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BUSINESS INTELLIGENCE REQUIREMENTS IN SMALL SIZED ENTERPRISES

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ABSTRACT

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Business Intelligence Requirements in Small Sized Finnish Enterprises

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Small and middle-sized enterprises (SME) now collect large volumes of information and are interested in business intelligence (BI) in order to be competitive. SMEs are important on local, national and even global basis as they form a major part of the economy. However, there is little research on what kind of requirements they have for BI. The aim of this master thesis is to elicit these requirements utilizing qualitative research by conducting partly theme-centered and partly a semi-structured interviews.

A common focus for all BI-related terms and perceptivities is that they all include the idea of analysis of data and information. In order to do this analysis, the data needs to be gathered and stored systematically first. While business intelligence brings benefits such as time and cost savings, most of its benefits are hard to measure as they are intangible in form of better business decisions.

The following factors have kept small-sized enterprises from utilizing BI tools: high price, high requirements for a hardware infrastructure, complexity for most users and irrelevant functionality. Prices of hardware have lowered, and new technologies like In-RAM analytics and cloud-services bring BI tools in reach of small-sized enterprises. As SMEs have several IT systems in use that provide data for analyzing, they have a need for cheap and easy-to-use BI systems.

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Pienet ja keskisuuret yritykset keräävät nykyisin suuren määrän tietoa ja ovat kiinnostuneet Business Intelligencestä (BI), liiketoimintatiedon hallinnasta, pärjätäkseen kilpailussa liiketoimintaympäristössä. PK-yritykset ovat merkittäviä paikallisessa, kansallisessa ja jopa globaalissa mittakaavassa, sillä ne muodostavat ison osan taloudesta. Siitä huolimatta on tutkittu hyvin vähän sitä, minkälaisia vaatimuksia ja tarpeita näillä yrityksillä on BI:tä kohtaan. Tämän Pro gradu -tutkimuksen tavoitteena on selvittää näitä vaatimuksia kvalitatiivisessa tutkimuksessa teema- ja puolistrukturoidulla haastatteluilla.

Yhdistävä tekijä BI-termistössä ja näkökulmissa on, se että kaikissa määrityksissä on idea tiedon ja informaation analysoinnista. Analysoinnin pohjaksi tieto tarvitsee ensin kerätä ja säilöä systemaattisesti. BI tuo sellaisia hyötyjä kuten aika- ja kustannussäästöjä, mutta suurin osa BI:n höydyistä ovat vaikeasti mitattavia, koska ne ovat aineettomia, esimerkiksi parempia liiketoimintapäätöksiä.

PK-yritykset eivät ole pystyneet hyödyntämään BI-työkaluja seuraavista syistä: kalliit hinnat, korkeat vaatimukset IT-infrastruktuurille, työkalujen hankaluus tavallisille käyttäjille sekä epäolennaiset toiminnallisuudet. Laitteistojen hinnat ovat laskeneet ja uudet teknologiat, kuten keskusmuistia hyödyntävä analytiikka ja pilvipalvelut, ovat tuoneet BI-työkalut pienten yritysten saataville. Pienillä

yrityksillä on käytössä useita ohjelmistoja, jotka tuottavat tietoja analysoitavaksi, minkä takia heillä on tarvetta halvoille ja helppokäyttöisille BI-työkaluille.

Asiasanat: business intelligence, liiketoimintatiedon hallinta, vaatimukset, pienet ja keskisuuretyritykset

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ABBREVATIONS

BI	Business Intelligence
BSC	Balanced Score Card
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
CRM	Customer Relationship Management
DW	Data Warehouse
EIM	Enterprise Information Management
ERP	Enterprise Resource Planning
ETL	Extract, Transform and Load
IS	Information Systems
IT	Information Technology
KPI	Key Performance Indicator
OLAP	Online Analytical Processing
SaaS	Software as a Service

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1 INTRODUCTION

1.1 Background of the research

The amount of data, which is the basic requirement for business intelligence or BI, has exponentially grown, and thus storing data has become cheaper. Business intelligence stands for utilizing this data and transforming it to better business decisions. Such data-driven decision making is also paving its way to the small and medium-sized companies or SMEs, as BI technologies have evolved and become more affordable. The competition in BI tools market has driven the technologies up and prices down; as a result, the benefits of BI have also come down to SMEs.

Business Intelligence has become an important competitive factor. Despite this, it is mainly utilized by large to medium-sized companies. Small companies are interested in BI tools but the high prices have usually kept them from using these tools. However, even small companies can get benefits from business intelligence.

The benefits that business intelligence brings are hard to measure, as they are intangible. They include time saving, cost saving, cost avoidance and revenue enhancement. Since it may be difficult to distinguish which cost savings were

results of BI and which were results of some other actions, investing in a BI system might be hard. (Lönnqivst & Pirttimäki, 2006. p 34)

In Finland, the market of business intelligence software is estimated to be 80 million euro in 2013. With BI and analytics services like integrating, implementing, developing and maintenance, the sum goes up to 240 million euro. (Vuokkola, 2013) Finnish CIOs report that analytics, data warehousing and reporting is their top spending priority. (Storås, 2013). In Market Visio's survey research that includes 107 Finnish companies, the usage of BI and analytics solutions have gone up to 96% while in 2010 it was a mere 56%. (Market Visio, 2014)

In order to be competitive, even small and middle-sized enterprises now collect large volumes of information and are interested in business intelligence systems. Small and middle-sized enterprises are regarded as significantly important on local, national or even global basis and they play an important part in any national economy. (Grabova et al. 2010 p. 39) Thus, improving the productivity and efficiency of the SMEs with business intelligence is significant from the viewpoint of the whole economy.

However there is little information on SMEs and their Business Intelligence situation, on what kind of systems they have, on how they can benefit from BI and how familiar they are with BI.

1.2 Aim of the research

The main objective of this study is to clarify the current state of business intelligence in small-sized companies and gain understanding of how business intelligence is regarded in small companies in Finland. The objective is more specifi-

cally to find out *what kinds of requirements small companies have for business intelligence.*

Research questions can be listed more specifically as:

- What is the current situation of BI in small companies? How do they understand BI?
- What kind of IT infrastructure and data do they have?
- What requirements and needs do they have for reporting?
- What kind of future plans do they have for BI?

The goal is to find commonalities between these requirements and any additional requirements regarding business intelligence and compile them to a single informative table. These final results can be used in the productization process when designing BI tools for small companies or when selecting suitable a BI tool from the existing BI solutions that are now mainly targeted to larger companies.

The commission of this Master Thesis and the starting point of the study came from a small business intelligence consulting firm, Pengon, and the results of this research are expected to be useful to them. The consulting firm wants to extend their product and service portfolio in a controlled way and find out in which direction they should develop their operations in order to prepare the company for the changing market situations.

Small-sized companies were the group of interest, as they are a potential new sector where Business Intelligence tools can be utilized and the consultant company that commissioned this thesis were interested in companies around this size.

1.3   Research methodology

This research is qualitative in nature. In qualitative research the aim is to describe real world and the research subject is explained comprehensively. The material is gathered from real situations, and information gatherer is usually a human. (Hirsjärvi, Remes & Sajavaara, 2009, p. 161–164) The role of the researcher is highlighted in qualitative research, in which their sightings can reinforce the current viewpoints or bring forth completely new views. (Hirsjärvi & Remes & Sajavaara. 2007, s. 131-132).

The primary research method for this study is interviewing, which is, according Hirsjärvi et al. (2009, p. 205), a suitable method when doing research on a subject that has not yet been studied extensively. While both business intelligence and small-sized enterprises have been researched widely, there were no previous studies on business intelligence in small-sized enterprises in Finland. This makes interview method suitable as it can be used to confirm international finding of BI in SMEs in Finland and also create new research in the field.

The material was gathered in spring 2013 with theme interviews that were carried out as personal interviews in one-on-one, face-to-face interviews or on phone. Personal one-on-one interviews are laborious, so there were only six of them. Four interviews were personal face to face interviews and two were done on phone. The interviewed companies were known to have previous knowledge of business intelligence, meaning that gathering more reliable data regarding business intelligence would be possible.

The first phase of this Master Thesis research was to create an understanding of business intelligence and SMEs' current situation with a literature overview. During the literature overview, the goals of the thesis and research questions were more precisely defined. After this, the target group of the research was

selected among the companies and the person suitable for the interview was selected from each company.

With the understanding of the key questions in business intelligence and its requirements gained from the literature overview, the interview form was created for the interviews. This was to make sure that the data relevant to the business intelligence phenomenon was to be collected and the research questions could be answered. The interviews were carried out and the answers were analyzed by dividing them into different business intelligence categories and by identifying the similar needs in business intelligence requirements. By analyzing the answers, forming the overall picture of the state of business intelligence requirements in small to medium-sized companies in Finland was attempted.

1.4   Structure of the thesis

This Master Thesis can be divided into two main parts. The first part is the literature overview where the reader is given a theoretical understanding of the subject before moving on to the empirical second part. This second part describes the interviews and their results. These two parts are combined in the conclusions at the end of the thesis.

This Master Thesis consists of seven chapters. The first chapter serves as an introduction chapter to the thesis, which includes the methodology and the aim of the research. The background and the basis of the subject are also briefly presented.

The second chapter is the first chapter of the literature overview and it contains an overview of small-sized enterprises, their special characteristics and their position as IT solution buyers and users.

The third chapter contains overview of business intelligence. At the beginning of this chapter, the basic concepts and terminology of business intelligence are introduced. Afterwards the benefits that business intelligence brings are inspected, and finally the BI tools market situation and the pros and cons of different BI tools are analyzed from the viewpoint of small-sized enterprises.

The empirical part is presented in chapters four and five. In chapter four, the backgrounds of the interview and the selection of the interviewed companies are introduced. Moreover, the method of the interviews performed is described in this chapter. The results of the interviews are presented in chapter five.

In chapter six, the literature overview and the empirical parts are summarized and the results of this Master Thesis are discussed and analyzed. In chapter seven, conclusions to the thesis are given.

2 IT-projects in SMEs

2.1 Definition

Statistics Finland defines small and medium-sized enterprises (SMEs) as follows: enterprises with fewer than 250 paid employees and whose annual turnover is no more than 50 million euro or the balance sheet total no more than 43 million euro. Further, small enterprises are differentiated from medium-sized enterprises in that the small companies have fewer than 50 paid employees, annual turnover is not more than 10 million euro or the balance sheet total is no more than 10 million euro. (Statistics Finland) This definition is same that the European commission uses, as we can see in Table 1.

Table 1. The definition of small and medium-sized enterprises. (European commission)

Company category	Employees	Turnover	or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

In Finland, 98% of all enterprises are SMEs. Furthermore, only one percent of this 98% are medium-sized enterprises, while the rest are small and micro-sized enterprises. (SVT, 2012)

In this Master Thesis, the definition of small enterprises is extended to those of which turnover is under 20 million euro. With a larger turnover, the enterprise has more data for BI tools to analyze and their ability to pay for BI systems is better.

2.2 Special characteristics of SMEs

In today's highly competitive environment, small and medium-sized enterprises lack the resources to compete with larger enterprises. In order to survive, many small and medium-sized enterprises adopt information technology because it can help them to exploit opportunities and strengthen their competitive capabilities (Shiau & Hsu & Wang, 2009) Small and medium-sized enterprises have been described as catalysts for the future economy. There is a special need to accelerate SMEs' growth and to improve their competitiveness. (Forssman, 2008)

The typical characteristics of SMEs have been connected to small scale, personality and independence. The high number of SMEs distributed in different industries and different markets means that one of the most important characteristics of small business is its diversity. (Forssman, 2008)

Resource and knowledge limitations, lack of money, reliance on a small number of customers and need for multi-skilled employees are few key characteristics that may differ SMEs from larger companies. The advantages linked to small firms are their flexibility, organic organization, centralized decision-making and the fact that they are close to the customers. (Forssman, 2008)

The diversity of managerial competencies within the firm, broad array of functionality, wide range of industry sectors, levels of complexity and the diverse

growth stages are some factors that make SMEs stand out of large firms. (Suraweera et al. 2006)

2.3   Special characteristics of IT projects in SMEs

The literature around IT and small business suggests that there are certain barriers for successful implementation of information systems. They include the high cost of IT, lack of time to devote for implementation process, the lack of IT knowledge or skill, difficulty in obtaining access to right advice with respect to IT and lack of understanding of benefits that IT can provide. On the other hand, the SMEs are also in an advantageous position with respect to implementing IT projects successfully. Such factors include intense involvement of the owner manager in management and decision making, high level of user involvement, flexibility and greater influence of external consultants and vendors. (Suraweera al. 2006)

Small and medium-sized businesses by their very nature lack resources, which effectively raises a barrier to information system (IS) adoption. (Shiau et al. 2009)

Shiau & Hsu & Wang (2009) found that when small and medium-sized enterprises are adapting ERP, the characteristics of the CEO and the benefits of ERP systems have positive effects in ERP adoption, while cost and technology complexity have negative effects.

Many SMEs have used electronic commerce to enhance their competitive ability in the last few years. The enthusiasm of the top management, the compatibility of electronic commerce with the work of the company, the relative advantage perceived from electronic commerce, and knowledge of the company's employ-

ees about computers are important factors in information system adoption. (Shiau et al. 2009)

There is a relationship between strategic value and the adoption of electronic commerce in small and medium-sized enterprises. Operational support, managerial productivity, and strategic decision aids influenced the perceived strategic value of e-commerce. Organizational readiness, external pressure, perceived ease of use, and perceived usefulness influenced e-commerce adoption. Shiau et al. 2009 validated that top managers who perceived e-commerce as adding strategic values to the firms have a positive attitude toward its adoption.

In case study of accounting software adoption in SMEs Suraweera al. 2006 found that although project management literature highlights the relevance of the triple constraint (cost, time and scope), their case study data does not provide evidence to the effect that the cost of the software has a detrimental effect on the acquisition and installation of software. It appears that small firms can afford the initial costs involved with the acquisition and implementation process. However, one owner manager indicated that she has difficulties of hiring an IT consultant due to financial limitations. This poses a question whether the SME's are aware of the overall cost of acquisition, implementation and long term maintenance of accounting software (including upgrading) and the associated IT systems.

Suraweera al. 2006 found that time taken for procurements and implementation related to accounting software have been very short in SMEs, compared to that of IT projects in larger businesses. For example, small firms adopt a very simple cycle with respect to adoption and implementation of accounting software. A detailed planning process does not take place with respect to requirements analysis, acquisition of software, selection of consultants etc. The need identification is mostly influenced by the chartered accountant who is hired for the

processing of company accounts. The planning phase is mostly confined to "talking to" the known community.

Suraweera al. 2006 also recognized that certain steps that are followed by large firms with respect to system implementation may be equally valid to small firms, but are generally ignored. In their study, in all case study firms, a proper requirements analysis has not taken place and the decision to select the software was not based on a rational investigation. However, it is noted that the SMEs are satisfied with such a "simple" process of decision making and the associated outcome. Therefore, one may question the applicability of a detailed planning process, including comprehensive analysis for requirements and selection of software etc in the context of SMEs.

In same study as above, it was found that technical expertise has always has been a critical issue, and has been overcome in all cases by making use of some form of external support. One interesting feature is that the role of consultants is quite different from that of large firms. In fact the consultant takes over most of the operational activities from the owner/manager. In this sense the consultant acts as person temporarily hired by the company. Maintaining cordial relationship with the consultants is also important. The project implementation and control aspects are mostly handled by the consultant, whose role is more operational than advisory. (Suraweera al. 2006)

Husu (2007, p.25-27) sums, that SME cannot be understood as miniature versions of big corporates. Different size firms have big differences. For example, organization and management styles differ in SMEs. When examining IT-investments, the limited resources of SMEs can be seen. These include time and money resources and expertise as there is rarely expertise inside the company. CEO of company has big impact in the investments as they depend on his/her abilities and enthusiasm. In IT investments, SMEs prefer open source and SaaS

products because of their cheap price. Also the personnel technical skills and available system-, equipment and support service has impact in investments.

2.4 Summary

SMEs' lack of resources is a repeated theme in this review chapter. Lack of resources describes not only SMEs in general but also in their IT projects. Lack of resources is even clearer in an IT project, which is an intangible investment that requires technical know-how. Thus, it is in interest to find out more specifically what resources SMEs have and in which areas do they lack resources. Especially technical know-how is a limit for BI projects, so finding out the resources connected to this is in interest in this research.

It is also noted that SMEs are agile and do not need detailed planning and processing to implement an IT project. Moreover, their decision making is fast and non-hierarchical compared to larger companies. This indicates that SMEs can also implement BI projects lightly and fast. However, it is also noted that diversity is the main aspect that defines SMEs and creates challenges to BI-projects.

3   BUSINESS INTELLIGENCE

3.1   Data, Information, Knowledge, Wisdom, Intelligence

One way to view the purpose of business intelligence is, that it refines data of organization to higher levels of abstraction.

Data is the lowest level of information and it is unstructured. (Olin 2011, p.10-11) Data are discrete, objective facts or observations, which are unorganized and unprocessed, and do not convey any specific meaning. It describes objective facts such as who, what, when, where, about something. (Jennex, 2009. p. 4)

When data is refined, it becomes information that has more meaning and more value to receiver. (Olin 2011, p.10) Information is data that is processed for a purpose. Data has been organized so that it has meaning and value to the recipient. Jennex (2009. p. 4) describes that information is data that is related to each other through a context such that it provides a useful story as an example, the linking of who, what, when, where data to describe a specific person at a specific time.

Knowledge is the combination of data and information, to which is added expert opinion, skills, and experience, to result in a valuable asset which can be

used to aid decision making. (Rowley 2007, p.11-13). Knowledge can be also viewed as interpretation of information. (Olin 2011, p.10)

According to Jennex (2009. p. 4), knowledge is information that has been culturally understood such that it explains the how and the why about something or provides insight and understanding into something.

Wisdom is placing knowledge into a framework or homological net that allows the knowledge to be applied to different and not necessarily intuitive situations. Intelligence is specific actionable knowledge needed to make a specific decision in a specific context. (Jennex, 2009. p. 4)

According to Jennex (2009, p.7) in business intelligence there is a need to differentiating between general information and knowledge and specific decision information and knowledge. Using term intelligence rather than wisdom captures this as intelligence refers to very specific actionable knowledge.

Relationships between data, information and intelligence and value gained by refining is illustratied in figure 1.
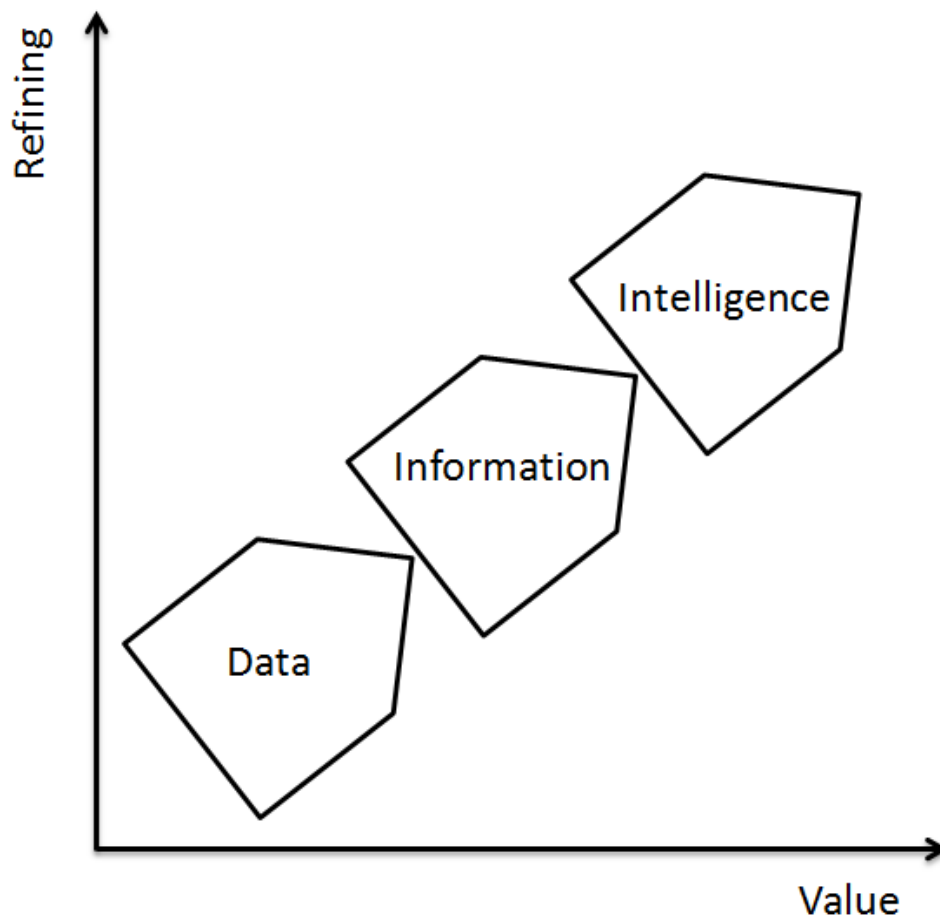
Figure 1. The purpose of business intelligence (Modified Olin 2011. p. 10)

3.2 Definition for Business Intelligence

There's no one definition for business intelligence.

Term "Business Intelligence" was first mentioned by Howard Dressner, analyst in Gartner, in the beginning of 1990. (Watson & Wixom 2006 p. 94, also Hovi et al. 2009) Finnish equilavent for BI "liiketoimintatiedon hallinta" was first used in 2002. (Aho, 2011, p.31)

While several source mention, that Gartner's Dressner was first to mention Business Intelligence, Hans Luhn Peter published article named "A Business Intelligence System" in IBM Journal in October 1958. Business processes weren't computerized at that time. Still Luhn defined Business Intelligence system and

its objective "to supply suitable information to support specific activities carried out by individuals, groups, departments, divisions, or even larger units". (Grimes, 2008)

Hovi et al. (2009, p.11) separate data warehousing and business intelligence. BI means tools that users use for reporting. Data warehousing (DW) includes planning and implementing databases and loading processes. BI is for business user and data warehousing is for IT-professionals. This kind of approach is very technical. Hovi et al. mention that BI can also mean entire solution of data utilizing and analyzing.

Sometimes term DW/BI-system is used to avoid confusion what is meant by BI. DW refers to databases of organization and BI refers to BI applications and DW/BI refers to them both. Kimball et al. (2001)

Business Intelligence can sometimes be understood as just an operating level reporting tool or technological concept, but some researches view that it also includes supporting functions in operative and strategic level with leadership-concepts and tools like performance management and IT administration. (Aho, 2011, p.31)

According to Pirttimäki Business intelligence can refer to the refined information and knowledge that describes state of company and its business environment or the process that produces insights, suggestions and recommendations for the management and decision-makers. (Pirttimäki, 2007, p. 57)

Definitions for BI vary between markets. In Europe the concept of BI is relatively common, but in North America BI activities are often called competitive intelligence (CI). (Pirttimäki, 2007. p. 57) In United States BI refers to information system viewpoint and in practice it means databases and reporting. (Aho, 2011,

p.31) External environment and external information sources are emphasized in North American literature. (Lönnqivst&Pirttimäki, 2006. p 32)

Business intelligence includes data mining and reporting but also analytical activities. With analytics Davenport and Harris (2007, p. 26) mean wide usage of data, statistical and quantitive analytics, interpretive and predictive models and basing activities, decisions and leadership on facts. Analytical activities can produce material for human decisions or they can lead automatic decision making. It's part of business intelligence - intelligent data management and intelligent business: technologies and processes which make use of data in understanding the business.

Lönnqvist & Pirttimäki refer to BI as a managerial philosophy and a tool used to help organizations manage and refine business information with the objective of making more effective business decisions. (2006. p. 32)

In another study by Pirttimäki, BI as a concept is defined as organized and systematic processes, which are used to acquire, analyze and disseminate information significant to their business activities. Companies learn to anticipate the action of their customers and competitors, market trends and fields of activities in their area. The information and knowledge generated is used to support their operative and strategic decision-making.
(Hannula&Pirttimäki, 2003. p.1)

In news articles, BI can be defined as "the ultimate CEO tool" where BI refers more into reporting, scorecards and analytical dashboards. (PR Newswire, 2006)

Thierauf (2001) sums business intelligence systems as "…gives as decision makers the ability to keep their fingers on the pulse of their business every step of the way."

Gartner defines Business Intelligence in their IT glossary as "an umbrella term that includes the applications, infrastructure and tools, and best practices that enable access to and analysis of information to improve and optimize decisions and performance." (Gartner, 2012)

Williams and Williams (2006, p. 2) argue that BI isn't single product, technology or methodology. BI is combines all these to organize key information that management needs to improve profit and performance. More broadly, they think BI "as business information and business analyses within the context of key business processes that lead to decision and actions and that result in improved business performance.". Figure 1 illustrates this.
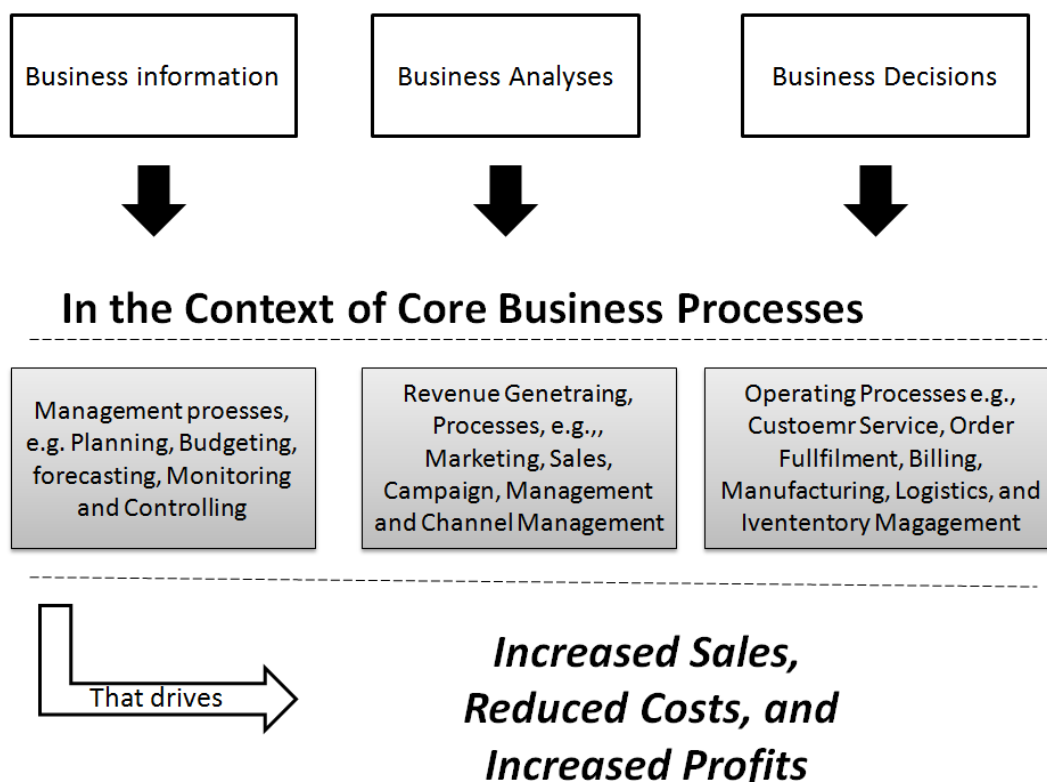

Figure 2. Business intelligence in practice (Williams & Williams, 2006. p. 3)

Common focus for all BI related terms and perceptivities is that they all included the idea of analysis of data and information. (Lönnqvist&Pirttimäki, 2006. p. 32)

Companies also use BI in different meanings. They have own terms like Enterprise Information Management (EIM). Usually BI is used to refer to reporting, and analytics is used to refer to forecasting. (Vuokkola, 2013)

Business Intelligence can contain various varieties of information (Hannula&Pirttimäki, 2003. p.2):

- Customer Intelligence
- Competitor Intelligence
- Market Intelligence
- Product Intelligence and
- Environmental Intelligence.

Also terms like strategic intelligence, tactical intelligence and operational intelligence are used to describe the level of information. (Thierauf. 2001, p. 192)

The definition in this master thesis is that BI is a concept that contains organized and systematic processes, which are used to acquire, analyze and disseminate information significant to business activities. This closely follows definition that Hannula and Pirttimäki (2003) introduced.

3.3 Business Intelligence framework

Business intelligence applications gather information about business processes and activities to make it available to business users, enabling them to make more informed decisions and take more effective action. BI enables businesses

to access, analyze and use their data for decision making in long-term planning, short-term tactical analysis and managing daily operational business activities. (Ballard et al. 2005, p.27-28)
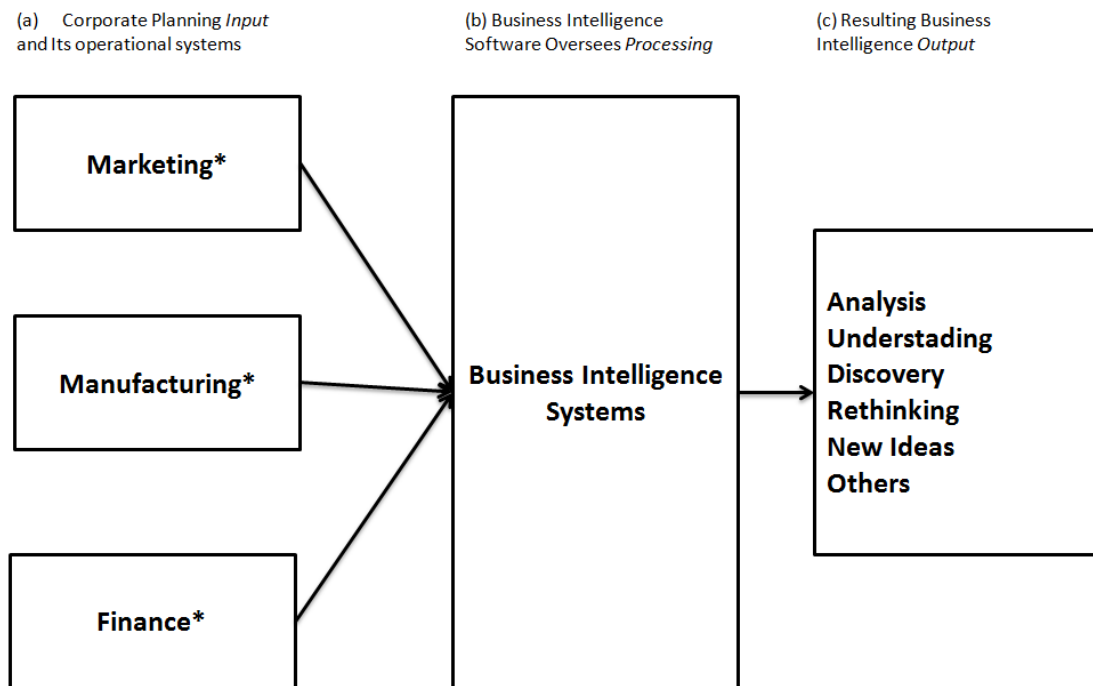
Figure 3. Business Intelligence System Framework for a Typical Company (Thierauf.2001, p.6)

Figure 3 describes typical business intelligence process in companies. Data is collected from different operational systems. Then it's processed and analyzed to produce material for new ideas.

In figure 4, Watson & Wixom (2006) have also made Business Intelligence Framework, where they emphasize two primary activities of BI: getting data in and getting data out.
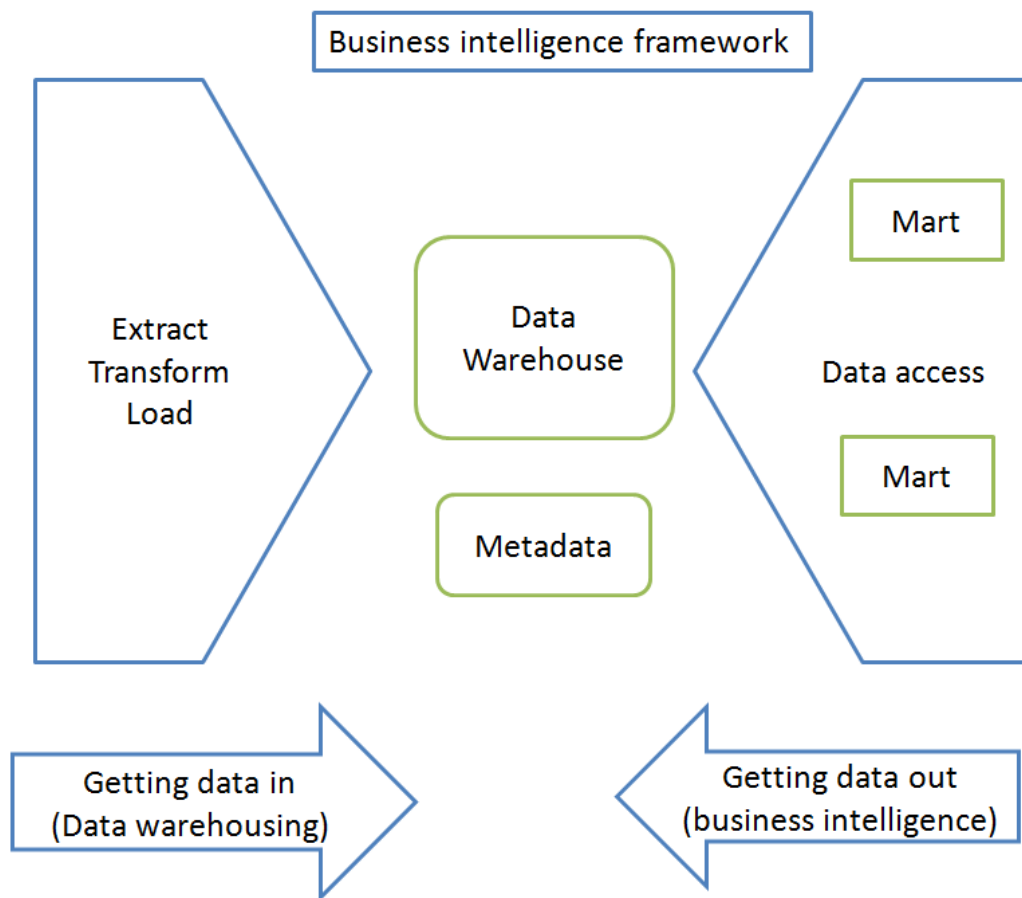
Figure 4. Business intelligence framework. (Watson & Wixom, 2006)

Getting data in delivers limited value to company. Company benefits from getting data out and this activity receives most attention in companies. This is called business intelligence and it consists of business user and applications accessing data from the data warehouse to perform enterprise reporting, OLAP, querying, and predictive analytics. (Watson & Wixom, 2006. p.97)
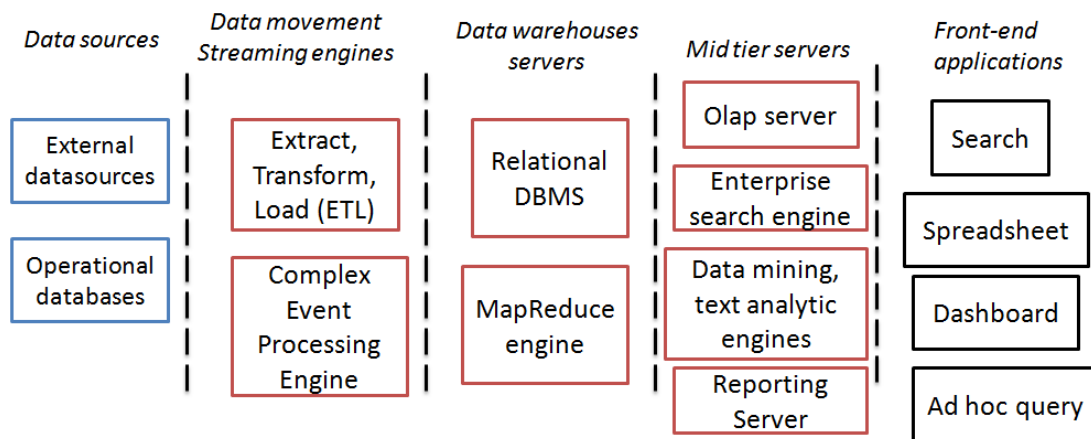
Figure 5. Typical business intelligence architecture (Chaudhuri et al. 2011, p. 90)

Typical business intelligence architecture is quite heavy as we can see in figure 5. Data sources have varying quality of data, they use incosistent representations, codes and formats, which have to be reconciled. Thus the problems of integrating, cleansing and standardizing data in preparation for BI tasks can be rather challenging. This preparation of data is called Extract, Transform, Load (ETL). In addition, there can be specialized engines referred to as Complex Event Processing (CEP) that make business decisions based on operational data itself. (Chaudhuri et al. 2011, p. 90)

The data over which BI tasks are performed is typically loaded into a repository called the data warehouse, usually relational database. MapReduce engine is needed with very large data volumes 'Big Data' as traditional Relational database has its limits. (Chaudhuri et al. 2011, p. 90)

Data warehouse servers are complemented by mid-tier servers that provide specialized functionality for different BI scenarios (Chaudhuri et al. 2011, p. 90):

- Online analytic processing (OLAP) servers: Efficiently exposes the multidimensional view of data to applications or users and enable the com-

mon BI operations such as filtering, aggregation, drill-down and pivoting.

- Reporting servers: Enables definition, efficient executing and rendering of reports.

- Enterprise search engines: Supports the keyword search paradigm over the text and structured data in the warehouse.

- Data mining engines: Enable in depth analysis of data that goes well beyond what is offered by OLAP or reporting servers, and provides the ability to build predictive models.

There are several popular frontend applications through which users perform BI tasks: spreadsheets, enterprise portals for searching, performance management applications that enable decision makers to track key performance indicators of the business using visual dashboards, tools that allow users to pose ad hoc queries, viewers for data mining models, and so on. Rapid, ad hoc visualization of data can enable dynamic exploration of patterns, outliers and help uncover relevant facts for BI. (Chaudhuri et al. 2011, p. 90)

3.4 Benefits of BI

Measuring the benefits of BI is not simple. Many of the effects that BI is assumed to create, such as benefits like improved quality and timelines of information, are primarily nonfinancial and even intangible. These nonfinancial effects should lead to financial outcomes, cost savings, but there may be time lag between these. This makes measurement of BI benefits quite difficult in practice. BI produces time saving, cost saving, cost avoidance and revenue enhancement. However, it may be difficult to distinguish which cost savings were results of BI and which were results of some other actions. (Lönnqivst & Pirttimäki, 2006. p 34)

Thierauf (2001, p.160) argues that the cost of business intelligence systems cannot be justified in terms of traditional cost-benefit analysis. The payoff from business intelligence systems are different from other types of information system in that they are often less tangible, less quantifiable.

In interview study by Hannula & Pirttimäki (2003) companies felt that best benefit (95 %) from business intelligence activities is better quality information for decision-making. Also "improved ability to anticipate earlier the possible and opportunities" (83 %) and "growth of knowledge base" (76 %) were viewed as important benefits. Cost (14 %) and time saving (30 %) were not considered very important benefits. Interviewees are also asked to name one factor to describe the most significant benefit of their activities. Following benefits were listed: (Hannula & Pirttimäki, 2003)

- Harmonizing the ways of thinking of company personnel
- Broadening understanding of business in general
- Strengthening strategic planning
- Increasing professionalism in acquisition and analysis of information
- Understanding the meaning of information

Williams & Williams (2006) mentions Wester Digital as example company that benefited greatly from BI. This manufacturer of computer hard disk drives uses BI to better manage its inventory, supply chains, product lifecycles, and customer relationships. BI enabled the company to reduce operating costs by 50%.

Shortly it can be said that Business Intelligence gives companies a competitive advantage by highlighting effective strategies and practices while revealing areas of inefficiency that can be corrected. (Armstrong, 2010. p.42)

Watson & Wixom (2006) have summarized benefits in spectrum shown in figure 6. below:
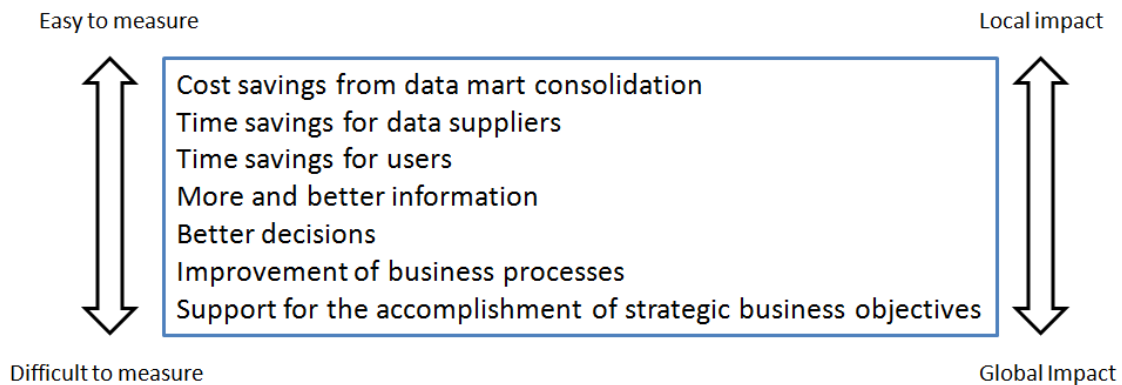
Figure 6. Business intelligence framework. (Watson & Wixom, 2006, p.97)

Benefits that are easy to measure have only local impact. For example, time savings coming from more efficient data delivery, are easy to measure as headcount reduction is tangible benefit. Analysis and predictions coming from BI-system help company to make strategic-level decisions like new product-line or new market, which have more global impact. But it's hard to measure benefits of these decisions. (Watson & Wixom, 2006, p.97)

3.5   Business intelligence in small companies

Business has never-ending need for insight, but small and midsize businesses are unable to benefit from the insight large enterprises can afford. The high costs of data warehousing have kept small and midsized businesses away from BI. (Armstrong, 2010. p.42-42)

Start-up costs of BI can well be into 6 six figure sums, meaning that BI solutions are only available for large companies like Wal-Mart and GE. However, in year 2006 new BI companies emerged promising the price of BI in the range of

20 000$ which is within reach of small and medium size business. (PRNewswire, 2006)

Other fact that helps smaller business buying BI system is "Try Before You Buy", where a BI suit is fully installed to key functions of company. This greatly helps evaluation as risk is shifted from small company to BI-solution seller. Having to make buy decision based on limited 2 week trial license or web-based demo is hard for smaller business as cost of investment is large for them and comes with great risk. In this kind of solution seller must be very positive that customer will buy their product. (PRNewswire, 2006)

According to Gartner's view (2013) the market for BI and analytics platforms will remain one of the fastest growing software markets. There's still numerous subject areas like HR and marketing where there is unmet demand. Many midsize enterprises have yet to even start their BI and analytic initiatives.

Grabova et al. (2010) list that business intelligence is inaccessible or insufficient for SMEs because of the following factors:

- high price
- high requirements for a hardware infrastructure
- complexity for most users
- irrelevant functionality
- low flexibility to deal with a fast changing dynamic business environment
- low attention to difference in data access in SMEs and large-scaled enterprises

In addition, many projects fail due to the complexity of the development process. Moreover, as the work philosophies of small and large-scaled enterprises are considerably different, it is not advisable to use tools destined to large-

scaled enterprises. Thereby, SMEs require lightweight, cheap, flexible, simple and efficient solutions. (Grabova et al. 2010 p.40)

3.5.1 Business intelligence requirements in small companies

The fundamental problem with the business intelligence systems is the high cost of purchasing, operating, and maintaining the necessary technology. In spite of a serious focus in the data warehousing industry to bring down the cost of solutions, low-cost products are still scarce because the current data warehousing computing paradigm is extremely inefficient. Traditional data warehousing uses row-based relational databases, which create an input/output bottleneck. This can be avoided by dividing the load among many processors, but this also rises the costs as there is more hardware that is needed. (Armstrong, 2010. p.43)

Armstrong (2010) has listed BI requirements for mass-marketing e-commerce companies:

- High performance without high cost
- Mixed workload capabilities
- Easy implementation and management
- Scalable infrastructure
- Standardized hardware and software

In addition to cost and performance, implementation needs to be easy and simple. Small to midsize business often lack the staff and resources necessary to implement complex data warehousing system. Scalability helps reducing the costs as well. Buying too large system for current use and ensuring there is space available for future means that money is spent up front. (Armstrong, 2010. p.44)

Especially for small and midsize businesses, standardized hardware and software offer many advantages over proprietary system. Standardized or commodity hardware means that systems are less expensive to buy and maintain and are easy to maintain and replace because they use same components as any other computer. Existing IT staff can monitor and maintain standard hardware and software, so no further expense is required for training. In addition to the cost savings standardization also offers possibility to take advantage of other products and services offered within the industry. (Armstrong, 2010. p.45)

On-demand data warehousing and business intelligence, where customer does not buy or install any hardware or any software, is cost efficient as it offers easily accessible data and greatly reduces IT costs. Customer uses web-based service for a monthly or annual subscription fee and uploads the data to the on-demand provider. But truly valuable data requires extraction, transformation and loading (ETL) process from several disparate data sources., which with current technology is infeasible even at low data volumes and impossible at higher data volumes. Also many businesses view their core operational information and BI as assets they do not want hosted off site or involving a third party. (Armstrong, 2010. p.45)

Another way to reduce the up-front costs is to use open source software. Some open source products are still immature today, but there are now several open source products (MySQL, PostgreSQL, MongoDB) making it easier and less expensive to deploy data warehouses and BI tools. Unfortunately, deploying a data warehouse complete with BI tools using open source software with commodity hardware and storage is simply beyond the means of many small and midsize businesses, which typically lack the IT resources and expertise. (Armstrong, 2010. p.45)

It's good to remember that other industries have struggled in similar ways when moving from complex, high-end solutions to meet the mass-market requirements of high performance, low cost and ease of use. For example, computer graphics industry in the early 1990s. At first, high-end graphics processing was limited to handful of Hollywood artists and professional designers who could afford the high cost of these systems and the resources and expertise required to use them. With the invention of the graphics processing chip, regular consumer PCs became packed with the same power. (Armstrong, 2010. p.46)

Costly ETL/DW-project can be skipped with In-memory BI tools. In-memory BI tool, load whole data directly from the source system to BI tool's RAM memory instead of hard-drives. RAM-memory is much faster than hard-drives in data warehouses. In memory analytics offers solution for entire data processing chain with very fast implementation times. However, this is only reasonable for very small environments with only few source systems. Fast-processing times also offer better user experience, which is why In memory analytics have gained market share. (Olin, 2011. p.70-72)

3.5.2   Business intelligence tools in small companies

Data storage and analysis interface solutions should be easily deployed in a small organization at low cost, thus be based on web technologies such as XML and web services. Web warehousing is rather recent, but a popular direction that provides a lot of advantages, especially in data integration. However web-based tools provide light interface and their usage is limited. Cloud-based BI tools are appropriated for small and middle-sized enterprises with respect to price and flexibility. However, they are so far enterprise-unfriendly and are in need of data security enchantments. (Grabova et al. 2010 p.40)

When doing analyzing and comparing different BI-tools and has found that most suitable for small companies are QlikTech's QlikView, Tableau and Tibco's Spotfire. This is mostly because of their price, but these products are also easy to use and have good visualization of data. QlikView is most used BI-tool in Finland (Market Visio, 2014). Traditional big players such as Microsoft, IBM, SAP and SAS are too expensive for small-sized business and they have low flexibility.

Olin (2001) compared SAP BusinessObjects and QlikView in his master thesis. He also mentions QlikView and other in-memory BI-tools as suitable for small companies as they only have few data sources and there's no need for costly data warehousing project. Grabova et al (2010) found that in-memory analytic tools build on top relational database, where data is saved to cloud, would be best BI-tool for small and mid-sized business. Harju (2014) examined business analytics, which includes predictive modeling and data mining. He found out that when it comes to advanced analytics in large companies, Finland lacks behind compared to other western countries. He also found out that smaller companies do not need advanced analytics and lack in resources in order to this.

3.6 Business intelligence tools

In most cases, there's at least some sort of reporting tool that comes with software. But properties of these software might not be enough for company's BI needs. ERP-systems aren't planned for reporting so they might have some short comings. For example, ERP-systems don't usually store history data as collected data masses could disturb operation of the system and searching big data masses can also disturb the system. Also if there's several different software used in company, separate BI-tool is most likely needed as separate systems do not communicate with each other and combining their information is impossible.

Gartner, an information technology research and advisory firm, analyzes business intelligence market regularly. In their newest market analysis - Magic Quadrant - in 2013 they named "Business Intelligence Platforms" to "Business Intelligence and Analytics Platforms" to emphasize importance of the analysis capabilities in BI-tools. Gartner divides software platforms to 3 categories: integration, information delivery and analysis. Each category has more precisely defined capabilities, total of 15. This listing expresses what kind of functions are needed from BI-tool.

- Integration

  o BI infrastructure

  o Metadata Management

  o Development tools

  o Collaboration

- Information Delivery

  o Reporting

  o Dashboards

  o Ad hoc query

  o Microsoft Office integration

  o Search-based BI

  o Mobile BI

- Analysis

  o Online analytical processing (OLAP)

  o Interactive visualization

  o Predictive modeling and data mining

  o Scorecards

  o Prescriptive modeling

BI-platforms are scored on these categories and placed to quadrant in figure 7.
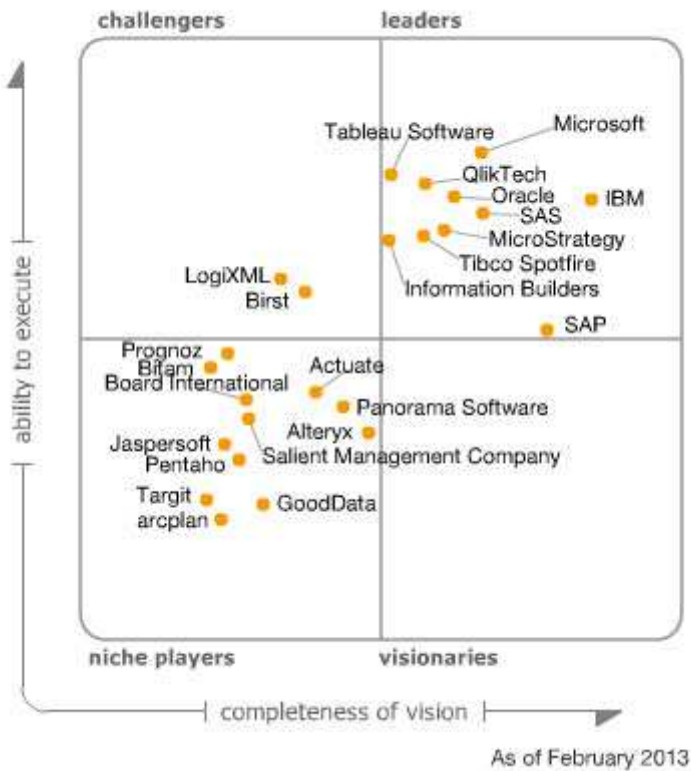
Figure 7. Market analysis of BI tools in 2013. (Gartner)

There are niche players who are focused in a certain area and their solutions are not usable anywhere else. The "visionaries" and "challengers" sections shown in figure 6 are nearly empty as most of the companies previously in these sections have moved to the "leaders" section in the last few years. This implies that BI market has matured as products are more complete and have more ability to execute requirements listed previously in this chapter.

3.7 SaaS and cloud-based Business Intelligence

Tyrväinen and Selin have defined criteria for Software-as-a-Service (SaaS). SaaS can be characterized as a standard software product operated by the SaaS provider, delivered using standard Internet protocols and consumed as on-demand services by the customers, typically using Web browsers as the user interface. Software is used with a Web browser or other thin client making use of stand-

ard internet protocol. A standardized software product is provided with no customization and there is no need to install software to the customer site. Deployment of Saas requires no major integration or installation. Customers pay for use of the software rather than licenses and the same multitenant installation is provided for several customers. (Tyrväinen & Selin, 2009)

From the user viewpoint low entry cost and pay-as-you-go pricing make adoption and use of SaaS attractive. From customer's perspective SaaS can be seen as outsourcing IT back-end management activities to the provider. (Tyrväinen & Selin, 2009)

Also cloud computing represents several benefits to the BI such as (Ouf & Nsar 2011, p. 653):

- On-Demand: Immediately available with no infrastructures deploy.
- Elastic: Can scale up or down quickly with changing requirements.
- Affordable: No large upfront costs, pay as user go.
- Flexibility: to scale computing resources with few barriers.
- Geographic scalability.
- Deploying BI in the cloud can help programs become more flexible, scalable and agile.
- It can be challenging to configure databases and BI tools to run in the cloud.
- Cheap Processing Power. The parallelization of cloud computing makes Relational Online Analytical Processing. (ROLAP)-based analytics possible, since queries can be
- Spread across multiple CPUs simultaneously.
- Elastic Scale. BI is very sensitive to unpredictable and high peak loads. Users don' t have to build for this, and can elastically scale to meet demand when it happens.

- Massive Multi-Tenancy. Users run a single instance of their BI platform across 1000s of customers, meaning the marginal cost to provision, service and upgrade each user is extremely low.
- Service-Orientation. Given the transient nature of hardware nodes.

While there are several benefits related to using business intelligence in cloud, there are some challenges that need to be considered. According to (Olszak, 2014) one of these is data security. This includes confidentiality, integrity and availability of the data to the cloud. With cloud computing, data is stored and delivered across the Internet. As a result, there are many risks surrounding the loss or compromise of data. For some organizations, this concern over security might be a barrier that is impossible to overcome Data hosting may be untrusted or unsecure, with the potential for data leakage. However, in many cases, the cloud vendors provide a more secure environment than what exists at customer sites.

Second issue is on premise integration. Data integration capability, one of the core BI capabilities, is crucial to defining a successful and robust BI solution. The cloud presents the potential for compromised data, metadata, and application integration. However, sudden movement to cloud is not feasible and a phased approach is usually recommended. There will be a coexistence model until the cloud BI market is more mature. (Olszak, 2014)

Cloud lacks control as it is tough to get Service Level Agreements (SLAs) from cloud providers. Data control and data ownership, reliability of service challenges are some of the main reasons for client concern. Also Vendor maturity is weak when it comes to business intelligence in cloud. There are too many cloud BI vendors, hosting providers with varying offerings, etc. thus making it challenging to choose the right vendor based on required needs and vendor capabilities. Also there is lack of standardized pricing models making it difficult for customers to select the right service provider. (Olszak, 2014)

There can also be performance issues. There can be significant latency if BI applications exist in the cloud but the data exists at a client site, especially when processing and returning large amounts of data. Also some analytics consider that returns on investment in cloud based BI solutions have not been fully proven nor yet measured (Olszak, 2014)

3.8   Summary

Business intelligence can be defined in several different ways. The biggest difference is in whatever data warehousing is included in the definition or is data warehousing viewed as separate subject. It is essential part of business intelligence as data can't be analyzed if isn't available. We can conclude that Business Intelligence means gathering, analyzing, storing and sharing information, which is used for business activities and decision making.

Small enterprises have come in the scope of BI-tools as cost of BI-tools has lowered. Small enterprises also have more IT-systems that gather more data that can be analyzed. Costly data warehousing and ETL-process can be skipped with new BI-tools that operate RAM-based. Hardware costs from servers has also lowered.

Benefits of business intelligence are hard to measure as they are intangible. BI brings direct benefits from cost and time savings and more indirect benefits from better business decisions. BI gives companies a competitive advantage by highlighting effective strategies and practices while revealing areas of inefficiency that can be corrected.

Business Intelligence tools market has matured. Cloud-based BI-tools will bring new possibilities in future, which can lower costs of BI making it even more suitable for smaller enterprises.

There's little academic research of business intelligence in small enterprises, but from this review we can conclude that there are several possible BI-tools for SMEs and for finding out which tool suits the need best we need to know what kind of requirements and possibilities SMEs have for utilizing BI-tools. BI brings many benefits and it is important to find out do these benefits also apply to SMEs and do SMEs know about these benefits.

4 INTERVIEWS

4.1 Research methodology

The interview is partly a theme-centered interview and partly a semi-structured interview. In theme-centered interviews, the topics are set beforehand but the questions are not in any particular order or format. In a semi-structured interview, the questions asked are the same for every interviewee, but the interviewees do not have premade answers to choose from. (Eskola & Vastamäki, 2007, p. 27).

The qualitative research interview is the most widely used qualitative research method and has also been used extensively in the Information Systems Discipline. (Schulze & Avital, 2001) The most used interview type is a semi-structured interview. A semi-structured interview is also used in this Master's Thesis and its definition is the following (Myers & Nyman, 2007):

Unstructured or semi-structured interview: *In an unstructured or semi-structured interview there is an incomplete script. The researcher may have prepared some questions beforehand, but there is a need for improvisation.*

It is also worth noting that in semi-structured interviews the researcher only has a minimal script to work with and therefore has to improvise for most of

the time, simultaneously listening carefully and constructing the next question or prompt based on the subject's response.

Myers and Nyman (2007) list several problems regarding semi-structured interviews. These include the artificiality of the interview, lack of trust, lack of time, level of entry, elite bias, Hawthorne effects, constructing knowledge and ambiguity of language.

In this study, the interview questions concern highly detailed information about the IT-infrastructure and key performance indicators (KPI) in companies. This can bring up the lack of trust issue where the interviewee does not want to divulge sensitive or important information. The ambiguity of language can also be problem, as questions can be very technical and the IT glossary might not be familiar to business-oriented people. Other problems mentioned by Myers & Nyman are not too critical, as the interview is short and the interviewed companies have a low hierarchy.

4.2   Selecting the interviewed companies

The case companies were mainly selected from Pengon's Customer Relationship Management (CRM) system. Some companies were recommended by acquaintances as good potential interviewees. The criteria were that that the interviewee company's revenue had to be under or around 20 million euro, that they had been interested in BI services or were known to have ERP systems and data to be analyzed, and that they had some knowledge of Business Intelligence solutions. The current customers of Pengon were not interviewed-The revenue criterion was chosen in order to focus the study to small-sized companies and it mainly follows the official definition of SMEs where 20 million is between small and medium sized companies' upper limits. Following official definitions

makes research more useful as it can be more easily linked to other researches and data sets.

By selecting companies that have previously been contacted, the quality of interviews is expected to be higher, as the interviewees have interest in and at least some knowledge about BI solutions. It was also known that these companies had ERP or other IT systems that gather data that could be analyzed and utilized for business. While certain industries might provide more data to be analyzed, in this research there were no criteria concerning the industry of company as most of the mainstream BI tools are not industry-specific.

4.3   Planning of interviews and questions

The data was collected by interviewing the selected people from the different companies. Emails including the basic information and topics of research were sent so that the interviewees could prepare for the interview. Later, the interviewees were called and the time of the interview was scheduled. Interviews were conducted personally in meeting or in two cases by phone when schedules were too hard to arrange. Interviews were not recorded as there was no intention to use straight citations and interview situations were more natural without recording device. Main points of answers were recording into the interview form.

In every interview the interviewee was a CEO, CFO or CIO of the company and had the authority to make decisions about BI solutions. These persons are also the users of the possible BI tools and would also benefit the most from BI system.

The interview questions were mainly composed from the theory material presented in chapters two and three. In summaries of these two chapters it is con-

cluded that resource of SMEs and knowledge of BI benefits are very important themes. Also the diversity of SMEs is to be accounted when planning for interview questions, thus we want to know on very specific level of their requirements and resources. Knowing about current IT-infrastructure is important as it defines what kind of BI-tools can be implemented. Some questions were taken straight from theory, for example analyzing qualities of different BI-tools were picked from Gartner's list. In some questions expertise from Pengon was used, for example it was known that purchase decision might not be easy for companies and more information regarding purchase decision is needed. Also questions related to future of BI were not taken from review parts, but rather related to interest to commissioner of this thesis.

Interview questions and topics can be divided into following main themes:

- Background information
- IT-systems and Databases
- Reporting
- Analyticis
- Purchase Decision
- Resources, Know-How and information sharing
- Future

In the questions regarding the company background, the goal was to know how widely different ERP systems were used, as they offer the main sources of data to be analyzed with BI tools. Another objective was to know how much knowledge on Business Intelligence and data analyzing the case companies had and whether they already had separate BI tools for reporting and data analyzing. The companies were also asked whether they felt that they had competence in data analyzing, or did they feel need for external help.

The questions concerning the analyzing of current data were asked to find out what the current reporting needs are, how wide and how regular they are and whether there are some areas that the companies would like to analyze but are unable to do so for some reason.

The purpose of the lasts themes was to find out attitudes towards Business Intelligence; whether companies believe that BI can benefit them or not, how they see its role in the future, are they deploying new systems that provide more data and are they offered data from their stakeholders or do they offer data to their stakeholders.

The answers to questions under these themes are collected to more comprehensive form in chapter five. Sorting interviews in to the themes helped executing the interviews as some detailed questions were not relevant in all interviews. In some interviews things were discussed in more general level and themes were helpful in these situations.

5 RESULTS OF THE INTERVIEWS

5.1 Backgrounds

Six out of nine companies that were sent an interview request agreed to be interviewed. Interviews were conducted in 2013. The industries of the interviewed companies were energy, parking, land management, bakery and technical service. Revenue ranged from 9 million to 20 million. The amount of employees varied from 12 to 220. One of the companies was a subsidiary of a bigger corporation.

The interviewed person was in all cases the CEO of the company. In two interviews they were accompanied by a CFO or some other person who knew company's information systems and reporting needs better. The interviewed persons were in charge of company's IT-related decisions.

Table 2. Basic information of interviewed case companies

	Industry	Revenue	Employees
KS Kitek	Lang management	10–20 mil	50–99
KSPT Insulation	Electrical installation	16.4 mil	85
Protacon	Technical services	15.4 m	220
Vuohelan Herkku	Bakery	10–20 mil	40
Ääneseudun energia	Energy	20 mil	35

Jyväs-Parkki	Parking	9 mil	12

The term "Business Intelligence" was not familiar to the people who were interviewed. Only two interviewees told that they had heard of the term before. One of them had merely heard the term, while the other one was more familiar with it. He summarized the term Business Intelligence in the following way: All the required business data is gathered from information systems to help predict the future.

In the interviews, terms "reporting" or "analytics" were used, as the interviewed persons were not familiar with the term BI, even though reporting is only one part of business intelligence. This is why analyzing the results of interviews are done by using these two terms. Reporting refers to more static and passive utilizing of history data and analytics refers to more active processes where data is utilized more actively in different ways, for example predicting future.

5.2 IT systems and data storages

There were several information systems in use despite the small size of the companies. Common information systems between the interviewed companies were not found. This is not surprising regarding the production systems or ERPs because the companies were not from the same industries. However, when it comes to financial, accounting and HR systems, there could have been common systems in use, but this was not the case among the companies in this research.
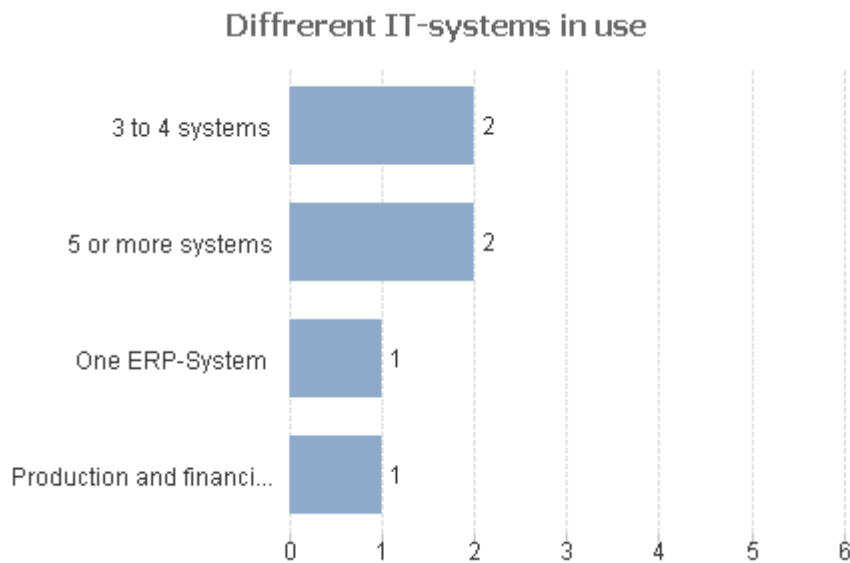
Diffrerent IT-systems in use

Figure 8. Answers related to different IT systems in use

Figure 8 visualizes the answers to question regarding IT-systems in use. There were 6 answers in total to every question. For the most part, the production systems and financial systems were separate, but in one company there was only one ERP in use that had all the required functions and areas covered, including accounting. In the second company, there was no ERP or any production focused IT system. In the third company, there was a separate quality control system and project costing system in addition to the production system. Other companies had a few or several different systems in use, mostly one system focused to production management and one system for accounting and other financial needs. Separate HR systems were not used, so the payment of salaries was most likely handled in financial systems and other HR needs, such as holidays and sick days were done manually.
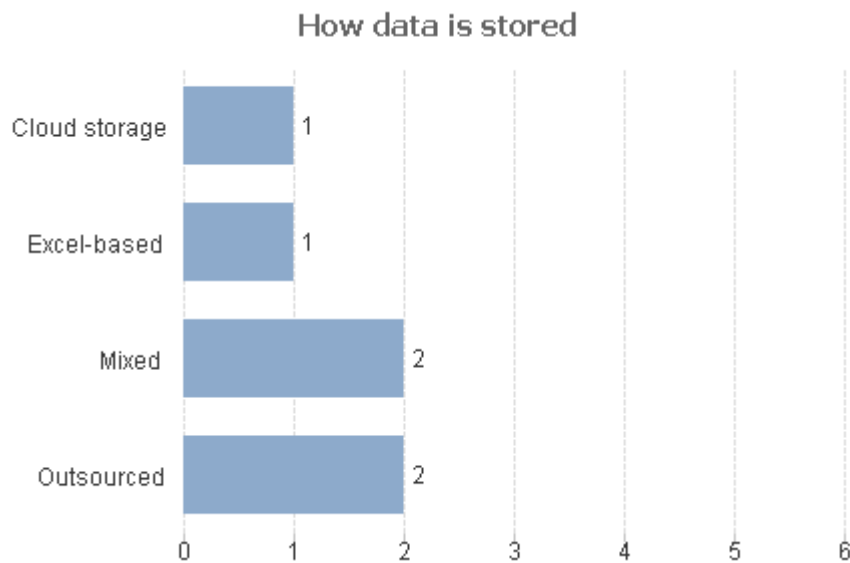
How data is stored

Cloud storage 1

Excel-based 1

Mixed 2

Outsourced 2

0 1 2 3 4 5 6

Figure 9. Answers related to data storage

From figure 9 we can see that there is spread in the answers as well. The companies had several kinds of IT structures. Data was stored and located in numerous different ways. One company had their data in an Excel format, while another company was using a cloud data storage service. Several companies had some outsourced systems. For instance, accounting was most commonly outsourced. This might bring some issues if the companies were to utilize the data that the third party system gathers – one interviewed thought it would be hard to access to data other ways than basic reports that system offers. He felt that freely accessing data in their outsourced solution would be impossible.

To the question regarding what kind of information is needed to lead the company, most companies answered that "everything these systems gather and save". In one company, it was seen that the data IT systems gather about daily operations is not that significant, while the financial performance indicators are more important. Everyone felt that systems gather and save plenty of data.

Problems related to the quality of data did not come up in interviews. The interviewees felt that the quality of their data was good and that the data could be utilized and there were no known issues regarding the saving or format of the

data. One interviewed person mentioned that the biggest problem with data is that it is not in digital format but in heads of the employees as so-called tacit knowledge and utilizing it is hard.
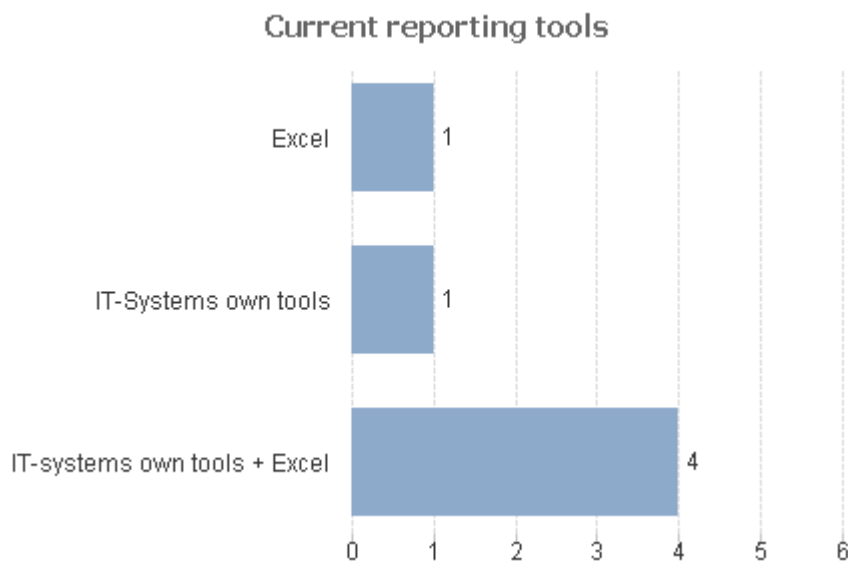
5.3 Reporting

Figure 10. Answers related to current reporting tools

In figure 10 can see that one company had separate reporting and analytics systems. Other companies were using reporting tools provided by ERP and other information systems or they used Microsoft Excel to create reporting and analytics. One interviewed said that the reports that their system provides are poor and they need to compile and visualize the reports in Excel. One company managed with very little Excel use, as their systems provided the needed reports in a satisfactory level. The company that had the comprehensive ERP system in use also needed to use Excel to compile reports.
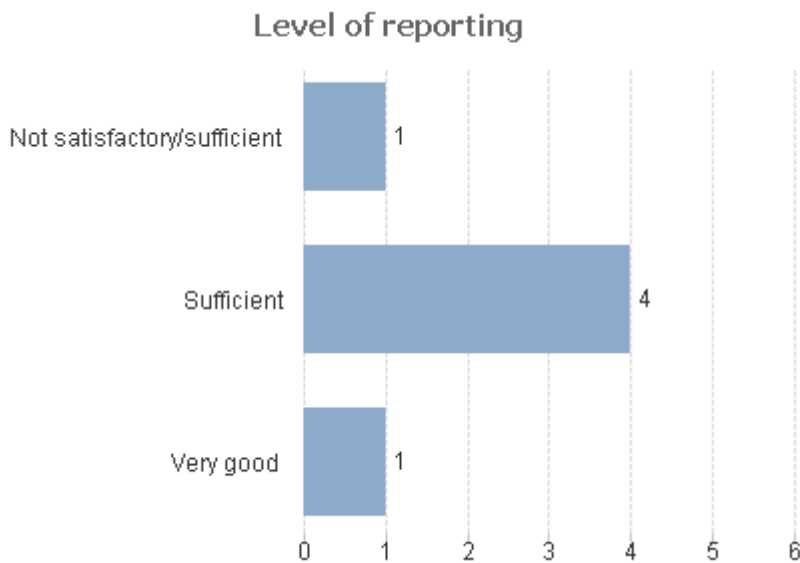
Figure 11. Answers related to current level of reporting

As we can see in figure 11, the level of reporting and analytics was seen as sufficient. In one company, the level was even described as very good. However, in some cases the specified information related to forecasting and cost pricing was not available. In one company, it was felt that the current level of reporting was not satisfactory or sufficient, as the BI project in that company had been delayed and confronted resistance inside the company. There were also shortcomings in the usage of history data, as the production systems did not save history data from a very long period. One company was dissatisfied with their HR reporting, as they had a need for a personnel gallery that the system could not provide. Only one company answered that they get everything they need from the systems they currently have.
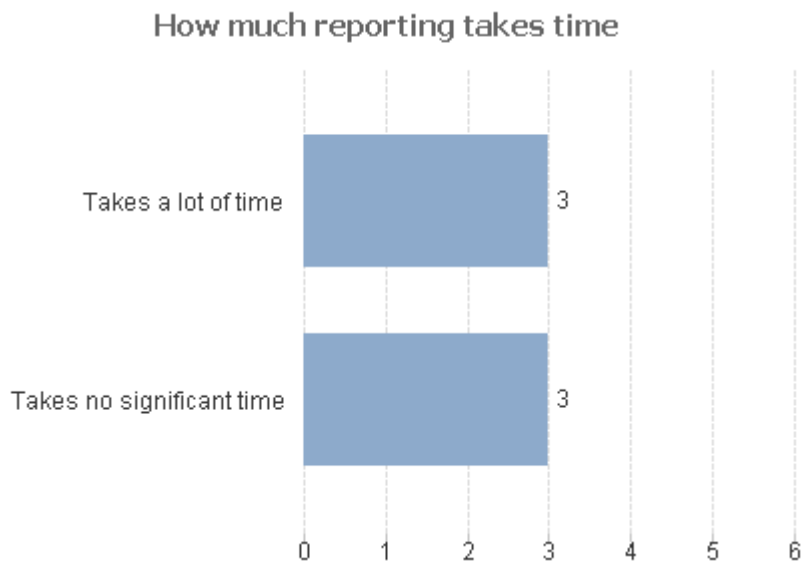
How much reporting takes time

Figure 12. Answers related to current level of reporting

The time used for reporting and related tasks varied between companies, which is illustrated in figure 12. Half of the companies answered that they felt that reporting takes a lot time, while the other half felt that reporting does not take a significant part of their time resources. However, in one company that used significant time resources for reporting related tasks, the time used in reporting was not seen as a problem.

When companies were asked how often they reported and how frequently they needed different kinds of reports, two companies mentioned that they used monthly reporting. In these monthly reports mostly financial KPIs were used. Other KPIs were not frequently reported. In three companies, the monthly level was not satisfactory, and they used weekly reporting instead. One company answered that they reporting needs were daily.
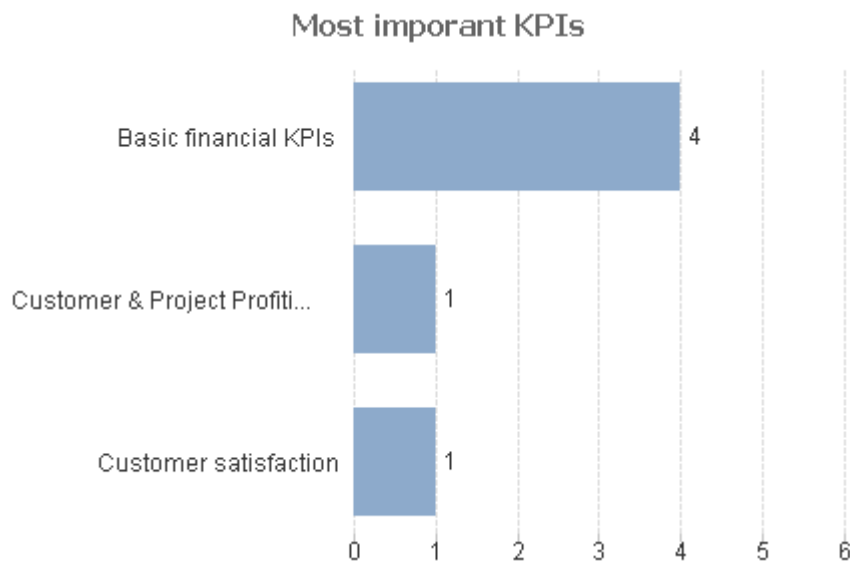
Most imporant KPIs

Figure 13. Answers related to time reporting takes

Companies were asked what their three most important Key Performance Indi-
cators (KPIs) were and answers are presented in figure 13. Several interviewees
could not name three KPIs right away and had to take time to think about the
question. Most companies named financial indicators like revenue, operating
profit and different costs. Budgeting versus actual was a KPI in one company.
Profitability related KPIs were followed only in company, which followed both
customer and project profitability. In one company, customer satisfaction was
named as a KPI.

5.4   Advanced analytics and the purchase decision

Familiraty with data mining, score cards and OLAP

Somewhat familiar — 1

Not familiar — 5

(axis: 0 1 2 3 4 5 6)
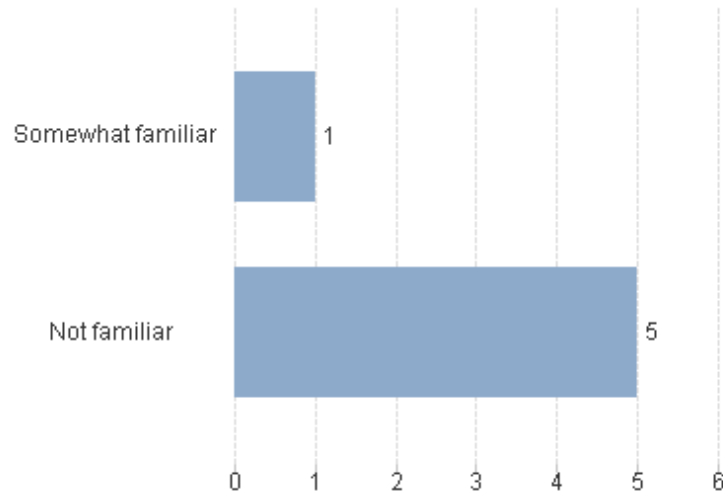
Figure 14. Answers related to advanced analytics

Figure 14 tells that advanced analytics like data mining, score cards and OLAP cubes were not familiar in the case companies at all. Only one company had heard about these before. This company also actively used score cards, which the company described as a good tool. They also utilized forecasting for their benefit.

Attitudes towards forecasting and its benefits

Current forecasting is suffici... — 1

Forecasting cannot be done — 1

Interest in forecasting — 3

Very interested in forecasting — 1

(axis: 0 1 2 3 4 5 6)

Figure 15. Answers related to forecasting

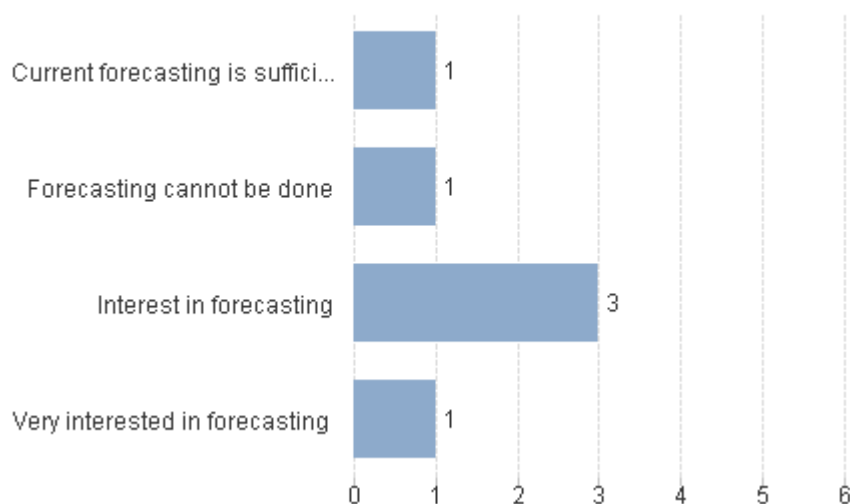As can be seen from figure 15, for the most part, the companies were interested in forecasting and the benefits it brings. Only one company said that the forecasts of their current system are enough. In another company, forecasting was considered difficult or even as impossible due to the nature of their business. One company mentioned that forecasting is very interesting and that it brings benefits to increasing company's revenue and profits. Different resources, work schedules and price lists were mentioned as objects for forecasting.
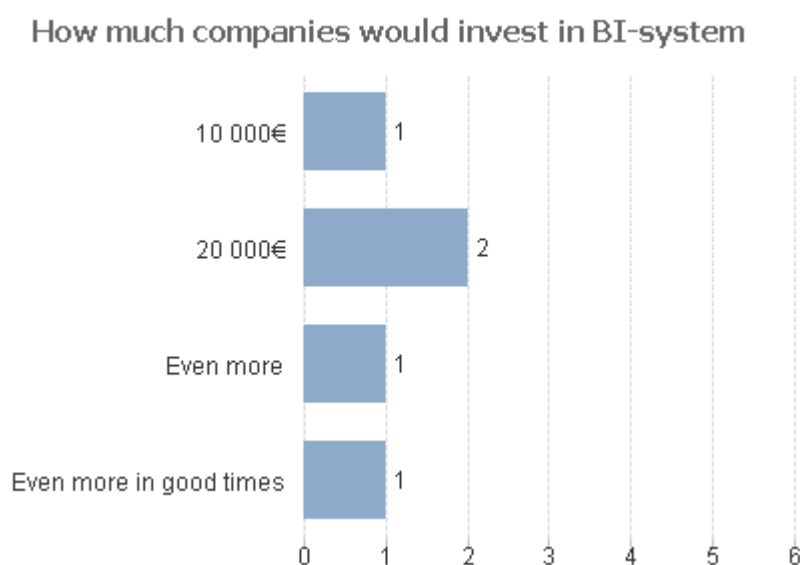
How much companies would invest in BI-system

Figure 16. Answers related to purchase decision

Figure 16 visualizes answers related to purchase decision. As for the cost of a possible BI tool, one company was prepared to pay 10,000€ and two companies told they could pay 20,000€. Other companies were prepared to pay more and considered investing to IT systems as same as any other machine investment. One interviewee mentioned that in good times they would be ready to invest in BI. It is to be noted here that in 2013 Finland's economy was still looking rather grim.

There were no clear viewpoints regarding the purchase decision of a possible BI system. Most interviewed people had not heard about test runs or the "seeing is believing" buying process. Test runs from company's own data were not seen

as important. Few felt that a test run from company's own data would bring value to the purchase decision, while a credible demo was seen as sufficient for this.

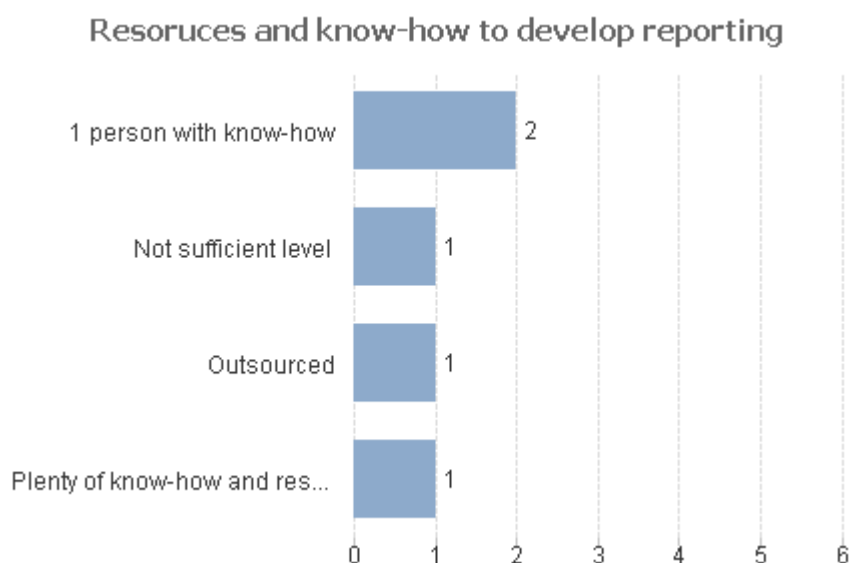## 5.5 Resources, know-how and information sharing

Figure 17. Answers related to resources and know-how

In figure 17 it can be seen that companies felt that they had their own resources and know-how in reporting, data warehousing and in analytics. In two companies they had only one person who had knowledge in these areas. The company that was a subsidiary of a corporation had the corporation support them in these areas. In one company they had outsourced their reporting and analytics. One interviewed CEO said that they had plenty of BI know-how, as business intelligence was considered important in the company. One company felt that they did not have a sufficient level of reporting knowledge.

Moreover, the development possibilities of the current systems were seen as good. The biggest obstacle was the lack of time for development work. The companies had Excel experts that could also develop reporting and analytics

systems further. In one company there was a project where data was fetched and other layout work made, so the company felt that they had very good chances to do the development work themselves without relying to outside resources.
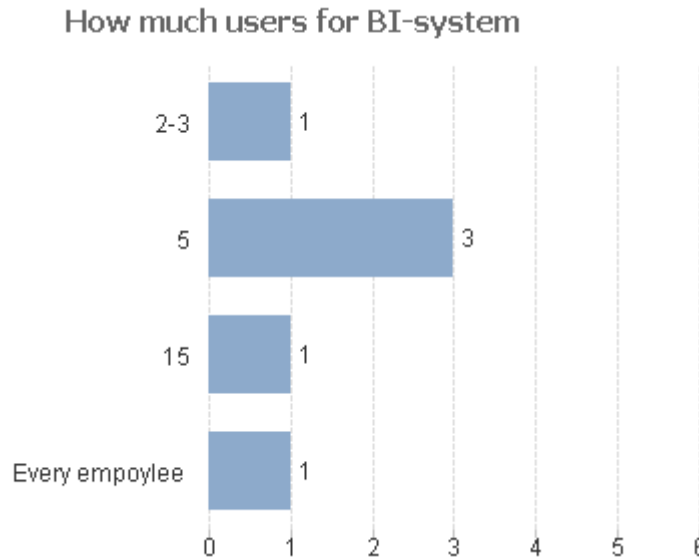
How much users for BI-system

Figure 18. Answers related to information sharing

The amount of users of a reporting system was usually five, as this was also the size of the executive group of companies as can be seen on figure 18. However, there were also answers that mentioned user counts as 2–3 or as high as 15. In the company that had the comprehensive ERP in use, everybody was seen as a user of the reporting system. In ERP there was a reporting tool for everybody to use, and these tools very also actively utilized. Some of the other companies also recognized the need of information in the management level and that business intelligence is not a thing only for top management.

The information was most commonly shared with different file servers. The reports, which are usually Excel files, are located in a file server where everybody can access them. In one company email was used to share documents, but this company was also implementing a file server solution. Some of the IT systems the companies used offered reports that could be sent automatically as email.

Companies felt that there was no need for mobile use in reporting. In two companies there were tablets in production use, but even these companies thought that reports and analytics did not need to be available on mobile. Companies felt that reports and analytics could only be done in the office and there were no need for them "on the road".

5.6   The future
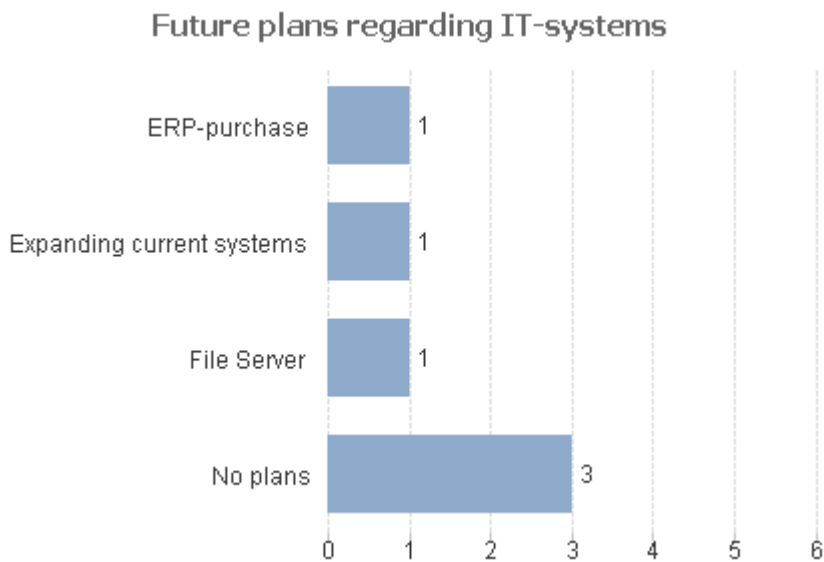
Figure 19. Answers related to future of companies IT-systems

Figure 19 illustrates that half of the companies had no plans for new information system purchases. The company that did not have an ERP was in process of getting one. One company was planning to buy a file server system and another company was expanding their current system by buying expansions that help with history data reporting.

The companies that had a BI system in use planned to develop their BI even further. Other companies did not have clear vision of investing into BI software. However, all companies planned to develop their reporting.

Future plans for gathering more data
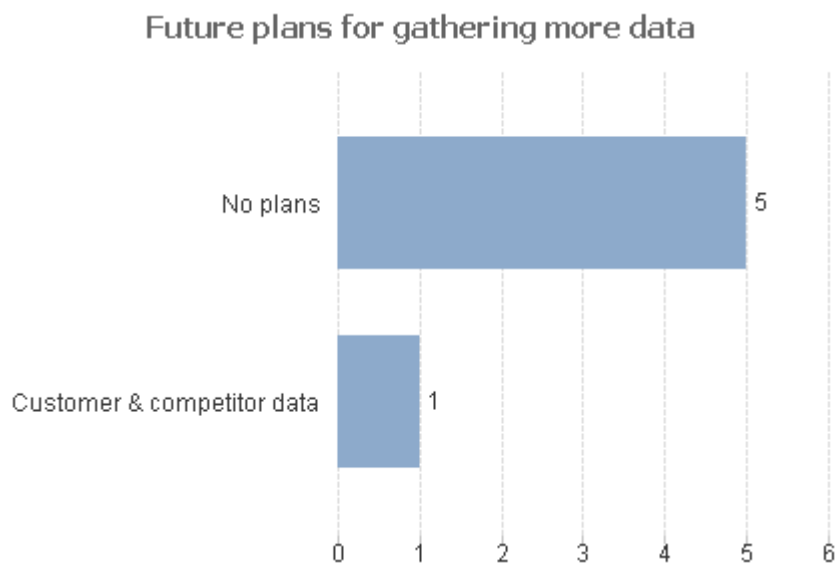
Figure 20. Answers related to data gathering plans in future

Figure 20 shows that most of the interviewees did not have plans for gathering new information. One interviewee said that even the data from current systems was not utilized in satisfactory levels. One CEO said that they had plans to gather more customer and competitor data from external sources. The problem with this plan is that the market information is usually scattered.

3rd party data offering

Figure 21. Answers related to data offerings of stakeholders

For the most part, companies' own customers and suppliers did not offer data or the offered data was not utilized as figure 21 presents. However, one of the

companies did utilize connections that the supplier offered to maintain their orders. Another company had access to the reseller's system which included data of the sales of their products. There were wishes to get more data from external sources, for instance from the maintenance system so that the planning of the maintenances would be better.

Does BI help to increase revenue
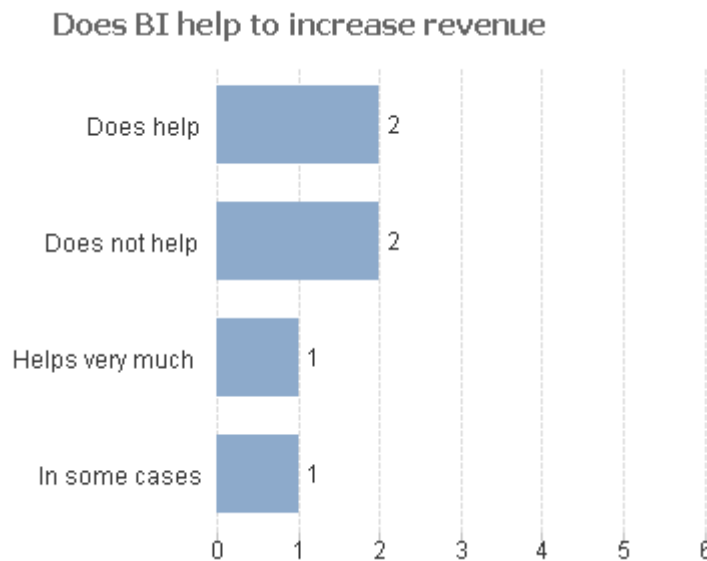
Figure 22. Answers related in BI ability to increase revenue

To the question whether they believe BI could increases revenue and help organizations to grow, two people answered that they do not as can be seen in figure 22. They felt that their business was too specific to benefit from BI. One interviewee answered that in some cases BI might even increase the profits. Three companies answered that they do believe in BI's possibilities, with one company emphasizing that there has been clear evidence of benefits of the BI. This company was by large margin more profitable than other companies in the sector. This was thanks to business intelligence, as they used it to keep track of different profits of projects and customers. This company also systematically collected customer information.

5.7 Summary

There were little commonalities to be found between the case companies. They used different kinds of IT infrastructure and various, but not common, IT systems. The amount of BI users also varied in companies, but most commonly it was seen as a tool only for the executive group of usually size of five people.

There were also extremes to be seen within the interviewed companies. One company had an especially good situation with business intelligence and had faith in it, while in other companies there was not so much trust in BI. There were also extremes in information system, as one company had a comprehensive ERP in use and one company did not have an ERP at all.

6   DISCUSSION

6.1   Answers to research questions

- What is the current situation of BI in small companies? How they understand BI?

The current levels of reporting were viewed as good by the companies even though some needed information were unavailable for them. Small and medium-sized enterprises generally should have less reporting than larger companies, as they are not stock market companies or corporate, but the time spent on reporting varied. In some cases the companies used lots of time resources on reporting. If this time resource could be saved with a BI tool, the BI investment would pay itself back. Otherwise the time saved from using a BI tool did not seem significant. The effects of non-direct benefits, such as better decision-making, cannot be deduced from the results, but in some cases there were strong belief in non-direct benefits.

IT-related investments were regarded as machinery investments, which tells that IT systems are viewed as important as production related machines even when they are intangible and do not produce easily measurable benefits. However, some companies said that BI is a something that can only be invested into in good times, which implies that BI is not viewed as a necessity.

Generally, companies felt that they could develop their BI system on their own without help from external consultants. In the theory part, Suraweera & Pulakanam & Guler found that small companies lacked the needed skills in IT projects and had to rely on external consultants. Therefore, there can be seen a conflict between the theory and interview results. Reason for this conflict might be that the selected companies actually have the needed resources and skills to develop a BI system or that companies do not understand how hard and demanding BI and IT projects can be.

There were also some findings in general lack of awareness what BI is about and what kind of benefits it could bring to companies. More advanced analytics were almost non-heard in case companies. When there is no knowledge of benefits BI brings, those benefits cannot be utilized.

The most significant finding based on the interviews regarding productization is that small companies cannot be offered one bulk product as their BI systems need to be tailored to them, since they have several IT systems that are incompatible. Therefore, productization is hard and the costs of the systems cannot be reduced this way.

- What kind of IT infrastructure and data they have?

Information systems, which create the base for collecting data, were used among the interviewed companies. Systemically gathering and storing the data is the first step and a requirement for utilizing business intelligence. From this viewpoint, small companies fulfill the requirement and BI can be implemented in them. However, for most part the utilization of BI was low. However, in the companies that used BI, the BI was considered highly important.

The situations with data warehouses differed, as there were data warehouses owned by the company itself as well as outsourced data warehouses. Getting the data out from outsourced data warehouses might be harder, as the third party can add one-time or monthly charges to accessing their systems. Moreover, for technical reasons, getting the data out of the system is very difficult. Also, it might not be clear to the company what kind of data is gathered and stored into a third party data warehouse.

There were many different information systems in use inside the same company with no communication between them. There was only one actual ERP in use that covered almost all of the company's needs; other companies need several systems to cover their needs. Most companies were single-office. As for the multi-office companies, the side office did not have any IT systems on its own and the same systems with the main office were used. This is most likely due to the small sizes of the companies, as the side offices are not large enough to require own IT infrastructure. While there are less IT systems in use compared to larger companies, it can be concluded that small companies also face challenges in harmonizing the information.

The quality of data was believed to be good, which is interesting considering that these companies had not gone through an ETL process. The ETL process aims to improve the quality of data and plays a major part in data warehousing projects, as the data received from ERP systems is not usable as it is. Thus, the quality of data should not be good. It might be possible that there is such little data in small companies and it is not as complex as in larger ones that there would not be so much need for an ETL process. Another possible explanation is that the quality of data is not known and real state of data quality is unclear. It might be the case that the first time the quality of data is inspected is at the start of BI-project, as there has not been any previous BI or DW projects.

Data was available from versatile sources, as there were IT systems in use in production as well in financing but also more specialized systems for gathering data. Plenty of data was stored in Excel files. External data sources were mainly not used, but some external data was gathered. All of the interviewees thought that the quantity of data will grow in the future.

The companies did not do any extra data gathering. Some data exchange was done with the suppliers but systematic external data gathering was practiced only in one of the interviewed companies. Business intelligence in small companies is most likely limited to internal information.

- What requirements and needs do they have for reporting?

The sharing of information was mainly done with a file server. BI tools offer more file and information sharing possibilities, which means that in this area a BI investment would add value. There are many problems with file sharing system. For instance, only one person can edit an Excel file at a given time, so there could be many versions of same information circulating if user makes their own versions. Files attached to email share the same problem but they also have the up-to-date problem as one cannot update information in file attached to email. Excel finds can be linked and updated so at least it possible have fresh data this way.

The user group of the BI system was mostly seen as an executive group of the company. But in one company they viewed each employee as a user of business intelligence, as one has to be able to follow and analyze their own work results. For the most part it could be said that the commitment of employees to the BI system was not considered important.

- What kind of future plans they have for BI?

Each company did have some kinds of plans for developing their reporting. Mainly the interviewed companies did not plan to invest into a new information system or into gathering new data. Therefore, in these companies the BI will most likely focus on better utilization of the old and existing data rather than utilizing new information. However, not every company believed that BI would benefit them financially, which might affect the BI related decisions in these companies.

The interest in gathering data from external sources varied. There was some external data usage, but as it was not systematical, it seems external data does not to seem to offer SMEs benefits in near future. Benefiting from external data would require gathering it and been interested in utilizing it. Seeing that only one company said that they do competitor analysis, it can be said that the small and medium-sized enterprises' BI focuses on analyzing the internal data rather than external data.

The views on the benefits of BI varied even more than the interest in external data gathering. There were extreme opinions in both sides: some thought that BI does not bring financial benefits while other argued that the benefits it brings are significant. It is not surprising that the companies that were most convinced of the benefits BI brings were also the companies that were most interested in further developing their BI systems. However, even the companies that had a negative view of the benefits of BI recognized reporting as a mandatory need that needed investing into.

The grim economic situation in Finland also affects the future of BI in SMEs. Some companies said that in good times investing in BI would be easier and that they would be more ready for it and could spend resources in developing their BI systems.

Ultimate objective of this master thesis was to find out what kinds of require-ments small companies have for business intelligence. These requirements for BI-system can be summarized and listed as following:

- Self-tailoring and customization
- Low cost
- Low user count
- Quantifiable benefits
- Forecasting abilities

It also to be noted that some requirements like mobility use was not found im-portant in this research. Also there are some hard to define requirements as "get rid of excels".

6.2   Discussion

The companies were not aware of price-lowering technology advancements such as cloud and in-memory technologies. This might tell that keeping a track of BI and IT technology developments is not a priority for the SMEs. This is also very natural considering that in all these cases the CEO handled several things in the company including the IT-related decisions and their time resources are limited. If the CEOs of SMEs knew about the current state of the BI systems and the benefits they bring, making investing decisions would be easier.

According the results of this Master Thesis, we can conclude that the source systems and business requirements in small and medium-sized companies are so different that these companies cannot be offered a general solution. Thus, the cost of a BI system cannot be lowered by giving up the customization part of the system. However, some of the customization needs could be given for the customer to do. The interviewed companies had the will and interest to develop

their BI systems but the ETL process, advanced calculation rules and the user interface designing can be challenging to do, meaning that SMEs might face know-how issues.

The resource and know how might be real issue for SMEs. Like Suraweera & Pulakanam & Guler (2006) mentioned in theory part, critical issue in IT-projects in SMEs is the lack technical expertise. While BI-systems are getting easier to use, technical expertise is still needed.

In theory it was mentioned that in SMEs the attitudes of management are very meaningful. Thus this master thesis touches important subject as interviewed persons were the CEOs of the companies and answers from them need to be given strong emphasis when pondering about adoption of the BI system in SMEs. Because technical possibilities for BI were found, the attitudes of management might the most important factor when making decision regarding the utilization of the BI benefits

6.3 The evaluation of the research

The research was conducted mainly according as it was planned. As many interviews that were planned at the beginning were not done, the resulting smaller interview material weakens the reliability of the results.

The goal of research can be seen as completed as this master thesis gives better picture of SMEs and their requirements towards BI. The research questions were answered as it came clear that SMEs had variation in their BI requirements.

The selecting of the interviewed companies holds limitations as it was hard to find suitable companies in Jyväskylä. This also means that these results might be only relevant to Middle Finland area.

The selection of the research method turned out to be suitable. When conducting interviews it turned out that the companies and the interviewed persons were very different. A structured interview might had provided low quality answers if the questions were not relevant in that particular case. Also the themes of the interviews were not that familiar to the interviews so structured interview form would not had been that suitable In semi structured theme interview there was possibility to explain questions more in depth.

6.4   Further research

Based on this research more specific questions could be formed and redone to wider material. Broader interview research would be good as the findings in this research would be more reliable and can be generalized.

Findings of this master thesis can also be used when planning BI-system for SMEs companies.

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APPENDICES 1 - INTERVIEW FORM

1. Nimi, Työtehtävä ja organisaatio

- Kuka organisaatiossanne vastaa tietojärjestelmiin ja raportointiohjelmistoihin liittyvistä hankinnoista?
- Toimiala, lyhyt kuvaus mitä teette?
    - Liikevaihto, henkilöstömäärä
- Saadaanko mainita nimeltä henkilö/yritys

2. Business Intelligence
- Mitä ymmärrätte termillä BI?

a. Tietojärjestelmät ja tietokannat
- Tietojärjestelmät, joista tietoa halutaan/tarvitaan?
    - Toiminnanohjaus? Myynnin/asiakas? Taloushallinto? Henkilöstöhallinto?
- Tietovarastot/tietokannat?
    - Arkkitehtuuri? 1 kerroksinen ERP:in yhteydessä vai 2 kerroksinen testi/raportointikannalla?
    - ETL-tarve? Datan laatu?

b. Raportointi
- Onko käytössä joku erillinen raportointiohjelmisto?
    - o Olemassa olevien ohjelmistojen omia työkaluja? Excelin käyttö?
- Onko näiden taso riittävä? Ollaanko tyytyväisiä?
    - o Jääkö jotain tietoja saamatta?
    - o Viekö aikaa?
- Aikatarve:
    - o Tarvitaanko päivittäin? Katsotaanko vain kerran vuodessa miten on mennyt?
- KPI:
    - o Mitä tietoja tarvitaan päätöksentekoon? Mikä näistä on tärkein? Kolme tärkeintä? Saadaanko kyseiset luvut nyt?

c. Analytiikka

- Kuutiot, Scorecardit, datan louhinta tuttuja?
- Ennustaminen ja sen mahdollisuudet/hyödyt?

d. Ostopäätös

- Onko Seeing-is-Believing/Try Before You Buy hyvä?
    - Miltä pelkän demon perusteella ostaminen tuntuisi?
    - Jäisikö ostamatta jos heti etukäteen pitäisi sitoutua rahan maksamiseen?

3. Osaaminen ja tiedon jakaminen

- Onko organisaatiossa joku, joka hallitsee tietovarastoinnin/raportoinnin/BI
    - Kuinka pitkälle organisaatio pystyy itse kehittämään järjestelmää?
- Tietojen jakaminen
    - Kuinka moni käyttäisi mahdollista BI-järjestelmää
    - Kuinka moni tarvitsee vain jotain yksittäistä tietoa
    - Miten tietoja nykyisiin jaetaan? Sähköpostit, yhdessä palaverissa?
    - Mobiililaitteet

4. Tulevaisuus

- Onko suunnitelmia uusien tietojärjestelmien käyttöönotosta?
- Onko suunnitelmissa/haaveissa kerätä lisää tietoa?
    - Sisäisistä/ulkoisista lähteistä?
    - Tarjoavatko omat toimittajat tai asiakkaat tietoja?
- Uskooko BI:n parantavan liiketoimintaa tai auttavan kasvussa?