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BUILDING A BUSINESS INTELLIGENCE CAPABILITY FOR SMALL AND MEDIUM SIZED ENTERPRISES

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ABSTRACT

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During the last decades both empirical research and practical experience have manifested the benefits of Business Intelligence (BI), including for example cost savings, improved efficiency, and better understanding of business partners. However, even though BI has been extensively studied, there seems to be a gap in the prior research: BI has been researched mostly from the perspective of large companies while leaving small and medium sized enterprises (SMEs) with less attention. SMEs naturally have fewer financial resources available than large companies, meaning less and smaller investments to IT. However, this does not necessarily indicate that SMEs could not get as significant benefits from BI as large companies. This study addresses this gap by examining how BI capability can be built in SMEs, and what kind of resources and strategic efforts it requires from SMEs. To observe BI from a wider perspective, the concept of BI capability was selected as a theoretical lens, as it incorporates technological, strategic, process and personnel related aspects. The literature review clarifies the concept of BI and tries to understand what kind of resources and strategic efforts are required to build a BI capability. Empirical part aims to clarify how BI capability can be built in SMEs in particular. Research was conducted using qualitative approach. Data was collected using theme interviews and analyzed using content analysis. Results revealed that the cornerstones of building BI capability are business-driven approach, agile methods, simple and easy-to-use technological infrastructure, focused data collection approach, and end user training. Furthermore, data revealed that there are two sets of resources that are required to build a BI capability. BI resources are the prerequisite for BI capability and include BI infrastructure, BI human resources, BI enabled intangibles, and high-quality data. Building of these resources requires another set of resources that are a recognized BI need, committed management, financial resources, time resources and personnel resources. Key conclusion of the study is that BI capability is created piece by piece over a longer period of time, rather than as a result of an individual BI project. Finally, both literature and empirical data suggested that the cornerstone of strategic guiding of BI efforts is "start small, think big" ideology.

Keywords: Business Intelligence, Small and medium sized enterprises, BI capability, BI resources, BI strategy

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Sekä tieteellinen tutkimus että käytännön kokemus ovat viime vuosina valottaneet Business Intelligencen (BI) hyötyjä, kuten kustannussäästöjä, parantunutta tehokkuutta sekä lisääntynyttä ymmärrystä kumppaneista. Vaikka BI:tä on tutkittu paljon, on aiemmassa tutkimuksessa havaittavissa selkeä puute: BI:tä on tutkittu lähinnä suurten yritysten näkökulmasta, jättäen pienet ja keskisuuret (pk) yritykset vähälle huomiolle. Vaikka pk-yrityksillä on isoja yrityksiä rajallisemmat taloudelliset resurssit, minkä takia niiden investoinnit IT:seen ovat harvinaisempia ja pienempiä, ei se kuitenkaan tarkoita, etteivät ne voisi saada BI:stä yhtä merkittäviä hyötyjä kuin isotkin yritykset. Tämä tutkimus pyrkii vastaamaan tähän puutteeseen perehtymällä siihen, miten ja millaisilla resursseilla ja strategisilla toimilla BI-kyvykkyys saadaan rakennettua pk-yrityksiin. Jotta BI:tä voidaan ymmärtää mahdollisimman laajasta näkökulmasta, valittiin teoreettiseksi linssiksi BI-kyvykkyyden käsite, johon sisältyvät niin teknologiset, strategiset kuin prosesseihin ja henkilöstöönkin liittyvät seikat. Tutkimuksen kirjallisuuskatsauksessa pyritään selkeyttämään BI:n käsitettä ja ymmärtämään millaisia resursseja ja strategisia toimia BI-kyvykkyyden rakentaminen vaatii. Empiirisessä osassa pyritään selkeyttämään BI-kyvykkyyden rakentamista pk-yritysten näkökulmasta. Tutkimus toteutettiin laadullisena tutkimuksena. Data kerättiin teemahaastattelun keinoin ja analysoitiin käyttäen sisällönanalyysia. Tulokset paljastivat, että BI-kyvykkyyden rakentamisessa avainasemassa ovat liiketoimintalähtöisyys, ketterät menetelmät, yksinkertainen ja helppokäyttöinen teknologinen infrastruktuuri, kohdennettu datankeruumenetelmä sekä loppukäyttäjäkoulutus. Lisäksi todettiin, että BI-kyvykkyyden rakentamiseen tarvitaan kahdenlaisia resursseja. BI-resurssit ovat BI-kyvykkyyden edellytys ja sisältävät BI infrastruktuurin, BI henkilöstöresurssit, BI:n luoman tietämyksen ja laadukkaan datan. Näiden resurssien rakentamisen taas tunnistetiin tarvitsevan yrityksen itsensä tunnistaman BI-tarpeen, johdon riittävää sitoutumista sekä taloudellisia, ajallisia ja henkilöstöllisiä resursseja. Keskeisenä johtopäätöksenä BI-kyvykkyyden todettiin syntyvän pidemmällä aikavälillä ja pala kerrallaan, eikä niinkään yksittäisen BI-projektin tuloksena. Sekä kirjallisuuden että empirian perusteella strategisen ohjaamisen kulmakivenä voidaan pitää “aloita pienesti, ajattele suuresti” ideologiaa.

Avainsanat: Business Intelligence, pk-yritykset, BI-kyvykkyys, BI-resurssit, BI strategia

FIGURES

TABLES

TABLE OF CONTENTS

1 INTRODUCTION

During the last decades business intelligence (BI) has gained a lot of attention among academics and practitioners. Company's ability to utilize data and BI in its operation and decision-making can generate significant benefits, such as cost reductions, better insights into suppliers and customers (Baker & Chasalow, 2015) and even a competitive advantage (e.g., Sidahmed, 2007; Llave, Hustad & Olsen, 2018). However, implementing BI from scratch is not a straight-forward process. For example, Yeoh and Koronios (2010) suggest that it is not enough to simply acquire a BI tool, but company must also invest into organizational and process related factors, such as clear business cases and change management. Succeeding in BI activities can also require major adaptation from an organization's culture, structure, and processes (Ramakrishnan, Khuntia, Kathuria & Saldanha, 2016; Wixom, Watson & Werner, 2011). Therefore, technological infrastructure is necessary, but not sufficient, condition for BI exploitation (Llave et al., 2018), meaning that technology acts as a foundation for BI but does not guarantee the value creation. Thus, even though technology is in the heart of BI, it should be observed from organizational perspective.

The concept of organizational capability refers to information-based and organization-specific processes that utilize organization's resources to achieve a desired outcome, such as improved efficiency (Amit & Schoemaker, 1993). Organizational capabilities observe organizations from a wide angle, and incorporate both technological, strategic, process and personnel related aspects. Thus, the concept of organizational capability is a meaningful theoretical lens for observing also BI in a holistic manner. From the perspective of BI, relevant subcategories of organizational capabilities are IT capabilities and dynamic capabilities. IT capabilities are a sum of several organizational and technological abilities, including for example the co-operation of business and IT, strategic understanding of how IT can benefit the organization, and IT infrastructure (Bharadwaj, Sambamurthy & Zmud, 1999). Via dynamic capabilities, in turn, organization is able to innovate and re-organize its resource base so, that it can unlock new, value-adding strategies (Eisenhardt & Martin, 2000). As BI incorporates technological components (e.g., Yogev, Fink & Even, 2012), collaboration

of different teams (Yeoh & Koronios, 2010), ability to understand the value of IT (Yeoh & Koronios, 2010), and ability to capture relevant information to enhance the operation (Rouibah & Ould-Ali, 2002), both IT capabilities and dynamic capabilities are relevant for observing BI. BI capability itself can be defined as organization's ability to move towards its goals by utilizing high-quality data and technology to transform its assets into more valuable ones (e.g., Kulkarni et al., 2017, Knabke & Olbrich, 2016). The concept of BI capability gives space also to non-technological aspects, such as strategic skills and operative processes, while keeping the focus in the aspects that are relevant for BI, and thus, is a meaningful perspective for observing BI holistically.

Large enterprises usually have more resources and capital to spend on IT-projects (Hwang, Ku, Yen, & Cheng, 2004), which may be the reason why most of the BI systems are implemented in large, international companies and why their adoption and utilization have been mostly studied in this context (Llave, 2017). When compared to larger companies small and medium sized enterprises (SMEs) usually have fewer financial resources available, limitations in their IT assets and competencies and different needs in regard to decision-making (Llave et al., 2018). However, this does not imply that SMEs could not benefit from BI. As a matter of fact, some studies have already shown that also smaller enterprises can gain significant benefits from BI, such as improved data quality and decision-making, and cost and resource savings (Scholz, Schieder, Kurze, Gluchowski & Böhringer, 2010). Based on these observations it would be interesting to understand how SMEs could benefit from BI in spite their limited resources and know-how.

This study aims to shed light on the aspects that should be considered when implementing BI in SMEs. This study will adopt a holistic view on BI by considering both technological, organizational, and humane aspects. As the concept of capability involves all these aspects (e.g., Bharadwaj et al., 1999), it will be used as a theoretical lens. Thus, to summarize the motivation of this study, prior study seems to have a gap, where the benefits of BI are well-known, but only from the perspective of large companies. SMEs form a major share of the total number of companies, for example in Finland the total share of SMEs is 98% of all companies (Suomen virallinen tilasto, 2017), and therefore, SMEs should not be omitted when studying the benefits of BI. To reduce this gap, this study aims to shed light on the usefulness and relevancy of BI in SMEs from the perspective of organizational capabilities. Research question of this study is as follows:

- How can BI capability be built in SMEs?

As the concept of capability is rather broad, the perspective of this thesis is narrowed down to aspects that relate to resources and strategy. The following two supportive research questions are used to explore these aspects of BI:

- What kind of resources are required from SMEs to build a BI capability?
- What kind of strategic efforts are required from SMEs to build a BI capability?

This study is divided into two main parts: literature review and empirical research. Literature review forms the theoretical base of this study and aims to clarify the essential components of BI from both technological and organizational perspective. In addition, literature review attempts to define the BI capability in more detail and investigate which resources, organizational capabilities and strategic efforts are prerequisites for BI capability. After the elaboration of literature, a theoretical framework for BI capability building process in SMEs is developed. Framework will be further utilized in the empirical part of the study. Empirical part of the research aims to answer the research questions using qualitative research approach. Data is collected by interviewing BI professionals who have experience of implementing BI in SMEs. As theme interview allows utilization of prior theoretical knowledge while leaving enough space for new ideas and observations, it fits well to purposes of this study and therefore, is used as a data collection method. Data is analysed using content analysis. Empirical data reveals several key aspects to consider when building BI capability in SMEs, including the importance of business-driven approach, agile methods, simple and easy-to-use technological components, focused data collection approach, and end-user training. Furthermore, data reveals what kind of resources SMEs need to build a BI capability, and on the other hand, to execute a BI project. Empirical data also clarifies the cornerstones of the strategic guidance of BI efforts in SMEs.

Remainder of this paper is structured as follows: chapters 2 and 3 form the theoretical base and the literature review of this study. Chapter 2 elaborates the aspects of BI in more detail, including technological aspects, strategic considerations, and implementation of BI in an organization. Chapter 3 discusses the BI capability and its building blocks, BI resources, and strategic guidance of the BI efforts in SMEs in more detail. Theoretical part of the study is concluded in chapter 3 by presenting a theoretical framework for BI capability building process. Chapter 4 introduces the research methodology, data collection process, background of the interviewees and data analysis techniques. Chapter 5 presents the findings of the empirical research. Findings are organized into the following themes: (1) SMEs as buyers of BI solutions, (2) BI implementation projects in SMES, (3) BI technology in SMEs, (4) BI human resources in SMEs and (5) strategic guidance of BI in SMEs. Finally, chapter 6 answers the research questions, compares empirical findings with the prior research and concludes the key contributions of the study. Chapter 6 also discusses the limitations of the study and provides suggestions for future research.

2 BUSINESS INTELLIGENCE

Business Intelligence was first mentioned in 1958 when Luhn described a system that utilizes data processing technologies and statistical procedures to automatically abstract and encode documents to support organizational activities (Luhn, 1958). However, even though BI was coined over six decades ago, a clear consensus of its content and scope does not exist. Instead, several different definitions have been proposed – some of them observing BI from a purely technological perspective and some from a more organizational perspective. From the technological perspective, BI can be seen for example as a collection applications, technologies and processes that are used to gather, store, access and analyse data to improve decision-making (Watson, 2009). Other widely accepted technology-driven definition is proposed by Wixom and Watson (2010, p. 14) who define BI as a "broad category of technologies, applications, and processes for gathering, storing, accessing, and analysing data to help its users make better decisions". In practice, BI system usually includes, but is not limited to, the following components: data warehouse, ETL-tool and OLAP utilities (Hwang et al., 2012)

It is inevitable that BI is strongly based on technological factors – without the right tools and technologies, it simply is not possible to benefit from BI. However, several authors have argued that technology itself is not enough to gain benefits from BI (e.g., Yeoh & Koronios, 2010), and therefore, BI should be observed from the organizational perspective. For example, Rouibah and Ould-Ali (2002, p. 133) define BI as "a strategic approach for systematically targeting, tracking, communicating and transforming relevant weak signs into actionable information on which strategic decision-making is based on". Also, Duan and Da Xu (2012) observe BI from an organizational perspective and define it as a transformation process where raw data is turned into useful information to get better strategic and operational insights, and to support decision-making which yields real business benefits. (Duan & Da Xu, 2012)

Based on these observations, BI is both technological and organization concept, and none of them should be neglected. This is supported for example by Petrini and Pozzebon (2009) who argue that even though the definitions of

BI may differ significantly, they still share two basic ideas. Firstly, the core of BI is formed by data gathering, analysis and distribution activities, and secondly, BI should always support strategic decision-making processes. (Petrini & Pozzebon, 2009) Therefore it is important to include both technological and organizational factors in the definition. This is done for example by Chen, Chiang, and Storey (2012) who adopt a holistic perspective on BI and describe business intelligence and analytics (BI&A) as follows:

> [BI&A] is often referred to as the techniques, technologies, systems, practices, methodologies, and applications that analyse critical business data to help an enterprise better understand its business and market and make timely business decisions. In addition to the underlying data processing and analytical technologies, BI&A includes business-centric practices and methodologies that can be applied to various high-impact applications such as e-commerce, market intelligence, e-government, healthcare, and security. (Chen, Chiang & Storey, 2012, p. 1166).

Therefore, adopted from Chen et al. (2012) and Petrini and Pozzebon (2009), this study defines BI as data processing, analysis and distribution techniques, technologies, methodologies, and applications that are combined with business-centric practices and methodologies to support decision-making processes.

2.1 Technological foundation of business intelligence

As discussed earlier, several studies have observed BI from a technical perspective and developed general, high-level definitions, which are applicable for most of the BI tools. For example, according to Wixom and Watson (2010) BI covers technologies, applications and processes that are used to gather, store, access and analyse data. Davies (2002) states that BI includes data acquisition, collation, assessment, and exploitation activities. According to Negash (2004) BI tools aim to improve information quality and accuracy by simplifying information storage, identification, and analysis processes. BI systems combine data from operational systems with analytical frontends to present complex information to support decision making. (Negash, 2004) Popovič, Hackney, Coelho and Jaklič (2012, p. 729) state that BI system is "quality information in well-designed data stores, coupled with business-friendly software tools that provide knowledge workers timely access, effective analysis and intuitive presentation of the right information". All these observations emphasize the data-driven nature of BI and therefore, it can be concluded that the heart of BI is data, while BI tools are just supporting the full exploitation of data.

2.1.1 Technological components of BI systems

To fully understand how organizations exploit data, it is useful to first understand the technologies that are in the background. According to Chen et al.

(2012) the technological foundation of BI is data-warehousing and information management. Data warehouse forms the fundamental infrastructure for saving historical data (Duan & Da Xu, 2012). According to Chaudhuri and Dayal (1997) data warehouses typically include historical and summarized data that can be better utilized in decision making than detailed data in operational databases. Data warehouses typically contain consolidated data from several databases and from several years, or even decades, and therefore they tend to be significantly larger than operational databases. As data warehouses can contain data from several different source systems (Chaudhuri & Dayal, 1997) it is usually necessary to prepare data before storing it for analysis purposes. Therefore, another essential component of data management is extract, transform and load (ETL) tool, which retrieves the data from source system, and integrates, converts, and loads it to data warehouse (Chen et al., 2012).

After the ETL-processing, data is available in data warehouse, and it can be explored and analysed. Data is retrieved from data warehouse usually via queries that can be defined as business questions communicated to data warehouse via BI tools (Sabag & Even, 2011). Typical query to data warehouse is ad hoc and complex, covering up to millions of records. (Chaudhuri & Dayal, 1997) Analysis is typically done by using online-analytical-processing (OLAP) tools. One key feature of OLAP is the multi-dimensionality, which means that interesting data such as sales can be queried according to different combinations of dimensions, such as time of sales, salesperson, or product. (Chaudhuri & Dayal, 1997) For example, an analyst may query the number of sales per product type and customer. Results of the OLAP query are then organized in a multidimensional cube, which is simply an array presenting multiple variables (Sabag & Even, 2011). A typical BI query consists of (1) dimensions which present business entities (such as product name), (2) facts which present numerical metrics (such as number of sales), (3) filters which limit data to a specific sub-set and (4) sorts which organizes the results in a certain order (Sabag & Even, 2011).

After analysis, results must be presented and distributed to users in a visualized and understandable format. Visualization is a process of "displaying encoded data in a visual format that can be perceived by human eyes" (Chung, Chen & Nunamaker, 2005, p. 62). Most OLAP tools have embedded data visualization features, but also additional reporting tools can be used (Chen et al., 2012). Depending on the use case, results can be presented for example in form of a simple report or graph. More advanced visualization techniques cover for example scorecards and interactive dashboards.

2.1.2 Data collection and refinement in BI systems

As observed previously, BI technologies support organizations' efforts to exploit data but are not actually valuable as they are. For example, if data is not available or it is bad quality, BI tools are rather useless. To better understand how data can be utilized, it is necessary to consider data related issues such as data collection strategies, data governance, data integration and data quality related issues before choosing a BI tool.

Ramakrishnan, Jones and Sidorova (2012) have examined different data collection methods. They state that in addition to actual acquirement of data, data collection deals also with providing clean, consistent, high quality and integrated data. They identify two separate data collection methods – (1) comprehensive method in which majority of available data is collected and stored in data warehouse and (2) problem-driven method in which organization collects only limited amount of data to solve a particular business need or problem. They state that data collection strategy can have a significant effect on the successfulness of BI implementation. They gently encourage organizations to consider problem-driven method very carefully as it seems that the comprehensive method is often chosen without reflecting the other possible options. (Ramakrishnan et al., 2012) In other words, organizations should not blindly focus on enabling the access to all data available, but they should carefully consider what kind of information users really need. (IşıK, Jones & Sidorova, 2013)

In addition to understanding users' needs, it is important to understand the types of data that the business environment contains. According to Chen et al. (2012) traditional BI tools are mostly based on structured data which is collected from legacy systems and stored in relational databases. However, the amount of unstructured data is constantly increasing which requires more advanced data analysis methods and technologies such as data mining and web analytics (Chen et al., 2012). Therefore, organizations should understand what kind of data they want to analyse – do they have structured data or is there a need to analyse also unstructured data?

Llave et al. (2018) emphasize the importance of business-driven data governance within BI implementation processes. Data governance deals with data availability, usability, integrity, and security, for example by creating guidelines on how to create, use and dispose data. They emphasize that data governance is a business matter, not an IT matter. (Llave et al., 2018) Data governance ensures that organizations have a control over their data. Organizations should also consider how users access data, and for example IşıK et al. (2013) state that organizations should match BI tools with user types as different users have different needs. Organizations should also consider how they can integrate data provided by different systems (IşıK et al., 2013) to avoid information silos and to gain full benefits from the data available.

Another factor to consider is data quality which refers to the consistency and comprehensiveness of the data (IşıK et al., 2013). By providing timeliness, high-quality and trusted repository of data BI contributes to the overall data quality within an organization (Sidahmed, 2007). Careful selection of the data collection strategies, understanding of users' information needs, business-driven data governance and high-quality integrations contribute to data quality by ensuring that data warehouse includes comprehensive, consistent and timeliness data that is available to the right users, and only for them, and is presented in an understandable format.

2.1.3 Technology as a starting point for BI

From a technological perspective, the core technologies of BI include data warehouses and ETL-tools, OLAP utilities and data visualization tools (e.g., Chen et al., 2012). In addition, an organization must carefully choose their data collection method, understand the types of data they are collecting, take care of data governance and efficiently integrate different systems to ensure high-quality data. However, several studies have shown that technology is only a starting point for BI. For example, Popovič et al. (2012, p. 730) state that "BIS [BI system] in its own right, adds value primarily at the beginning of the information value chain" by supporting the transformation of data into information. Petrini and Pozzebon (2009) observed that the major difficulties in BI implementation have methodological and conceptual nature. They state that seeing BI projects merely as technical projects causes many projects to fail. (Petrini & Pozzebon, 2009) Finally, Elbashir, Collier and Sutton (2011) state that to simply acquire the "state-of-the-art" software is not enough, but an appropriate organizational capability must be developed, too.

Based on these observations it can be concluded that technology and data form the foundation for BI and act as a starting point for data exploitation. This is supported for example by Llave et al. (2018, p. 3) who state that "high-quality BI&A assets are a necessary—but not sufficient—condition for achieving BI&A impacts". To succeed in BI implementation, it is important to see BI as a business-driven concept in which technology has only a supporting role. Organization should carefully evaluate their business needs for BI and then select technologies that best support those needs, not vice versa.

2.2 Business intelligence and organizational aspects

Even though BI has a strong technological foundation, and there is a clear consensus of the main technology components of BI, several authors argue that above all BI is an organizational concept. For example, Rouibah and Ould-Ali (2002) see BI as a strategic approach that supports decision-making by identifying business-relevant information from an organization's environment. According to Duan and Da Xu (2012) business intelligence transforms raw data into useful information which is then used to gain real business benefits as it provides more effective strategic and operational insights and supports decision-making. Ramakrishnan et al. (2012) have identified three general and business-driven purposes for BI - (1) to gain insights, (2) to establish a single version of truth and (3) to enable organizational transformation. Russell, Haddad, Bruni and Granger (2010) suggest that BI's purpose is to reduce uncertainty and provide support for decision making. BI is promised to deliver insights into strengths and weaknesses, market opportunities and threats and to forecast unforeseen events (Russell et al., 2010). These purposes originate themselves from organizational needs and describe the business-driven nature of BI.

To summarize, from an organizational perspective BI is used to capture business-relevant information, such as weaknesses (Rouibah & Ould-Ali, 2002) or strategic insights (Duan & Da Xu, 2012), from organization's environment to enhance organization's operation and decision making. However, it does not make sense to try to catch every single sign from the environment. If the captured information is not relevant for the business, it is useless. Therefore, the identification process should be strategically steered to identify the relevant and useful information.

2.2.1 Strategic alignment of BI

Business intelligence is often used to support organization's strategic efforts. Petrini and Pozzebon (2008) state that strategic decisions relate to the activities that steer the implementation and evaluation of organization's medium- and long-term vision, mission, goals, and objectives. On the other hand, BI can be used to support tactical and operative day-to-day decision making (Petrini & Pozzebon, 2008). Either way, before implementing a BI solution, it is important to understand organization's decision-making environment and business needs. Additionally, an appropriate organizational culture and organizational skills must be developed to fully utilize BI. Without a business-driven approach, the full potential of data and BI cannot be exposed.

IşıK et al. (2013) have studied BI in different decision-making environments and present two extreme ends for them. First environment covers structured and operative decisions which usually are short-term and need detailed and repetitive data. The second environment covers unstructured, strategic decisions which usually are longer-term decisions requiring a broader range of data collected from multiple sources. They argue that different decision-making environments require different approaches to succeed in BI. Their results show that unstructured and strategic decision-making environments usually require more flexibility, which refers to the capability to support decision-making despite the variation in business processes, technologies, or business environments. Strategic decisions require also more risk management, and capabilities to support decision making when some of the facts are unknown. Operative decisions in turn require less flexibility and risk management. (IşıK et al., 2013)

Even though most organizations settle somewhere in between of these two extreme ends (IşıK et al., 2013), and differences may not be that straightforward, organizations should carefully analyse their real information needs, instead of focusing too much on technical aspects (Popovič et al., 2012). Different decisions need different support and therefore, understanding decision types and information needs should be the first step in BI implementation. Based on this analysis, an organization can then develop appropriate organizational capabilities, define information collection strategy (Ramakrishnan et al., 2012) and choose their BI tools and technologies. Understanding one's environment and information needs will help organization to ground its BI efforts in their business. Yeoh and Koronios (2010) argue that from an organizational perspective, one of the critical success factors in BI systems is a clear, strategic

vision and well-established business case which identifies the benefits, resources, risks, costs, and schedule of BI implementation. If a BI system does not align with business vision, it will not meet the business objectives and therefore it satisfies neither business needs nor customers. (Yeoh & Koronios, 2010).

Another factor to consider is organizational culture. Popovič et al. (2012) observed that analytical decision-making culture directly improves the use of information within an organization. Wixom et al., (2011) present that creating an open data culture in which users are encouraged to share data can lead to new and interesting uses of data, thus supporting organization's BI efforts. Finally, Ramakrishnan et al. (2016) state that interactive and collaborative culture empowers the transformation of raw data into more explicit intelligence and enhances employees' capabilities to self-organize their knowledge to facilitate problem solving and innovation. Therefore, organizations should be aware of their culture – if there is not a collaborative, analytical and empowering culture present, BI efforts may need further support, or even cultural changes. This means, that BI tools, data, and even appropriate capabilities will not automatically generate benefits if an organization and its employees do not trust in data. Reports and recommendations gained from the BI system must be also followed to gain benefits from them (Baker & Chasalow, 2015) and if employees do not trust them, they probably will not follow them. On the other hand, if an appropriate culture already exists BI may be more easily and fluently adopted within an organization.

Organizational culture can be enhanced for example via creation or development of an absorptive capability which is "an ability to gather, absorb and leverage new information" (Elbashir et al., 2011, p. 155). Elbashir et al. (2011) argue that BI innovation is driven bottom-up: operative management's capabilities to absorb and leverage new information directly impacts on the BI assimilation whereas top-management's absorptive capabilities have only indirect effect. On the other hand, it has been stated that top-management commitment and sponsorship is even the most important factor in BI implementations as it has a potential to break down the barriers to change, or the 'state-of-mind' within an organization (Yeoh & Koronios, 2010). These conflicting findings reflect the complex and holistic nature of an organizational culture. Top management may be able to initiate the cultural changes and break the reluctant 'state-of-the-mind', but it is as crucial to ensure that also operative level is onboard and feels empowered by the BI.

To conclude, an organization should carefully consider its decision-making environment and decision-making needs – strategic decisions require more flexibility and risk management support whereas operative decision may include less uncertainty but are usually more strictly regulated (IşıK et al., 2013). Organizations must ground their BI efforts in business, not in technology, and understand what they need and how BI can support these needs. Organizational culture can play a significant role in BI implementation as collaborative and analytic culture usually enhances BI adoption and utilization (Popovič et al., 2012; Ramakrishnan, 2016). Commitment of both top and operative manage-

ment play an important role when organizational culture requires adjustments (Elbashir et al., 2011; Yeoh & Koronios, 2010).

2.2.2 Implementation of BI

Prior literature has identified some key factors, that should be considered when implementing BI in an organization. Firstly, Yeoh and Koronios (2010) state that one of the process-related critical success factors in BI implementation is business-centric championship and balanced team composition. Their study shows that BI initiatives should be strongly supported by business, but in addition to business skills, BI team should also have required IT expertise to be able to deal with multiple platforms, interfaces, legacy systems, and tools. It is important to involve business experts in "IT-activities", such as requirements engineering and testing, to develop architecture and data models that represent business users' perception of business objectives and processes. (Yeoh & Koronios, 2010) Also, IşıK's et al. (2013) study shows that to succeed in BI, organizations should pay attention to both technical BI capabilities, such as data quality and integration of BI system with other systems, and organizational BI capabilities, such as abilities to deal with changing processes and technologies. Even though these are not directly BI team's capabilities, the BI team must be capable to handle them both. BI implementation should ground itself to business, but IT competencies should not be neglected – collaborative relationship between IT and business is a crucial factor in BI implementation.

Another factor identified by Yeoh and Koronios (2010) is the importance of a business-driven and iterative development approach. Their study revealed that it is usually better focus on small developments, to deliver quick and measurable improvements. So called big-bang implementations usually involve greater number of risks, and therefore is not a recommended approach for BI implementations. (Yeoh & Koronios, 2010) Similar results were found by Llave et al. (2018) who emphasize the need for iterative and gradual approach in BI implementation process. They presented so called "start small, think big" - approach, in which organization should focus on the things that are easy to deliver to give quick wins to the business, but simultaneously have a complete future vision for BI. (Llave et al., 2018)

Based on these observations, organizations should focus the needs that are most critical, but on the other hand, can be rather easily solved. When the "BI expertise" gradually evolves, organizations can move on to more complex problems. It is important to notice that BI systems differ significantly from traditional information systems, such as online transaction processing (OLTP) -systems, due to their evolving nature (Yeoh & Koronios, 2010). Where OLTP system is rather stable after its implementation, BI system should be able to evolve with the business and its constantly changing needs. Therefore, iterative development approach does not only concern the very beginning of BI implementation, but rather the whole lifecycle of BI solution (Kulkarni, Robles-Flores & Popovič, 2017). Organizations should constantly analyse and prioritize their problems

and consider how BI could help to mitigate them, and BI system should be able to adjust to these needs.

It is crucial that organizations see BI as a holistic concept which requires careful consideration of both technological, strategical and process related factors. BI efforts should be strategically steered, but the actual work happens on the operative level. Organizations should work towards finding a balance between IT and business competencies and focus on small, incremental improvements. It is important to see BI as a constantly evolving system which should be flexible enough to support decision-making even when the organization's needs, technologies, or environment changes (IşıK et al., 2013). As observed by Llave et al. (2018) organizations should adopt "start small, think big" approach on BI to capture the dynamic, constantly evolving nature of BI, and to fluently embed BI in operation, processes, strategy, and culture.

3 ORGANIZATIONAL CAPABILITIES

Capability is a wide concept, which can be used in several contexts and levels, varying from a single human to groups of people, and from organizations to larger populations, such as countries. Cambridge dictionary (n.d.) defines capability simply as "an ability to do something". According to Amit and Schoemaker (1993), in the business and management context capability refers to information-based, firm specific, intangible, or tangible processes that utilize a combination of resources to achieve a desired outcome, such as enhanced productivity or strategic flexibility. Capabilities consist of skills and processes, which transform inputs into outputs with a greater value (Wade & Hulland, 2004). Amit and Schoemaker (1993, p. 35) state that "capabilities are based on developing, carrying, and exchanging information through the firm's human capital". They add that in practice, capabilities can be materialized for example in a form of reliable service, market responsiveness or rapid product development cycles. (Amit & Schoemaker, 1993). Leonard-Barton (1992) argues that if a capability strategically differentiates an organization from others and thus provides a competitive advantage, it is considered as a core capability. Core capabilities include the following four dimensions: (1) employee knowledge and skills, (2) technical systems, (3) managerial systems and (4) values and norms (Leonard-Barton, 1992). Concept of capability can be used to describe organizations skills in various levels and areas. To better understand the concept of BI capability, it is useful to limit the scope from high-level business capabilities to its BI-related sub-categories. As BI is tightly connected to both technological and organizational factors, also BI capability includes characteristics from both IT and business-related capabilities.

3.1 IT capabilities and dynamic capabilities

In the context of information technology (IT), for example Bharadwaj et al. (1999) have studied IT capabilities. They state that IT capability is a combination of

several organizational and technological capabilities that "reflect a firm's overall ability to sustain IT innovation and respond to changing market conditions through focused IT applications." (Bharadwaj et al., 1999, p. 381) Aral and Weill (2007) state that IT capabilities are a combination of competencies and practices. Competencies refer to skills, which consist of employees' IT skills and the quality of organizations IT management, whereas practices refer to routines which consist of IT use culture, digital transactions (or digitalization of operations) and internet architecture, which for example, in case of a retail store could refer to integration of digital and physical stores (Aral & Weill, 2007). Bharadwaj et al. (1999) argue that IT capability reflects organization's abilities in six interrelated categories: (1) partnerships between IT professionals and business users, (2) external IT linkages between the firm and its business partners, (3) business-IT strategic thinking which is an ability to see how IT could bring value to the business, (4) IT-business process integration which is an ability to constantly strive to more effective and efficient business processes, (5) quality of IT management and (6) IT infrastructure which is a technological foundation covering both data, network and processing architectures. (Bharadwaj et al., 1999)

Another widely discussed sub-category of capabilities is dynamic capabilities. According to Eisenhardt and Martin (2000, p. 1107), dynamic capabilities are "the antecedent organizational and strategic routines by which managers alter their resource base … to generate new value-creating strategies". They state that dynamic capabilities are often claimed to be vague and tautological, but in fact they are identifiable and specific processes, which integrate, reconfigure, gain, and release resources (Eisenhardt & Martin, 2000). Winter (2003) emphasizes that the word 'dynamic' refers to change, which can be inferred also from Eisenhardt's and Martin's definition. Winter (2003) compares dynamic capabilities with ordinary, zero-level, capabilities, which are vital for firms to collect revenue and conduct their core business. Dynamic capabilities, in turn, are higher-level capabilities which "extend, modify or create ordinary capabilities" (Winter, 2003, p. 991).

As technological aspects form a foundation for BI, the concept of BI capability can be considered as a sub-category of IT capability. On the other hand, BI capability can be observed from the perspective of dynamic capabilities. This is supported by the discussion in chapter 2.2 where it was observed that BI is often used to capture relevant information from organization's environment, which is then used to enhance operation and decision-making. Additionally, BI is labelled by constantly evolving nature, which supports its positioning under the category of dynamic capabilities. Not all IT capabilities are dynamic capabilities, but as aspects of change and dynamism are often highly relevant in the context of business intelligence, BI capability settles logically among the dynamic capabilities.

3.2 Business intelligence capabilities

According to Kulkarni et al. (2017) BI capability is a special type of IT capability that is used to provide high-quality information and systems to support planning and decision-making, and finally, to achieve a better competitive position. Ramakrishnan et al. (2016, p. 5024) define BI capability as "the ability to mobilize and deploy BI functionalities in combination or co-present with other resources and capabilities". Knabke and Olbrich (2016) adopt a dynamic perspective and define BI capability as an organization's ability to survive in changing business environment by transforming their assets, both BI and organizational, into assets of greater value. Transformation includes for example reconfiguration and management of BI assets, such as BI applications, and other assets, such as people and processes (Knabke & Olbrich, 2016). To summarize, BI capability can be seen as an organization's ability to move towards its goals by utilizing high-quality data and technology to transform its assets into more valuable ones. BI capability is highly interconnected with organizations other capabilities and assets (Ramakrishnan et al., 2016; Knabke & Olbrich, 2016), and therefore it is important to understand organization's capabilities, assets, and resources as a whole. It is crucial to remember that even though BI capability is a sub-category of IT capability (Kulkarni et al., 2017), fundamentally it is a business-driven concept where technological factors are just a fraction of the whole picture.

3.2.1 Sub-categories of BI capability

To understand BI capability more deeply, it can be divided into sub-capabilities which form the overall BI capability. Ramakrishnan et al. (2016) have identified three sub-categories which contribute to BI effectiveness, which is the success or failure of BI within an organization. First capability is BI innovation infrastructure capability, which is an organization's ability to support innovation by BI via the following dimensions: (1) BI technology, which refers to organization's technological readiness to adopt BI, (2) BI culture, which refers to enhancement of data utilization via interactive and collaborative culture and (3) BI structure, which refers to modular organizational design. Second dimension is BI process capabilities, which refers to the ability to support and accommodate customer- and B2B-activities with BI. This dimension includes for example an ability to meet customers' needs, ability to use BI to engage new business partners and improve coordination with existing partners. Third dimension is BI integration capability, which refers to the ability to accommodate BI to organization's systems via acquirement, cleansing and transformation of data. (Ramakrishnan et al., 2016)

Knabke and Olbrich (2016) adopt a dynamic perspective on BI and define three dynamic BI capabilities used to achieve BI agility. First capability is adoption of BI assets, which consists of adoption and configuration of BI technology, BI-personnel education, and BI tools and applications. Second capability,

achieving market understanding and intimacy by using BI, covers the BI-generated knowledge of customers, suppliers, and other external entities. It covers also BI generated knowledge of the organization itself, such as its position and performance in the markets. Third capability, supporting business operations with BI, creates an internal view on the organization and supports planning and execution of primary and auxiliary business processes. Coordination, governance, and other organizational topics are included in all these capabilities. (Knabke and Olbrich, 2016)

Yogev et al. (2012) distinguish between strategic and operative BI capabilities. Strategic BI capability covers for example extensiveness of BI (i.e., how broadly BI system integrates organization's functions and technologies), ability to reach the employees who need BI, and abilities to support decision making by identifying opportunities by using BI. Operative BI capability covers for example information analysis and knowledge creation abilities, collaboration and knowledge sharing between different parts of an organization and information acquirement by using BI system. (Yogev et al., 2012)

Even though these definitions observe BI from slightly different perspectives, they can be rather naturally mapped under three broad categories: (1) technological BI capability, which refers to the establishment of BI infrastructure, (2) strategic BI capability, which refers to the ability use BI to better understand business environment and (3) operative BI capability, which refers to the ability to use BI to support business processes. All BI capability definitions recognize each of these aspects, except Yogev's et al. (2012) definition which does not mention the technological capabilities but instead positions technology under BI assets and resources which act as a starting point for BI capabilities (Yogev et al., 2012). Similar conclusion was made also in this study as technological aspects of BI are seen only as a foundation of BI. However, in the context of BI capability, technology does not only refer to the physical infrastructure, but also for example to organization's abilities to support innovation with BI technology (Ramakrishan et al., 2012). Therefore, similar to Ramakrishnan et al. (2016) and Knabke and Olbrich (2016), this study considers technological BI capability as a sub-category of the general BI capability. Table 1 summarizes the mapping of the definitions.

To summarize, BI capability is a sub-category of both IT and dynamic capabilities and describes organization's abilities to move towards its goals by utilizing BI. To fully exploit BI capability, it is important to integrate BI efforts with other organizational capabilities. BI capability can be divided into three sub-categories: technological BI capability, strategic BI capability, and operative BI capability. These categories describe the nature of BI capability in more detail and reveal how BI capability can be integrated into organizational activities. It is important to notice that these capabilities emerge only after BI has been implemented. For example, to use BI to better understand environment, customers, and competitors (strategic BI capability), BI must be already implemented within an organization. In other words, these capabilities do not explain resources and capabilities an organization should have before it can implement BI and

develop the BI capability. Therefore, the next chapter will elaborate the pre-implementation requirements in more detail.

TABLE 1 Mapping of BI capability definitions

Capability	Examples
Technological BI capabilities: ability to establish the BI infrastructure	• Acquirement, cleansing and transformation of data; technological readiness to adopt BI (Ramakrishnan et al., 2012) • Adoption and configuration of BI technology, BI-personnel education, BI tools and applications (Knabke & Olbrich, 2016)
Strategic BI capabilities: ability to understand business environment via BI	• Interactive and collaborative culture, modular organizational design (Ramakrishnan et al., 2012) • BI generated knowledge of customers, suppliers and other entities, BI generated knowledge of organization's own position and performance in the markets (Knabke & Olbrich, 2016) • Ability to reach employees who need BI (Yogev et al., 2012)
Operative BI capabilities: ability to support business operations via BI	• Ability to meet customer needs, ability to engage new business partners, ability to improve coordination with existing partners (Ramakrishnan et al., 2012) • Ability to support planning and execution of business operations (Knabke & Olbrich, 2016) • Ability to analyse information and create knowledge, organization-wide collaboration (Yogev et al., 2012)

3.2.2 Resources and capabilities that are required to build a BI capability

According to Wade and Hulland (2004) resources are assets and capabilities that are available and can be used to detect and respond to market opportunities or threats. Amit and Schoemaker (1993) define resources as "stocks of available factors that are owned or controlled by the firm" (Amit & Schoemaker, 1993, p. 35). They state that resources consist of knowhow, financial or physical assets and human capital (Amit & Schoemaker, 1993). However, to be exact, Amit and Schoemaker's definition conflicts slightly with Wade and Hulland's definition: Wade and Hulland claim that resources consist of assets and capabilities (i.e., capabilities precede resources), whereas Amit and Schoemaker claim that capability is the capacity to utilize resources (i.e., resources precede capabilities). The relationship of these concepts is clearly blurred which is not alleviated by the existence of several similar concepts such as asset, ability, and competence. This study will adopt Amit and Schoemaker's (1993) definition of resources as antecedents of capabilities and use capabilities as a theoretical lens. In other words, this study maps resources and other similar concepts such as ability and asset under the concept of capability (i.e., capability covers resources, abilities, assets etc.). However, this mapping should not be followed too rigorously as sometimes other capabilities can also contribute to development of

another capability (i.e., capability precede capability). Therefore, this mapping is only suggestive and aims to simplify the terminological complexity.

Yogev et al. (2012) state that the following two assets contribute to BI capability: (1) BI system, which typically includes a data warehouse, ETL-utilities, end-user tools and OLAP-utilities, and (2) BI team that has both technical skills, such as application development and integration skills, and managerial BI skills, which refers to an ability to create an alignment between BI and organizational strategy and processes. (Yogev et al., 2012) Similar classification is presented by Sidahmed (2007), who adopts a resource-based view on BI and classifies BI resources into three categories. First category, BI infrastructure, covers physical systems and hardware, such as data warehouses, data storages, ETL-tools, analytical tools and communication and visualization technologies. Second resource deals with BI human resources, which should be a balanced combination of technical and managerial skills. Finally, there are BI-enabled intangible resources, which are non-financial and non-physical assets, such as knowledge assets and customer information. (Sidahmed, 2007)

Wixom et al. (2011) argue that BI capability is established by (1) high-quality and integrated data, which is easily available to employees, (2) business strategy, which enhances the synergies between business and IT, and (3) BI tools, which are used for querying and reporting data to enable business strategy. Aral's and Weill's (2007) argue that IT resources in general consist of IT assets and IT capabilities. IT assets consists of (1) infrastructure, (2) transactional assets, which automate processes, (3) informational assets, which produce information for example for management, planning and analysis purposes, and finally, (4) strategic assets, which support innovation of new opportunities. IT capabilities consist of competencies, which cover IT skills and IT management quality, and practices, which cover the IT use culture, digital transactions, and internet architecture. Even though Aral and Weill use the expression "capability" to describe the components of IT resources, their definition is rather similar to Yogev et al. (2012) and Sidahmed (2007) definitions of HR-related resources and Sidahmed (2009 definition of intangible assets. Therefore, Aral and Weill's definition is here paralleled with the other definitions, and the terminological contradiction ignored.

As discussed earlier, sometimes other capabilities can contribute to the development of another capability, which is the case also with BI capability. Knabke and Olbrich (2015) present a set of dynamic IS capabilities that are relevant to BI. Firstly, organization and governance describe organization's abilities to manage its BI resources. Secondly, business processes cover all activities which relate to organization product and service offerings. Thirdly, change management and change behaviour observes organization's abilities to handle change. Fourth capability, people and culture describe the organization's "personality". Fifth capability, technology and infrastructure present organization's general hardware and software assets, and how they are used. Finally, IS portfolio and IS architecture define organization's IT applications and their architec-

ture. All these capabilities are needed to survive in turbulent environments, in which BI is often utilized. (Knabke & Olbrich, 2015)

Finally, Baker and Chasalow (2015) identify three organizational capabilities that precede the BI dynamic capability, and the actual use of BI. First capability, organizational processes, covers abilities to sense, learn, coordinate, and integrate. It describes for example organization's ability to understand its environment and recognize market opportunities (organizational sensing) and ability to allocate and mobilize resources, organize, and coordinate activities (organizational coordinating). Second capability is firm's existing IT assets, which consists of IT architecture and information repositories. Third capability is firm history, which is organization's existing market position combined with existing relations with external parties. Organization's future capabilities are dependent on the existing capabilities, and therefore organization's history will constrain and shape the future opportunities, such as strategic alternatives. Especially existing IT and information capabilities will outline the development of dynamic BI capability. (Baker & Chasalow, 2015) Different definitions of BI resources and pre-capabilities are summarized in table 2.

TABLE 2 Resources and capabilities that precede BI capability

Author	**Building blocks of BI capability**
Yogev, Fink & Even, 2012	• BI system • BI team
Sidahmed, 2007	• BI infrastructure • BI human resources • BI enabled intangibles
Aral & Weill, 2007	• Infrastructure assets • Transactional assets • Informational assets • Strategic assets • Competencies • Practices
Wixom, et al., 2011	• Data • Business strategy • BI tools
Knabke & Olbrich, 2015	• Organization and governance • Business processes • Change management and change behaviour • People and culture • Technology and infrastructure • IS portfolio and IS architecture
Baker & Chasalow, 2015	• Organizational processes • Firm IT assets • Firm history

BI has a holistic nature instead of being simply a specific technology or tool (e.g., Yeoh & Koronios, 2010). With respect to this, Yogev's et al. (2012) definition itself is slightly too narrow since it does not incorporate any organizational or

process related factors. On the other hand, Aral's and Weill's (2007) definition is maybe too broad, as it defines IT resources in general. However, some aspects are relevant also in this context, such as infrastructure, informational assets, and competencies. Wixom's et al. (2011) definition includes both technological and strategic resources, but it at least partly neglects the skills and competencies of the employees using BI. Kanbke's and Olbrich's (2015) perspective provide useful insights into the areas that are related to BI capability, but unfortunately, do not explicitly define what is required from these factors.

However, both Baker's and Chasalow's (2015) and Sidahmed's (2007) definitions observe BI capability from holistic perspective, and incorporate technological, organizational, and process-related factors of BI systems (Yeoh & Koronios, 2010). Sidahmed (2007) definition provides insights into concrete resources an organization must have – physical infrastructure, sufficient skills, and non-physical, intangible assets. On the other hand, Baker's and Chasalow's (2015) definition describes firm-specific contextual factors from which an organization starts its BI journey and provides some insights into lower-level organizational capabilities that can be developed in order to improve BI capability. Sidahmed's (2007) and Baker and Chasalow's (2015) definitions will be used in this study to define the concrete resources an organization must have, and to understand firm-specific contextual factors which either speed up or hinder the development of BI capability. For example, if organization has old IT infrastructure and bad quality data, it might be more difficult to achieve technological BI capability than if the IT systems are modern and support the analysis and reporting needs. On the other hand, if organization has skills and processes to observe and draw conclusions from its environment, adopting BI skills is a natural continuum to it, meaning that strategic BI capability can be adopted with less effort. Figure 1 illustrates this relationship.

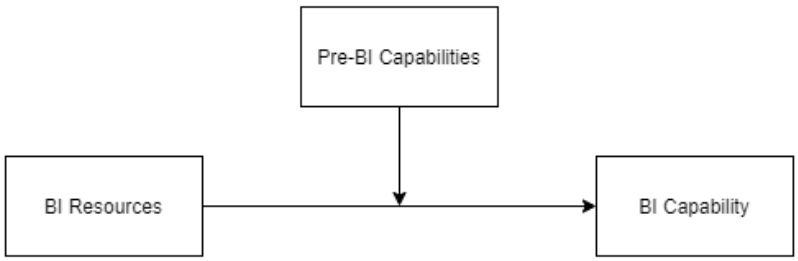

FIGURE 1 Moderating effect of pre-BI capabilities between BI resources and BI capability

3.2.3 Strategic guidance of BI implementation activities

To simply have the resources and capabilities available for implementing and utilizing BI is not enough. Even if an organization could generate high-quality reports with their BI system these efforts are useless if nothing changes in the operation of the organization. Reports and recommendations generated from the BI system must be followed to gain benefits from them (Baker & Chasalow,

2015) and therefore, it is important to strategically guide BI efforts and activities. Llave et al. (2018) suggest several activities that contribute to organization's efforts to transform BI and Analytics (BI&A) investments into BI&A assets. An organization should form a BI&A strategy, select a suitable organizational structure for the BI&A strategy, select right projects for BI&A activities and manage them effectively. In addition, their results show that it is crucial to take care of data quality by creating and maintaining a business-driven data governance. Via these strategic efforts, organizations can identify "which data they want to use, which decisions they should get support for, and how to turn data into valuable information" (Llave et al. 2018, p. 2-3).

Another option to strategically guide BI efforts is to utilize Yeoh's and Koronios' (2010) framework of critical success factors (CFSs) for BI system implementation. It consists of three dimensions - (1) organizational CFSs, such as well-established business case, (2) process related CFSs, such as business-driven and iterative development approach and (3) technological CFSs such as sustainable data quality. Hallikainen, Merisalo-Rantanen, Syväniemi and Marjanovic (2012) mention also several CFSs for BI, such as a well-defined project scope, business-driven project lead and executive sponsorship. In addition, based on their results they identified some "lessons-learnt" -guidelines. For example, the role of BI shadow community (i.e., employees who are exited of BI and promote its use to others) was significant, even more important than anything else, in disseminating BI thinking. It was also important to give employees enough time to adapt to the change and thus gradually, via small innovations, develop the "mental model" of BI thinking. Also, to demonstrate the business value of BI organizations should focus on business process improvements. (Hallikainen et al., 2012) Table 3 summarizes the strategic efforts guiding the BI implementation process.

As BI related studies are often carried out in large companies and the needs of SMEs can differ significantly from the needs of large companies, some of these strategic guidelines and CFSs are not applicable in the context of SMEs. For example, Scholz et al., (2010) pointed out that the top management support may be a necessary condition for a successful BI implementation in large companies, but in SMEs top management is usually the one that decides on IT issues (Scholz et al. 2010) and therefore, the decision to implement BI probably means that top management is already supporting the BI project. In that sense, as Llave's et al. (2018) study is conducted in SMEs their recommendations are directly applicable also in the context of this study.

As Yeoh's and Koronios' (2010) and Hallikainen's et al., (2012) studies are conducted in large organizations, their guidelines are not directly applicable. However, they provide some high-level insights that can be applied also in SMEs. Firstly, both emphasize the gradual and iterative development approach that focuses on delivering "quick wins" to the business. Secondly, all studies, including Llave's et al., (2018), highlight the business-driven approach to BI implementation, which can be set as a general guideline also for SMEs. Hallikainen's et al. (2012) concept of "shadow communities" could also benefit

SMEs – if there are employees who are truly exited of BI, they may be able to propagate their enthusiasm also to others. Due to smaller size of SMES, disseminating excitement, or BI thinking (Hallikainen et al., 2012), may be even easier than in large organizations. However, this may also work in opposite direction – if there are people who aggressively resist BI, they may easily propagate resistance. Therefore, change management, or at least the awareness of the "mindset" of the organization, is essential also for SMEs.

TABLE 3 Strategic efforts that guide BI implementation

Author	Strategic efforts that guide BI implementation
Llave et al., 2018	• Formulate BI&A strategy • Select appropriate organizational structures for BI&A strategy • Select right BI&A projects • Manage BI&A projects effectively • Risk management • Investments in sales and operation planning • Data governance • "Start small, think big"
Yeoh & Koronios, 2010	• Committed management support and sponsorship • A clear vision and a well-established business case • Business-centric championship and a balanced team composition • Business-driven and iterative development approach • User-oriented change management • Business-driven, scalable, and flexible technical framework • Sustainable data quality and integrity
Hallikainen et al., 2012	• BI shadow communities (BI enthusiasts) • Enough time to adapt and gradual development of BI thinking • Focus on business process improvements

3.3 Theoretical framework: building a BI capability for SMEs

SMEs usually have fewer financial resources, IT assets and competencies than large companies (Llave et al., 2018), which may be why BI systems are more popular in large companies than in SMEs (Llave, 2017). This, however, does not mean that SMEs could not generate benefits from BI. For example, Scholz et al. (2010) observed that BI can result improvements in data quality and decision-making, and savings in costs and resources also in SMEs. This study aims to extend this knowledge and will focus on SMEs instead of larger companies. According to European Union's (2003) an enterprise is considered as small and medium sized enterprise if the following conditions are true: (1) an enterprise employs less than 250 persons and (2) an annual turnover does not exceed EUR 50 million AND/OR an annual balance sheet does not exceed EUR 43 million.

Llave et al. (2018) have studied how BI&A (BI & Analytics) creates value in SMEs and present a three-phase framework for BI&A value creation (figure 2) First phase, "The BI&A Conversion Process", describes how BI&A investments

are converted into BI&A assets. Conversion process is guided via strategic activities (see table 3) such as BI&A strategy formulation and project management (Llave et al., 2018). In Llave's et al. (2018) research BI&A investments refer to physical technology infrastructure, human resources, and management. In this study these factors are referred as BI resources (BI infrastructure, BI human resources, BI intangible assets) instead of investments. Unfortunately, Llave's et al. (2018) study does not explicitly define what is meant by BI asset. However, Trieu (2017), whose model is the foundation of Llave's et al. (2018) model, defines BI assets as BI technology, human resources, and application portfolios. This definition is very similar to the definition of BI&A investments and therefore, this study aims to differentiate these steps more clearly by paralleling BI&A assets to BI capabilities. This is supported for example by Yogev et al., (2012) who argue that BI capabilities are the mediating factor between resources and business value, which is also applicable to Llave's et al. (2018) definition which posits BI&A assets between BI&A investments and BI&A impacts.

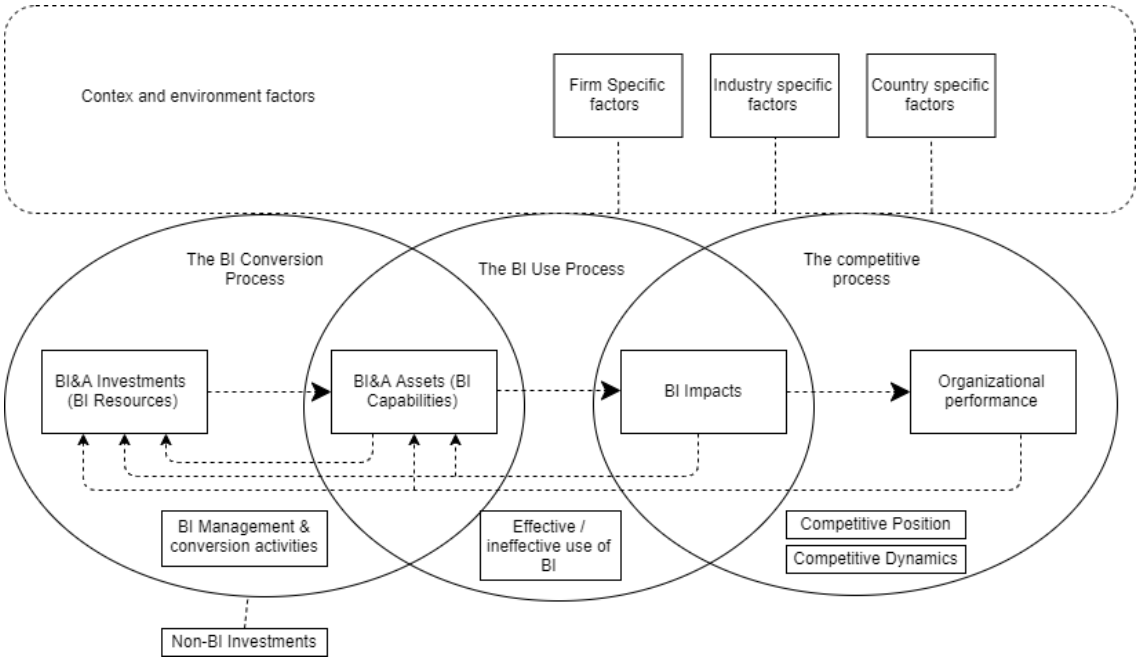

FIGURE 2 Framework for BI & Analytics value creation (adopted from Llave et al., 2018)

According to Llave et al. (2018) second phase, "The BI&A use process", describes how BI&A assets are turned into BI&A impacts, which refers to achievement of a desired outcome such as improved operational efficiency or improved products or services. In this phase, transformation happens via effective use of BI. In the last phase, BI&A impacts are turned into organizational performance in a phase called "the competitive process". Organizational performance refers to "successful goal accomplishment, satisfaction of constituents, and the ability to obtain valued inputs from scarce resources" (Llave et al., 2018, p. 4) Llave et al., (2018) state that factors affecting on improvements of the organizational performance are organization's competitive position and competi-

tive dynamics. In addition, firm, industry, and country specific factors can speed up or hinder the transformation process in this and previous phase (from BI&A assets to BI&A impacts). As the value-creation rarely is a linear process, it is possible to iterate between steps. (Llave et al., 2018)

Llave's et al. framework incorporates both resources (originally referred as BI investments), strategic activities and capabilities (originally referred as BI assets). In addition, even though Llave's et al. (2018) framework originally describes how BI&A creates value, it also simultaneously illustrates the BI capability building process from BI&A investments (BI resources) via BI assets (BI capabilities) into BI impacts. Last phase, "the competitive process", completes process from impacts into business value. However, as the present study is mainly interested on the building process, the last phase is irrelevant in this context. In terms of simplicity, also context and environment factors are considered irrelevant as they are mostly part of value-creation phase. Therefore, by adjusting terminology, making some simplifications, and omitting the last phase ("the competitive process"), framework nicely summarizes the theoretical observations of this study and forms the theoretical foundation for the empirical part. Simplified and adjusted version of Llave's et al. framework is presented in the figure 3.

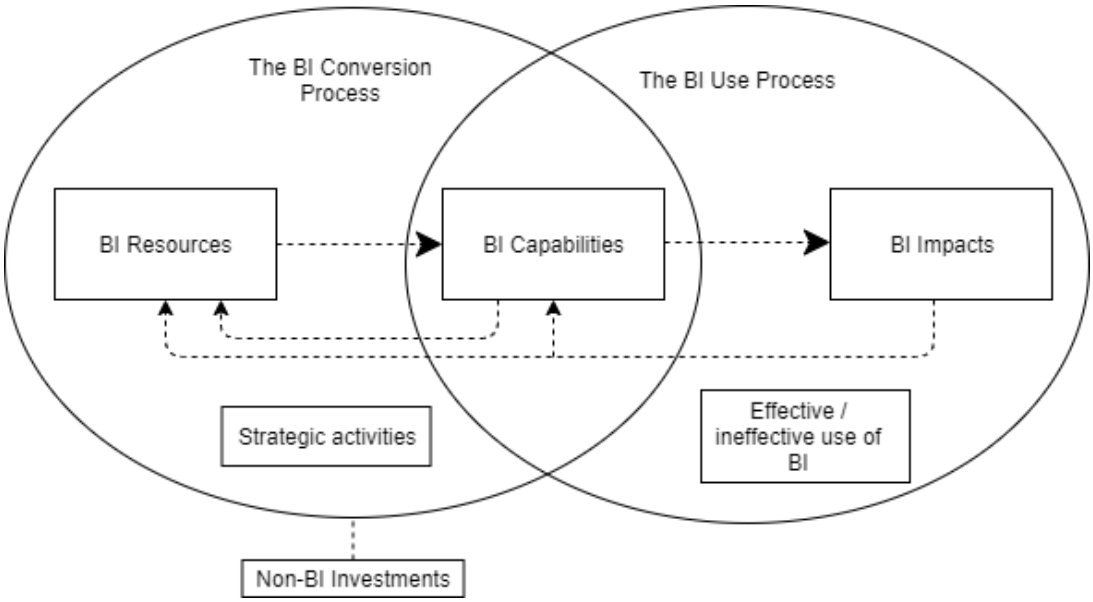

FIGURE 3 Framework for the BI capability building process

4 METHODOLOGY

Empirical part of the present study aims to shed light on the formation of BI capabilities in SMEs by answering the research question "How can BI capability be built in SMEs?" and its supportive questions "What kind of resources are required from SMEs to build a BI capability?" and "What kind of strategic efforts are required from SMEs to build a BI capability?" To achieve this, qualitative approach was selected as a research methodology and theme interview as data collection method. After data collection, interview data was analysed using content analysis. This chapter will present the research methodology, data collection method and analysis techniques in more detail.

4.1 Data collection methods

Hirsijärvi and Hurme (2008, p. 58-59) state that qualitative studies aim to deepen the understanding of certain events, to get more information of some specific phenomenon or to find new theoretical perspectives. Statistical generalizations are seldom in the scope of qualitative studies. (Hirsijärvi & Hurme, 2008, p. 58-59) As most of the BI related studies are conducted in large companies (Llave, 2017) and there is not yet extensive knowledge on how BI is implemented in SMEs, it is important to continue shedding light on this topic to better understand the possibilities and requirements of BI in SMEs. Due to limited amount of prior theoretical knowledge, it would be rather challenging to form exact hypotheses and draw statistical generalizations of BI utilization in SMEs, and therefore, qualitative approach was chosen as a research methodology.

The most common data collection methods in qualitative research are interviews, questionnaires, observation, and analysis of different documents. (Tuomi & Sarajärvi, 2018) Observation of real-world BI projects would be an efficient way to shed light on the phenomenon under interest, but due to limitations in resources and time, this method had to be omitted. Another efficient method would be to discuss with professionals that have experience from BI-

implementations in SMEs and thus, try to seek commons structures and confluences from their experiences. Through the direct interaction with the research participant, interviews empower the generation of rich data, which can be further turned into a large set of new ideas and insights (Schultze & Avital, 2011). Therefore, interview was chosen as a research method. It is the most used data gathering tool in qualitative research (Myers & Newman, 2007) and one of the greatest benefits of interview as a data collection method is the flexibility and interactivity of a research situation: it allows the researcher to repeat questions, correct misunderstandings and make clarification to questions. (Tuomi & Sarajärvi, 2018)

According to Tuomi and Sarajärvi (2018) interviews can be categorized based on their structural differences. Structured interviews usually consist of pre-determined questions and answer options and suit particularly well to hypotheses testing. Therefore, they are mostly used in quantitative studies. Semi-structured, or theme interview consists of pre-determined themes and elaborative questions, that reflect the theoretical framework of the study. Theme interview gives a lot of flexibility to interviewer, as it is possible to deepen the level of discussion based on interviewee's answers. Depending on the research arrangements, it might also be possible to leave out, change the order and rephrase the questions during the interview. Finally, unstructured interview is a discussion-like situation, where interviewer builds the whole interview based on the interviewee's answers. (Tuomi & Sarajärvi, 2018) As BI utilization in SMEs is not yet very well-known area, drawing precise hypotheses from the previous literature is not possible, which excludes the structured interview from the scope of data collection methods. However, previous research still reveals some general ground rules, which can be used as a starting point in the interview and therefore, theme interview was chosen as a data collection method for this study.

Empirical part of this study aims to clarify how BI solutions are implemented in SMEs, what kind of resources are needed to build a BI capability and what kind of strategic efforts are required from SMEs to build a BI capability. As literature presented in the previous chapters was able to shed some light to these topics, it has been used as a starting point for the themes of the semi-structured interviews. Interviews have the following six general themes: (1) background information, (2) typical BI implementation projects in SMEs, 3) BI technologies in SMEs, 4) BI skills in SMEs, 5) Strategic guidance of BI in SMEs, and 6) Best Practices and Lessons Learned. Additionally, each theme has a set of supportive questions that help to elaborate the theme more specifically. Goal of the data collection is to discuss each theme with each interviewee, but emphasis may vary depending on the background of interviewee and a general flow of discussion. Supportive questions can be used if needed, but it is not necessary. Additionally, if new interesting questions arise during the interview, they can be freely taken up, without limiting discussion to pre-determined questions.

Myers and Newman (2007, p. 5) state that "when used to its full potential, the qualitative interview is a very powerful data gathering technique". Howev-

er, they emphasize that it is important to also consider its challenges and pitfalls such as the artificiality of the interview, lack of trust and time, level of entry, elite bias, construction of knowledge and ambiguity of language. (Myers & Newman, 2007) Some of these challenges are also relevant for this study. Firstly, artificiality of interview and lack of trust, that are common challenges in any interview-based study, are relevant for this study as well. The qualitative interview is an artificial situation, which requires interaction with a stranger and from interviewee's perspective, presenting or creating opinions under a time pressure. (Myers & Newman, 2007) The awkwardness of the situation might generate a lack of trust and reserve towards the interviewer. Even though the topic of the present study does not involve discussion of sensitive topics, the risks related to artificiality are still real. This challenge is mitigated by sending the interview questions to interviewees before the interviews, so that they can familiarize themselves with the topics in advance. Additionally, aim is to create a neutral and relaxed atmosphere during the interview. For example, before starting the interview interviewer explains the idea of theme interview and clarifies that different themes can be emphasized according to interviewee's preferences. For example, if someone is nervous about a specific theme, it can be clarified that this topic can be discussed only on a high-level, and other themes then in more detail, which might ease the situation.

Second potential risk is Elite Bias, which refers to situation where interviews are focused only on senior and other high-profile employees, due to which study might fail understanding the broader picture (Myers & Newman, 2007). The present study aims to answer research questions via discussion with experienced BI-professionals who have gained experience from implementing BI in SMEs. These employees tend to be managers and senior experts, which might reinforce the elite bias. However, after careful consideration, this was not deemed to be a showstopper, as interviewees come from different organizations and with different backgrounds, which enables getting a broader picture of the topic even though they all would be managers or senior employees.

Finally, the most significant pitfall of this study is Construction of Knowledge, which according to Myers and Newman (2007) means the formation of a "believable story" during the interview, when interviewee reacts to interviewer, and is required to reflect things that they might never have explicitly thought before. This means, that the information gathered during the interview has not explicitly existed beforehand, but instead, is formulated during the interview. This risk applies especially to novel researchers, for whom it might be challenging to notice the process of knowledge construction. (Myers & Newman, 2007) As the present study is a master's thesis, and researcher's first interview study, challenge of knowledge construction is present, and probably cannot be fully avoided. However, it is mitigated by a careful familiarization with the theory of interviews, careful preparation of interviews, using neutral and plain language during the interviews, and avoiding making too broad generalizations during the interviews. Additionally, transcript of the interview re-

cording was sent to interviewees afterwards, which gave them opportunity to check the discussion afterwards, and present corrections if needed.

4.2 Execution of interviews

Data was collected by interviewing companies that had experience on providing BI solutions to small and medium sized enterprises. As the goal of qualitative study is not to generalize, but to better understand certain events, to get more information of some specific phenomenon or to find new theoretical perspectives, it is justified to use discretionary sampling (Hirsijärvi & Hurme, 2008, p.58-59). Therefore, interviewees were chosen based on the extensiveness of their knowledge and experiences. Potential companies were searched online. As most of the companies had customer references on their web page, it was possible to infer, which companies had experience on smaller companies. If a specific company's experience on SMEs was unclear, it was separately confirmed before scheduling an interview. Potential companies were contacted via e-mail or their web pages, and interviews scheduled with each interested company. In total 11 companies were contacted from which six were willing to participate. Four of the contacted companies did not reply and one of them was found unsuitable for the study as they provide services only for large companies. Interviews were scheduled with suitable companies based on interviewee's availability. Themes and example questions were sent to interviewees about a week before the interview session.

Interviews were conducted in the spring 2020. Two first interviews were conducted face-to-face, but due to the COVID19 restrictions, the remaining four interviews were conducted remotely, via Teams-technology. One hour was booked for each interview, and durations varied between 48 minutes and 62 minutes, average duration being 55 minutes. To ensure the reliability of interview data, all interviews were recorded using phone's in-built recorder. Recordings were transcribed word-to-word with text-editing program within 1-2 weeks from the interview. After that, transcript was sent to each interviewee for reviewing and commenting. All interviewees confirmed that they have received the transcript, but none of them wanted to adjust or correct the interview data afterwards.

4.3 Background of interviewees

In total six BI-professionals from different companies were interviewed. Roles of the interviewees varied from CEO and Sales Managers to BI consultants and developers. All interviewees have several years of experience from BI, from three years up to 20 years. Companies represented by the interviewees all hit the SME category in terms of turnover and number of employees: turnover

ranged from less than 1 million to 10 million, and the number of employees from three to 75 people. Three of the companies focus purely on BI and analytics solutions, while three of them also offer other IT services. All companies offer BI consulting services, including for example requirements specification, implementation, and support. In addition, two companies also have capabilities for advanced analytics and artificial intelligence. Companies have different focus areas in their customer base, but all of them offer services also to smaller companies. In principle, however, customers are companies with a turnover of at least 10-20 million Euros.

4.4 Analysis techniques

In general, analysis techniques can be divided into deductive and inductive reasoning. Deductive technique proceeds from general observations towards details, meaning that prior theoretical findings form a strong base and hypothesis for the study. Inductive technique, on the other hand, aims to generalize specific empirical observations to theory. In addition to these two extreme ends, there is also abductive technique, which is a mixture of the deductive and inductive approach and is suitable when empirical observations as based on a general theoretical idea, or a "theoretical clue". (Tuomi & Sarajärvi, 2018) As applicability of BI is not extensively studied in SMEs but there are still some theoretical observations available, abductive approach was selected as an analysis technique for this study. Thus, theoretical ideas, including for example BI resources presented by Sidahmed (2007) as well as Llave's et. al (2018) framework for BI value creation in SMEs, are used as a starting point for this study, while still leaving space for new findings and observations.

Content analysis is a general, well-known, and much used analysis technique in qualitative studies (Tuomi & Sarajärvi, 2018), and will be used also in this study. According to Tuomi and Sarajärvi (2018) content analysis can be divided into three broad phases. Firstly, author must decide the subject of interest and separate the interesting information from the rest of the material. Secondly, author should cluster the material, by looking for similarities and differences from the material, and grouping similar concepts together. These groups form the sub-categories that can be further combined into broader categories. Finally, author should conceptualize the material, which means the formulation of the theoretical concepts from the clustered material. (Tuomi & Sarajärvi, 2018) The data analysis was started in accordance with phase 1 described by Tuomi and Sarajärvi (2018), by crystallizing the areas for which information is useful for answering research questions before going through the data. The data was then carefully read through several times, after which the points that answer the research questions or are otherwise useful, were separated by color-coding them. These items were collected in Excel, where each expression extracted from raw data was given an ID so that at a later stage of the analysis it would be possible to return to the original expression. The raw text was then reduced, meaning

that each extracted expression was summarized in own words, while taking care that it was not changed, and nothing was omitted.

In accordance with phase two described by Tuomi and Sarajärvi (2018), material was analyzed in a data-driven manner by color coding expressions that were related together. On this basis, a total of 33 categories were formed, each containing 6-14 reduced expressions, with an average of 9.9 expressions per category. The categories were then iterated several times, resulting in merging, and dividing some categories. Goal was to find categories that are relevant to answer the research questions. In accordance with phase 3 described by Tuomi and Sarajärvi (2018) categorization was continued by classifying the detailed categories into 10 high-level categories, which answer the research questions. Analysis was continued by comparing these purely data-driven categories with the interview themes that had been formed based on the theory. Based on this comparison, five theory-compatible themes were formed, complemented by novel ideas from empirical data. These themes are as follows: (1) SMEs as buyers of BI solutions, (2) BI implementation projects in SMEs, (3) BI technology in SMEs, (4) BI human resources in SMEs and (5) Strategic Guidance of BI in SMEs. Each of the five themes contains sub-categories, and each of them contain summarized expressions formed in phase 1. Each category, subcategory and summarized expression can be easily traced back to the original expression based on the ID given in phase 1, which increases the reliability of the study. Finally, results were formalized into a written report, meaning the chapter 5 (Findings) and 6 (Discussion) of the present research.

5 FINDINGS

This chapter presents the results of the data collection and theme interviews. Interviewees were BI professionals who have experience from implementing BI in SMEs and represent the vendor's perspective on BI implementation. Therefore, the word 'vendor' used in chapters 5 and 6 refers to an organization that provides BI consultancy services, such as requirement analysis, implementation projects, support, and training. The word 'customer' refers to an SME buying BI consultancy services from the vendor. This chapter is divided into five themes that discuss the different aspects of BI projects and BI capabilities. Chapter 5.1 discusses the special characteristics of SMEs as buyers of BI solutions. Chapter 5.2 describes the BI implementation projects in SMEs. Chapter 5.3 represents the findings related to BI technology and data. Chapter 5.4 describes the human resources and skills required to benefit from BI. Finally, chapter 5.5. discusses the findings related to strategic guidance of BI in SMEs.

5.1 SMEs as buyers of BI solutions

Interview data reveals some special characteristics of SMEs, that should be taken into consideration when starting to build a BI capability in SME. These include the limitations in financial and other resources and challenges caused by these limitations, strong urge to focus on running the operative business, impact of the industry on the BI needs and impact of individual employees to organization's overall interest towards BI. Based on the interviews, SMEs have a rather good understanding of the BI, but need support with putting BI into practice. Finally, it can be concluded that financial and sales reporting in a form of descriptive analytics is the most natural starting point for BI in SMEs.

5.1.1 Characteristics of SMEs

SMEs usually have limited amount of financial and other types of resources available for BI, or generally for anything else that is not part of their core busi-

ness. To survive in the markets, they must focus on running their operative business and managing everyday challenges. Moreover, small companies are often privately owned, which makes the financial situation even more vulnerable. As one of the interviewees stated, life in the SME sector is often quite tough.

> "They [SMEs] fight with the basics questions like do they have enough sales, or do they have enough money in the bank. – – Life in SME-sector is quite tough. Many of the companies are privately owned and there are not a lot of funds available. Owners have pledged their houses and other personal assets as security for the company. – – If everything goes wrong, there is no one to provide financial support to owners"
>
> Interviewee 1

Due to limited resources, SMEs quite rarely invest in consulting services, and if they do, investment must directly support their core business. SMEs rarely have wild visions for BI, but instead very practical business-driven needs. Unlike large companies, SMEs cannot afford experimenting with BI or analytics.

> "Biggest difference between SMEs and large companies is that SMEs cannot afford experiments. For a large company – – it is not an issue to invest 50000 Euros or even 100000 Euros just for an experiment. They can try if they could benefit from a certain type of analytics and test it out with a pilot. SMEs cannot afford experiments like this. All BI they buy must directly support their business."
>
> Interviewee 5

Many interviewees pointed out that industry has a greater impact on the BI needs than the size or turnover of the company. In some industries data and BI are a crucial part of the business, and in some industries, companies rarely think how they could benefit from data and BI. One of the interviewees explained that there can be a relatively small company, which operate in a data-intensive business, software development or marketing for example, and therefore, has rather sophisticated needs for BI. On the other hand, there can be a fairly big company such as a car repair shop, whose BI needs are on a lot rougher level, for example they only want to have high-level sales KPIs and a rough estimate of the future sales.

Another special characteristic of SMEs is the impact of individual employees on organization's decisions and overall culture. In SMEs all employees typically know each other and interact on a daily basis, which is why managers and other employees can significantly affect company's interest towards BI. Some managers tend to focus on their core skills and running the business, and do not care about BI. On the other hand, some managers constantly think how they could increase the efficiency of their company, and therefore are more inclined to explore BI.

Majority of interviewees pointed out that despite of the limited resources, SME's knowledge about BI is nowadays rather good. They understand the business-driven nature of BI and know that mere technology will not fix any

problems. However, their knowledge of BI might still be superficial. Many smaller companies seem to know that BI is beneficial and important, but struggle understanding how it can be put into practice, what it requires from them and how it affects to organization's operations and culture. However, at this point it is worth noticing that BI vendors might have a bit biased impression of the knowledge of SMEs. As one of the interviewees pointed out, only companies that are interested of the BI will order BI projects, and the rest will continue with the old course of action and never appear in sight of BI vendors. Knowledge level of all SMEs in general, including the ones that never have ordered BI project, might therefore be a bit weaker.

Why then would an organization not be interested in BI? Reason can be for example heavy reliance on "gut feeling" and distrust of the data. It is also possible that company has an existing BI-system that is not suitable for their purposes, which is why they have an impression that all BI systems are useless. On the other hand, it is possible that organization genuinely does not have a need for BI. For example, if an organization is very small, it is possible that personnel have accurate knowledge of the operation even without data and BI.

> "The smaller the company the higher is the possibility that personnel have an accurate overall view of the operation. However, if volume of the operation starts to grow, and company gets more branches and personnel, no one can anymore have an accurate view of the business, unless there is data. Necessity of data grows as the volume of the operation grows".
>
> Interviewee 4

5.1.2 Typical BI solutions in SMEs

Five out of six interviewees agreed that the most natural starting point for BI is finance and sales reporting. It is vital to any company who wants their business to be profitable. Moreover, finance and sales data are created "automatically" from the orders, purchases, invoices and other financial documents, and therefore it usually exists already before any BI solution has been implemented. Compared for example to production data, finance data can be rather effortlessly utilized in reporting, and therefore is a natural starting point for BI.

> "Things that every company needs, including SMEs, are of course the finance reporting and finance KPIs. And the more accurate, the better. Another example is sales… How much has been sold? Who has sold? Profitability of sales, costs of sales and so on. All this kind of sales KPIs, and even the predictability of sales, are things which, according to my experiences, SMEs need and from which they are interested in"
>
> Interviewee 5

On the other hand, as one of the interviewees pointed out, finance and sales reporting is so vital to organizations that this capability might already exist. Finance software often provide their own reports, which is why SMEs might

not need support with finance and sales reporting, but rather with other areas, such as marketing, logistics or production.

Many interviewees stated that majority of BI solutions in SMEs are usually in the area of descriptive analytics, meaning the reporting with historical data. Some SMEs are of course interested of more advanced analytics solutions, such as predictive analytics. However, implementation of advanced analytics solutions requires special capabilities from both data and company itself, which rarely exist before basic BI capability is built. SMEs might not, for example, have enough data to do predictions. Moreover, price of this kind of solution may prove to be overly expensive for SMEs, which is why SMEs tend to remain in the area of descriptive analytics.

5.2 BI implementation projects in SMEs

This chapter discusses the BI implementation projects in SMEs and their special characteristics. Firstly, before SME even begins to consider investing in BI, they must have recognized a specific need or challenge they think could be solved with BI. These needs can arise from different areas of business, such as technology, business, or personnel. After recognition of BI need and decision to invest in BI, a BI implementation project can start. Special characteristics of BI projects in SMEs are a short duration, light-weight resourcing, and preference to agile methods. BI project is started by writing a high-level technical specification and selecting a suitable technology, after which vendor starts to implement the BI system. To run the project successfully active communication, easy status tracking and documentation of design decisions are important. SMEs can prepare for BI project by ensuring the sufficient commitment of the management, condition of the source systems and availability of the key personnel resources.

5.2.1 Emergence and acknowledgement of BI need

Before the BI project itself can begin, a specific need for BI must have emerged in SME. BI need might be strategic or operative, or mixture of them, but it must exist, and SME must recognize the need, before they are able to consider implementing BI. Majority of interviewees stated that the BI needs of SMEs are usually quite simple and concrete. Often, the aim is to understand overall situation better.

BI needs might emerge in different areas of the organization. Needs might be technical, such as the technical challenges caused by the increasing number of source systems or increasing amount of data, lack of technical skills, insufficiency of the current, for example Excel-based reporting, or a fear that the current reporting solution will fall apart.

> "There might be some existing solution, which unfortunately in quite many companies is one, single Excel stored somewhere in the cloud. – – All data is stored in that

> one Excel, and everyone is using it at the same time, and it is just very impractical. – – They would like to get it in a user-friendly and centralized format, so that it is easy to use and easy to find. – – They want to get rid of the fear that one day their Excel will fall apart, and they lose all their data."
>
> Interviewee 6

As data is in the heart of BI, BI need can also originate from the data-related challenges. For example, organization might have noticed that the quality of their data is insufficient and want to address that. There can also be challenges in getting the data: they might not get the data they need at all, or then the data they get from source systems is simply not sufficient.

Organization might also recognize business-driven needs for BI. They might have a concrete pain point, or a formalized reporting need, which they know can be solved with BI. Organizations might aim to get more visibility and transparency to their business. They might have understood that BI can solve business-critical gaps in knowledge and want to harness their data for more efficient use. For example, organization might have recognized a need to use and understand their sales data better in order to eliminate unprofitable products and plan future sales more efficiently.

> "One example I often mention due to its concreteness is that an organization has its realized sales in one system. – – Then they have budgeted sales in some other system, but they cannot compare realized and budgeted sales except from two separate screens. Need is often very concrete and simple: they want to analyze sales data so that they can see historical data about who has sold, what he has sold, which part of the sales if profitable and so on, and then easily compare with budgeted sales to analyze how they have done against their plan."
>
> Interviewee 4

A need to streamline the work can also push organization towards BI. Organization might have noticed that they could reduce the amount of manual work, which is usually very time-consuming and prone to errors. Data might be available in different sources, and in order to analyze data, user has to login to separate systems and compare data manually from different screens. Organization might want to have a more user-friendly reporting tool, or they want to make reporting more efficient, for example by automizing the data collection:

> "They [SMEs] might notice that the structuration of work is not sensible. I just had a call with a company that has a financial manager whose monthly salary is about 10.000 Euros. This financial manager uses four days per month for preparing Excels. He collects the data and makes Excels. It is about 15% of his working hours. This is one typical reason - rationality of the work."
>
> Interviewee 2

Finally, BI need might rise from organization's personnel. Organization might recognize that their current reporting knowledge has centered around one person, which causes a significant risk for the organization: what happens if this person changes the company or retires? How will the organization be able to manage their reporting after that? Organization might want to mitigate this risk by making their reporting solution clearer and by expanding the knowledge to a larger group of people. It is also possible, that organization wants to shift reporting responsibilities towards end users, and away from key users, so that key users can focus to tasks that are more business-critical, than preparing reports and data to end users.

> "There is always that one technical guy who operates the whole reporting solution and they [SMEs] would like to mitigate this. There have been cases where company has an employee close to the retirement age, who has operated the whole reporting and data collection solution for the past 30 years. They realize that this person will not be there forever, which is why it would be nice to have a renewed reporting solution, so that the whole business won't stop when this one person retires."
>
> Interviewee 6

Table 4 summarizes the examples of BI-needs. As discussed, BI need might emerge in variety of areas. As one of the interviewees pointed out, nature of the need can depend on who has noticed it – management typically pays attention to strategic aspects, whereas IT personnel, for example, has tendency to notice technical challenges. However, many of the interviewees emphasized that it is extremely important that management recognizes the business benefits of BI, such as streamlining of the work and better data quality, even if the need itself originates from technical issues.

Majority of interviewees stated that from their perspective BI project typically starts when SME contacts them with a specific need. It is not typical that SME contacts vendor with unclear or ambiguous requirements - they always have something in their mind. Vendor can help them to crystallize the need, but initial idea must have originated within SME. One of the interviewees summarized why it is important that BI need is recognized by the SME itself, and why vendor cannot usually help with ambiguous needs:

> "Customers who are still thinking what they should do with BI and what they need… From our perspective this kind of customers are not very interesting, because they rarely buy anything. Without deeply familiarizing yourself with the company, it is quite difficult from the outside to tell what this company in particular should measure, and what would benefit them. – – In a sense, you should know their business even better than they know it, so that you would be able to say that this is an area from which you should have an accurate picture and maybe some predictability, and therefore, you should pay this much money of it, and it will pay this much money back to you."
>
> Interviewee 4

TABLE 4 Examples of BI needs in SMEs

Area	Examples of BI needs	Interviewee
Technical	Increasing number of source systems, increasing amount of data	Interviewee 1 Interviewee 2 Interviewee 3
	Insufficiency of the current reporting system (e.g., Excel-based reports)	Interviewee 1 Interviewee 3
	Fear that current reporting solution will fall apart (e.g., Excel-based reports)	Interviewee 6
	Lack of technical skills	Interviewee 1 Interviewee 3 Interviewee 4
Data	Bad quality data	Interviewee 3 Interviewee 6
	Challenges of getting the needed information	Interviewee 2
	Insufficiency of the information provided by source systems	Interviewee 2
Business	Need to solve a recognized, concrete business-driven challenge	Interviewee 1 Interviewee 3 Interviewee 4 Interviewee 5
	Need to gain better understanding of the overall situation	Interviewee 4 Interviewee 6
	Need to get more data and transparency to operation	Interviewee 3 Interviewee 6
	Understanding of the importance of utilizing data	Interviewee 2
	Recognition of new reporting requirements	Interviewee 3
Streamlining of the work	Reduction of manual work	Interviewee 2 Interviewee 6
	Reduction of effort and errors caused by manual work	Interviewee 2 Interviewee 6
	Need to get more user-friendly and effective reporting solution	Interviewee 1 Interviewee 6
	Need to combine data to one target so that user does not have to login to multiple systems in order to analyze data	Interviewee 4 Interviewee 6
Personnel	To mitigate risks when one person is in control of the whole BI solution	Interviewee 1 Interviewee 6
	Need to move data analysis responsibilities from key user to end users	Interviewee 6
	Need to release personnel to more business-critical tasks	Interviewee 6

5.2.2 Characteristics of BI projects in SMEs

Interview data reveals some themes that characterize BI projects in smaller companies. These themes include the duration of BI-projects, project organization and project methodologies. Because SMEs typically have a very limited resources, it is important that BI projects are executed quickly. Typically, BI

projects in SMEs last about one or two months. Depending on the situation, the duration can sometimes be a bit longer, but usually no more than six months. This applies to projects in which data is retrieved from a database of a source system. If data is retrieved for example from Excel-based data sources only, project can be executed even in a couple of days. Duration of the project is determined for example by the number of source systems, and format and location of data. Typically, small companies do not have many source systems or unusual data formats, which allows the quicker implementation cycles. Customer's good awareness of their needs can also speed up the project.

It is important to note that when BI is implemented for the first time in the organization, building a technological foundation that allows future extensions and adjustments, will require additional efforts. Therefore, first BI project will take a bit more time and resources than the possible further projects.

> "It will take about 1,5 months. Then customer will have a solid foundation and data-platform, and for example some financial and sales reporting on top of that. The first phase takes from 1,5 to 2 months, and after that, new sources can be added in sprints of about 1 month."
>
> Interviewee 3

Another factor characterizing BI projects in SMEs is the vendor's light-weight project organization. Typically, projects are consult-drawn, meaning that there is no formal project organization with subject matter experts, project managers and steering groups. Instead, a consult herself is responsible for the project management, communication with the customer as well as the implementation of the BI solution. There is no project manager who would follow the schedule and budget. Many of the interviewees stated that BI projects employ typically only one or two consultants. This is again because of the limited resources of SMEs: they simply do not have resources to employ multiple consultants nor have a heavy project organization.

> "We usually do not have dedicated project managers in our projects. – – It is on the responsibility of our consultants to discuss with the customer during weekly meetings and so on. There are no external people checking the progress or booking meetings. – – Project organization would be an additional cost, and in my opinion, in SME sector it is completely unnecessary cost to pay. – – Smaller companies cannot afford to pay two 200 euros per hour costing consultants. And usually, they just want to have that one reliable player there who can help them. They do not want to have anything extra."
>
> Interviewee 1

Third factor characterizing the BI projects in SMEs is the preference for agile methods. All interviewees stated that they would recommend using agile methods in BI projects. One of the most important benefits of using agile methods is the ability to "change course". Firstly, it is almost impossible to know the usability and quality of the data without seeing the actual data in the source

system. Therefore, it is challenging to tell beforehand whether a specific solution will be feasible or not. The quality of the data, and thereby the feasibility of the solution, is revealed only during the BI project. Therefore, it is important to be able to do adjustments if the planned features seem to exceed the budget or schedule or are even deemed to be unfeasible.

> "There will always be challenges in the quality of data. When you have planned the project with waterfall methodology, written the specifications and started the project, and then notice for example that one column is missing from the source data even though client claimed to have it. Or maybe 95% of the figures in source data are '999' because that is a fast way for users to bypass that field in the source system. – – That is why we use agile methods."
>
> Interviewee 1

It is also typical that customer starts to understand the potential of BI only during the project. Without practical experience from BI, it might be difficult to imagine the use cases beforehand. Therefore, when customer starts to gain more knowledge about BI during the project and the BI need starts to concretize, it might be necessary to change the course from what was initially thought to better answer the actual BI need. It is even possible that customer recognizes new, even more important areas for BI, and want to add those to the scope.

> "Agility is important because customers usually do not understand – – what is even possible with BI. They usually compare it with their old solution and learning away from the old always takes time. When they start to understand the new solution, new findings will appear, and they start to realize new areas where BI could be used."
>
> Interviewee 2

To conclude, inability to change course is what makes waterfall methodology and fixed-cost projects challenging in the area of BI. Waterfall methodology relies heavily on the ability to define the scope and specification beforehand, but in BI projects it is often difficult, because vendor cannot know the quality of data, and customer may not be able to crystallize their need before starting the project. On the other hand, in agile projects specifications are done only on a high level and therefore, customers must be able to trust the vendor a bit more than in waterfall-projects, where the outcome is a clearer in the beginning. Despite of this, benefits of agile methods seem to be obvious in the area of BI.

5.2.3 Managing BI projects in SMEs

After SME has recognized a BI need and selected a suitable vendor, BI project can officially start. First step of building a BI solution is to ensure that both parties, customer and vendor, understand business needs, use cases and goals in the same way. This is followed by making a high-level technical specification, which covers at least a description and number of source systems, what kind of

data should be retrieved, how data from different sources should be combined and visualized, and how data should be stored.

Majority of interviewees pointed out that a high-level technical specification is sufficient. It should be treated as a guideline rather than as a plan that is set in stone. As discussed already in chapter, 5.2.2, making exact technical specifications is challenging because getting enough details about the data before actually starting the project is very challenging. On the other hand, it is not recommended to omit the whole specification phase, because creating a specification ensures that both parties understand goals of the project correctly. This ensures that the project focuses on solving an actual, business-critical need. Specifications also help to keep the original goal in mind throughout the project. They act as a tool that can be used to compare new requirements against the original requirements to analyze whether adjustments to original plan will bring real business value to company. Writing a high-level specification can also help to recognize and mitigate risks beforehand.

> "Specification has to be on that level that we know what should be retrieved from the system. For example, quite often company has one or more web-based applications from which they would like to bring data together and then show some trends based on the data. Because no one has ever seen what in the database, the work begins by understanding what customer wants. – – We rarely do highly refined specifications beforehand. – – We draft the guidelines, and then more or less in an agile way start implementing those."
>
> Interviewee 4

After ensuring the correct interpretation of customer's business and technical needs, vendor chooses the most suitable technology to address the need, after which the actual implementation work can begin. As discussed in chapter 5.2.2 BI projects are most often implemented utilizing the agile methods in which regular communication plays a key role. Many interviewees stated that they aim to close co-operation and communication with the customer throughout the project. They argued that this way customer can be kept engaged, which yields the best results. Efficient communication is also one of the key means in enabling the ability to change course early enough, if unexpected challenges or new requirements emerge.

> "The thing which applies to any IT-project, including BI-projects, is to always remember the business-critical problem that we are solving with the project. – – Keeping business need in mind avoids the situation where we would solve a wrong problem or produce reporting that is not that important for the customer. This fundamental challenge can be mitigated by keeping the customer engaged. That is why we aim for a dialogue with the customer by doing the implementation in quick sprints, then presenting the intermediate results to customer, and asking for their feedback. In that way we can still quickly correct the course if something seems to go wrong."
>
> Interviewee 5

Communication can happen via several different channels, such as weekly or daily meetings with the key project resources, project management tools such as Jira, and feedback discussions where intermediate results are presented to customer. Management commitment can be strengthened for example by steering group meetings, where project is followed on a high-level and the relationship of benefits and costs is enlightened. One of the interviewees described the communication with smaller companies as highly flexible. However, he also emphasized that some level of structuration is still needed, for example mutually agreed response times.

Interviewees emphasized that customers should be able to follow the progress of a project easily. Tools, like Jira, can be used to follow the progress and documentation of the project, but in addition to those, it is important that vendor is very transparent about any challenges emerging during the project. This is especially important in SMEs as resources are very limited, and company might not be able increase the budget to address the challenges but would rather abandon the project right away. Customer should be able to constantly analyze the gained benefits and their relationship to costs, so that course can be corrected early enough. At any point of time in the project, benefits should be clear to the customer. As one of the interviewees pointed out, in addition to project costs and schedule, it is important to also follow the progress of the long-term costs, such as licenses, storage cost and monitoring expenses. For example, it is important to estimate how changes to initial plan will affect on long-term costs. If maintenance costs start to increase too much, it is important to discuss with the customer and quickly correct the course.

> "If we notice for example that we cannot keep the budget, we have to raise the issue immediately and discuss with the customer. Of course, even the common sense says that it would be extremely stupid to hide the problems."
>
> Interviewee 5

In addition to technical documentation, it is as important to document the background of the decisions. This includes for example the reasoning for the chosen solution, and description why something was included in the scope and why something was left out. This is important because BI projects in SMEs are typically on the responsibility of only one or two consultants, and in addition only few people from customer's side typically participate to active development phase. Documenting the background of decisions mitigates the risk related to lightweight resourcing: if one of the key resources leaves the project, all critical knowledge does not disappear with her, and project can be kept on track.

> "Writing a script of course generates clear technical documentation. But it is also important to document why something has been done, what customer wanted, what we wanted to do and so on. That is actually even more important. Then, if customer's contact person changes, we can explain why something has been done. Or if person changes on our side, we know why something was done. – – If I think what could go wrong, is that one consultant is responsible for the whole project and then he be-

> comes sick or decides to change company. What happens when we put next consultant to that project? If the documentation is not done on a sufficient level, customer may get a feeling that they have to start from the scratch because new consultant does not have a proper understanding."
>
> Interviewee 2

To summarize, BI project is started by writing a high-level technical specification and choosing the best technology based on customer's need. Active communication is a crucial part of the agile BI projects and can happen via several channels. It is important that customer can easily follow the progress and trust that it is proceeding as expected. If issues emerge, they should be raised quickly, and course corrective actions taken. Finally, it is important to document the background of decisions in order to mitigate risks related to small project organization.

5.2.4 Preparations for a BI project

This chapter presents some themes that should be taken in account before starting a BI project. Firstly, in order to succeed in implementation of BI, it is important that management is committed to the project and understands the business value of BI. Management should understand on a high level how comprehensive BI is and how the organization should change in order to gain full benefits from BI. Without sufficient engagement of management, BI project might not get enough resources, or the business need might not be correctly formalized.

> "It is extremely important that management is committed to the implementation of BI. – – If management is not committed, BI implementation won't necessarily get sufficient personnel and financial resources. – – One possible scenario is that a financial manager wants to have a BI solution and we start implementing it, but then he suddenly starts to monopolize the whole project. He can even be jealous if we ask for example sales personnel whether they would need anything, and they do not have courage to say yes because they know that financial manager makes the decisions about money. That is why it is important that upper management is engaged, so that BI project does not stop to one person who can monopolize the BI tool."
>
> Interviewee 2

Secondly, it is good to ensure the condition of source systems. If the source systems, such as ERP and CRM systems, are very old and in a need of renewal, it is better to start by renewing the source systems and postpone the BI project. If the source system renewal projects are already on-going, it is better to let them finish and ensure the successful deployment before starting a BI-project.

> "Quite often customers ask a BI project from us, but then they also say that they should renew their ERP and CRM systems. In that case we have to tell them that it does not make sense to start BI project now. They have to carry out the source system

> renewals first. – – The mere ERP project is so hard experience for many companies because its effects are so widespread. It does not make sense to start implementing BI, when no one can even use the source system."
>
> Interviewee 6

Thirdly, it is good to ensure that sufficient personnel resources are available for the BI project. Many of the interviewees pointed out that there are two key resources that are needed for BI project: a person with technical knowledge and a project owner. Technical resource is responsible for introducing the source systems from technical perspective and if the source system is managed by a 3rd party, which often is the case in smaller companies, technical resource takes care of the communication with 3rd parties. Project owner is responsible for the overall management and communication of the project and actively participates in the project activities. If there are, for example, other projects ongoing where these persons are already heavily engaged, and therefore cannot invest their time to BI project, risks such as miscommunication and exceeding of the budget and schedule, are more likely to realize. Therefore, it is good to ensure that these resources are available and able to invest enough time to BI project.

5.3 BI technology is SMEs

This chapter presents the findings related to technological components of BI, data collection strategies, technical implementation of BI systems and data quality. Key findings reveal that in SMEs BI infrastructure is simple and typically includes only one or two cloud based tools. Data is collected selectively, meaning that data is extracted from a limited number of source systems and only data that is necessary for achieving the goals is extracted. High-level steps of the technical implementation are as follows: (1) building of the back-end system, (2) building integrations to source systems, (3) extracting and transforming data according to business requirements, and (4) building reports and visualizations. Finally, this chapter discusses the challenges related to data quality, how BI can expose those and how they might affect the BI project.

5.3.1 Technological components of BI

Based on the interview data, the most used BI technologies in SMEs are Microsoft Power BI and Qlik. Qlik is a rather powerful tool with data collection, preparation, modeling, and visualization capabilities, and therefore, it can be used as a stand-alone tool to cover organization's BI-needs. Microsoft Power BI, on the other hand, covers mainly the visualization part and therefore, often requires a separate data warehouse or similar to take care of the data collection and preparation tasks. Light-weight implementation of data warehouse is possible with cloud services.

One of the interviewees stated that sometimes the lightness of the solution might surprise customers, who were prepared to implement a wider system. Current BI technologies are far-developed, and usually complex solutions with separate data warehouse, ETL, OLAP and visualization technologies are not required.

> "When someone asks if Power BI or Qlik is enough, the answer is definitely yes. – – Some time ago customers used to say that they need a firmer system. We could not understand what they mean with 'firm', except more expensive, slower, and maybe even worse system. – – Modern systems are so nowadays very powerful. Their engines can run anything."
>
> Interviewee 2

BI is typically implemented as cloud-based solution. In fact, majority of the interviewees pointed out that it is the development of cloud technology in particular that has enabled the utilization of BI in smaller companies. Cloud technologies have decreased the prices of technology and made them affordable also for smaller companies. In addition, cloud technology has changed the pricing model of BI: instead of massive up-front investments to BI tools, company can now pay them with a stable monthly-based fee.

> "Ten years ago, only few companies were able to implement BI. – – If you wanted to have a BI project, you had to invest 100.000 Euros in data warehouse and reporting licenses. – – Cloud technologies have changed that. With cloud technology, you can take the first step more easily, because you can buy with pay-as-you-go model. – – Up-front investments are no longer needed."
>
> Interviewee 1

5.3.2 Data collection strategy

Before it is possible to start building the actual data platform, it is necessary to understand from which systems data should be collected, what kind of data is needed and how much data customer wants to collect. This process is started during the specification phase, as discussed in chapter 5.2.3, and iteratively carried on during the project. Majority of the interviewees stated that data is typically collected from a limited number of source systems as the goal of the project is always to solve a specific BI need. Additionally, as some of the interviewees pointed out, the number of source system directly effects to duration and thus, the price of the project, which is why the number of source systems stays low in SMEs. Within the selected source systems, only the data that is useful for reaching the goal is extracted. Data that does not serve the goal is not extracted or stored to data platform.

Based on the interview data, there are multiple reasons for preferring this kind of focused data collection method. Firstly, even though the price of data storage has decreased over time, it is not advisable to increase the size of data

warehouse with data for which usage has not been recognized. Even if it would be a small cost, it is an unnecessary cost. It is also important to notice, that the amount of data will grow over time, which means that at some point it is necessary to extend the data platform even if only highly relevant data is collected. Secondly, limited resources of SMEs might not allow doing anything else than what is absolutely necessary. Thirdly, collecting more data than is needed can result in a solution that is overly expensive and complex. Finally, if company in future finds out that there is more business-critical data that should be collected to data platform, BI solution can be rather easily extended.

On the other hand, it is not advisable to do unnecessary limitations either. Iterative approach allows adjustments to the plan, if useful and relevant data is found in the middle of implementation. One of the interviewees summarized the data collection methodology as follows:

> "Usually, it is not worth collecting everything from the source systems. There is typically a lot of data, and if any usage has not been recognized for it, SMEs typically want to focus the effort and costs to data, which promotes the goal. On the other hand, we should not do unnecessary limitations either. For example, if we start building sales reporting, and select the tables that we believe promote the goal, but if we then find something else that is useful, we do not drop it. Only if there are for example some performance requirements, for example to not burden the source system any more than is absolutely necessary, we have to make limitations."
>
> Interviewee 4

5.3.3 Technical implementation of BI system

Steps of implementing a BI system includes building the back-end system, making necessary integrations, preparing the data, creating data models and finally, visualizing the data. Implementation is started by building a basis of BI, which is often called data platform. It refers to technological solution to extract and store data from source systems, so that it can be utilized in BI. Data platform is the place where data is physically stored, such as cloud-based data warehouse. Even though BI is often implemented only in a specific area, such as finance, it is important to conceptualize the larger potential of BI already in the beginning and built the data platform so that it is easy to add new areas of business to it.

In order to get data to data platform, it has to be integrated with source systems. Integration must be made to all systems from which data is needed. Based on the interview data, the number of integrations in SMEs varies from two to three, meaning that there are typically two or three source systems from which data should be collected. Typically, there is at least one database from which data is to be collected. Additionally, there can be other types of sources such as Excels.

Many of the interviewees stated that integrations are not typically a big technical challenge, but this of course depends on the situation. For example, loading and handling of rare data formats such as IoT and sensor data requires more complex solution than handling of well-structured finance data, which,

however, is more typical use case in SMEs. However, even though integrations themselves are not usually a challenge, there might be challenges with IT infrastructure and source systems. Firstly, in SMEs source systems and IT infrastructure is typically managed by a third-party company. Therefore, in order to open connections to source system and make the integrations, support from the 3rd party vendor is needed. This dependency might slow down the project: firstly, it might take time to find a correct person and secondly, this person must have enough time to prepare the connections. If the schedule is very tight, dependency on a third-party company might cause a risk of delay. Another possible but rare challenge is that source system vendor for some reason is not willing to give access to the data or requires unreasonable compensation, a license fee, for example. Finally, taking a connection from cloud technology to on-premises database can in sometimes be challenging.

> "One thing that might slow down the project is that the IT infrastructure is almost always managed by a third party, and we have to communicate with them. – – It depends a little bit on the company, how fast they reply."
>
> Interviewee 6

As described in chapter 5.2.4, fluent and successful implementation of BI requires two key resources from the customer: a project owner and a technical specialist. The latter one plays a big role in this phase of the project. Technical specialist is the person who either is able to prepare the connections to source systems, or who can communicate with the source system vendor in order to get the connections open. If the key technical resource is not available at this point of the project, it might cause significant delays.

When connections to source systems have been established and integrations created, data has to be prepared before it can be used in BI. Traditionally, this is called ETL process, and it covers for example understanding of the structure of the data, cleansing and re-organizing the data, making necessary calculations, and validating the data. It is also necessary to implement rules and authorizations so that right people have the right data at the right time.

> "In order to utilize BI, it is necessary to dig out the data from the source system and understand its structure. It is necessary to consider, which calculations are required, and then implement and validate them. Data must be modeled in a way that it is possible to build visualizations on top of that. There is no technology that would directly do that."
>
> Interviewee 4

As it was with integrations, challenges with data extraction and preparation vary case by case. For example, working with finance data is rather easy, as it is well structured and there rarely is huge amounts of data. On the other hand, extracting and preparing IoT-data, for example, is rather challenging. In SMEs BI is typically implemented within well-known areas such as finance and sales,

so challenging data formats appear quite rarely. Other challenges that might appear include for example so called data blackspots meaning that link between two source systems is missing. There can also be different representation of business objects, such as organization structure, in different systems, which makes combining of data challenging. It is also possible that the quality of data proves to be a challenge. If the quality of data is much worse than was expected, it might cause delays in the project, and increase of the costs, or even stop the whole project. Data quality is discussed further in the next chapter.

As some of the interviewees pointed out, this rather invisible back-end work makes up a significant part of the project duration and expenses, whereas front-end work, meaning the visualizations is rather quick and straight-forward process. Customer must understand this aspect of BI.

> "In BI projects, 80-20-rule applies. In other words, searching and organizing the data takes 80% of the time, and the front-end work, where reports are built, takes 20% of the time. – – This is one of the stumbling blocks in BI projects: customer might think that they can just start using PowerBI and it will directly solve their problems. They must understand that they must reserve enough time for the back-end work."
>
> Interviewee 1

Final step is to visualize the prepared data. Data can be organized for example in a form or reports or dashboards, depending on the customer's needs. Reports support statistical, refined reporting whereas dashboards provide self-service capabilities by giving user possibilities to drill-down, filter and aggregate data.

5.3.4 BI and the quality of data

Interview data reveals that issues with data quality are very common and that all companies always have bigger or smaller challenges with their data quality. For example, data might not be reliable, it has been collected in wrong format, there is not enough data, or it has not been properly maintained. As described by one of the interviewees, one explanatory factor for data quality issues is the companies' strong focus on operative topics. Having a well-functioning operative system does not guarantee a good data quality. Operative systems focus on efficient and optimal operation, and reliable storage of data, and often, data quality is not a priority. Therefore, issues with data quality are often noticed only when data is needed for other purposes, such as BI.

> "Both small and big companies typically invest in technologies and software to solve an operative problem with that software. For example, they want to have a call center software to manage incoming calls. They focus on solving the operative problem and do not to think how usable data is for analytics. So, based on my experiences, it is not common that companies would systematically beforehand think, which systems and what kind of data they would need, so that it can be later utilized in decision-making."

Interviewee 4

If data is processed and stored in multiple, separate operative systems, getting an overall picture of the cross-system data quality and consistence can be very difficult. Therefore, it is very likely that company does not have much, if any, knowledge about the quality of data prior to BI project. This, in turn, may have led to a situation where company has used erroneous data in decision-making for years, without knowing that it is not correct. When BI project is started, and data from multiple source systems combined, more reliable picture of data and its quality is achieved. BI makes data quality issues more concrete and helps customers to understand their own data and its challenges better.

One of the main purposes of BI is to provide high quality and readable data for the organizations. To ensure the high-quality outcomes, data is cleansed, re-organized and manipulated before using it in BI and reporting. This indicates that it is possible to technically manipulate source system data in order to improve its quality. However, it is important to distinguish between "technical" quality issues, which can be solved during the data preparation phase and "usage related" quality issues, which cannot be technically solved and require actions from the customer. One of the interviewees gave the following example of the technical quality issues:

> "For example, there has been a case where person and company names were in the in the same fields of a same table. Company names were in the 'SURNAME' column and so on, which made it very messy. – – This type of cleansing we have to do. We put company information to its own table in our system and give better names for the columns."

Interviewee 6

On the other hand, "usage-related" quality issues include for example incorrect values, inconsistent data, or lack of central data points. They might slow down the project significantly, or even be show-stoppers. "Usage-related" quality issues can be described for example as follows:

> "If we, for example, have a factory, which has 10 employees who manage the production, make different production orders and correct them if necessary – –. All employees work on their own way and use the system from their own perspective – –. If there is no consolidated reporting about what is happening in the factory, none of these 10 employees really knows what others are doing, whether they themselves are doing something wrong, and whether they all are using the system in different ways. So, quite often, when we show them a production management report that we were supposed to make – – we have to conclude that it is not possible, because all employees are using the system in different ways. We do not have commensurable data."

Interviewee 4

BI can efficiently expose this kind of issues in the data quality, but not fix them. In other words, if the data itself is wrong, it cannot be technically con-

verted into usable format. Therefore, it is on the customer's responsibility to decide whether they want to take the any actions to improve the data quality. These actions can include for example corrections to source system logic, re-training of the users or even changes to ways of operating the business. Table 5 summarizes examples of usage-related quality issues and potential actions to solve those.

TABLE 5 Examples of "usage-related" data quality issues

Business Area	**Example**	**Potential actions to improve data quality**
Production	Factory has 10 employees. Each of them uses system in a different way, which results the lack of commensurable data and prevents creating a production management report.	Re-training of the users, changes to source system to prevent misuse of the system
CRM, master data	"Something else" option has been selected as industry for all customers, which prevents making industry specific analysis of the customers.	Manual correction of the data entries, re-training of the users, re-structuring of the processes
HR	Company has three source systems and organization structure has been defined differently in all of them, which prevents making a sensible HR analytics.	Decision of the correct organization structure and manual correction to system
General	95% of the entries in source data are '999' because that way user can quickly bypass the field. No sensible analysis can be done based on this data.	Manual correction of the data entries, changes to source system logic to prevent misuse of the system, re-structuring the process
General	Data is inserted to wrong fields.	Re-training of the users, changes to source system logic to prevent misuse of the system

To conclude, interview data clearly highlights that one of the most obvious benefits of BI is the improved data quality, or at the very least, the exposure of the data quality. This might not yield immediate benefits and therefore, BI project should be seen as a starting point for improving data quality. Business value and benefits are generated over time when company has better data available for decision-making.

> "Often it is so that – – customer itself does not know that they have problems with data quality. They might have used incorrect and erroneous data for decision-making for years because the system itself does not expose the quality of data. When we implement the BI, they start to notice the mistakes. Often, their first reaction is that the figures in BI system are wrong. That BI system displays wrong information, and that it cannot be trusted. Then, when we start investigating the issue, we notice that BI figures are the correct ones. Because in BI, data is collected from multiple sources, which gives correct information and not wrong information that one single

system might give. And because of this, the first benefit of BI is that data becomes valid, and company starts to get better information."

Interviewee 2

5.4 BI human resources in SMEs

This chapter presents the findings related to human resources that required to benefit from BI. All interviewees agreed that BI tools in SMEs should be intuitive and easy-to-use, and that using BI should not require any special technical skills from the users. Nevertheless, importance of end user training should not be neglected as it will help users to understand the benefits of BI. Findings reveal that change resistance in BI projects appears quite rarely, but personnel might feel burdened due to time pressure and other simultaneous system changes. This can be mitigated via end user training, active listening of users and by concretizing the benefits that BI will bring to their day-to-day work.

5.4.1 Training requirements in SMEs

Interview data reveals that users in SMEs typically have some prior experience from BI or data analysis. For example, they might have used an older BI system or gathered and combined data manually in Excel. Especially employees who are working in finance have prior experience from BI, and even some knowhow of databases and data itself. This is probably explained by the fact that data and reporting is already in the heart of finance. However, even though users may have prior experience from reporting, knowledge may have remained superficial. As one of the interviewees pointed out, users may have spent a lot of time with manual work, such as collecting data, combining it in Excel, and finally creating reports, leaving no time for the analysis work itself.

"SMEs have the data analysis skills, but their time goes to unnecessary preparation – – of data. This means that they have experience from data analysis, but they do not necessarily understand how data should and could be analyzed."

Interviewee 3

Regardless of the prior knowledge level, BI tools must be easy to use. This has been recognized by the vendors as all of the interviewees argued that day-to-day usage of BI, such as displaying, filtering, and drilling down the data, does not require any specific technical skills. However, instead of learning new technical skills, employees should know some data literacy to be able to draw correct conclusions from the data. Additionally, users must have a sufficient understanding of organization's business and its key performance indicators.

> "In my opinion, the solution should be made so user-friendly that it does not require any special skills from the customer. I think that it should be enough that they know their own business, and BI tool should be so user-friendly that any further skills are not required."
>
> Interviewee 5

Even though the modern BI tools themselves are user-friendly and intuitive, having an easy-to-use tool is not automatically guaranteed: as many of the interviewees pointed out, having a user-friendly system requires that it has been built well. This means for example that data set has been cleansed and organized so that it is easy for users to understand what everything means. Additionally, data literacy and intuitiveness should be built into the system, so that user can easily notice things that interest them and intuitively find options to drill-down and filter the data.

Even though using BI is not usually difficult, many of the interviewees highlighted the importance, or even necessity, of training. One of the interviewees justified this as follows:

> "When a system is implemented, it is always good to organize a training so that the system is taken into use. There are always people who will not start using the system if they do not understand the benefits of it."
>
> Interviewee 2

Practices of providing end user training vary between different vendors. Some of the interviewees told that they typically train end users by themselves whereas in other companies it is more typical to train only key users, who will then train the end users internally. In any case, end user training is typically a very compact package. Length and extent of the training naturally depends how widely organization wants to adopt BI, but mainly it can be managed lightly. Based on the interview data, at the shortest training takes a couple of hours, or even less if users are working only with ready-made dashboards, and at its longest one day. In this time users gets a good starting point for using BI even if they have never seen the BI tool before. Therefore, it can be concluded that using BI does not require any specific technical skills from end users, but rather an ability to understand the importance of data and BI for the organization and skills to draw correct conclusions from it.

Depending on the organization, its technical capabilities and use case, there can also be users like developers, key users, and controllers, who are required to handle the data more widely. For example, if users are going to create their own data analysis or develop new models and reports, a more extensive training is required to understand where data comes from and how it has been processed. This is to get a sufficient understanding of data modelling, to avoid erroneous data models, to gain skills for writing code and functions and to follow best practices. However, as one of the interviewees pointed out, even though deeper technical knowledge is required, these skills are still in the area

of normal, technical capabilities that key users and controllers typically already have. Therefore, threshold to master these skills is typically tolerable for these types of users. Key users are also typically participating closely to BI implementation, so part of the training can already be covered during the project.

5.4.2 Mitigation of change resistance

Many of the interviewees mentioned that in BI projects the atmosphere is typically good. Change resistance seems to appear rarely, or almost never. There might be individual persons who resist the change, but it is not common that the entire organization would be against BI. However, there are still some scenarios in which resistance, or exhaustion, might appear. For example, schedule and resourcing pressures might burden the personnel and cause exhaustion as well as multiple, consecutive system changes. Also, if BI implementation is going to bring changes to employees' tasks and responsibilities, for example if responsibility to construct reports is transferred from IT personnel to end users, they might be worried about increasing amount of work.

To conclude, external factors such as other projects and tightness of the resources, can cause tiredness and exhaustion, and in some cases even change resistance. However, change resistance towards the BI itself seems to appear rarely. In fact, as the importance and benefits of data is nowadays widely recognized, employees can even call for more data and better tools in order to do their job more efficiently. One of the interviewees described this as reverse change resistance. It is also possible that current BI tools are so impractical that employees already know that situation could be better. These are naturally fruitful starting points for BI projects. However, if change resistance or exhaustion appears it can be mitigated by good communication and training to show that BI will help employees in their every-day tasks. Majority of the interviewees emphasized that by concretizing the benefits and prospects of BI, excitement among end users can be created and change resistance reduced.

> "If there have been multiple system changes, personnel might feel burdened and irritated because another project is starting. But after we have explained why we start implementing BI, they usually quite quickly realize that this will help them in their day-to-day work and reduce the amount of silly, manual work. So that in the end, new system will save a lot of time. Explaining this will help with the atmosphere."
>
> Interviewee 3

Based on the interview data end users consider BI tools as useful and user friendly. Many of the interviewees mentioned the word "excitement" when describing the atmosphere among end users after BI project and training. BI can potentially benefit many employees in different roles, but naturally employees who earlier had to spend a lot of time with constructing the reports are most excited of the BI tools and the reduction of manual work. To conclude, even though change resistance rarely appears in BI projects, the importance of good communication and concretization of benefits via training for example should

not be neglected. Via them it is possible to generate excitement and have end users onboard in the journey of building BI capability.

5.5 Strategic guidance of BI in SMEs

This chapter discusses the findings related to strategic guidance of BI in SMEs including the risk management, support needs, benefits of BI, and strategic approach for building the BI capability. Key findings reveal there are three risks that apply especially to SMEs: insufficient commitment of the management, limited budget, and risks related to limited personnel resources. Data reveals that all organizations need support after the BI project, but the amount can vary depending on the organization's preferences and skills. Nevertheless, customers are typically satisfied with their BI solution and gain both operative and strategic benefits from BI. Finally, empirical data suggests that BI capability is formulated one piece at a time and over a longer period of time, rather than as a result of an individual BI project. BI helps organizations to understand their business better, which can potentially generate new ideas for utilizing BI to deepen the knowledge even more.

5.5.1 Risk management in BI projects in SMEs

Based on the interview data, there are three types of risks that apply especially to smaller companies: insufficient engagement of the management, limited budget and risks related to personnel resources. Another significant risk is data quality, which is discussed in more detail in chapter 5.3.4. These risks should be considered before starting BI project and managed carefully during the project.

Insufficient engagement of the management might cause several challenges before, during and even after the BI project. For example, management might not be willing to invest in BI, or as pointed out by one of the interviewees, even resist BI project, if they do not understand the relationship of benefits and costs. It is also possible, that management sees the benefits of BI but does not want to invest enough resources. They might think that implementation is a simple, straight-forward process, with no need for proper monetary, personnel and time resources, which naturally will not yield the best results. Finally, if management is not engaged, BI project might fail in prioritization, meaning that BI is implemented in some non-relevant area and not where it is most needed. Therefore, it is important to engage management right from the beginning, concretize the benefits and their relationship with costs, and carefully prioritize the scope in order to gain maximum benefits from BI.

Limited budget is naturally a risk that applies especially to SMEs. For example, if some area of the project, such as integrations or quality of data appears to be more difficult than was expected, it can lead to exceeding of the budget, which might in turn lead to situation where company simply cannot afford to continue the project. One of the interviewees pointed out that some-

times it is noticed during the project that maintenance costs of the system will be too high. Then the scope of the project must be significantly reduced, or in the worst case, the whole project must be cancelled. By contrast, another interviewee pointed out that technological risks are nowadays quite minimal. He explained that for example suitable technology as well as costs of the project and maintenance can be estimated very accurately. Nevertheless, SMEs are more prone to unpleasant surprises than bigger companies and might not tolerate exceeding of the budget. Therefore, it is crucial to follow the costs carefully, and communicate early and openly throughout the project in order to understand the current and future costs.

> "Especially in SMEs the budget is a risk. I mean, if there are some problems... – – For example, if the quality of data or integration to source system turns out to be significantly more laborious than expected – – it usually leads to exceeding of the budget. A big company can take the hit, but SMEs might notice that they cannot afford the project anymore."
>
> Interviewee 5

Third category, risks related to limited number of personnel resources, was strongly emphasized in the interview data and majority of the interviewees mentioned it as a risk that applies especially to small companies. There are several challenges related to the limited number of employees in SMEs. Firstly, in small companies one person might be solely responsible for the "big picture", such entire reporting and analytics system, without anyone else having knowhow of this area. If this person leaves the company, either before, during or after the BI project, company loses all of its knowhow at once. Similar risk appears also on the vendor's side: due to limited resources, BI projects are typically very lightly resourced, which means that they are often managed and run by a single consultant. If this consultant leaves in the middle of the project, it might be challenging to transfer the project smoothly to another consultant without causing too much disruption to customer. Many of the interviewees pointed out that they are aware of this risk and manage it by always having a "back-up" consultant who has enough knowledge to jump in if the primary consultant leaves the project.

Personnel resources are vulnerable even to smaller changes, such as sick leaves or more critical projects, which can lead into re-allocation and withdrawal of the resources, thereby affecting the schedule of the BI project. Another personnel related risk is the limited technical knowhow, as sometimes it can be challenging to find a person with sufficient knowhow from both business and technology, especially if the scope is outside of finance and sales. To conclude, personnel related risks will most likely be present when implementing BI in SMEs. They cannot be avoided: sometimes, it simply is not possible to spread the knowhow to several people, or book resources fully to specific projects. However, it is important to be aware of the risks and mitigate them through prioritization, communication, and documentation.

"In SMEs the customer's own personnel is a risk. – – There are typically no extra resources, and therefore if there are sick leaves, other absences, or other projects... For example, they might be simultaneously doing an ERP project, which typically has higher priority as it is more critical for business and production than BI. Then resources might be withdrawn from the BI project, which might affect to the schedule."

Interviewee 3

Table 6 summarizes risks in SMEs and potential ways to mitigate these risks including risks related to data quality that were discussed in chapter 5.3.4.

TABLE 6 BI related risks and their mitigation in SMEs

Risk	**Possible effects**	**Mitigations**
Insufficient commitment of the management	• Management is not willing to invest in BI, or even resists BI • Management is not willing to invest enough resources to BI • BI project fails in prioritization	• Management is engaged early on the process • Benefits and their relationship to costs are concretized early
Limited Budget	• If unexpected budget exceeding appears, SME might not be able to afford the project anymore • If the maintenance costs become too expensive, scope has to be reduced or the project terminated	• Careful following of the costs throughout the project • Open and early communication about the potential issues
Limited number of personnel	• Individual employees are solely responsible for the entire system. If this person leaves, company loses all its knowhow. • Sick leaves and more critical projects can eat up the availability of key resources and hinders the BI project. • Organization might lack business-technical knowhow.	• Careful prioritization of the different projects and their schedules • Careful documentation of the background of the BI solution, including reasons for decision and actions • Active and early communication about the potential issues
Light resourcing of BI projects	• If consultant leaves in the middle of the project, smooth continuation of the project might be challenging	• Ensuring that there is a back-up consultant with sufficient knowledge available • Careful documentation of the background of the BI solution, including reasons for decisions and actions
Data quality issues	• If data is worse than expected and cannot be technically corrected, budget might be exceeded and in worst case, project terminated	• Open and early communication about the potential issues

5.5.2 After the BI project

After the BI project, different types of support are needed. Firstly, BI system, as any other IT system, will always need maintenance services such as updates. Secondly, changes in the source systems can cause a need to adjust BI system. For example, if a new branch is added to an ERP system, it might require changes in the BI system as well. Thirdly, customer might identify needs for enhancements, and want to do further development for the system. Finally, customer might need help from the vendor with data or usage related questions.

Therefore, some level of support is always needed, but the amount and format vary between different customers. One of the interviewees explained that the amount of needed support depends on how well the organization's IT department or IT employees are able to adopt the BI system, resulting that some organizations need support only occasionally whereas others need constant help. Other interviewee mentioned that some companies do not even want to understand the technical aspects but only want to have ready-made reports while the vendor takes care of the rest. Therefore, it is not possible to make broad generalization about the amount of needed support as it is heavily dependent on the organization's IT skills, resources, and strategy.

> "There is no single answer or model that would fit everyone. Some level of support is always needed, but the amount can vary. It varies from the continuous maintenance to occasional phone calls you have to answer. This depends heavily on how well customer's own IT organization or data analysts have been able to adopt the solution we have built."
>
> Interviewee 5

In addition to different needs of different customers, also different vendors seem to have a bit different practice for providing the support. One of the interviewees told that in their case customer is typically responsible for the front-end tasks, including for example building of new dashboards and reports. Support is provided in a form of continuous services, which covers the back-end of BI, including for example the maintenance of the data model and monitoring of the system. He also mentioned that customer's internal key user typically acts as first line support helping end users with simple questions and issues. Another interviewee explained that in their case continuous services are not typically taken into use, but customers run the system independently, including both back-end and front-end. Support is purchased on a need-basis. This applies especially to very small companies where systems are typically quite simple. Another interviewee stated that some level of support is always needed, but small companies are rarely interested in buying structured, contractual support.

Based on the interview data, customers typically perceive BI as a user friendly and useful tool. Many interviewees mentioned that customers start using BI in their every-day work. Seems that usage related questions and issues are quite rare, and additional training is not typically needed. To conclude,

support is often purely technical, for example system updates or adjustments. Customers are able to take care of routine-like issues and if there is some ambiguity, they are able to start investigations independently.

BI brings organizations both operative and strategic benefits. From the operative perspective, BI helps employees in their every-day work by making data more accessible. As one of the interviewees stated, BI brings data "one click away". By doing this, BI supports, streamlines and accelerates the every-day work. BI decreases the amount of manual work, which brings savings in time and reduces the number of mistakes.

> "For example, when a salesperson goes to a store, he can easily check from his mobile device that in these kinds of stores and in these areas their products have been sold a lot. If his customer then asks details of a specific product, salesperson can easily tell how much it has been sold in this area and what they would recommend for the customer. This way BI supports the every-day work. – – You do not have to create a separate report every time - you have all the information available all the time. – – This way you can react quicker and make better decisions."
>
> Interviewee 2

From the strategic point of view, BI helps to reveal causalities that were not noticed earlier due to challenges in combining data, errors in data or bad visualizations, for example. Unlike many operative systems, BI is capable of collecting historical data, thereby enabling for example trend analysis, which can help to spot previously hidden causalities. Based on the interview data it seems that these benefits can be achieved already by reconditioning the current state. In other words, there is no need for specialized and fancy plans for utilizing the data, but benefits can be realized even by starting small.

> "Starting to use BI is always an eye-opening experience. For example, you can ask from a company if they are invoicing everything they can, or if they have sent all necessary invoices in the last month. If they do not have any data about it, it is quite clear that they will say that 'of course we are invoicing everything'. – – But then, when we show them the data, it always reveals that some invoices were not sent or something else like that."
>
> Interviewee 4

5.5.3 Nature of BI: building BI capability one piece at a time

Interview data strongly highlights the need to develop BI system and BI skills one piece at a time, instead of deploying them as a "big bang". Many interviewees pointed out that best results are achieved when BI is built incrementally, starting from a simple, well-known area, and then gradually progressing to other areas. However, as one of the interviewees pointed out, even when starting small, it is still good to conceptualize wider roadmap already in the beginning. This means gaining a high-level understanding of the big picture and overall BI needs. After the implementation of the first area, BI capability can be

gradually expanded by adding new data sources, progressing from descriptive analytics towards more advanced analytics, and extending the user group of BI.

Interview data reveals that urge to develop BI piece by piece and to expand the usage over time is not only vendors' attempt to manage BI project better. Instead, this need seems to rise from somewhere deeper. Compared to other IT systems, such as ERP or CRM systems, BI seems to have special nature, which emphasizes the need for constant evolvement and tolerability for changes. In the interview data, BI is described for example with the following expressions: *"BI system is never complete (Interviewee 2)"*, *"change is constant (Interviewee 3)"* and *"usage of BI system will expand over time (Interviewee 3)"*.

There are especially two areas that drive BI towards the constant evolvement. Firstly, as discussed already before, as BI is tightly integrated to other systems, such as ERP and CRM systems, changes in these systems often affect also BI system. Changes can be purely technical, such as system updates, or operational, such as adding new branch to ERP system. Secondly, as BI combines and organizes data from multiple systems, it will shed light to aspects that were earlier hidden behind bad and unmanageable data. Thus, BI will deepen organization's knowledge of its own business and provide long-needed support for decision-making, which then can inspire organization to develop their BI capability further to understand their business even better. In other words, prospects of BI start to really reveal themselves only after organization has adopted BI and started to use it. Therefore, it can be concluded that before the existence of any BI capability, it is very challenging for organizations to know, where they in particular could use BI. Therefore, it is best to start with a well-known area, like finance, to achieve the basic understanding of BI and its possibilities, which then creates a better readiness to deepen the capability.

> "One could say that the areas of application start to reveal themselves only after company understands how BI can be used."
>
> Interviewee 2

> "We start somewhere, and then, as the organization starts to get an idea about what their systems contain, new questions start to arise. They might think that now that we see this thing, we want to see a bit more, so that we can understand even better."
>
> Interviewee 4

Based on the interview data, vendors are well-aware of the evolving nature of BI and are often prepared to continue development after the first round of implementation. From technology point of view, making changes and adjustments to BI system is not a challenge, because current, modern BI technologies have been designed to support the evolving nature of BI. Many of the interviewees pointed out that initiatives and ideas for further development often comes from the customers themselves. However, as one of the interviewees pointed out, due to limited budgets of SMEs, further development projects are

typically small-scale and occasional, compared to bigger companies, which might be able to put on-going investments into exploration of new areas.

In addition to constant evolvement, interview data reveals some other factors that characterize the "nature of BI" and describe how BI capability can be deepened. One of the interviewees described a situation that often holds back the benefits of BI: it is quite typical that information flows fluently top-down, meaning from management to employees, but for some reason stops on its way from employees to management (bottom-up). However, in an ideal situation, information would flow through organization, both top-down and bottom-up. Everyone would have access to information they need and would understand the importance of data. Companies can strive for this ideal for example by identifying places where the flow of information stops, and areas where information is not flowing at all. It is also useful to build up data literacy skills throughout the organization, so that everyone knows the importance and benefits of data.

Another interviewee highlighted the importance of organizational actions and change as part of BI. Results that BI provides do not themselves create value or fix problems – it is the actions and decisions taken based on the results of a BI tool, that can make a difference. This is the organizational side of BI: course-corrective actions should be defined, understood, and obeyed for each result that BI reveals. Only this way organization can make its operation more coherent and gain true benefits from BI. These actions require commitment, perseverance, and patience. Interviewee described these crucial elements of BI as follows:

> "Of course, BI provides support to decision making, but fundamentally, how we at least see it, is that company should understand what actions they should take based on the results given by a BI tool. – – They should understand that BI is not just random KPIs or numbers – – and after seeing them, you can go and have a cup of coffee. No. It should be clearly defined, that if a KPI is on this level or on that level, I have to do these things, or contact this person and ask about this thing, and start investigating. This is very important, and complex thing."
>
> Interviewee 3

To summarize, when organization starts to build its BI capability, it is useful to acknowledge the deeper nature of BI. By starting small, organization builds a basis for coherent and value-adding development of the BI capability. When organization starts developing BI capability from well-known, but business-critical area, it will learn from its own business and start seeing areas in which BI would yield benefits for them in particular. It is useful for organizations to acknowledge the fact that their BI system will change and evolve over time. Finally, it is important to understand the organizational aspects of BI: just by taking BI into use, organization is only on the half-way of its journey. Organization must understand what measures built in BI mean, what kind of actions different results yield, and then consistently act according to them.

6 DISCUSSION AND CONCLUSIONS

Research question of the present study is: ”How can BI capability be built in SMEs?” Additionally, the following two supportive research questions are used to examine the resource and strategy related aspects of BI capability in more detail: (1) ”What kind of resources are required from SMEs to build a BI capability?” and (2) “What kind of strategic efforts are required from SMEs to build a BI capability?” This chapter will answer the research questions and compare the empirical observations with the prior research. This chapter will also supplement the Llave’s et al. (2018) framework with the observations from empirical data. Finally, this chapter will discuss the limitations and contributions of this study and provide suggestions for the future research.

6.1 Answers to the research questions

Even though BI has been mostly studied in the context of large companies (Llave, 2017), there are studies that have shown that also smaller companies can benefit from BI (Scholz et al., 2010). This observation is strongly supported by the present study. Declining storage space prices, development of cloud technologies, as well as the change of pricing models, have made BI more accessible for SMEs. However, implementing BI in SMEs has special characteristics, such as extremely limited resources, vulnerability to changes and concreteness of business needs. By acknowledging the special nature of SMEs, BI can be implemented in a way that it yields true business benefits and supports every-day work in SMEs.

6.1.1 Research question: How can BI capability be built in SMEs?

Research question of this study aims to understand how BI capability can be built in SMEs. Results reveal that the following five areas are the cornerstones of building BI capability: (1) business-driven approach, (2) agile methods, (3)

simple technological infrastructure, (4) focused data-collection method, and (5) importance of end-user training. Each of these areas are discussed next.

Several studies have argued that BI projects should have a business-driven nature, instead of technological (Yeoh & Koronios, 2010; Hallikainen et al., 2012). BI efforts should be grounded in business by analysing the business needs and how BI can solve these needs. This observation was supported by the empirical data. Majority of the interviewees emphasized, that BI should support the business, and that mere technology will not yield benefits. In fact, it seems that this aspect of BI comes rather naturally in SMEs: as resources are limited, there is no room for impractical, or ambiguous experiments with new technologies. SMEs will invest to BI only, if its business-driven benefits are indisputable.

Business-driven nature of BI is established by understanding real business needs. IşıK et al. (2013) argue that organizations should first analyse their decision-making environment and understand whether collected data should support long-term strategic decisions or short-term operative decisions. Clear strategic vision and well-established business case that identify for example benefits, risks, and costs, is one of the success factors of a BI project, and without them, project will not necessarily meet its business objectives (Yeoh & Koronios, 2010). While these observations loosely apply also to SMEs, empirical data reveals that means of understanding business needs are more pragmatic. Business needs in SMEs are typically quite simple, such as streamlining the work by combining sales and budget data to one dashboard so that users do not have to login to different systems and compare data from two screens. Therefore, as the goal is often to solve a concrete pain point, it also easier to understand the need, and produce business benefits without in-depth strategic analysis.

Even though it is critical to understand business needs, it can also be challenging to make decisions that can be set in stone. For example, it is often difficult to know the quality of data beforehand, and customer's priorities might change during the project, which is why BI projects are often constant balancing between original goals and new ideas. Empirical data reveals that agile methods are especially suitable for these types of projects, as they allow changes and adjustments to the plan on the fly. They also provide tools and practices for constant communication, which helps to notice possible challenges, and adjustment needs early. This is especially critical in SMEs where resources are limited and vulnerability to unpleasant surprises such as budget exceeding is real. Literature presented in this study does not explicitly mention agile methods, but for example Yeoh and Koronios (2010) and Llave et al. (2018) have highlighted the importance of iterative development approach in BI projects.

Components of BI system include data warehouse, ETL and OLAP utilities (Yogev et al., 2012), and possibly a separate reporting and visualization tool (Chen et al., 2012). Empirical data reveals that technical landscape of BI in SMEs is typically simpler than presented in literature. Typically, goals can be achieved with one or two tools, which take care of the end-to-end BI process, including data storage, data preparations, data modeling and visualization. Thus, all components mentioned by Yogev et al. (2012) and Chen et al. (2012)

are contained in the BI tool, and there is no need to make separate investments to multiple tools. Additionally, cloud technology is preferred in SMEs, which simplifies the landscape even more. Empirical data strongly highlights the necessity of simplicity and user-friendliness of BI tools in SMEs: when resources are limited, tools must support the business without a need to learn sophisticated technical skills.

Ramakrishnan et al. (2012) have identified two extreme ends for data collection methods: (1) comprehensive method in which majority of data available is collected in data warehouse and (2) problem-driven method in which only data that supports the specific business goal is collected. They have observed that organizations often tend to choose comprehensive method and encourage organizations to consider benefits of problem-driven method more thoroughly. (Ramakrishnan et al., 2012) Based on the interview data, SMEs naturally lean towards problem-driven data collection method, because their resources usually do not allow anything else than the necessary. Vendors on the other hand prefer problem-driven data collection strategy to avoid swelling data warehouses with unnecessary data and making overly expensive and complex solutions. Therefore, empirical data does not support Ramakrishnan's et al. (2012) observations of the tendency to choose comprehensive data collection strategy. However, both empirical data and literature highlight that problem-driven data collection method is often preferrable than the comprehensive approach.

Based on the empirical data, change resistance towards BI itself rarely exists, but employees might feel burdened and exhausted because of schedule and resourcing pressures caused by consecutive system changes. While literature presented in this study focuses on high-level concepts such as organizational culture (e.g. Popovič et al., 2012) and development of appropriate capabilities, such as absorptive capability (Elbashir et al., 2011, p. 155), interview data reveals more concrete means of mitigating the change resistance and exhaustion. Key of mitigating change resistance is to concretize the benefits of BI by explaining how it will support the employee's daily work for example by reducing of manual tasks. To achieve this, the importance of end user training was highlighted: it is not needed because using BI tools would require a lot of new skills, but to crystallize the benefits and usefulness of BI.

6.1.2 Supportive research question 1: What kind of resources are required from SMEs to build a BI capability?

Literature review of the present study defines BI resources as follows: BI infrastructure, BI human resources, and BI enabled intangibles (Sidahmed, 2007). Additionally, it was observed that the following organizational capabilities can speed up or hinder the formation of BI capability: organizational processes, firm's existing IT assets and firm's history (Baker & Chasalow, 2015). This chapter will examine how empirical data correlates with these observations.

First BI resource introduced by Sidahmed (2007) is BI infrastructure, which covers physical systems and hardware, such as data warehouse, ETL and visualization tools. According to Llave et al. (2018) technological infrastructure

is necessary, but on the other hand, not sufficient, condition for utilizing BI. This observation is supported by the empirical data. In SMEs BI infrastructure is built by vendor during the BI project. As described earlier, BI infrastructure in SMEs is simple and lightweight, including typically one or two cloud-based tools and intuitive, user-friendly front-end. Cloud technology has eliminated the need for expensive up-front investments to different components of BI, and enabled buying BI as a service with a stable monthly fee. Thus, BI infrastructure is achieved during a BI project through vendor's efforts and expertise, while SMEs can easily start gaining benefits from their BI tools.

To gain benefits from BI tools, there must be users know how to use them. Therefore, the second BI resource is BI human resources. According to Sidahmed (2007) BI human resources should be a balanced combination of technical and managerial skills. In other words, users must know how to use the BI tools as well as have sufficient managerial skills and understanding of the business processes (Sidahmed, 2007). Similarly to BI infrastructure, this resource is formulated during the BI project through the end user and key user training. Empirical data clearly highlights that using BI tools does not require any specific technical skills. Instead, there is a need for data literacy skills, meaning the ability to draw correct conclusions from the data. Additionally, users should have a sufficient knowledge of organization's operation and KPIs. Exception to this are employees who are going to build new data models – they should invest more time for building deeper technical skills. As a whole, these findings support Sidahmed's (2007) observations about balanced combination of technical and managerial skills.

Third resource presented by Sidahmed (2007) is BI enabled intangibles, which means non-financial and non-physical assets such as knowledge and customer information. Empirical data reveals that before taking BI into use, it can be difficult to imagine how and where it could be used. Therefore, it is advisable to start by implementing BI in some well-known area such as finance or sales, which will yield benefits to any company. When organization's knowledge of BI starts to deepen during the BI project, organization begins to understand better what is possible with BI and what they could achieve with it. When these ideas are combined with organization's in-depth knowledge of their own business and industry, organization has a better ability to identify specific areas in which they could utilize BI than they had before BI project. Therefore, BI's relationship to organization's strategy starts to deepen only after BI is taken into use, which then contributes to operative and strategic BI capabilities discussed in chapter 3.2.1. Thus, empirical data supports also the third BI resource category identified by Sidahmed (2007).

Even though literature review of the present study recognizes data's high relevance to BI, it does not place it among the BI resources. However, empirical data strongly highlights the importance of high-quality data. All companies naturally have data, but its usability, reliability and quality are not usually known before starting a BI project. Issues like data inconsistencies between different systems or having data that is poorly maintained might reveal during the

BI project. Data that is understandable and able to provide interesting insights into users is therefore achieved during a BI project by combining, cleansing, and re-organizing raw data from operative systems. Another important aspect of data are serious data quality issues caused by the incorrect or inconsistent usage of operative systems. Then, data cannot be technically manipulated, and improving the data quality can require for example manual corrections, changes to source systems to prevent incorrect usage or re-training of users. In this case, it might not be possible to achieve BI capability, because it simply is not possible to build meaningful data models and visualizations on top of the data. Based on these observations, it can be argued that without high-quality data BI capability cannot be achieved. Therefore, high-quality data should be considered as a BI resource. Based on these observations, BI resources defined in literature review are supplemented with an additional element: high-quality data. Figure 4 summarizes the original BI resources (Sidahmed, 2007) supplemented with empirical data's observations of high-quality data.

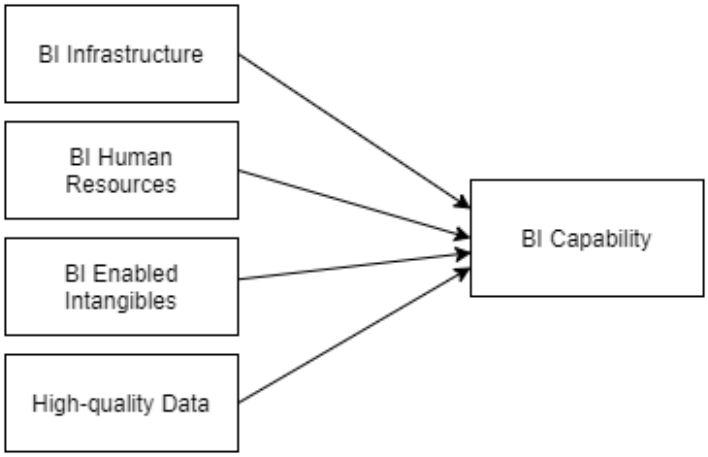

FIGURE 4 BI resources that contribute to BI capability

In addition to BI resources, literature review identified existing organizational capabilities that can either hinder or speed up the process of building BI capability. These capabilities include organizational processes, firm's existing IT assets and firm's history (Baker & Chasalow, 2015), from which only the "firm's existing IT assets" came up during the interviews. Because BI utilizes the data from operative systems, their condition can significantly affect the successfulness of a BI project. If operative systems are in a need of renewal, it might not be a sensible idea to start building BI on top of them. Instead, organization should start by renewing their operative systems. Thus, empirical data supports Baker and Chasalow's (2015) observation about the existing IT assets as a moderator between BI resources and BI capability. However, two other areas, organizational processes, and firm's history, did not come up in the empirical data, and therefore, this study cannot draw conclusions about those aspects.

Finally, empirical data reveals some resources that are required to build the BI resources. The first indication of organization's readiness to BI is the for-

mation and recognition of a BI need. Ramakrishnan et al. (2012) have recognized three business-driven purposes for BI: (1) to gain insights, (2) to establish a single version of truth and (3) to enable organizational transformation. Russell et al. (2010) argues that BI's purpose is to reduce uncertainty and support decision making by shedding light into strengths and weaknesses, market opportunities, threats, and future events. Even though these high-level purposes might affect in the background, SMEs' needs are on a more concrete level. SMEs will invest in BI only if its benefits to business are undeniable. Thus, companies will not even think about BI if they do not already have any idea how BI could help them. In this study this concept is called BI need and it can emerge in different areas of organization. For example, BI need might arise from technical challenges, such as challenges of combining data from multiple sources; from business, such as desire to understand sales data better; or from personnel risk that has emerged when one person is responsible for the whole BI system. However, formation of BI need as such is not enough. Organization should also discover that their problem could be solved with BI. For example, organization can keep working with their impractical tools, if they are not aware that problem could be solved with BI. Thus, the pre-requisite of BI resources is that organization has a specific BI need and has discovered that it can be solved with BI.

Second resource needed to build BI resources is the sufficient commitment of management. This is necessary to get sufficient financial and personnel resources and to ensure the correct prioritization of BI. Scholtz et al. (2010) have observed that commitment of management is not necessarily a significant success factor in SMEs, because it is often the management itself who starts IT initiatives (Scholtz et al., 2010), which is why decision to implement BI is already supported by management. However, empirical data of the present study contradicts with this observation, as many interviewees emphasized the significance of the commitment of management. It seems that also in SMEs initiative towards BI can arise outside of the management, for example from IT or finance team. Thus, engagement of management must be carefully considered to avoid resourcing and prioritization issues.

Concrete resources of BI project include time resources, financial resources, and personnel resources. Based on the empirical data, typical BI project takes approximately from two to three months. Prices of BI were not explicitly discussed during the interviews, but interviewees brought up that the most significant individual factor affecting the costs is the number of source systems: the more sources the more expensive project. Additionally, in service-based models' expensive up-front investments are not required, as costs are based on a monthly fee. Finally, there are two key resources required from the customer: project owner or manager and technical specialist. Availability of these resources is essential for running the project successfully. Similar resource needs have been recognized also by Yeoh and Koronios (2010) who argue that one of the CFSs of BI implementation is the balanced team combination. They state that BI should certainly be supported by the business, but technical skills are essential to operate with complex platforms, interfaces, legacy systems, and

tools. (Yeoh & Koronios, 2010) In a sense, this study confirms that this observation applies also to SMEs, but obviously in a smaller scale, because technical landscape is often much simpler.

To summarize, formation of BI capability requires four types of resources: BI infrastructure, BI human resources, BI enabled intangibles (Sidahmed, 2007) and high-quality data. BI resources are built during the BI project, which for its own part also require resources. These resources include the formation and recognition of BI need, commitment of management, time resources, financial resources, and personnel resources. Figure 5 summarizes the different resources and their relationship.

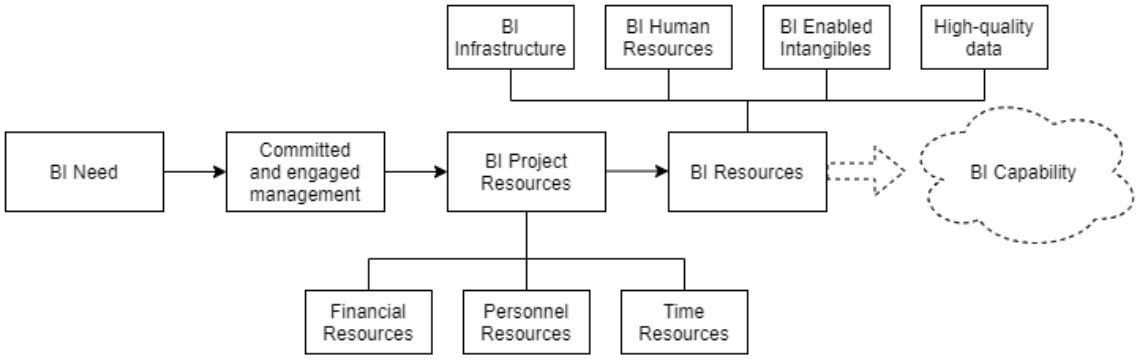

FIGURE 5 Resource requirements from SMEs and their relationship

6.1.3 Supportive research question 2: What kind of strategic efforts are required from SMEs to build a BI capability?

Second supportive research question aims to understand how organization should strategically support the development of their BI capability. In the literature review, it was concluded that the strategic activities presented by Llave et al. (2018) are directly applicable in the scope of this study, as their study was also conducted in SMEs. These include a formation of BI&A (BI and Analytics) strategy, selection of suitable organizational structure for BI&A strategy, selection of right projects for BI&A activities, and efficient management of BI&A projects. Additionally, organization should create business-driven data governance and manage risks effectively. Through these efforts, organization can then identify relevant data, decisions that need support and means for turning data into valuable insights. Core of these activities is so called "start small, think big" approach, in which organization keeps its focus on easy-to-deliver and benefit-yielding improvements, but has complete, innovative vision for BI in the background. (Llave et al., 2018) Additionally, literature review concluded that idea of gradual and iterative development approach (Yeoh & Koronios, 2010; Hallikainen et al., 2012) might be useful also in SMEs, although it originates from studies that were conducted in large companies.

Most of the activities presented by Llave et al. (2018) come up also from the empirical data. However, many of them are even smaller-scale and less structured than described in Llave's et al. (2018) research. For example, first

activity, "formulate BI&A strategy" is present in the empirical data, but instead of in-depth strategic analysis, it is enough to conceptualize and understand the potential benefits and opportunities of BI on a high-level. Second activity, "select appropriate organizational structures for BI&A strategy", did not arise from the empirical data, which is why this study will not take a stand on it. Third activity, "Select right BI&A projects", in turn, is quite extensively present in the empirical data. Majority of the interviewees argued that BI should be first implemented in the business area that will yield quick benefits to organization, and on the other hand, is rather simple to start with. This step also emphasizes the importance of committed management: because top management typically has the best visibility over all areas of organization, they often have the best impression of where BI is really needed. They also have the power to prioritize between different options. Regarding the fourth action "Manage BI&A projects effectively", empirical data highlights agile methods, active communication, and openness as cornerstones of project management.

Llave et al. (2018) highlight the importance of risk management. Empirical data reveals four types of risks that apply especially to SMEs: (1) insufficient commitment of management, which may lead to insufficient resources and mistakes in prioritization, (2) limited budget due to which unpleasant surprises during the project can in worst case stop the whole project, (3) limited personnel resources, meaning the dependency on specific persons, both from customer's and vendor's side, and (4) data quality issues that in worst case can stop the whole project. It is important to understand these risks and carefully follow and mitigate them through the BI project.

Llave et al. (2018) also highlight the importance of data governance and state that it covers for example availability, usability, and security of data, which can be achieved for example by creating guidelines about who can handle and display the data. Even though literature highlights the importance of data governance, it was discussed only incidentally and only with few interviewees, which is why this study cannot draw explicit conclusions about it.

Finally, both literature and empirical data reveal that the cornerstone of strategic efforts is a business-driven, iterative, and gradual development approach. Yeoh and Koronios (2010) observed that approach that focuses on small developments, which quickly produces measurable improvements, is typically more successful and risk-free than implementing BI as a "big bang". Similar observation was made by Llave et al. (2018) who argue that organizations should focus on things that are easy to deliver and thus, give quick wins to business. Therefore, based on the literature, organizations should focus on business-critical problems, which are easy to solve. On the other hand, organization should have a larger vision for BI and understand how BI could benefit them in the future. Then, as BI expertise gradually deepens, organization can start solving more complex problems with BI. This idea is crystallized by the concept of "start small, think big", which was coined by Llave et al. (2018).

As discussed in chapter 5.5.3, very similar conclusion can be drawn also from the empirical data. Firstly, empirical data highlights that is it important to

start with well-known area of business and simple analytics that will yield rapid and concrete benefits to organization, or as described by Yeoh and Koronios (2010), "deliver quick and measurable improvements". This way organization is drawn inside the BI, after which it can proceed to more complex areas of BI. Interview data also reveals, that even though organization starts small, larger potential of BI should be conceptualized already in the beginning, at least on a high level. Secondly, dividing overall BI capability into smaller sections is not just BI vendors' attempt to manage BI project better. Instead, it is the special nature of BI that requires this kind of iterativity. This has been noticed also by Kulkarni et al. (2017) who state that even after the implementation project, BI should be able to adjust to business and its changing requirements. This observation is supported by the empirical data: BI must be able to adapt to changes in operative systems as well as to the evolvement of organization's own capabilities. Because understanding of BI and its benefits increases along with the usage, it is natural that organization starts to gradually find areas of BI that are even more critical and interesting to them. Organizations should understand this special nature of BI: instead of trying to fix everything at once, they should be prepared to give BI enough time.

Based on these observations, it can be concluded that iterative and gradual development approach presented by Yeoh and Koronios (2010) as well as Hallikainen et al. (2012) applies seamlessly also to SMEs. BI capability should be developed incrementally, once piece at a time. Focus should be kept in areas that are easy to solve and bring concrete business benefits to organization. Thus, Llave's et al. (2018) "start small, think big" approach can be argued to be the cornerstone of strategic steering of BI activities in SMEs. Then, visionary, and innovative desire to constantly develop the organization gives wings to the strong business-driven focus on concrete problems, which is the core of all BI development in SMEs.

6.1.4 Evaluation of the framework for the BI capability building process

Llave's et al. (2018) framework for BI&A value creation acts as a theoretical foundation for the present study (Figure 2). This chapter discusses how empirical data fits to theoretical framework, presents adjustments to model created in literature view and finally, summarizes the results of this study. Content of the Llave's et al. (2018) model has been described in more detail in chapter 3.3, where original model was renamed to "Framework for BI Capability Building Process" and adjusted to better fit the scope of this study (figure 3). This model is examined next and supplemented with the findings from empirical data.

In the framework for BI capability building process, BI resources are converted to BI capability through "The BI Conversion Process", which is supported by strategic activities. After that, BI capability is turned into BI impact via "The BI Use Process". In Llave's et al. (2018) study BI Impacts refer to the achievement of the desired outcome, such as better products and services. On a high level, empirical data fits well to this model. Order of the phases is the same, meaning that BI resources precede BI capability, which then precedes BI im-

pacts. Strategic support is recognized as a key enabler of the formation of BI capability. However, as the present study is more interested in the phase where BI capability is built, "The BI Conversion Process" phase is elaborated further and supplemented based on the empirical data.

Firstly, "BI Resources", which based on the literature review is the first step of the process, is divided into two parts. Latter part will keep the title BI resources, which refers to BI infrastructure, BI human resources, BI enabled intangibles (Sidahmed, 2007) and high-quality data. However, before organization can have these BI resources, they must be built. Therefore, the second part takes a step back and utilizes the original concept from Llave et al. (2018) study: BI investment. In the literature review, this concept was equated with BI resources, but based on the observations from empirical data, BI resources are achieved through a BI project, during which a BI vendor builds the BI resources for a customer. Thus, building of BI resources as such requires resources and investments from the organization, which is why it cannot be the first step of BI capability formation.

Furthermore, before the BI investment, there is yet another step, which in this study is called "BI need". Because SMEs focus tightly on running the operative business, they will not invest in BI if they do not think that it will have concrete business benefits. Therefore, decision to invest in BI starts by the emergence of BI need, after which organization has to recognize this need and realize that BI could potentially solve it. Thus, BI resources, or even the BI investment, will not take place if organization does not have a concrete need for BI, or if they have not identified their need. Therefore, BI need is added as an additional step preceding the BI investment, and even the "BI conversion process". Thus, BI need is the initiator of the BI capability.

Interestingly, BI need is just not an initiator of BI capability, but it also reflects the end point of BI, which in this study is referred as BI impact, the achievement of the desired outcome. For example, organization's BI need might be to streamline the work by eliminating the need to login to different systems and manually compare data from separate screens, and as a BI impact, they have more effective work, better data analysis quality and reduction of errors. Another example of a BI need is that organization wants to understand their sales data better, and as a BI impact, they are able to make their sales more efficient, as they understand what products sell in which scenarios. Yet another example is that organization wants to mitigate personnel risk by reducing the dependency on individual employees, and as a BI impact, the continuance of the operation is ensured as BI skills are spread around a larger group of people.

In addition to adjustments to first part of the model, impact of the strategic activities is extended to cover the whole process, and even the iteration between different steps and BI projects. By contrast, the original model placed it only under the "BI conversion process". Formation of BI capability requires gradual approach, and therefore it is necessary to steer this process strategically to ensure for example a correct prioritization, business-driven approach, and longer-term plan for achieving the BI capability.

Both literature and empirical data highlight the importance of iteration, which is why the adjusted model will keep the iteration lines from the original model. In practice, this means for example that BI Impact, such reduction of manual work, can lead to increase of BI resources, which in this example could be the users' BI skills because now they can focus on the valuable data analysis instead of spending much time with laborious manual tasks, such as collecting and combining data in Excel (BI Impact → BI Resources). Another important example is the emergence of new BI needs, which may arise at any point of the process. For example, when data is visualized and concretized, organization might notice that the quality and amount of data is inadequate, which leads to need to collect better data (BI resource → BI need), or when organization starts to provide BI to users who need it, also other user groups notice how they could benefit from BI (BI capability → BI need). However, iteration from BI resources, BI capability and BI impact to BI investment was intentionally left out. As mentioned already before, in SMEs all BI investments are always based on a real, business-driven need. If there is not a such need, investment to BI will not take place and therefore, investment to new areas of BI must always flow through BI need. Figure 6 presents the renewed version of framework for BI capability building process and summarizes the results of this study.

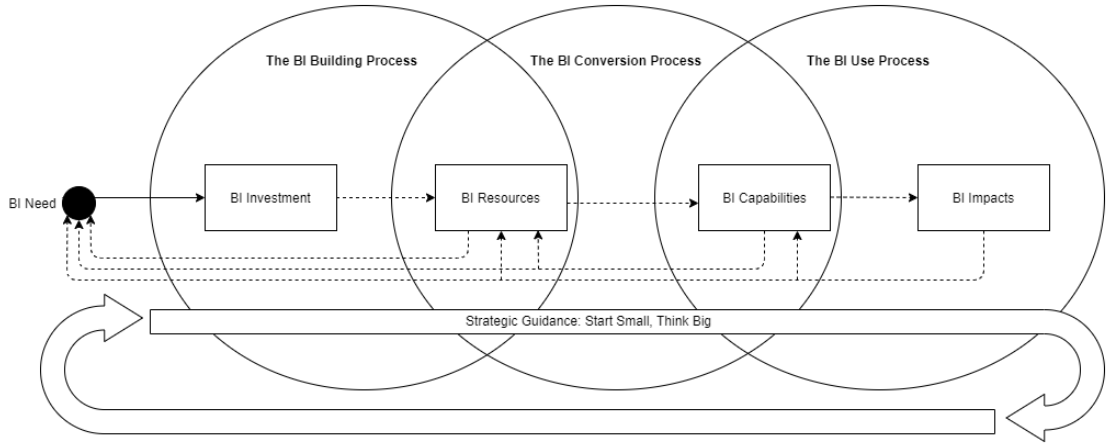

FIGURE 6 Renewed version of the framework for the BI capability building process

6.2 Limitations and contributions

Limitations of this study include the limited number of prior studies, low number of interviewees and ambiguity of the concept of SME. Firstly, only few prior studies have been conducted in SMEs, meaning that majority of the theoretical observations are based on the studies that are conducted in large companies. As observed already before, large companies differ significantly from SMEs in regards their BI needs. Empirical data naturally aims to shed light to usability of BI in SMES, but as the themes of the interview are based on the theory, some areas that are relevant for SMEs in particular might have been unintentionally

disregarded. Even though theme interview is a flexible data collection method and allows adjustments during the interview, it cannot be guaranteed that all relevant topics have been covered during the interviews.

Second limitation is the low number of interviewees. There were only six interviewees, which is very low number for drawing theoretically reliable conclusions. This will naturally weaken the reliability of the study. Additionally, topic has been researched purely from BI vendors' perspective, and therefore, this study cannot take a stand on how SMEs themselves see the formation of BI capability. However, these limitations are mitigated by the fact that all interviewees were from different companies and had different backgrounds. They all have experience from multiple BI implementations in SMEs in different industries, and therefore, despite the low number of interviewees, data still covers a relatively big number of SMEs.

Finally, the ambiguity of the concept of SME can weaken the reliability of the study. During the interview it was emphasized that this study focuses solely to SMEs, but as all interviewees have experience from BI implementations in both SMEs and large companies, it cannot be guaranteed that interviewees reflected their observations only from the perspective of SMEs. Therefore, empirical data might also contain observations that apply mainly to large companies.

Despite its limitations, this study provides both theoretical and empirical contributions. From theoretical perspective, this study provides a clarifying perspective to the definition of BI capability. For example, this study identified three general areas of BI capability: strategic, operative, and technical BI capability. These areas describe in more detail what BI capability includes. Additionally, this study describes the resources and strategic efforts through which BI capability can be achieved. Therefore, this study clarifies the concept of BI, which traditionally has been rather ambiguous.

From empirical perspective, this study has two main contributions. Firstly, this study clarifies the formation of BI capability in SMEs, which has traditionally been an untypical area of application for BI. This study crystallizes especially the resources that are needed to achieve BI capability (BI infrastructure, BI human resources, BI intangibles, and high-quality data), and on the other hand, the resources that are needed to achieve the BI resources (BI need, commitment of management, financial resources, time resources and personnel resources). BI need was especially important observation as it clarifies why an SME even starts to consider the usability of BI in their organization. Without BI need, and recognition of it, BI capability cannot be established in SMEs. This differs from large organizations that might be able to invest in new technologies just to experiment whether they would provide them benefits.

Secondly, based on the empirical data Llave et al. (2018) framework was supplemented with additional elements: firstly, the BI need was added as a starting point for the formation of BI capability. Secondly, a new phase "The BI Building Process" was added to describe how BI resources are built. It is important to notice that Llave et al. (2018) framework describes the topic from the perspective of value creation, whereas this study focuses on the building of BI

capability which is the first part of the value creation process. Therefore, elements that were added to Llave et al. (2018) framework are supplementary and describe the topic from different perspective, and do not overturn Llave et al. (2018) observations. To conclude, this study provides SMEs a tool to explore their own readiness to build a BI capability. This study also clarifies the challenges that can be solved with BI and what building a BI capability requires from an organization. Therefore, this study succeeds in its goal to shed light to BI in SMEs and proves that also SMEs can gain benefits from BI.

6.3 Future research

Future research should aim to deepen the knowledge of formation of BI capability in SMEs. Because BI has not been extensively studied in the scope of SMEs, it would be interesting to understand even better how BI capability can be efficiently built in SMEs. As SMEs are extremely vulnerable for unpleasant surprises, such as sudden budget exceeding, future research should further clarify the process of building BI capability and describe how SMEs in particular could get the most out of BI. The present study has been conducted from the perspective of BI vendors, which is why in future it would be especially interesting to conduct similar study, but from the perspective of SMEs. For example, by interviewing SMEs that have implement a BI, it could be clarified how SMEs themselves see the formation and expansion of their BI capability.

Another way to shed light to this topic would be to conduct a case study in which it would be followed how BI capability is built piece by piece, and how SME, with the support of BI vendor, grows their BI skills and knowledge. It would be especially interesting to see how SME considers the formation of their BI capability in a longer period of time, for example before the project, after the project and one year after the project. Has BI changed their ways of working? Has BI capability been extended for example by adding new sources systems or user groups? Has the satisfaction of the personnel increased when the manual work has decreased? These two types of studies would efficiently supplement the present study's observations of the required resources and strategic efforts, and thus, provide support to SMEs on their way towards the BI capability.

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APPENDIX 1 THEME INTERVIEW FORM

Theme 1: Background information about the company, their BI solutions, and interviewee

- What is your role in the company and how long have you been in your current role?
- What kind of BI solutions does your company offer? What does the solution include (e.g., technology, education, support, consulting, etc.)?
- To what kind of companies do you offer BI solutions? For example, is the customer base limited to certain industries or companies of a certain size?

Theme 2: Typical BI deployment projects in an SME

- What kind of BI solutions do customers typically buy? Do they simply want the technology, or do they also want also training, support and consulting?
- What is a typical BI project like? How long will it take?
- What kind of problems SMEs want to solve with BI? Are the problems operational in nature (e.g., monitoring production data) or strategic (e.g., gaining a deeper understanding of sales data)?
- What kind of objectives does BI serve in SMEs? Do they want, for example, to find new perspectives, enable wider organizational change, or simply get more support for decision-making?
- Do the customers usually have a clear idea of what they want to achieve with BI? If the objectives are unclear at the beginning, how do you start refining them?

Theme 3: BI technology in SMEs

- What kind of technologies are typically needed? What kind of changes are usually made to the customer's technologies?
- What kind and how many integrations are typically needed?
- Are companies, in principle, collecting enough data or do you introduce new data sources during the project?
- Is data usually collected comprehensively from all possible sources or in a focused way, to solve a specific problem?
- How is data quality monitored and maintained?

Theme 4: BI skills in SMEs

- What is a typical BI user like in the company?
- What kind of skills are required from users to use BI smoothly?
- Do customers typically have previous experience in data analysis?
- How much training and support does it take to deploy the BI tool?
- Can you think of a situation where more training and support has been required than usual?
- What kind of support do customers need after the project?

Theme 5: Strategic guidance of BI in SMEs

- How do you manage and track BI projects?
- What are the risks associated with BI projects in SMEs?
- Are customers usually aware of the culture of information-based management?
- Is there change resistance in BI projects? What is the atmosphere at BI projects like?

Theme 6: Summary – Best Practices & Lessons Learned

- What are the most important principles and best practices that every BI project should follow?