as a part of a business intelligence implementation process. This leads the theoretical study to the final last section of theoretical background where all above mentioned concepts are merged in one business intelligence value-oriented framework.

Thesis suggests business intelligence value-oriented framework based on comprehensive business analysis, qualitative interviews, and detailed literature analysis. The key role in suggested framework plays business process re-engineering process, which is aimed at re-engineering organization's existing processes in order to align implemented business intelligence solution with strategy, goals, and objectives of the company. Moreover, framework stresses the important of the business value measurement, in order to track the progress and improvement of business intelligence solution.

Developed framework was applied within Digita Oy. The results of framework usage within one particular company are discussed in the following section.

5.2. Results of the case study

Nowadays, companies are looking for solutions, which could enable them to efficiently manage their data and to make effective data-driven decision. In their opinion, business intelligence is supposed to be a unique solution for this issue. The goal of business intelligence is to transform large volumes of data stored in relational databases into meaningful business information, which could help companies improve their performance. However, many companies still do not understand the real meaning and value of business intelligence. As a result, many companies have difficulties with creation, capture, and maximization of business value.

This thesis was conducted in close cooperation with Digita Oy. The company is one of the leading companies in wireless and digital solutions in Finland. Digita has several information technology solution and started implementation of business intelligence solution aiming to improve its business performance. However, company was not able to see any significant business value of implemented solution. Thus, the goal of this thesis was to find possible ways to capture and maximize business value of business intelligence in a case company.

This thesis suggested extending existing business intelligence implementation process with actions required to capture and maximize business value of business intelligence. These actions are oriented on solution integration into managerial and operational processes, alignment with the organization's strategy, as well as, focus of the whole project should be shifted from technological to business development. These ideas are implemented in a business intelligence value-oriented framework discussed in the previous section, as well as, developed framework was applied within Digita Oy. Company's business strategy and organization were analyzed and several business opportunities were identified. Together with company, it was decided to proceed with only two business opportunities – production controllers' dashboard and license analysis. These two opportunities are different by nature: dashboarding solution is bringing value when licensing optimization cuts costs.

First, in scope of this thesis requirement analysis for dashboard solution was performed, as well as, demo solution was developed and is currently in use. In order to evaluate business value of this solution was performed survey of the key users. The survey showed that new solution is aligned with company strategy and key users are satisfied with results. However, the most important founding of the survey is that users became more interested in business intelligence solutions. After presentation of demo and few month of its intensive use majority of product controllers have got plenty of ideas on improvement, additional functionality, and also ideas for new solutions that would support them in their work. Moreover, they are ready to share experience with other colleagues to raise their interest for the potential new implementations.

Second, current business intelligence solution was analyzed and it was concluded that company is currently overpaying for powerful tools, which are not utilized to the full extent. Thus, it was decided to investigate option of migration to toolset provided by other vendor. Microsoft was chosen as the most feasible option as company is already utilizing some of its tools. Analysis showed that company could save 219662,65 EUR in 6 years' period by migrating to suggested tools. Such good finance indicators may serve as a good reason for the planned change. However, before taking final decision more detailed analysis should be performed. Taking into consideration complexity of software purchasing process and various factors that should be taking into account it is hard to judge on switching from one software vendor to another. Purchase of software products is concerned with plenty of other direct and hidden costs. Even if license comparison shows significant cost reduction the outcome of switching could not bring significant cost reduction or even bring new additional costs.

These two suggested solutions definitely increase business value of business intelligence within Digita Oy, as well as, suggested framework can serve as a tool for further development of business intelligence solution. However, there is still room for improvement. Few of potential improvements could be: report cleanup and reorganization, utilization of data warehouse, and hiring of internal business intelligence professional. There are many reports which are not in use or designed in the way which does not make sense. Data warehouse currently is not utilized much; however, it could bring great opportunities and benefits for company. Hiring of business intelligence professional could bring essential reduction in business intelligence costs. Moreover, it could bring capabilities and know-how to the company.

5.3. Evaluation of the study

This section evaluates the success of research strategy and research process designed in sections 3.5 and 3.6. This thesis was aimed at solving real company's business pains and study conducted within this paper was triggered by real life case. The focus was on improvement of current business value of business intelligence by providing company with a tool for further business intelligence implementation. This study was important and relevant in terms of company as such investigation was not conducted within this company before.

In order to accomplish this study, it was decided to conduct empirical, deductive, qualitative research, based on case study. This study was empirical as it was based on gathering empirical data, followed by analysis and reporting of results. Therefore, study included following steps: definition of the research problem, review of existing theories and literature, construction of framework, application and prove of the framework in a real-world company, and conclusions. Deductive means that study gradually narrowed from the whole generic business intelligence area to discussion on business value of

business intelligence. Study is based on qualitative research as it was more oriented on gathering data through interviews, observations and analysis of gathered data through qualitative data analysis methods. Finally, case study research was done by observations conducted in real world settings with a goal to put researcher into the situation and get a holistic understanding of the phenomena.

Data gathering methods used in this research were existing material analysis and qualitative interview. In case of this study such resources as intranet, documentations, marketing materials, and specifications were used. Qualitative interviews were conducted together with company employees. Interviews were 45-60 minutes long and questions listed in Appendix 3 were used for interview. Results were recorded and analyzed. List of interviewed employees can be seen in Appendix 1.

To ensure internal validity of this study various sources of information are used. For this study were used such resources as different theory sources, interview with various people in the organization, as well as, the intranet of case company. External validity is kept to some extent as well. Despite the fact that study was performed in one particular company, the results of this study can be applied to other companies with minor modifications. This can be done due fact that research does not utilize any specific unique attributes of case company. Moreover, this study is reliable as all interviewees are the professionals within the company, who works in this business already for several years and know their business and company well.

To sum up, author was able to implement research strategy designed in earlier stages of his research. All required information was available and interviewees kindly agreed for face-to-face interviews. However, research process had also several issues related to change of author's job. At some stage of the research process there was a conflict of interest between previous and current employer, but this conflict was successfully solved. Finally, the area of business intelligence is wide and cannot be included in one single Master thesis. Thus, it was important to clearly define and follow scope of the research.

5.4. Suggestions for further research

This thesis introduced a business intelligence value-oriented framework, which has been applied within one particular company. However, it would be interesting and beneficial to test designed framework for a larger set of companies among various industries, in order to get more detailed feedback on it.

Moreover, this thesis opens many interesting possibilities for further research. It would be beneficial to investigate further such topics as IT strategic development and total impact of information systems on business performance. Thus, more comprehensive study on business value measurement could be conducted.

Finally, framework introduced in this thesis reminds the Scrum software development model. Thus, opportunity of combining these two could be investigated. The identified business opportunities could be considered as a task backlog and a simple Scrum iteration could be business opportunity implementation. Such kind of research could be a great area for researchers interested into agile business intelligence implementation models.

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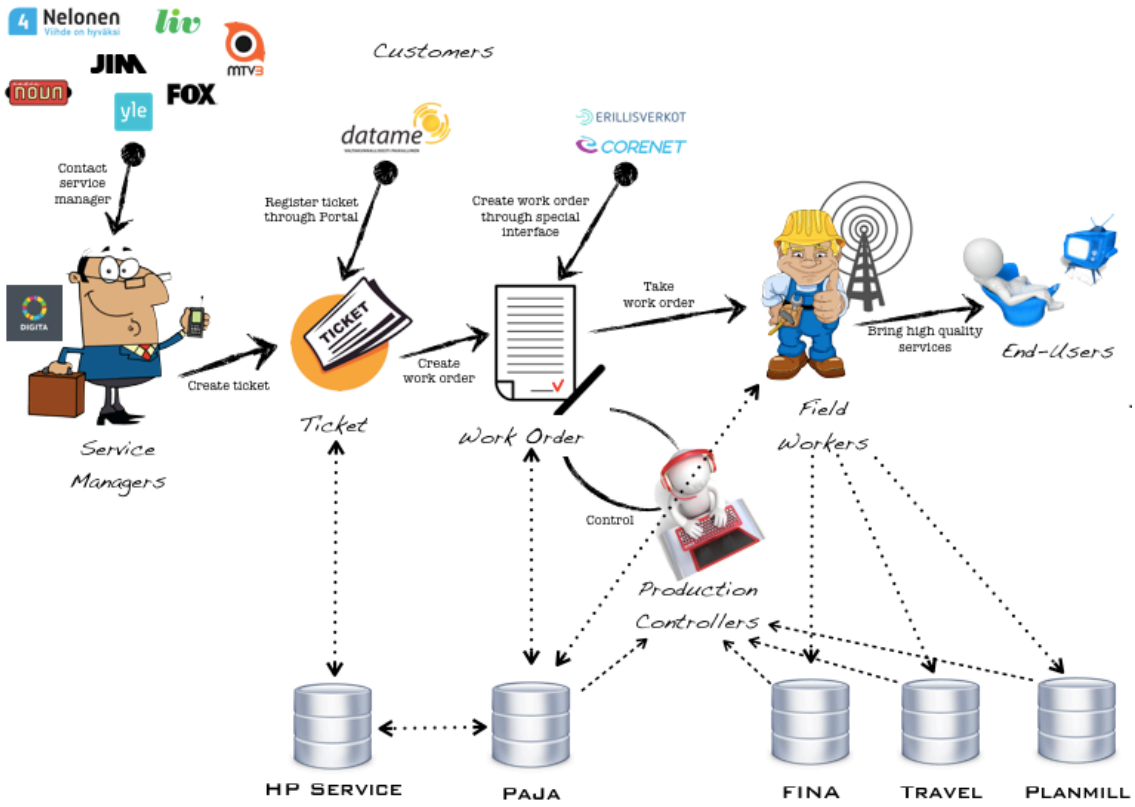
APPENDICIES (4 pieces)

APPENDIX 1: INTERVIEWEES OF THE STUDY

Date	Department	Position
06.09.2012	Multimedia and IT	Chief Information Officer
07.09.2012	Multimedia and IT	Business System Manager
14.09.2012	Finance and Sourcing	Finance Controller
15.09.2012	Finance and Sourcing	Sourcing Manager
16.09.2012	Engineering and Operations	Production Controller
21.09.2012	Masts and Real Estate	Department Manager
28.09.2012	Development and International Services	Department Manager
01.11.2012	Multimedia and IT	Chief Information Officer
01.11.2012	Engineering and Operations	Production Controller
01.11.2012	Multimedia and IT	Business System Manager
08.11.2012	Engineering and Operations	Production Controller
08.11.2012	Multimedia and IT	Business System Manager
15.11.2012	Engineering and Operations	Production Controller
15.11.2012	Multimedia and IT	Business System Manager
22.11.2012	Engineering and Operations	Production Controller
22.11.2012	Multimedia and IT	Business System Manager
30.11.2012	Engineering and Operations	Production Controller
30.11.2012	Multimedia and IT	Business System Manager
04.04.2013	Multimedia and IT	Business System Manager
12.04.2013	Multimedia and IT	Business System Manager
16.05.2013	Multimedia and IT	Chief Information Officer
16.05.2013	Multimedia and IT	Business System Manager

APPENDIX 2: DETAILED MASTS MAINTAINANCE PROCESS



APPENDIX 3: QUESTIONS FOR INTERVIEWS

Departments	Questions
Media and Information Technologies	• Which organization do you represent? • What is your role and responsibilities within your organization? • What is current vision and strategy of your company? • What are the most important drivers in your organization? • What does term business intelligence means to you? • What information technology solutions, information systems do you have now? • When did the business intelligence project was initiated? • Who were initial designers and developers of solution? • What is current business intelligence architecture like? • Does current solution support vision and strategy of the company? • What are the data sources for business intelligence solution? • Is there centralized data warehouse implemented as part of BI solution? • What purposes does data warehouse serve for? • What are the main channels for information distribution? • What content and to whom it is delivered? • Who are the end-users of business intelligence solution? • How many consumers there are? • Do you measure business value of business intelligence solution? • Which business value metrics do you utilize? • How do you monitor and measure improvements and development of current solution? • Which tools are used for business intelligence implementation? • What are costs of current IT solution? • What kind of license agreement do you have? • How well current solution is documented? • Who has access to documentation? • Who maintains and develops solution now? • Do you outsource development and maintenance or keep it

	inside the company? • What kind of external contracts with consulting companies do you have do you have? • How would you change the current solution?
Finance and Sourcing; Engineering and Operation; Masts and Real Estate; Development and International Services	• Which organization do you represent? • What is your role and responsibilities within your organization? • What is current vision and strategy of your company? • What are the most important drivers in your organization? • What does term business intelligence means to you? • What are your measures of company's success? • What are KPIs you use in your work? • Does current solution support vision and strategy of the company? • Does current business intelligence solution support decision-making and management processes? • What kind of solution there is to support decision-making and management processes? • What are the questions answered by current solution? • What are the questions that should be answered in future? • What information is needed to answer them? • How often do you use current solution? • How satisfied you are with current solution? • How much you are familiar with features and potential improvements business intelligence can offer to your organization? • How much you were involved into implementation process of the current solution? • How would you change the current solution? • Do you have any specific vision, functionality you would like to see in future?

APPENDIX 4: QUESTIONS FOR SURVEY

Question	**Rate (1-10)**	**Comment**
How often do you use provided solution?		
How useful is provided solution for you?		
Are you satisfied with the solution provided?		
Do you have any improvements in mind? If yes, please list them in comment field.		
Is implemented solution aligned with the company strategy and mission?		
Are predefined goals and objectives for solution met?		
Does this solution provide you with improved approach of doing your daily job?		
Is this solution solving business problem that triggered it implementation?		
How would you evaluate performance of this solution?		
How would you evaluate availability of this solution?		
How would you evaluate user friendliness of this solution?		
Do you have any ideas on development of a new tool which could support you in your work?		