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Managing user-related challenges of Self-Service Business Intelligence

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ABSTRACT (MAX. 200 WORDS):
Organizations today are heavily reliant on data to make the right decisions, and Self-Service Business Intelligence (SSBI) rose to prominence with the promise to solve some of the problems related to traditional Business Intelligence. Despite the promises of SSBI, many initiatives fail or do not reach their full potential. Related literature has identified user-related challenges of SSBI, but no study has solely focused on formulating recommendations on how these can be managed. This study aims to fill this research gap by identifying user-related challenges of SSBI and creating a set of recommendations for how these can be managed. A qualitative interview study was conducted, including professionals and users from the industry. The findings highlighted several user-related challenges, such as accessing and using data and users lacking the right skills and knowledge to work with SSBI in a self-reliant manner. The collected data provided insight that allowed the researcher to formulate several recommendations on how these challenges could be managed. The results highlight the importance of providing users of SSBI with the right training and support to work with the tools, providing users with the right set of tools, and creating an environment that enables and promotes the use of SSBI.

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1 Introduction

New technological advancements such as social media, smartphones, and sensor technology have resulted in an increasing amount of data being generated at a constantly increasing pace (McAfee & Brynjolfsson, 2012). Through data analysis, patterns in the data can be identified and structured to generate information, which has proven valuable for businesses-leaders by providing them with insight about their organization (Davenport & Harris, 2017) and help them achieve a competitive advantage (Berndtsson, Lennerholt, Svahn & Larsson, 2020; McAfee & Brynjolfsson, 2012). Because of this, decision-makers have become more and more reliant on decision support for managing information and are today using various decision support applications to make data-driven decisions based on facts instead of only relying on intuition and experience (McAfee & Brynjolfsson, 2012; Davenport & Harris, 2017). Business Intelligence (BI) provides support in this direction and has emerged as an umbrella term that includes and combines a set of technologies, applications, and processes for accessing and analyzing data to help decision-makers make better decisions on time (Wixom & Watson, 2010). Today, BI has a given place in the modern organizational structure and continue to top IT investments (Cognizant, 2019), since it is no longer seen as something "nice to have" but is now a prerequisite to survive and thrive in today's harsh and rapidly changing business climate (Watson, 2010; Davenport & Harris, 2017).

Despite the importance of data analytics, many organizations have extensive problems with the transformation to become more data-driven and meet this increased need (Berndtsson et al. 2020; Davenport & Harris, 2017). To move toward a data-driven approach and meet the needs for data analysis across all organizational levels requires an environment that offers flexibility and fast decision support (Passlick, Guhr, Lebek, & Breitner, 2020). However, the traditional BI environment is often not able to meet these demands since it is considered slow, inflexible, time-consuming, and heavily reliant on power users which leads to BI becoming a bottleneck (Ponniah, 2010; Duy, Thomas, Cho, De, Jun Choi, 2018; Lennerholt, Van Laere & Söderström, 2020). In a traditional BI environment, a distinction is usually made between power users, such as technical IT specialists, and casual users, as non-technical decision-makers (Eckerson, 2012; Alpar & Schulz, 2016). When casual users of a traditional BI environment want to make a data-driven decision, a request and response scenario occurs, best described as a "merry-go-round" (Ponniah, 2010; Lennerholt, Van Laere & Söderström, 2018). Power users interpret incoming requests from casual users and then combine different types of data, analyze it, and then visualize the result to create customized reports as requested (Lennerholt, Van Laere & Söderström, 2018; Imhoff & White, 2011). If casual users want to analyze the situation from another angle, the process flow must start over, which is time-consuming. As more data becomes available and more users want to make data-driven decisions, rather than relying on gut feeling, the workload, and pressure on power users increases who find it difficult to satisfy and keep pace with the demand for analysis (Ponniah, 2010). This increasing demand leads to a slowdown in the speed of the "merry-go-round", where BI and the request-response relationship become a bottleneck within organizations, resulting in reports sometimes taking months to deliver (Lennerholt, Van Laere & Söderström, 2020; Lennerholt, Van Laere & Söderström, 2018; Imhoff & White, 2011).

The ever-increasing need to make data-driven decisions combined with power users' inability to meet users' needs, result in longer lead times for reports, and the request to conduct and assemble their own analyses by decision-makers have resulted in organizations looking for

alternative approaches to traditional BI (Imhoff & White, 2011). Self-Service Business Intelligence (SSBI) has emerged as a new approach to BI that enables casual users, without the technical knowledge, to become more self-reliant by accessing data, performing analyzes, and creating analytical reports on the fly without the involvement of power users (Imhoff & White, 2011; Alpar & Schulz, 2016; Lennerholt, Van Laere & Söderström, 2020). In a survey by Logi Analytics (2015) 91% of respondents answered that it is important for business users to be able to access the data and information they need without interfering with a power user or the IT department. SSBI has the potential to empower and shift the role of the casual user, from solely being an information consumer, to being an information producer (Bani-Hani, Tona & Carlsson, 2018; Eckerson, 2012). Becoming more self-reliant means benefits for casual users, power users, and the overall organization. Casual users get easier and faster access to analysis, power users get a reduced workload and thus a reduced pressure on themselves and can instead focus on more value-adding activities, and the organization that gets more efficient, which in return can lead to comprehensive cost savings (Imhoff & White, 2011; Lennerholt, Van Laere & Söderström, 2018).

A survey from Dresner Advisory Services (2020) ranked end-user self-service capabilities at number 6 (out of 37 possible) amongst the top technologies and initiative strategic to BI and a new study from BARC (2022) ranked self-service capabilities as number 5 (out of 20 possible) amongst the most important Data, BI and analytics trends. The expectations on SSBI are seemingly high amongst practitioners, which is not strange considering that the leading consulting group Gartner (2018), predicted that SSBI users would produce more analysis than data analysts by 2019. SSBI is seemingly an important tool that shows high potential for organizations and practitioners to democratize data analytics. Despite this, merely investing in the technology and installing SSBI software does not necessarily guarantee success and lead to a better BI environment, as it is often more complex than it looks (Lennerholt, Van Laere & Söderström, 2018; Eckerson, 2012; Passlick et al. 2020). In this context, the implementation and use of SSBI face several challenges, which may be the reason for why many SSBI initiatives fail or do not live up to their expectations (Logi Analytics, 2015; Alpar & Schulz, 2016).

1.1   Problem

In contrast to traditional BI, where challenges are widely recognized in academia and have reached a high level of maturity (Weiler, Matt & Hess, 2019), the academic literature on user related SSBI challenges and how to address them is scarce (Lennerholt Van Laere & Söderström, 2020). Passlick et al. (2020) have identified factors that may have a negative impact on the intention to use SSBI applications. Lennerholt Van Laere and Söderström (2020) and Lennerholt Van Laere and Söderström (2018) have identified several user-related challenges that may constitute a barrier to the implementation and use of SSBI. With their study, Weiler, Matt, and Hess (2019) have contributed to the challenges associated to self-reliant users to understand the effect of user uncertainty during SSBI implementation. However, several of the previous studies on SSBI challenges has mainly focused on identifying challenges that organizations and their users may encounter less on how these challenges could be managed (e.g., Lennerholt, Van Laere & Söderström, 2020; Lennerholt, Van Laere & Söderström, 2018; Weiler, Matt & Hess, 2019). Earlier research that attempted to investigate how challenges could be managed has primarily focused on technological developments, implementations, and corresponding technological challenges (Johannessen & Fuglseth, 2016; Schlesinger & Rahman, 2016). Some researchers have, in their studies, touched on how certain user-related

challenges can be managed and given recommendations for how to handle them to guide the SSBI initiative, and highlighted success factors that are essential to succeed with SSBI (e.g., Passlick et al. 2020; Bani-Hani, Tuna & Carlsson 2018; Eckerson, 2012; Stodder, 2015; Lennerholt, Van Laere & Söderström, 2020). However, managing challenges have not been within the main scope of the existing research and provide little to no support on how to best address user-related challenges of SSBI.

The lack of scientific research on challenges associated with the use of SSBI and, more specifically, recommendations on how to address these calls for more research to increase knowledge in the field, close the research gap, and in the long run, lower the number of SSBI initiatives that do not reach their full potential or fail (Logi Analytics, 2015). Furthermore, researchers within SSBI argue that the literature on challenges deriving from SSBI is immature and more research on SSBI challenges is needed (Lennerholt, Van Laere & Söderström, 2020). Moreover, it has been stated that future research should focus on validating and extending identified challenges and try to identify solutions for how to best manage these to increase the adoption rate of SSBI initiatives (Lennerholt, Van Laere & Söderström, 2020; Lennerholt, Van Laere & Söderström, 2018; Weiler, Matt & Hess, 2019).

Based on the seemingly high expectation of SSBI among practitioners (e.g., BARC, 2022; Dresner Advisory Services, 2020; Gartner, 2018) with its great potential in combination with its low success rate, low adoption rate, and the relatively low amount of research on user-related challenges within SSBI, makes it an interesting and important area to investigate more in-depth. Therefore, this research paper will further examine user related SSBI challenges to validate previous challenges and identify new ones, but above all, try to guide practitioners on how they can manage these challenges by formulating recommendations on how to best overcome them.

1.2 Research questions

The scientific literature on SSBI displays a lack of knowledge regarding how identified user-related challenges can be managed. To address the identified problem, the following research questions have been formulated.

RQ1: What user-related challenges do organizations face when using Self-Service Business Intelligence?

RQ2: What factors are critical for managing identified challenges associated with the use of Self-Service Business Intelligence?

Throughout this study the term user-related challenge is used extensively, in the context of this study this refers to factors that can have a negative impact on end-user's ability to use a tool or system to achieve a desired goal or outcome.

1.3 Purpose

Our research aims to study the problems users encounter while working with SSBI, and through a qualitative interview study uncover how professionals themselves think these could be mitigated and handled. By collecting insights from both users and experts within the field, the researchers set out to identify and conclude general recommendations that can aid practitioner and minimize the number of SSBI initiatives that fail or do not reach their full potential. This study will contribute to this relatively unexplored topic of SSBI, by closing the identified research gap and lay the foundation for future research on the topic.

1.4 Delimitation

The field of BI can be broken down into several sub-fields. Hence delimitations need to be made. The BI phenomenon will be discussed in an overall format, where essential elements included in the concept that supports this study's overall purpose will be discussed. However, the scope of the research paper is to identify challenges linked to the niche sub-field SSBI, where the focus will be. BI's other subcategories are not of interest to this study and will thus not be elucidated. Moreover, for the study to be more manageable and, in the end, achieve a high degree of validity and usability in practice, the research will be limited to SSBI, associated user-related challenges, and how these successfully can be managed. It is not challenges related to the implementation process that is the focus of this research, but rather user-related challenges related to the use of SSBI within organizations that have already implemented the technology. Therefore, the research will be limited to users who use SSBI applications, and experts with in-depth experienced on the topic of SSBI. The study will further be limited to large enterprises within the EU and will not address industry specific user-related challenges of SSBI, the result will therefore be highlighted in a more general context. According to Alpar and Schultz (2016) users within SSBI can be divided into several different user groups based on their ability. However, the challenges and recommendations derived from this study will not be adapted after such a classification.

2 Theoretical background

In the following chapter, research related to Business Intelligence and Self-Service Business Intelligence are presented and summarized, along with the specific challenges and success factors related to SSBI, as highlighted by previous research. The theoretical foundations which this study and the succeeding chapter are based upon, is laid in this chapter.

2.1 Business Intelligence

The success of most organizations is highly dependent on the quality of their decision-making (Davenport & Harris, 2017). In response to an ever-increasing amount of data to analyse and growing pressure to deliver more useful and quicker responses to customers, organizations have turned to Business Intelligence (BI) applications to improve organizational decision-making (Isik, Jones & Sidorova, 2011). Using decision support systems for better decision-making is not a new phenomenon. As early as the 1970s, decision support applications emerged to help managers plan and optimize specific business goals and activities better. The progress in the field resulted in the emergence of the term and the academic concept of decision support systems (DSS) (Wixom & Watson, 2010), which is an area of the information systems (IS) discipline that focuses on supporting and enhancing managerial decision-making (Hayen, Rutashobya & Vetter, 2007). Despite the greater availability of statistics, DSS did not flourish during the time and evolved into several subfields and applications, such as Expert Systems and Executive Information Systems (Davenport & Harris, 2017; Wixom & Watson, 2010). The focus on managing data first became essential when vast amounts of data became available from transaction systems such as Enterprise Resource Planning (ERP) and Point of Sale (POS) systems and later from the internet. This focus area of DSS was referred to as OLAP (online analytical processing), which later became Business Intelligence (Davenport & Harris, 2017). The term Business Intelligence can be dated back to the early 1990s when it was coined by Howard Dresner, a researcher at Gartner Group, to describe concepts and methods to improve business decision making by using fact-based support (Negash & Gray, 2008; Wixom & Watson, 2010). The term came to reach wide adoption in the field of DSS and OLAP. It became the natural emergence of various technologies such as data warehousing, data cleaning, and visualization, which were combined to create a more intelligent environment, replacing the terms previously used to describe fact-based support (Negash & Gray, 2008; Davenport & Harris, 2017). Ever since the term was coined, various definitions of BI have emerged and been used, but there is no consensus in the literature on a single definition. Negash and Gray (2008) describe BI as data driven DSS and defines it as:

> "Systems that combine, data gathering, data storage, knowledge management, with analysis to evaluate complex corporate and competitive information for presentation to planners and decision maker, with the objective of improving the timeliness and the quality of the input to the decision process... BI systems provide actionable information and knowledge at the right time, in the right location, and in the right form" (Negash & Grey, 2008, P. 176).

The definition of the phenomenon BI as a collective term for tools, methods, and technologies is recurring in the literature, where it has been defined as an umbrella term to describe the:

"Technologies, applications, and processes for gathering, storing, accessing, and ana-
lysing data to help users make better decisions" (Wixom & Watson, 2010, P. 14).

For the purpose of this study, BI is defined by considering the relationship between the previ-
ous definitions. BI is the process that enables data-driven decisions for decision-makers using
tools, methods, and technologies.
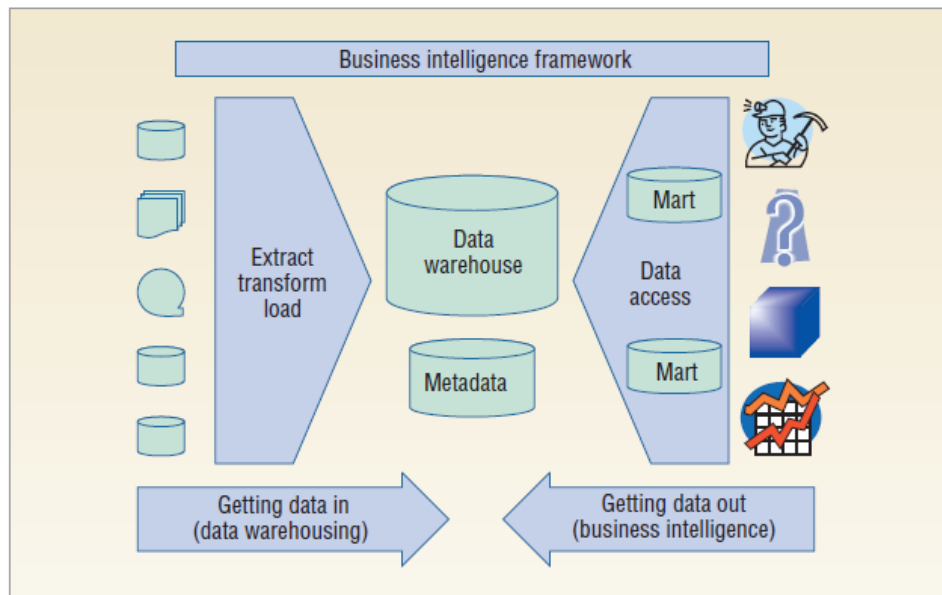
Figure 1: The Business Intelligence Framework (Watson & Wixom, 2007, P. 97)

Figure 1 shows an overall illustration of a BI environment and the process for BI that includes
two main activities, getting data in and getting data out (Watson & Wixom, 2007). Getting
data in refers to data warehousing and is about loading data from the organization's internal or
external source system into a data warehouse (DW) (Watson & Wixom, 2007). The data
warehouse is the core of BI (Lennerholt, Van Laere & Söderström, 2018), and can be de-
scribed as a repository for integrated information with access that allows analysis of data to
support decision-making (Hayen, Rutashobya & Vetter, 2007). It is characterized by four ele-
ments "subject-oriented, integrated, non-volatile, and time-variant collection of data" (Inmon,
2005, p. 29). The process of retrieving data from internal or external data sources, converting
collected data, and placing it in a data warehouse is referred to as ETL (Extract, Transform,
and Load). The ETL system (or process) is everything between the operational source systems
and the DW/BI presentation area. It makes it possible to retrieve data from the original source,
do something with it, such as pre-processing, and load it into tables that users can explore
(Kimball & Ross 2013). Loading data into the data warehouse does not in itself provide much
value for an organization. Only when users and applications utilize this data to make decisions
does that value occurs, which is what the process of getting data out refers to (Watson &
Wixom, 2007). This has previously been primarily done through OLAP, which creates queries
against the data warehouse to generate advanced analytics (Watson & Wixom, 2007). How-
ever, technological advances in machine learning, data mining, and newer generation of eas-
ier-to-use tools that can operate on an entire dataset have emerged and attained substantial
popularity, such as Tableau and QlikView, which has come to replace OLAP to a greater ex-
tent (Davenport & Harris, 2017).

BI is well-established today in organizations and a must-have since data-driven organizations are more likely to capitalize on business insights than organizations that are not data-driven (Berndtsson et al. 2020). BI is today often the foundation that gives organizations a competitive edge and the opportunity to identify new business prospects (Imhoff & White, 2011), which is why organizations invest billions of US dollars within the field (Anjariny, Zeki & Hussin, 2012). Despite all the interest and investments, not all BI initiatives live up to expectations (Isik, Jones & Sidorova, 2011). Many organizations find it challenging to meet the demand for information and analysis and struggle to derive value from investments to become data-driven, which means that potential data-driven decisions do not materialize (Stodder 2015; Imhoff & White 2011; Berndtsson et al. 2020). BI in the form described in this chapter can also be referred to as traditional BI (Ranjan, 2008). In traditional BI, power users and technical specialists, such as the IT department, often provide casual users as non-technical decision-makers with the requested information (Imhoff & White, 2011). The previously mentioned benefits and opportunities that organizations strive for with BI leads to a higher demand for data and reports, which places increased pressure on the power users, who may have difficulty delivering data and reports on time, which leads to BI becoming a bottleneck (Lennerholt, Van Laere & Söderström, 2020). Figure 2 illustrates the process when casual users request information from power users and their insufficient attempts to respond to requests.
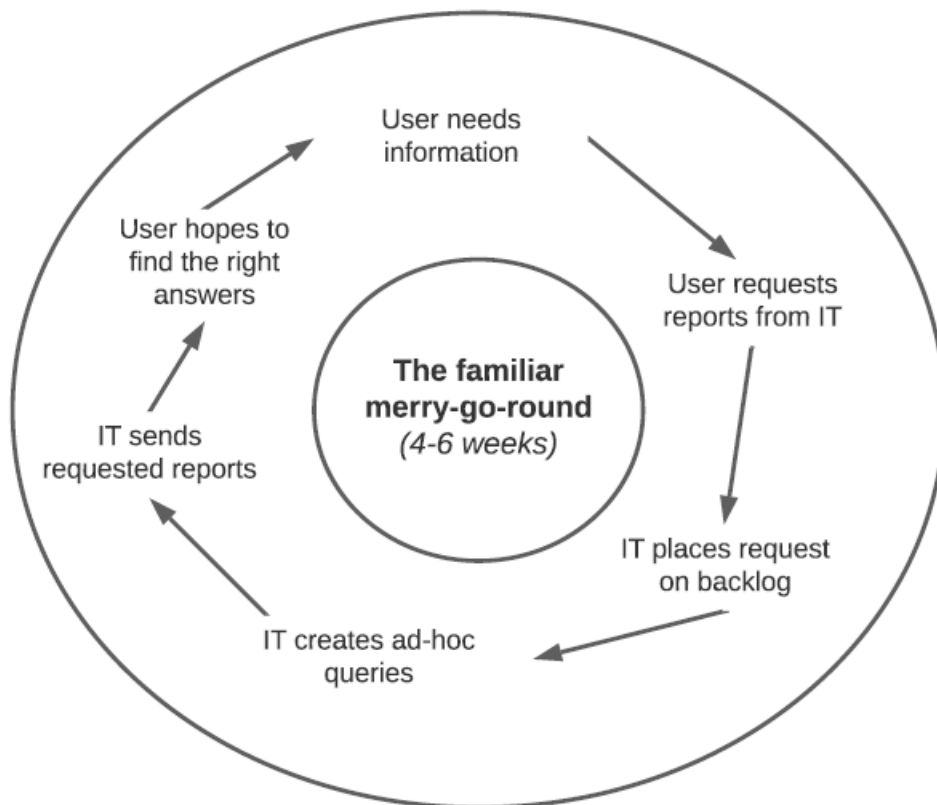
Figure 2: Cycle when users request new data (Ponniah, 2010, P.11)

To meet and be able to act in today's dynamic business market, a short reaction time is required in this context. The merry-go-round in traditional BI and standard reporting, shown in Figure 2, contradict these frequently changing business needs and requirements, whereas traditional BI is often unable to meet these demands sufficiently (Passlick et al. 2020). Table 1 briefly summarizes some of the shortcomings of traditional BI.

Table 1: Shortcomings of traditional BI

Shortcomings	Authors
Power users obtain too many ad-hoc requests, resulting in an extensive overload. With limited resources, power users cannot respond to the countless requests in a timely manner.	(Ponniah, 2010; Alpar & Schulz, 2016; Bani-Hani, Pareigis, Tona & Carlsson, 2018; Imhoff & White, 2011; Lennerholt, Van Laere & Söderström, 2018)
Requests are constantly changing all the time. Casual users need more reports to extend and understand the previous reports.	(Ponniah, 2010; Alpar & Schulz, 2016; Imhoff & White, 2011)
Casual users get into the loop of asking for more and more additional reports, leading to casual users asking for every potential combination directly, which increases the load on power users even more.	(Ponniah, 2010)
Casual users must rely on power users to provide the data/information. They are not able to access the report themselves interactively.	(Ponniah, 2010; Bani-Hani, Tona & Carlsson, 2018; Lennerholt, Van Laere & Söderström, 2018; Michalczyk, et al. 2020; Weiler, Matt & Hess, 2019)
The information environment for strategic decision-making must be very flexible for analysis. Power users have been incapable of providing such an environment.	(Ponniah, 2010; Passlick et al. 2020; Weiler, Matt & Hess, 2019)

The shortcoming of traditional BI, as highlighted in Table 1, increased practitioners' interest in other solutions to solve some of the highlighted problems. This paved the way for a new variant of BI, that utilized a more user-friendly approach that allowed the casual users to perform data analysis on their own, without the interference of power users (Imhoff & White, 2011; Alpar & Schulz, 2016). This is referred to as Self-Service Business Intelligence and will be further examined and explained in the following chapter.

2.2 Self-Service Business Intelligence

As highlighted in the previous chapter, there are many challenges related to BI. In a survey conducted by Imhoff and White (2011), 78% of the respondents wanted a faster time to value from their BI solutions, explaining the increased demand and interest in other BI solutions to decrease the casual user's dependency on power users and IT departments to create their reports. This, in conjunction with technological advancements that focused on making digital solutions more self-service oriented resulted in a new set of BI solutions and tools being developed, with a new dimension and focus on self-service (Bani-Hani, Tona & Carlsson, 2018). BI tools with self-service capabilities are called Self-Service Business Intelligence (SSBI) and can help empower business users by making them less reliant on power users and IT departments by offering an environment and interface that allows them to create their own reports from large sets of data (Imhoff & White, 2011; Alpar & Schulz, 2016; Bani-Hani, Tona & Carlsson, 2018). The self-service phenomenon is nothing new but has become increasing popular in parallel with technological developments that allow users of different technologies to be more self-reliant. This is done by making service offerings more convenient for the consumer by turning them into active participants in service delivery, rather than passive audience (Scherer, Wünderlich & Von Wangenheim, 2015). This approach further offers the possibility for service providers to lower the price of service delivery since this can be automated using digital technology (Scherer, Wünderlich & Von Wangenheim, 2015; Curran & Meuter, 2005).

The adoption and use of self-service approaches is today widespread in various fields and industries, such as by banks to automate transactions, airlines for self-check-in and supermarkets for self-checkouts (Scherer, Wünderlich & Von Wangenheim, 2015; Curran & Meuter, 2005). The same principles have been applied in SSBI, with the goal of making end-users more self-reliant by giving them the ability to perform their own data analysis and create their own reports (Imhoff & White, 2011; Alpar & Schulz, 2016; Bani-Hani, Tona & Carlsson, 2018). The potential benefit of SSBI is further highlighted in a survey from Logi analytics (2015) that showed that the number of report requests sent to the IT department was lowered by 47% in organizations that implemented and used SSBI solutions. Resulting in less strain and pressure being put on the IT department since they no longer need to create all the reports, allowing them to put their resources into other valuable projects (Imhoff & White, 2011) and achieve a significant amount of costs savings (Schlesinger & Rahman, 2016). SSBI is considered an important aspect of BI, with 62% of the businesses in a survey conducted by Dresner Advisory Services (2020), rating SSBI capabilities as either "very important" or "important". Offering self service capabilities to BI has further shown to be valuable as further highlighted by Dresner Advisory Services (2020), covering technologies and initiatives strategic to BI, where end-user self-service capabilities were ranked number 6 out of 37 BI-related technologies, highlighting its importance. Another study performed by BRAC (2022), based on the responses of 2396 IT-professionals, ranked SSBI as the fifth most important trend in data, BI and analytics, with the overall grade of "important".

There are as highlighted by Bani-Hani, Tona and Carlsson (2018) many definitions of SSBI, with some viewing it as a facility within the BI environment, some as a BI system and some as an ability, and as of now there is no unanimous definition. Four popular and commonly used definitions are shown in Table 2.

Table 2: SSBI Definitions

Definition	Author(s)
"The facilities within the BI environment that enable BI users to become more self-reliant and less dependent on the IT organization. These facilities focus on four main objectives: easier access to source data for reporting and analysis, easier and improved support for data analysis features, faster deployment options such as appliances and cloud computing, and simpler, customizable, and collaborative end-user interfaces"	(Imhoff and White, 2011, p.5)
"Self-service business intelligence is defined here as end users designing and deploying their own reports and analyses within an approved and supported architecture and tools portfolio"	(Gartner Glossary, n.d.a)
"Self-service BI builds upon collaborative business intelligence and user governance to create an environment where users can easily create and share insights in a managed and consistent fashion"	(Dresner Advisory Services, 2020, p.3)
"SSBI is a new approach to BI that aims to increase the level of co-production and decrease the level of individual's dependency during user's engagement with a broad range of applications and tools comprehensively embedded throughout the process of solving an analytical task"	(Bani-Hani, Tona & Carlsson, 2018, p.166)

The definition from Bani-Hani, Tona and Carlsson (2018) leans on the concept of co-production, which denotes the process when a user uses a firm's service, in this case an SSBI application, and integrates this with their own personal resources to create personal benefits and value. This makes the user a co-producer in the process of value creation and therefore bears a responsibility for the produced service (Bani-Hani, Tona and Carlsson, 2018). This is furthermore the definition we will draw upon in this study since we consider SSBI as a part of BI that further extends its functionality by using self-service technologies while still maintaining the same general goal.

SSBI allows casual users to perform their own data analysis, create reports, and queries from large datasets without having to involve BI specialists or power users, by allowing them to create reports containing the information they want, when they want it (Alpar & Schulz, 2016). More experienced power users can still use SSBI to fulfill their needs and finish their tasks more swiftly than before. In some SSBI applications, business users can integrate data from new sources into their current data warehouse and analyze it directly, illustrating the flexible nature of SSBI (Alpar & Schulz, 2016). SSBI can be used to reduced risk of not making fact-based decision by eliminating some of the bottleneck that existed in traditional BI (Abelló, Darmont, Etcheverry, Golfarelli, Mazón, Naumann & Vossen, 2013), increase the user's flexibility, which can result in an overall improvement in the organization's operational efficiency (Lennerholt, Van Laere & Söderström, 2018), agility (Bani-Hani, Deniz & Carlsson, 2017) and the number or unique ideas generated (Imhoff & White, 2011).

There are several drivers behind why companies may choose to adopt and implement an SSBI solution, such as to cope with the constantly changing business environments, with the IT departments inability to deliver requested reports on time, and with the increasing reliance and need for organizations to become data driven (Imhoff & White, 2011; Logi Analytics, 2015). SSBI is furthermore attractive to users since it makes it easier for them to access data, allows for a faster time to value since it requires no or little training to use and they can create the report they want, when they want it which can increase their productivity and agility (Imhoff & White, 2011).

2.2.1 User Roles

Decision makers, information consumers, specialists and analysts involved in BI are commonly split into two separate categories: casual users and power users. Casual users are typically operational workers, inexperienced with using technologies to perform data analysis and therefore mostly consume information though readymade dashboards or reports or only need to specify the parameters (Alpar & Schulz, 2016; Michalczyk et al. 2020). Power users are more experienced and have the right technical skills to perform data analysis and can produce new information and create new information sources (Alpar & Schulz, 2016; Michalczyk et al. 2020). These two user groups have very different information needs, with casual users mostly consuming information through dashboards and reports that have been ready made for them by power users and are able to utilize the presented information based on their set of skills (Bani-Hani, Tona & Carlsson, 2018; Eckerson, 2012). Power users need to explore data and often create new or combine existing data sources to answer specific business questions (Eckerson, 2012). A request-response relationship therefore exists between the different stakeholders in the traditional BI environment, which can be seen as one of the major contributions of the SSBI approach since this approach has the potential to minimize or eliminate this dependency (Imhoff & White, 2011; Alpar & Schulz, 2016). The relationship between BI specialists or IT departments, and business users has been described as a major bottleneck that sometimes hinders business users from making crucial decisions on time, since reports sometimes can take months to deliver (Lennerholt, Van Laere & Söderström, 2018). Eckerson (2012) highlights another user-group that he calls superusers, who have more experience with BI tools and knows all its features and functions. The Superuser will be the go-to person for help with ad hoc functionality and is according to Eckerson (2012) the main target for most of the SSBI tools.

Alpar and Schulz (2016, p.152) further argues that SSBI allows for an "analysis democratization", by making it more accessible to virtually anyone, with the end goal of empowering business users to move from data exploitation to data exploration, shifting their role as information consumers, to information authors (Bani-Hani, Tona & Carlsson, 2018). With SSBI, business users are no longer only exploiting data, but are now able to explore it (Stodder, 2015), without the help of power users who are typically a part of the IT department (Abbasi, Sarker & Chiang, 2016). Different SSBI applications can furthermore vary in what level of self-service they offer, which will be described more in depth in the following section.

2.2.2 Levels of Self-Service Business Intelligence

Because of the varying user roles and different use cases there is a need to create a common understanding regarding the different levels of self service in an SSBI application (Michalczyk et al. 2020). Self-service can in the context of SSBI be separated into three different levels depending on what level of system support and user self-reliance that is offered (Figure 3). Alpar and Schulz (2016) suggested a framework that can be used to separate different SSBI applications into three separate levels, based on what level of self-service they offer. The three suggested levels are: *usage of information, creation of information, and creation of information resources*.

Lowest level – Usage of information: At this level, business users get access to information and reports or access to a system environment that has been set up by power users in advance, and only need to set the parameters (Alpar & Schulz, 2016). Applications at this level are best suited for casual users who lack technical and analytical skills since this will allow them to gain some analytical insight by making information easy to find and interpret (Alpar & Schulz, 2016). Some applications at this level offer a "drill anywhere" function, allowing the users to search, filter and navigate the presented data visualization (Michalczyk et al. 2020). This is often visualized in a hierarchical structure where the user starts at the highest level and can go more in depth to investigate different levels and areas using predefined paths, until they obtain the required level of detail or reach the bottom. Some systems may allow the user to switch between different sources of data, but the user is still restricted to what has been set up in advance (Alpar & Schulz, 2016; Michalczyk et al. 2020).

Second level - Creation of information: At the second level, casual users can access data and information and use it to perform their own analytics, such as predictive analysis or text analysis, to generate new reports. This is based on the rationale that others cannot always predict all the future needs of a user, making this approach more flexible. With applications at this level, users can create data visualizations from large data files by themself and choose if they want the data to be represented as flat, relational, or multidimensional and are no longer dependent on power users for this (Alpar & Schulz, 2016). The applications often utilize non-code and drag-and-drop solutions to offer a more user-friendly interface for the casual user (Michalczyk et al. 2020). However, this approach does increase the risk that faulty analyses are created because of, for example, the casual users lacking understanding of complex data relationships (Alpar & Schulz, 2016).

Third level - Creation of information resources: The functionality of systems on this level greatly goes beyond the capabilities of traditional BI systems, by allowing casual users to harness and combine new data sources that have not been prepared by the IT department or a power user to create new information sources (Alpar & Schulz, 2016; Michalczyk et al. 2020). Casual users are with systems on this level able to combine information resources with corporate data to create new insights, with the applications allowing for autonomous integration and hides much of the complexity for the user (Alpar & Schulz, 2016). This does however increase put an increasing pressure on user skill level, since they need to understand data relationships, the usage of low-quality data and how to sidestep of data access rights (Alpar & Schulz, 2016).
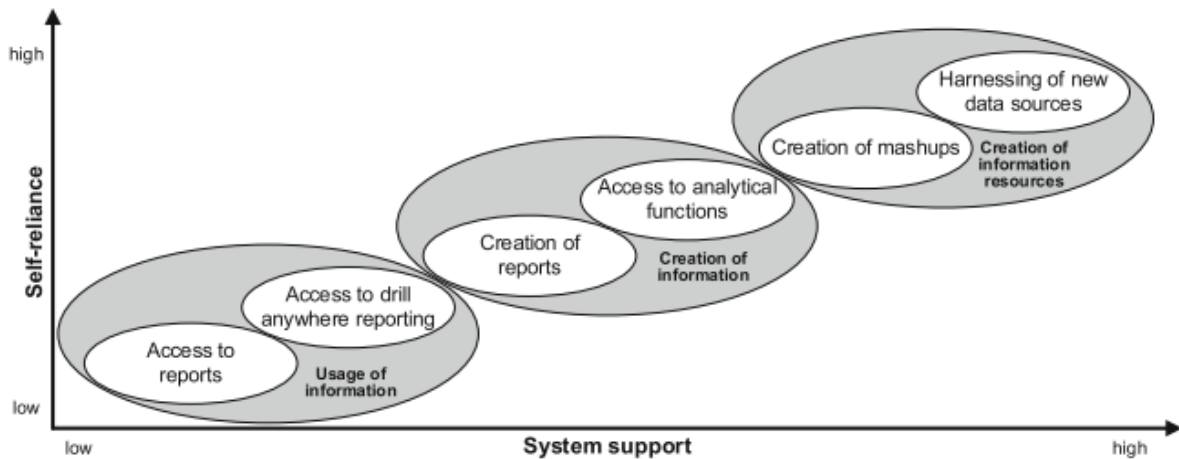
Figure 3: Levels of Self-service (Alpar & Schulz, 2016, p.152).

The more flexibility the SSBI applications offer to the user, the more BI skills they need (Alpar & Schulz, 2016). Therefore, the concept of SSBI does not have the same meaning to all users, since the appropriate tool for a group of users might be determined by factors such as the specific tasks needed to be performed, informational demands and the users technical and analytical skills (Alpar & Schulz, 2016). The general rule of levels in self-service is that with an increasing level of self-service, users with lower technical and analytical knowledge will require more support from the system to perform specific tasks (Michalczyk et al. 2020; Bani-Hani, Tona & Carlsson, 2018).

2.3 Challenges with the use of Self-Service Business Intelligence

SSBI has reached increasing popularity among businesses due to the benefits it brings to the table compared to traditional BI (Lennerholt, Van Laere & Söderström, 2020). However, despite extensive efforts and investments, many SSBI initiatives fail (Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2018). For SSBI initiatives to reach their full potential and avoid failure, challenges when using SSBI need to be addressed (Lennerholt, Van Laere & Söderström, 2020). In this study, challenges are factors that may hinder the success of SSBI and have a negative impact on the end-user's ability to use an SSBI tool or system to achieve a desired goal or outcome. From the conducted literature review, several user-related challenges have been identified that may have a negative impact on the ability to use SSBI. The results have been summarized in subcategories, where challenges related to the same thing are grouped together and then divided into two main categories, technical and organizational user-related challenges. Technical challenges refer to technical hands-on challenges that users face while working with SSBI tools and system functionalities that can negatively affect the user's ability to operate in a self-reliant manner. Organizational challenges refer to strategic and knowledge-related challenges at a higher level that influences how users and organizations work with SSBI tools and initiatives, which may hinder the user from working effectively with SSBI in a self-reliant manner. An overview of the identified challenges can be seen in Table 3 and Table 4.

2.3.1 Technical user-related challenges

Difficult to use SSBI tools. SSBI should enable casual users to become more self-reliant without the support of power users. A prerequisite for this is that SSBI tools are easy to use (Lennerholt, Van Laere & Söderström, 2020). However, it has emerged that SSBI tools are difficult to use and that casual users struggle to understand SSBI tools and find them confusing (Lennerholt, Van Laere & Söderström, 2020; Eckerson, 2012; Weiler, Matt & Hess, 2019). Organizations often take a one-size-fits-all approach when choosing SSBI tools and give everyone in the company access to it, which is a recipe for disaster (Lennerholt, Van Laere & Söderström, 2020; Eckerson, 2012). Users have different skills and needs, which should be reflected when selecting SSBI tools. Suppose the SSBI tools are too complex, difficult to use, and do not suit individual users' needs. In that case, it can lead to casual users reverting to old habits and asking power users for support, alternatively turning to more familiar nonstandard SSBI tools, such as Excel, and create own isolated solutions, which opposes the purpose of implementing and using SSBI (Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020).

Poor system performance and system mistrust. Users generally have a low tolerance for poor system performance (Weiler, Matt & Hess, 2019). If the SSBI environment is slow to produce analytical output, there is an imminent risk of frustrating users giving up using the tools (Eckerson, 2012) and users receiving a negative impression of SSBI from the start, leading to strong scepticism against the SSBI initiative (Weiler, Matt & Hess, 2019). It has also emerged that poor system performance in the form of not everything working correctly tends to lead to users distrusting the systems and turning to more familiar tools for double-checking so that the output is correct (Weiler, Matt & Hess, 2019).

Lack of data quality. A key factor and a known issue within traditional BI is data quality, which is a problem in SSBI too, where it can become even more problematic when casual users who are not used to handling data need to decide if the data is of sufficiently high quality, accuracy, freshness, completeness, and reliability (Lennerholt, Van Laere & Söderström, 2018; Imhoff & White, 2011). To succeed with SSBI, the data must be of sufficiently high quality, and it has been shown that one of the biggest obstacles to SSBI success is a lack of data quality (Imhoff & White, 2011). If the data is of low or unknown quality, where casual users do not trust the data, they may withdraw from using it, or worse, use and include insufficient data that gives incorrect outcomes in the presented report, which may lead to users not trusting SSBI, leading to an SSBI initiative that fails (Lennerholt, Van Laere & Söderström, 2018; Imhoff & White, 2011).

Users lack the right technical skills. A significant influence on the success of SSBI is users' technical skills (Weiler, Matt & Hess, 2019). Although SSBI is supposed to simplify the process to use BI and analytics, some technical user skills are still required (Lennerholt, Van Laere & Söderström, 2020). In traditional BI, power users perform complex operations, such as clean data, formulate queries to join tables correctly, and so on, which with the introduction of SSBI is transferred to casual users (Lennerholt, Van Laere & Söderström, 2018; Lennerholt, Van Laere & Söderström, 2020). The contemporary research indicates that casual users lack the right level of technical competence to perform these complex tasks and that users' limited IT skills have a negative effect on the outcome of SSBI initiatives (Lennerholt, Van Laere & Söderström, 2020). Moreover, Imhoff and White (2011) have shown that the most significant barrier to SSBI, which is guaranteed to cause failure, is the lack of appropriate skills in users.

Users lack the ability and struggle to access and use data. Accessing and using data simply and efficiently is highly important and a core function within SSBI (Imhoff & White, 2011). The contemporary research indicates that this is often not the case and that users struggle to access and use data. An essential prerequisite is to know which data sources are available for analysis. Casual users have low awareness of which data sources are available for decision-making, and even if users know which data sources are available, they have problems identifying where the sources are located and how they can be accessed (Lennerholt, Van Laere & Söderström, 2020). If users manage to access the data needed, it has been shown that they lack knowledge about how data can and should be used, for example, when data should be joined and when it should not be joined, which results in incorrect data-driven decisions (Lennerholt, Van Laere & Söderström, 2020). Moreover, it has been stated that casual users struggle when several different data sources are to be integrated and joined at the same time and that casual users, to a relatively large extent, still need support from power users to add new data that is missing (Lennerholt, Van Laere & Söderström, 2020).

Difficulties in creating and modifying reports. Analytical reports are often used as a foundation for making data-driven decisions. With SSBI, casual users can create reports independently without requesting data and reports from power users. However, the research reviewed highlights that casual users struggle and find it difficult to both create and change reports and that it is a time-consuming process that requires extensive manual work, despite the purpose of SSBI is to facilitate and streamline the process of creating reports (Lennerholt, Van Laere & Söderström, 2020). Casual users have problems creating valuable reports from the available data sources and are at most able to build their analysis based on data and reports created earlier by power users. Even more advanced and technically savvy users find the creation of reports with SSBI a complex undertaking Thus, users often need to ask power users for support to create and modify reports, which contradicts the main purpose of implementing SSBI in an organization (Lennerholt, Van Laere & Söderström, 2020).

Inexplicit data definitions. When users gain access to SSBI tools and more control over data, problems arise due to inexplicit data definitions. Inexplicit data definitions refer to data sources using the same term but, having different meaning and calculating the data differently in different reports, or that the names are unclear for business users who do not understand what the object or term represents and what data they are selecting (Schlesinger & Rahman, 2016; Stodder, 2015). Inexplicit data definitions can lead users to guess what a particular data object represents, resulting in inconsistent, incomplete, and erroneous results as the guesses are often incorrect, resulting in data-driven decisions being made based on incorrect data and calculations (Schlesinger & Rahman, 2016).

Table 3: Technical user-related challenges

Overview of challenges	Description	Authors
Difficult to use SSBI tools	SSBI tools are too complex, difficult, and confusing to use, leading to casual users having to ask power users for support or using nonstandard SSBI tools instead.	(Lennerholt, Van Laere & Söderström, 2020; Eckerson, 2012; Weiler, Matt & Hess, 2019; Imhoff & White, 2011)

Poor system performance and system mistrust	SSBI systems that do not work correctly or are slow to produce analytical output lead to frustration and general scepticism towards SSBI among users.	(Eckerson, 2012; Weiler, Matt & Hess, 2019)
Lack of data quality	Users cannot determine if the data included in reports is of sufficient quality to provide accurate analytical output, resulting in decisions being made with faulty data.	(Imhoff & White, 2011; Lennerholt, Van Laere & Söderström, 2018; Weiler, Matt & Hess, 2019; Passslick et al. 2020)
Users lack the right technical skills	Casual users lack general technical competence to use SSBI effectively and have problems performing complex operations needed to use SSBI in a self-reliant manner.	(Eckerson, 2012; Weiler, Matt & Hess, 2019; Imhoff & White, 2011; Lennerholt, Van Laere & Söderström, 2020; Lennerholt, Van Laere & Söderström, 2018)
Users lack the ability and struggle to access and use data	Users have problems knowing which data sources are available, how they can be accessed, and lack knowledge about how data should and can be used and often have to rely on power users in that regard.	(Lennerholt, Van Laere & Söderström, 2018; Lennerholt, Van Laere & Söderström, 2020; Imhoff & White, 2011)
Difficulties in creating and modifying reports	Users have extensive problems creating new valuable reports and changing existing reports, which means that they often have to ask power users for help to complete this task.	(Lennerholt, Van Laere & Söderström, 2020)
Inexplicit data definitions	Unclear data definitions lead to users not understanding its meaning, what data they select and what it can be used for, leading to users guessing its meaning, resulting in erroneous results and faulty decisions.	(Schlesinger & Rahman, 2016; Stodder, 2015)

2.3.2 Organizational user-related challenges

Redundant reports exist. An extensive problem that organizations face when more and more users gain access and the opportunity to create their own analytical reports is that it can lead to report chaos (Eckerson, 2012). When users are given greater freedoms and have access to more data, it opens for inefficient duplication of work. Users are not aware of which reports already exist and create all sorts of combinations of reports, often duplicates, which can proliferate at an unsustainable rate, where it is no longer possible to keep track of which reports already exist and if they are still relevant (Alpar & Schulz, 2016; Lennerholt, Van Laere & Söderström, 2020). It has also been reported that it becomes more difficult for users to locate the right report needed for decision-making and whether it can be trusted when reports are created with all possible combinations and shared across the organizational board between entities that perform different tasks (Eckerson, 2012; Alpar & Schulz, 2016).

Lack of education and training. Advocates of SSBI proclaim that it should simplify the process of analytics compared to traditional BI, which may lead to the misconception that SSBI does not require any education and training (Lennerholt, Van Laere & Söderström, 2020). However, it has been reported that SSBI requires more training than anticipated (Eckerson, 2012) and that one of the most significant barriers to SSBI initiatives is a lack of training for casual users who do not have the knowledge required to be self-reliant (Imhoff & White, 2011). Despite this, it has emerged that many organizations do not arrange proper education as part of SSBI implementation (Lennerholt, Van Laere & Söderström, 2020). Even if organizations carry out SSBI training, the problem remains that users do not actively use SSBI after training (Lennerholt, Van Laere & Söderström, 2020), which may be part of the problem that casual users forget how to use SSBI tools, especially their more advanced features (Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020). The result of no or too little training combined with users forgetting its functionalities is that casual users abandon SSBI since they find it easier to ask power users to create a report instead of doing it themselves (Eckerson, 2012).

Quality assurance of reports issues. Ensuring the quality of reports is a problem that can become apparent when SSBI is introduced to casual users that do not have the same knowledge as the department with experts who previously created the reports for the organization. As more and more casual users gain access to data, more reports will be created and shared within the organization. A challenge related to this is to ensure that casual users have created high-quality reports where data has been appropriately used (Lennerholt, Van Laere & Söderström, 2018; Lennerholt, Van Laere & Söderström, 2020). If users have missed something while creating reports, it will lead to faulty reports, which will negatively affect the implementation and use of SSBI (Lennerholt, Van Laere & Söderström, 2020). Moreover, as more and more reports are both created and shared within and across organizational boundaries, there is a risk that decisions will be made on incorrect reports. Users are prone to assume that reports are of high quality since someone else already has developed the report and "approved" its quality, which can lead to users wasting their time working with unreliable reports that are based on incorrect data (Lennerholt, Van Laere & Söderström, 2018). Organizations also face the problem when casual users are given access to edit existing good reports created earlier by power users. It has been reported that casual users add and modify existing reports, leading to multiple reports that do not fit together and become impossible to trust (Lennerholt, Van Laere & Söderström, 2020).

Users lack analytical skills. The fact that casual users with SSBI are allowed to create their own analytical reports does not in itself provide much value. Users need to understand its content and what attributes and metrics they should use in a report to utilize selected data to make appropriate decisions. It has emerged that casual users often lack analytical skills to interpret SSBI reports and understand what the data means (Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020). In the past, power users with the right skills have created reports containing relevant data, attributes, and metrics and have presented the content in an appropriate way, which makes it possible to make correct data-driven decisions. When the creation of reports is transferred to casual users, the problem arises that the users do not understand the different nuances of the data and which data can be used for what, for example, if the data is suitable for seeing trends or if it can be used for a specific calculation (Lennerholt, Van Laere & Söderström, 2020; Eckerson, 2012). If casual users do not understand the data and can evaluate the reports produced, they risk analysing reports containing faulty information and errors, leading to wrong data-driven decisions (Lennerholt, Van Laere & Söderström, 2020).

SSBI is time-consuming. It has emerged that users perceive SSBI as a time-consuming and exhausting process (Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020). Casual users who are not technically inclined have described it as creating SSBI reports takes too much time and require lots of manual work. Users do not see the benefit of SSBI technology versus the more traditional approaches previously used for analysis or that users get stuck in manual troubleshooting that is both complicated and time-consuming (Lennerholt, Van Laere & Söderström, 2020).

Users have a low interest in using SSBI. Users without the technological drive and interest in new technology may find it more difficult to see the benefits of SSBI and how it can contribute to and support them in their daily work (Lennerholt, Van Laere & Söderström, 2020). If users do not see any progress and have a generally low interest in SSBI and its tools, it will be more challenging to achieve adoption of SSBI (Lennerholt, Van Laere & Söderström, 2020).

Insufficient data governance. Organizations struggling with issues in SSBI can often trace the problems to data governance (Weber, 2013; Imhoff & White, 2011; Lennerholt, van Laere & Söderström, 2018; Passlick et al. 2020). Data governance that is too lax or too strict will undermine the SSBI initiative (Weber, 2013). Allowing a wild west approach, where everyone can execute changes and deploy them to production, can lead to inconsistency and duplication of data and reports, resulting in a lack of control (Weber, 2013; Lennerholt, Van Laere & Söderström, 2018). Without control and appropriate data governance, each individual user can create their own unique version of the truth. Users may use different approaches that produce different results, leading to chaos (Weber, 2013; Lennerholt, Van Laere & Söderström, 2018). Giving users everything, including access to all the data, and letting them do whatever they want, is the hallmark of an organization that struggles and often leads to SSBI failing (Weber, 2013). In contrast, a far too strict data governance strategy, where users cannot serve themselves in a self-reliant manner, can contradict the purpose of implementing SSBI, which may result in users having less interest in using SBBI (Passlick et al. 2020; Stodder, 2015).

Table 4: Organizational user-related challenges

Overview of challenges	Description	Authors
Redundant reports exist	Users are not aware of which reports already exist and whether they are credible or not. They continuously create new reports, which leads to duplication of work. It becomes difficult to check which reports exist and locate the right report.	(Alpar & Schulz, 2016; Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020)
Lack of education and training	Users lack the right skills to use SSBI effectively, but many organizations do not arrange sound education, or the training provided is insufficient. Moreover, users forget how to use SSBI tools and their functionalities.	(Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020; Imhoff & White, 2011)

Quality assurance of reports issues	The challenge with quality assurance of reports refers to whether the reports created by users are of sufficiently high quality and credibility to be used as a basis for decision-making. Furthermore, there is a built-in trust that reports created by someone else are of sufficient quality.	(Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020; Lennerholt, Van Laere & Söderström, 2018)
Users lack analytical skills	Users lack the knowledge to understand and evaluate what the result produced means, what the available data represents, and how the data should be used to get a correct result.	(Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020)
SSBI is time-consuming	Users believe that SSBI is generally time inefficient and requires far too much manual work, leading to users not seeing the benefits of SSBI.	(Eckerson, 2012; Lennerholt, Van Laere & Söderström, 2020)
Users have a low interest in using SSBI	Casual users may find it difficult to see how SSBI can help them in their work and have a low interest in the change of introducing and using SSBI.	(Lennerholt, van Laere & Söderström, 2020)
Insufficient data governance	Too strict or lax data governance can undermine the use of SSBI. Weak data governance can lead users to create their own unique version of the truth, while too strict governance removes part of the purpose of implementing SSBI.	(Lennerholt, Van Laere & Söderström, 2018; Stodder, 2015; Imhoff & White, 2011; Weber, 2013; Passlick et al. 2020; Weber, 2013)

2.4 SSBI critical success factors

In this chapter, several critical success factors identified from the SSBI literature during the literature review are summarized into seven overarching categories. The researcher view of critical success factor is aligned with Gartner Glossary's (n.d.b) definition:

> "A methodology, management tool or design technique that enables the effective development and deployment of a project or process".

The critical success factors were identified in a systematic way from the articles that were deemed relevant and included in this studies literature review. Therefore, a through selection of articles had previously been made, where articles not deemed appropriate were discarded, more about this process can be read about in section 3.2. These articles were then thoroughly read and analyzed to identify factors that could, according to the definition stated previously, be considered as critical success factor. Several articles arguing the same, or similar things were grouped together under broader names. The identified critical success factors are

summarized in Table 5, along with a brief description of each factor and the authors who mention it.

System is easy to use. Several authors highlight the importance of SSBI tools being user-friendly and usable and argue that this as an important prerequisite for them to be accepted and used (Imhoff & White, 2011; Stodder, 2015; Daradkeh & Moh'd Al-Dwairi, 2017). A user's intention to use a SSBI tool can be impacted by its perceived ease of use, since users will feel encouraged to use a tool if they perceive the information it can produce, as relevant, understandable, and meaningful, while the system is still perceived as easy to use (Daradkeh & Moh'd Al-Dwairi, 2017; Passlick et al. 2020). Bani-Hani, Tuna and Carlsson (2018) further highlights that it is crucial that SSBI tools are easy to use, since its main premise is to reduce complexity for users who lack technical experience or analytical skills. Therefore, offering a user-friendly interface is crucial to allow these users to work self-reliant and create their own accurate reports (Imhoff & White, 2011; Bani-Hani, Tona & Carlsson, 2018). The tool must be easy enough to use, so that users are able to perceive the system as useful, and therefore needs an interactive and user-friendly interface allowing them to perform their BI needs and decision-making tasks in a productive manner (Daradkeh & Moh'd Al-Dwairi, 2017). Users furthermore need to be able to grasp what the presented information means for them to find the system useful (Imhoff & White, 2011). It is therefore important to make these tools available for the users without the need of mastering statistics and mathematics (Alpar & Schulz, 2016).

Perceived usefulness of SSBI. For SSBI to be successful it needs to ensure that the tools are accepted by the users and can deliver on the expected contribution to the user's information needs (Passlick et al. 2020). Passlick et al. (2020) argues that three underlying factors will help to achieve this: flexibility, expected time-savings and the tools ability to ensure a certain level of data quality. The expected contribution of an SSBI tool to a user's information needs, will drastically impact the chance of it being viewed as beneficial and be used (Passlick et al. 2020). Daradkeh and Moh'd Al-Dwairi (2017) further argue that there are three different types of quality factors that affect if the system is perceived as useful, affecting the user's intention to use an SSBI tool, namely information quality, system quality and analysis quality. These factors have a major impact on the user's intended use of an SSBI tool, since users will feel encouraged to use a tool if they perceive the information it can produce, as relevant, understandable, and meaningful (Daradkeh & Moh'd Al-Dwairi, 2017; Passlick et al. 2020). The system itself must furthermore deliver analytical capabilities in a timely manner without delays and bugs and have good design with many features to be perceived as useful (Daradkeh & Moh'd Al-Dwairi, 2017). Finally, the system should be able to provide analytical functionality and capabilities on a level that is deemed appropriate by the user, to make it feel useful since it can help them fulfill their needs (Daradkeh & Moh'd Al-Dwairi, 2017). These quality factors should be seen as important antecedents and as the basic requirements for making an SSBI tool seem useful and easy to use to the user, which have also shown to increase the intended use of the SSBI (Daradkeh & Moh'd Al-Dwairi, 2017). It is furthermore important that the benefits a tool can produce and how it can fulfill individual users' information needs are clearly communicated to the users by the organization to further highlight its usefulness (Passlick et al. 2020; Weiler, Matt & Hess, 2019).

Consider different user groups. Eckerson (2012) highlights the importance of taking into consideration the fact that there is no standard user of SSBI, and that different users have different needs, unique information requirements and will interact with the system in differing ways. Mapping out and creating an understanding of different users' requirements and needs

is therefore essential and should be seen as a critical success factor for the implementation and use of SSBI (Eckerson, 2012). Different users can have different information needs which will require tools that offer various system support depending on the user's self-reliance (Alpar & Schulz, 2016; Eckerson, 2012; Imhoff & White, 2011).When choosing a tool, or a set of tools, it is important to find the balance between a tool that are not too complex for the casual users, but also not too easy and inflexible for the power user, since both user groups need to be satisfied to ensure optimal performance (Eckerson, 2012). It is therefore important to find the right degree of freedom which the tools allow, balancing control and data analysis capabilities that fulfill different user's needs (Alpar & Schulz, 2016; Bani-Hani, Tona & Carlsson, 2018; Imhoff & White, 2011). There are according to Eckerson (2012) two types of Self-services, one for information consumers and one for information producers, as seen in Figure 4, putting different needs on the SSBI tool. The author further highlights that finding this balance can be challenging, since casual users often find the tools too complex while the power users find them too inflexible and argues that a better strategy is to deliver the right tools to the right users depending on their specific needs.

Casual users will around 80% of the time use the provided SSBI tools to access reports and dashboards that have previously been made by power users and that only around 20% of the time is spent on ad hoc functions, such as creating new reports and dashboard, with the other way around for the power users. This is referred to as the 80/20 rule (Eckerson, 2012). To make this a reality, power users should set up a standard dashboard for the casual users that is not too complex, with a limited number of metrics and dimensions that can be changed by the casual users and will satisfy around 80% of their needs, which Eckerson (2012) referred to as a MAD (Monitor, Analyze and Drill to detail) dashboard. Instead of providing casual users with tools they find too complex to use. Eckerson (2012) further argues that a superuser should be assigned to each department to handle the remaining 20% of ad hoc needs. Superusers are a critical success factor to achieve success with using an SSBI tool, and that these people need the right training and support to provide the best possible solutions (Eckerson, 2012), which is supported by Stodder (2015) who argues that users who perform more advanced tasks need more training.

To help grasp what different information needs that exist within an organization they can be plotted out in a hierarchy of needs as seen in Figure 4**.** Creating a hierarchy of needs can be helpful for choosing the right tool(s), but also to help evaluate the existing tools and to find out if they fulfill the user's information needs. Tools within the organization should be evaluated on a regular basis since information needs are not static and therefore tend to change often (Eckerson, 2012). This highlights that for an SSBI environment to be successful does not solely depend on the organization's technical capabilities, but also how well the tool meets and fulfills the users' different needs (Schlesinger & Rahman, 2016).
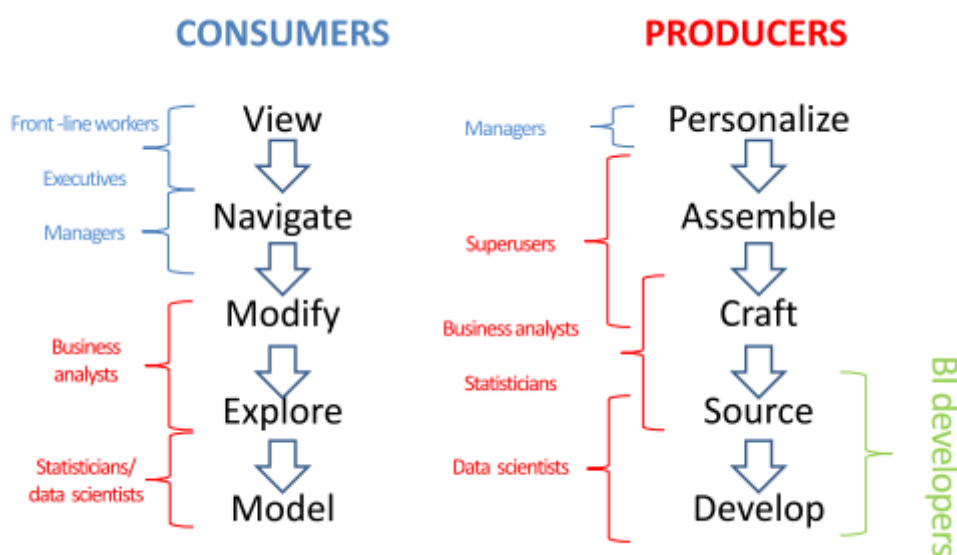
Figure 4: Hierarchy of needs (Eckerson, 2012, p.22).

Train and educate users. Several authors highlight that users need to get the right training on how to use SSBI tools and how SSBI can benefit their work, since this will greatly increase the likelihood that they will want to use the technology and further help them to achieve expected benefits and their information needs (Passlick et al. 2020; Bani-Hani, Pareigis, Tona, & Carlsson, 2018; Stodder, 2015; Johannessen & Fuglseth, 2016). This has shown to be increasingly important for inexperienced users since they are more likely to believe that SSBI cannot help them achieve their information needs, which might otherwise decrease users' intention to use SSBI since they do not see the benefits (Passlick et al. 2020). More experienced users must not be forgotten either, since these are expected to carry the more advanced ad hoc activities, and therefore need to receive sufficient training to perform these tasks as well (Passlick et al. 2020). An example could be the superusers, as suggested by Eckerson (2012), who argues that these are a critical success factor to SSBI, and that these people need the right training and support to provide the best possible solutions, which is supported by Stodder (2015) who argues that users who perform more advanced tasks need more training. Training users can further help them realize the benefits of using SSBI and raise their expectations, further increasing the likelihood that they can see the perceived benefits of the technology and how it can contribute to their information needs, increasing the intention amongst users to use the provided tools (Passlick et al. 2020). The mere implementation and introduction of an SSBI tool will not bring any success. If the users cannot see the benefit of using the tools to produce reports or contribute to their information needs, they will simply not use them. It is therefore important for companies to highlight the benefits of using SSBI and how it can contribute to their information needs (Passlick et al. 2020).

Although SSBI is successful in providing equal access to data, to fully seize its opportunities, it is important that users have the right incentives to facilitate the learning process of SSBI, and for organizations to be aware that employees' skills often develop in parallel with new opportunities or problems that arise (Bani-Hani, Deniz & Carlsson, 2017). Users furthermore need training to gain an understanding of how SSBI can be integrated into established work routines, covering both the outcome and the process perspectives (Weiler, Matt & Hess, 2019). In their article, Lennerholt, Van Laere and Söderström (2020) highlights several challenges with SSBI, a majority of which are user related, further highlighting the importance of providing users with the right training. Users' needs to receive a formal education, since this

should be seen as a prerequisite to becoming self-reliant, where the education is tailored to users' different backgrounds and needs, given their differences starting points (Lennerholt, Van Laere & Söderström, 2020).

Appropriate data governance. A prerequisite to ensure the success of any SSBI system is having a data warehouse set up properly, where the company's data is stored in a standardized manner, ensuring data consistency across the entire organization (Schlesinger & Rahman, 2016). This data can be combined with data from other sources to enrich the information in the generated dashboards and reports (Eckerson, 2012). However, the importance of data governance increases with the introduction of data from external sources, and access rights should therefore be added to control who is allowed to add new data (Alpar & Schulz, 2016). Companies need to invest in a robust data management environment, with data warehousing and data marts for each department and an overarching semantic layer (Eckerson, 2012). This is important to ensure that users do not create reports and make decision based on the wrong data (Weiler, Matt & Hess, 2019). Since one of the main benefits of SSBI is to empower casual users without the technical know-how, the applied data governance strategy must ensure that users without the understanding of data structures and relationships can access and combine data sources and still create reliable and high-quality reports (Eckerson, 2012; Alpar & Schulz, 2016). Data must furthermore be properly incorporated into the data warehouse to minimize errors, which should also include decisions regarding how long data is stored until it is deemed outdated (Lennerholt, Van Laere, & Söderström, 2020).

As more user's access data using SSBI, organizations need suitable data governance to oversee who can access what kind of data, depending on their role and if requested data is appropriate for the user's analytical process (Stodder, 2015). Data governance is also needed to ensure data privacy, data security and that regulations are complied with. Stodder (2015) highlights the importance of organizations finding the right balance in data governance, since having a too strict, or to relaxed data governance can cause various types of problem. This is further described by Clarke, Tyrrell, and Nagle (2016) who stresses the importance of finding the right balance for the SSBI environment and data governance and therefore developed a framework called "Governance of Self-Service analytics framework" that companies can use to determine the maturity of their SSBI environment and, in relation to this, help decide how strict their data governance guidelines should be. The suggested framework utilizes several questions to recommend an appropriate data governance strategy for their SSBI environment (Clarke, Tyrrell & Nagle, 2016). Finding this balance is important since there is no "one size fits all" solution to data governance, making it crucial to find the right balance to ensure the system fulfills the end-users needs (Clarke, Tyrrell & Nagle, 2016).

Schlesinger and Rahman (2016) argue that organizations that use, or plan to use, SSBI need to implement a comprehensive semantic layer for SSBI that provides a unified and standardized view of the organization's data that is expressed in business related terms. This would further allow different users and groups to use the same data for analytical purposes across an entire organization or enterprise, increasing the trust in the data they use (Schlesinger & Rahman, 2016). This approach could help to minimize confusion amongst end-users across the organization (Bani-Hani, Deniz & Carlsson, 2017), since not having a semantic layer increases the chances of reports being made on local knowledge or unique versions of truth, resulting in other employees without this knowledge having to guess the meaning of certain terms since there is a lack of definition, which will further lead to confusion and lack of trust in produced reports since no one knows what data they are based on (Schlesinger & Rahman, 2016). The semantic layer is meant to represent business data in a more comprehensive, and to the

business user, understandable way by using common business terms instead of data language. Complex data is compiled and grouped under commonly used business terms to offer a combined and standardized view of data across the organization, meaning that different departments and groups all have access to, and use the same data to produce reports and dashboards. This can, according to Schlesinger and Rahman (2016) result in employees putting more trust into produced reports since they no longer, to the same extent, run into problems with inconsistent data that results in inaccurate reports. This approach has the possibility to reduce costs and increase agility by making business data more accessible and accurate (Schlesinger & Rahman, 2016). It would further ensure business users use the right metrics and data for their reports, resulting in higher quality reports and lover confusion regarding different definitions (Eckerson, 2012). How a semantic layer can be designed and used is discussed more in detail by Schlesinger and Rahman (2016).

Ensure data Quality. Like data governance, data quality is important to ensure the success and effectiveness of SSBI, meaning that that user can rely on the results and reports produced by the SSBI tool (Passlick et al. 2020; Daradkeh & Moh'd Al-Dwairi, 2017). Several authors argue that for an SSBI tool to be perceived as useful and provide a utilitarian value for the user, high data quality needs to be ensured to the reports it produce are seen as reliable (Daradkeh & Moh'd Al-Dwairi, 2017; Passlick et al. 2020). High quality outputs are also important to ensure that decisions made upon this information are correct, resulting in better decisions being made, which can further increase the systems perceived usefulness (Passlick et al. 2020; Lennerholt, Van Laere & Söderström, 2018). Data quality may further impact other success factors, such as the perceived usefulness of an SSBI tool (Daradkeh & Moh'd Al-Dwairi, 2017; Passlick et al. 2020), making it an important factor to consider.

Create and comply with standards and best practices. A critical success factor for organizations to be successful with their SSBI initiatives is to create and follow standards and guidelines for ways of working (Weber, 2013). Without sound practices in place, Weber (2013) argues that any success in SSBI will be isolated and short lived. Therefore, it is important to state the objectives and best practices of SSBI are established and well-documented and that some sort of governance process is set up to ensure that these are complied with (Weber, 2013). Vendor Specific guidelines and best practices should furthermore be complied with since every vendor specific software usually has its own guidelines (Weber, 2013). An example of this could be what both Abelló et al. (2013) and Alpar and Schulz (2016) suggest that companies should develop guidelines that allow for the sharing and reusing of reports within organizations, where reports would be ranked using a star rating and number of accesses and saved in a commonplace allowing them to be reused by other employees, in other departments. This approach could also be used to reuse popular data queries formulations and data sources (Abelló et al. 2013).

Table 5: SSBI Critical success factors

Success factors	Description:	Authors:
SSBI Tool is easy to use	SSBI tools needs to be perceived by the user as easy to use, since this may impact the user's intention to use them.	(Imhoff & White, 2011; Stodder, 2015; Daradkeh & Moh'd Al-Dwairi, 2017; Passlick et al. 2020; Bani-Hani, Tuna & Carlsson 2018)
Perceived use-fulness of SSBI.	SSBI tool needs to be perceived as reliable, be able to produce high quality outputs, offer enough analytical capabilities, work on a timely manner without bugs, and can contribute to the fulfilling users' information needs to be considered useful by the user.	(Passlick et al. 2020; Daradkeh & Moh'd Al-Dwairi, 2017)
Consider different user groups.	Different users' groups, different needs should be considered, depending on factors such as their skill level and analytical needs for a SSBI initiative to reach its full potential. It is important to find the right tool(s) to satisfy different users groups.	(Alpar & Schulz, 2016; Eckerson, 2012; Imhoff & White, 2011; Bani-Hani, Tona & Carlsson, 2018; Stodder, 2015; Schlesinger & Rahman, 2016)
Train and educate users.	Users' needs to get the right training to be able to derive sufficient value from an SSBI tool, where different users' previous skill level is taken into consideration. Training can further contribute to users gaining an understanding of how it can contribute to their information needs and benefit their work.	(Passlick et al. 2020; Bani-Hani, Pareigis, Tona, & Carlsson, 2018; Stodder, 2015; Johannessen & Fuglseth, 2016; Eckerson, 2012; Weiler, Matt & Hess, 2019; Lennerholt, Van Laere & Söderström, 2020)
Appropriate data governance.	Having the right level of data governance is key for allowing the right level of data access across an organization, follow regulations and ensure the quality of produced reports. Adopting a semantic layer can further benefit organization by ensuring correct use of data for non-technical users.	(Eckerson, 2012; Alpar & Schulz, 2016; Lennerholt, Van Laere, & Söderström, 2020; Bani-Hani, Deniz & Carlsson, 2017; Schlesinger & Rahman, 2016; Stodder, 2015; Clarke, Tyrrell & Nagle, 2016)
Ensure data quality	High data quality must be ensured to ensure that reports and outputs produced by the SSBI tools are of high quality and reliable for it to be perceived as useful.	(Passlick et al. 2020; Daradkeh & Moh'd Al-Dwairi, 2017; Lennerholt, Van Laere & Söderström, 2018)
Create and comply with standards and best practices	Organizations that use, or plan to implement SSBI need to create and comply with best practices and guidelines to maximize the benefits of SSBI.	(Weber, 2013)

3 Research Methodology

This chapter presents the methodology used for conducting the study and covers the general research strategy, how data collection and the literature review were performed, how collected data was analysed and how a high research quality was ensured while following ethical guidelines.

3.1 Research strategy

According to Recker (2013), the choice of research strategy should depend on the research questions. To best answer the stated research questions, a qualitative approach was chosen for this study, since the qualitative approach can be used with the aim to create an in-depth, individualized, and contextualized understanding based on the research participants own experiences and perspective of the studied phenomenon (Patton, 2015; Recker, 2013). A strength of the qualitative methodology is its ability to discover unexpected trends that the researchers did not expect, that would most likely be missed if another approach was used (Patton, 2015; Recker, 2013). This is derived from the openness of the qualitative inquiry since its aim is to capture and document people's experiences, which may result in new and unexpected details and trends emerging (Patton, 2015). The qualitative approach is therefore appropriate when the phenomenon under investigation is not fully understood, well-researched, or still emerging (Bhattacherjee, 2012; Recker, 2013), making it a suitable approach for this study since there is a lack of prior researcher on how identified user-related challenges with SSBI can be managed, and since this study aims to collect people's subjective experiences and opinions.

The qualitative approach allows for rich data to be collected, which can be used to create a thick description of the phenomenon than can further help generate a holistic picture of the phenomenon (Recker, 2013). How people act in certain situations is highly contextual, which implies that people in different contexts might handle user-related challenges with SSBI differently, which a qualitative approach may further help investigate by exploring these very contexts and help create a comprehensive and clear picture of this complex phenomenon (Recker, 2013). A qualitative approach will further allow the researchers to collect people's own experiences and opinions of how they have worked, or suggestions on how one could work to manage and overcome these challenges (Recker, 2013; Bhattacherjee, 2012). Considering this, and the reasons stated previously, a qualitative approach is seen as the most suitable approach for this study since the phenomenon under study is not well understood and a qualitative approach will therefore help the researchers to uncover and explore what user-related challenges that professionals and users themself face with SSBI, and how they have worked to manage these challenges.

The quantitative research approach is generally more popular but was not chosen for this study since it is less suitable for studies where there is a lack of prior research (Recker, 2013; Bhattacherjee, 2012). According to Recker (2013) emerging problem areas are usually first studied using qualitative approaches to explore it and develop a comprehensive understanding and description, which can later be strengthened by quantitative studies as they mature over time. Quantitative methods primarily focus on collecting numeric data (Recker, 2013), but trying to answer the stated research questions using this data type is not deemed suitable nor

useful by the researchers, since it will not provide enough insight about people's experiences and the different contexts and understanding to create a holistic picture of the studied phenomenon (Bhattacherjee, 2012). Collecting numerical data of user-related challenges of SSBI without understanding the context and the wider setting which they originate from, would make them useless since they may have different meanings depending on the surrounding context, which could be better understood using a qualitative approach (Recker, 2013), making it more suitable for this study.

In qualitative research, it is important that researchers present what research philosophy their study is built upon and present their personal assumptions about the nature and source of knowledge, since every step in the research process builds upon these beliefs (Patton, 2015). Goldkuhl (2012) argues that both pragmatism and interpretivism are two possible and important research paradigms that can be used for qualitative research within IS. However, pragmatism is more appropriate when the researchers are planning to intervene with respondents' work (Goldkuhl, 2012). In the scope of this study, the researchers are not interested in intervening, only investigating, and gaining an understanding of the phenomenon under study, making the research approach more aligned with the interpretive paradigm. Interpretivism is a research paradigm that assumes that reality is socially constructed and not objective, and that there is no singular truth, but that it is rather subjectively constructed by human experiences and contexts and is embedded in their social setting, which it cannot be separated from (Bhattacherjee, 2012; Saunders, Lewis & Thornhill, 2019). Therefore, Humans and the social world can, according to interpretivism, not be studied in the same way as the natural sciences are studied as they are too complex to boil down into specific universal theories since multiple social realities can exist depending on different interpretations (Saunders, Lewis & Thornhill, 2019).

Humans create and attach meaning to everything around them, and since people come from different backgrounds, cultures and live through different experiences the same artifact or situation can have different values for different people (Lee,1991). This may further determine what challenges different people experience with SSBI, who may have different ideas or approaches to how these can be managed. Collecting what is meaningful to people working with SSBI can therefore help contribute to richer data and contributing to creating a comprehensive holistic picture of the phenomenon by being able to view it from different angles (Saunders, Lewis & Thornhill, 2019). The goal of interpretivism is to create a rich understanding of the social world, and its different contexts (Patton, 2015). Bhattacherjee (2012) asserts that an interpretive approach is suitable when trying to describe social reality through a sense-making process rather than hypothesis testing process, which resonates with the purpose of this study, where the researchers, by gaining a rich understanding of stakeholder's subjective experiences and meaning, aim to identify user-related challenges with the use of SSBI along with ways on how these can and have been managed. From this standpoint, the aim of the research is to collect the already existing subjective experiences from users and professionals, reconstruct them and use them as building blocks in developing recommendations, which is similar to how Goldkuhl (2012) describes the core essence of interpretivism. Qualitative research is according to Walsham (2006) often influenced by interpretivism, considering this, and the nature of the research topic, interpretivism is seen as the most suitable research philosophy for this study.

3.2 Literature review

After identifying the topic of interest, a literature review was conducted where the existing literature on SSBI was thoroughly examined. Conducting a literature review can be seen as the process where the author(s) demonstrates their knowledge within a specific field of study and its related theories and can therefore be seen as a proof of knowledge (Randolph, 2009). Conducting a literature review can further help researchers distinguish between what has already been done, and what needs to be done within a field of study and can be seen as the foundation which the rest of the study is built upon, since a faulty or weak literature review can derail or harm the reliability of the study (Randolph, 2009). The literature review provides a framework for the study where new findings can be related or compared to the previous ones. Without conducting a thorough literature review it would be impossible for the researcher to establish how their findings related to the previous ones and how they can further advance the research filed (Randolph, 2009). Bhattacherjee (2012) furthermore states that the purpose of a literature review is threefold: 1. to survey the current literature in the field of interest, 2. to identify key articles, authors, theories, and previous findings in that specific area, 3. to identify gaps in the literature that need further investigation and research. The researchers of this study applied this approach, leading to the identification of the gap in the literature that this study aims to help fill, which further assisted in creating the research questions.

In line with Randolph (2009), the researcher of this study set up certain criteria stating what sources needed to fulfill to be included or excluded in the literature review. This included criteria such as, sources being written in English, covering a domain of knowledge that was deemed relevant for the field of study and contained information that the researchers thought could help them to answer the research questions. Articles chosen were furthermore primarily peer-reviewed, to ensure their quality and trustworthiness. Since the topic of SSBI is relatively niched and some areas lack through research, most peer-revied articles that exist on the topic, that were accessible, and relevant for this study have been included in the literature review.

Randolph (2009) further stresses the importance of researchers describing how their literature review was conducted, so that other researchers, under similar circumstances, would find an identical set of articles and sources. It is therefore important that researchers state what specific queries and keywords they used in their literature review and what database they searched (Randolph, 2009). The literature review in this study was primarily conducted using the search engines Google scholar and LubSerach, by Lund University, to find and review journal articles, dissertations and other literature related to the field of study. To search for literature to include in the literature review, the following queries were used.

- ("Business intelligence" OR BI)
- BI AND SSBI
- "Self-service business intelligence"
- "Self-service BI"
- "Self-service analytics"
- SSBI
- ("Self-service business intelligence" OR SSBI) AND challenges
- ("Self-service business intelligence" OR SSBI) AND problems
- ("Self-service business intelligence" OR SSBI) AND success factors
- ("Self-service business intelligence" OR SSBI) AND adoption

- ("Self-service business intelligence" OR SSBI) AND user-related challenges
- "Self-service Technologies"

The sources identified from the initial search were further reviewed and relevant references were identified and further review, which was done in an iterative process. If an identified article referred to another article which seemed relevant for this study, that article would be further reviewed to ensure the correctness of the reference and to identify further sources. This process was further utilized to ensure that mostly primary sources were used. According to Randolph (2009), this is a good way for identifying relevant sources, and the author further stresses that this is how 90% of sources are commonly found. This approach was used in the literature review until saturation was achieved, in line with Randolph (2009) recommendation.

3.3 Data collection

When conducting qualitative research, choosing the right method for data collection is critical to ensure the study's outcome and overall quality (Patton, 2015). Several different data collection methods are commonly used in qualitative studies, such as interviews, observations, and documentation (Recker, 2013), however, interviews are the most commonly used (Schultze & Avital, 2011; Bhattacherjee, 2012), and are an essential part of most interpretive studies (Walsham, 2006). Interviews allow the researcher to engage in a two-way conversation with the subjects to get a first-person account of the participants' view of reality (Schultze & Avital, 2011). To answer the stated research questions there's a need to collect stakeholders' subjective perspectives and understanding of the studied phenomenon and collect information from different stakeholders, therefore, interviews were seen as the most suitable data collection method for this study. There are as described by Recker (2013) many types of interviews with their specific use-cases. In this study, descriptive interviews were viewed as the optimal data collection method since this would allow the researchers to collect rich data that could be used to create a thick description of the studied phenomena as experienced by the respondents (Schultze & Avital, 2011; Saunders, Lewis & Thornhill, 2019). A thick description does not only take the human behavior and different social context into account, but also the intentions of the subject, resulting in a richer description of the studied phenomenon being generated (Schultze & Avital, 2011). There are as described by Myers & Newman (2007) several different ways to structure interviews, with varying levels of structure that are deemed fit for different purposes. In this study, semi-structured interviews were used to allow the researchers to ask unplanned follow-up questions to make the interviewees elaborate, or clarify their answers, allowing researchers to drill deeper into specific topics and probe for more detailed answers. This interview approach was deemed suitable for this study because of the relatively unexplored nature of the topic. Being able to ask to follow up questions not part of the interview guide was therefore seen as an essential part of the interview to ensure that the researcher was able to gain a sufficient level of detail and understanding from the interviewee's answers.

However, there are some weaknesses with using interviews as a data collection method that researcher should be aware of, such as the challenge of reflexivity where the interviewee responds to questions with what he/she thinks the interviewer wants to hear (Recker, 2013). To avoid this, comments, and reactions from the interviewers following the interviewee's answers were held to a minimum during the interview, and questions in the interview guide were formulated in a structured but unbiased and neutral way to not affect the interviewees answers,

since this otherwise might affect the respondents' answers (Patton, 2015; Bhattacherjee, 2012). Another potential problem is the collection of inaccurate data due to interviewers not being able to recall certain answers or details (Recker, 2013). To mitigate this challenge, interviews were, if allowed by the interviewee, recorded, and transcribed shortly after the interview, to ensure data accuracy. The transcriptions were thoroughly read and analyzed by the other researcher who checked the materials for potential misinterpretations or mistakes to ensure quality and correctness. Artificiality is another potential problem with interviews that occurs mainly because of a lack of trust between researcher and interviewee since the researcher is typically a stranger to the interviewee (Recker, 2013). This was handled by starting each interview with some small talk and easy and non-threatening questions.

Because of respondents' different geographical locations, the interviews were conducted using the video-conference tool Microsoft Teams. This approach was chosen over telephone interviews since the researcher believed, similar to how Bell, Bryman and Harley (2019) argue, that it is important to see the interviewees facial expressions and body language during the interview, which would be completely lost in a telephone interview. Conducting online interviews allowed the research to include interviewees that otherwise would have been unable to participate due to the geographical distance, and therefore allowed the inclusion of a wider range of participants compared to if interviews were conducted face-to-face. Bell, Bryman, and Harley (2019) further argue that there is no significant evidence that this type of interview would reduce the interviewer's ability to secure rapport, in comparison to an interview held face-to-face, which the researcher of this study agree with since they did not experience any problem with understanding the participant and extracting valuable information.

The interviews were conducted in either Swedish or English depending on what the interviewee felt most comfortable in, and they lasted between 23 - 47 minutes. All interviews were, with the interviewees permission, recorded and later transcribed using the online software Trint, making this process more efficient and resulting in a high level of accuracy. This tool was useful since it allowed the researcher to save valuable time by making the transcription process more efficient. The interviews that were conducted in Swedish were first transcribed and later translated into English using the site deepl.com/translator, to ensure an accurate translation. The translated version was thereafter thoroughly examined and compared to the non-translated version to ensure their quality and correctness. A time-consuming process that was done to ensure transparence of this study since not everyone who might take part of it is proficient in Swedish.

3.3.1 Interview Guide

Before the interviews for this study were conducted, an interview guide of a semi-structured nature was created to help structure the interviews, plan what questions to ask, help manage the limited time and ensure that the interviews were performed in a similar manner, following the same general structure of questions (Patton, 2015). The full guide can be seen in Appendix A. In a semi structured interview, the interview should be scripted beforehand with a set of questions that the interviewers plan to ask (Myers & Newman, 2007). The interview guide was therefore created and structured according to the structure provided by Myers and Newman (2007, p.14), which included the following steps:

1. Prepare the opening
2. Prepare the introduction
3. Prepare the key questions
4. Prepare the closing

In the opening part of the interview, the interviewees presented themselves and their study, gave general but important information to how data would be handled to ensure the participants integrity and anonymity. The interviews were recorded, but before the recording was started the researcher's asked participant for permission, which they all agreed to (Myers & Newman, 2007). In the introduction part, the researcher briefly presented the study, its topic and purpose. According to Walsham (2006) this is a good way of easing up the tension and make the interviewee more relaxed, which should pay-off in the long term by resulting in a higher quality interview. The first questions of the interview focused on creating a general understanding of the participants background and therefore included the participants job title along with his/her background and previous experience with BI and SSBI. This was further done to make the respondent feel more comfortable with being interviewed and build trust. Following this was the section called "key questions" which was separated into two separate categories and contexts identified from the literature, as described in section 2.3. These questions were created to go more in depth into the different areas of interest related to SSBI. Finally, the closing part of the interview were designed to allow the respondent to add anything or expand on things they had previously said that they believed the interviewer might find interesting. The interviewers furthermore asking if there was anything they should have asked that they did not, which was done to catch perspectives and answers that the interview questions failed to capture, and that otherwise would have been lost (Bell, Bryman & Harley, 2019). The interviewee was finally asked if they had any questions for the interviewer, whereupon the interviews were concluded.

According to Myers and Newman (2007), despite having a general structure to the interview, researchers must be careful not to over prepare the script since this could make them less flexible and able to ask appropriate, off script follow-up-questions. Myers and Newman (2007) therefore stresses that researchers should always use an unfinished script to ensure a higher level of flexibility and improvisation in their interviews. This was taken into consideration when designing the interview guide and conducting the interviews. A key aspect that was taken into consideration when formulating the interview questions was in what way they would help to answer the research questions. The questions must be formulated in a way, so the respondent find them understandable, and it is therefore important to use an appropriate level of language (Bell, Bryman & Harley, 2019), which was also regarded while creating the interview guide. Bell, Bryman, and Harley (2019) further highlight the importance of not asking leading questions, which was taken into consideration when creating the interview guide and during the interview. Questions were therefore formulated in a neutral way, with an appropriate language style, in an effort not to affect the respondents' answers and to ensure the questions are understandable to the interviewee so that this does not to affect their answers (Patton, 2015). Words and concepts that could be challenging to understand were therefore thoroughly described, or exchanged for easier ones, to ensure that the participant understood their meaning.

3.3.2 Respondent selection

In contrast to quantitative research that relies on random sampling where respondents are selected based on statistics, most qualitative research relies on purposive sampling, where respondents are selected based on their specific traits or properties of interest that are deemed valuable or interesting by the researcher for the purpose of the study (Patton, 2015; Bell, Bryman & Harley, 2019). In purposive sampling, respondents are selected based on the researcher's judgment that they will be able to provide the study with data that can be useful for answering the research question (Bryman & Harley, 2019). However, because it is a non-probability sampling approach, purposive sampling can make it challenging to generalize to a wider population (Saunders, Lewis & Thornhill, 2019).

A purposive sampling approach was utilized in this study, where participants were selected based on their specific traits and experiences that, from the researcher's point of view, made them interesting to include in the study based on the belief that they could generate rich data of the studied phenomenon. With this type of sampling, researchers need to stake out certain criteria to help determine what respondents that are relevant to include in the study and which to exclude (Bell, Bryman & Harley, 2019). Two separate sampling groups were included in this study, one being users of SSBI and the other one being consultant, or experts, with experience in working with SSBI. These two groups were included to allow the researcher to study the phenomenon from different perspectives with the intent to collect richer data. The sampling group users was seen as a key group to include, since they would be able to provide insight about what challenges they face while working with SSBI themselves and how they had worked to manage these. Users were chosen based on the following criteria.

- Their experience in working with SSBI tools to perform analysis and create reports: This was seen as a crucial point for them to be able to provide the researchers with useful and interesting data.
- Language: Respondents were able to communicate in either English or Swedish. This was an important aspect when selecting respondents since this otherwise would make the interviews less fruitful since the researchers were not comfortable in any other languages.

The sampling group of consultants were also included, since they were thought to be able to provide the researcher with valuable insight from multiple different SSBI projects and provide information about what user-related challenges they had faced and how they had managed these. Consultants with diverse backgrounds were therefore chosen since their various perspectives and experiences were believed to help further enrich the collected data by being able to view the phenomenon from different angles to help create a holistic view. Consultants were chosen based on the following criteria.

- Their experience with SSBI: This was seen as a crucial point for them to be able to provide the researchers with useful and interesting data.
- Working with users: The consultants had been involved in projects where they worked directly with the end-users of SSBI.
- Language: Respondents were able to communicate in either English or Swedish. This was an important aspect when selecting respondents since this otherwise would make the interviews less fruitful since the researchers were not comfortable in any other languages.

Although not in every case, their current position was also taken into consideration: Senior consultants with experience from many different BI and SSBI projects were believed to be able to provide the researcher with richer data, compared to more junior consultants. Therefore, primarily senior consultants were included.

Considering these criteria, the researchers used their contact networks from work and previous studies to contact people working within several large consultancy firm and were able to get in contact with several potential candidates. From these candidates, a number were selected based on the criteria stated previously, with the result of a total of 6 respondents that were interviewed, summarized in Table 6. Of these respondents, 2 belonged to the sampling group of users (R4, R6), and 4 were part of the sampling group consultants (R1, R2, R3, R5).

Table 6: List of respondents

ID	Title	Interview Language	Length	Date	Appendix
R1	IT-consultant	Swedish	43 min	April 21st 2022.	Appendix B
R2	Senior consultant, Data engineer	English	46 min	April 22nd 2022.	Appendix C
R3	Senior consultant	English	47 min	April 21st 2022.	Appendix D
R4	Junior IT application Specialist	English	23 min	April 22nd 2022.	Appendix E
R5	BI front-end architect	English	27 min	April 25th 2022.	Appendix F
R6	Manager in analytics and information management	English	26 min	May 5th 2022.	Appendix G

Respondent 1

R1 works as an IT-consultant at a large consultancy firm in Sweden. The respondent worked primarily with various decisions support systems, with a focus on governance and management. R1 has around 10 years of experience in working with BI, and around 4 years of experience in working with SSBI and has further worked with and developed educations on the topic.

Respondent 2

R2 works as a senior consultant at a large consultancy firm with a global reach, at one of their offices in Sweden. The respondent is today working as a data engineer, have almost 14 years of experience with BI, and 4-5 years of experience of working with SSBI. R2 has furthermore worked with the development of his/her own SSBI tool, that was implemented into a well-known computer-hardware manufacturers company.

Respondent 3

R3 works as a senior consultant at large consultancy firm in Germany and works with the implementation of BI and SSBI. R3 have around 3 years of experience with BI, and one and a half years of experience of working with SSBI.

Respondent 4

R4 works as a Junior IT application specialist at one of the big four consultancy firm, located in the Czech Republic. R4 is currently working in a project of SSBI implementation and have 2 years of experience in working with BI and SSBI as a user.

Respondent 5

R5 works as a BI front-end architect at a large consultancy firm, located in Czech Republic. R5 has 4 years of experience in working with BI and around 2 years of experience with SSBI and has work with SSBI implementation, change management and often directly with the end-users.

Respondent 6

R6 is working as a manager within analytics and information management, in a large consultancy firm with a global reach. R6 has around 10 years of experience in working with BI and has worked in several projects that involve SSBI since 2017 and has during this time experience of worked with SSBI as a user.

3.4 Data analysis

To answer the research questions, the collected data needed to be analyzed and interpreted, which is considered as a crucial step to understand the data and make sense of it (Patton, 2015). In qualitative data analysis, in contrast to quantitative data analysis, there is no clear cut or single way of how it can be performed (Oates, 2006). There are multiple different techniques and methods that can be applied, the most suitable one may depend on several factors, such as the researcher's philosophical standpoint, aim of study and the research questions (Bell, Bryman & Harley, 2019). One of the most substantial challenges of qualitative research is that it rapidly generates a vast amount of complex and rich data, making it challenging to analyze in a structured way (Bell, Bryman & Harley, 2019).

There are several approaches to qualitative data analysis, however in this study a thematic analysis was used, which is a method for identifying, organizing, and analyzing patterns or concepts of meanings that emerge through the dataset to identify general themes (Braun & Clarke, 2006), which can help create meaning out of abstraction (Recker, 2013). This approach was seen as appropriate for this study since it would allow the researcher to identify recurring themes or concepts in the data set, by offering a systematic, and structured way to conduct qualitative data analysis (Braun & Clarke, 2006), allowing for large qualitative data sets to be analyzed (Saunders, Lewis & Thornhill, 2019). To identify themes, codes and concepts were first identified from the transcriptions and later grouped together in different ways to create meaning (Braun & Clarke, 2006). A theme often consists of several codes or concepts that appear to be related to one another in some way and that are deemed important by the researchers to answer the research questions (Saunders, Lewis & Thornhill, 2019). When

searching for themes researchers should be looking for things in the data such as, repetition, categories, linguistic connectors, similarities and differences, and missing data (Bell, Bryman & Harley, 2019). However, a theme can also consist of a single code or concept that is considered important for the research questions and can therefore be elevated to become a theme on its own (Saunders, Lewis & Thornhill, 2019).

Patterns or themes are commonly identified using one of two different approaches, either a deductive or an inductive approach (Braun & Clarke, 2006). For this study the latter was chosen since the study aims to identify challenges and ways of how these can be managed. Considering the lack of previous research, the deductive approach was deemed less suitable since data in this case would be analysed according to an existing framework (Patton, 2015). In contrast to this, the inductive approach allowed the researcher to explore themes related to their research question, and allow for new concepts, patterns, themes, and explanations to emerge from the collected data (Saunders, Lewis & Thornhill, 2019).

For conducting the data analysis, the structure proposed by Braun and Clarke (2006) was used, since it provided the researchers with a somewhat structured way of conducting thematic analysis. The framework consists of six steps that are described in Table 7, along with an example of how the researcher worked in each step.

Table 7. Thematic analysis structure by Braun & Clarke (2006) and a description of how the researchers followed it.

Phase	Description
1. Familiarizing yourself with the data.	During the first phase, the researchers read, and re-read the finished transcriptions several times to become familiar with the dataset, before looking for codes. When reading the researchers, they did however take notes about general ideas that emerged. Transcribing the interviews further helped the researchers become familiar with the dataset.
2. Generating initial codes.	In this phase, the researchers analyzed the dataset and identified initial codes, which was done in a systematic way. Codes were in this case characteristic or features in the data that were deemed interesting by the researcher for the sake of the study. Equal attention was given to each part of the dataset to ensure that nothing was overlooked, and the researchers aimed to identify as many codes as possibly, since it is hard to know exactly which codes will be interesting at a later stage. Codes were structured using an online tool called Miro, and initially each code was placed together with the other codes with the respondent where they emerged. Two codes identified during this process was "Users have issues with small/basic things, like filtering" and "Users lack basic technical skills and need to ask experts for help".
3. Searching for themes.	When the dataset had been coded and the research had a long list of codes, these were sorted into different potential themes, based on similarities, relationships or other aspects that made them relate to each other in some way. This phase ended with several identified themes, and sub-themes

	being created. The two codes mentioned in phase 2 were, because of their similarities, were in this phase sorted together under a theme called "Users lack appropriate skills to work with SSBI and need support".
4. Reviewing themes.	During this phase the initial themes were further reviewed and refined to decide if there was enough data to support them or if a theme should be split into multiple sub-themes, or several themes being combined into on. In this phase, the theme called "Users lack appropriate skills to work with SSBI and need support" was separated into two sub-themes "Users lack the appropriate skills to work with SSBI" and "Users still needs support" to make them more precise and since there was enough data to support both.
5. Defining and naming themes.	Identified themes were further reviewed, refined, and defined with the goal of capturing the core essence of what each theme was about, which included reviewing the themes names, and creating a definition of each theme, to help clarify what it meant and included. The theme "Users still needs support" was further refined and renamed to make it clearer and was therefore renamed to "Users still needs support, but many organizations lack guidelines for proper error-management". This step ended with a final set of themes.
6. Producing the report.	This phase began when the research has a set of fully worked out themes and are writing the report. Here the researchers decided to include this theme in the report since they considered it interesting and relevant for the study.

This approach was deemed appropriate since it is commonly used within qualitative research and is furthermore well-aligned with the researcher's philosophical standpoint, since it would allow the voices of the research participants to emerge through the analysis and allow for different perspectives of the studied phenomenon to be seen, making it suitable for this study (Saunders, Lewis & Thornhill, 2019). Using thematic analysis, the researchers strived to identify and uncover recurring user-related challenges with SSBI and ways of how these could be managed. This method allowed for data to be structured in meaningful ways to generate a rich understanding of the phenomenon that could be used to generating a holistic picture. Since qualitative data analysis is heavily reliant on the researcher's interpretation and subjective views, the results are prone to be affected by researchers' own biases (Walsham, 2006; Patton, 2015). In this study, the researchers strived to mitigate the result being affected by their own biases by conducting analyst triangulation where each of the researchers conducts coding separately, whereupon the results were compared and discussed to ensure that the researchers interpreted the results in a similar way and to minimize biases in data collection (Patton, 2015). This approach generally leads to higher quality coding and a more consistent result (Linneberg & Korsgaard, 2019).

3.5 Research quality

To ensure that the research conducted is of high quality and standard, the researcher should, during the process of developing objectives and choosing methods, consider how issues of validity and reliability might affect the research (Recker, 2013). If the researcher considers validity and reliability issues when making choices concerning objectives and methods, a solid foundation is laid out that can improve the overall quality of the study (Bell, Bryman & Harley, 2019; Berndtsson, Hansson, Olsson & Lundell, 2008). Reliability refers to "the degree to which the measure of a construct is consistent or dependable" (Bhattacherjee, 2012, p.56). In other words, to the degree, a specific study can be replicated with identical conditions and with the same results, and if there are several researchers, they have the same view and interpretation of the information that emerges (Bell, Bryman & Harley, 2019; Bhattacherjee, 2012). Since the research approach is qualitative, and the data collection therefore by nature is qualitative, it is not easy to meet the criterion of replicating the study exactly, as the data collection depends on the individual respondent's answers and how the data analysis is conducted (Bell, Bryman & Harley, 2019). To the extent possible with qualitative research, reliability was achieved by designing a comprehensive literature review to form a reliable, relevant, and unambiguous interview guide as described earlier. The same interview guide was followed during each interview so that all respondents could answer the same key questions that were designed to fulfil the research purpose and answer the research questions. However, since a semi-structured approach was taken, follow-up questions arose based on respondents' answers to key questions, which could conceivably add depth to the conversation and the research conducted, leading to some variation among the questions asked, but still within the framework of the main question. To ensure that both researchers had the same view and interpretation of the information that emerged, the transcript from the interviews were discussed between the researchers.

The researcher must also address validity and potential threats to validity to ensure a high-quality study (Berndtsson et al. 2008; Bell, Bryman & Harley, 2019). Validity is described as the relationship between what the researcher intends to measure and what was actually measured (Bell, Bryman & Harley, 2019; Berndtsson et al. 2008). Bell, Bryman, and Harley (2019) have described two forms of validity, internal and external. Internal validity refers to "whether or not there is a good match between researchers' observations and the theoretical ideas they develop" (Bell, Bryman & Harley, 2019, p.363). External validity, or transferability as it is often referred to in interpretive research, refers to the extent that a study's results can be generalized to other settings (Bhattacherjee, 2012; Oates, 2006). Research can gain a higher level of transferability by providing a thick description of the studied phenomenon, so that the readers of the study themselves can determine to what level the results are transferable to other settings (Bhattacherjee, 2012; Oates, 2006). This can further be done by providing a full description of the research questions, design, context, findings, and interpretations, give the reader a full picture of the study and its contexts (Saunders, Lewis & Thornhill, 2019). To increase the transferability of this study, the researcher strived to prove a thick description of the studied phenomena, including different contexts and settings. Qualitative research tends to be less generalizable compared to quantitative studies that rely and statistical generalizability, this should however not be seen as a weakness since the goal of qualitative research focuses more providing insight that can be used to generate theories (Saunders, Lewis & Thornhill, 2019). Considering this, this study does not set out to be as generalisable as a quantitative study, but instead aims to provide deeper levels of insights that can be used in the development of future theories on this specific topic.

The validity of this study was further ensured by using a systematic approach to conduct the literature review to ensure the relevance of the collected material that formed the basis for the data collection and to avoid missing important and relevant sources, leading to weak validity. Moreover, the researchers worked independently on coding the transcriptions during the data analysis, but, similar to what was described previously, followed up with joint discussions to ensure a common interpretation of the collected material and to reduce the change of researchers own biases affecting the analysis. Furthermore, to improve the study's credibility, which parallels internal validity (Bell, Bryman & Harley, 2019), the research's theoretical and methodological decisions have been clearly described, including the selected data collection technique. The transcription of conducted interviews and descriptions of the interviewees are presented in their entirety, which increases the study's credibility, according to Bhattacherjee (2012). To make statements and draw confident conclusions based on the data collected, the interviewees were able, if desired, to check the transcripts to ensure that the interpretation of the information was correct and provide evidence that this is what the interviewee said, which is an essential part in ensuring high validity and confirmability (Berndtsson et al. 2008; Bhattacherjee, 2012).

3.6 Ethics

Ethics within science is about finding a balance amongst different interests, such as generating new knowledge and minimizing risk associated with conducting research. Vetenskapsrådet (2017.p13) states that "*We are to conduct qualitatively good research with an important purpose, and at the same time protect those individuals taking part in the research*" and highlight the need for finding a balance between "*the criterion of protection of the individual*" and "*the research criterion*". How this equilibrium is found mostly depends on the research discipline and what type of research is being conducted (Vetenskapsrådet, 2017). This study has followed the general rules of research conduct as stated by Vetenskapsrådet (2017.p10), covering rules such as: "*tell the truth about your research*", "*openly account for your methods and results*" and "*strive to conduct your research without doing harm to people, animals or the environment*".

A qualitative approach was chosen for this study, and interviews was conducted to collect data. During interviews, sensitive information about the participant's personal experiences, feelings, and thoughts can be collected as people often share more than they originally intended to, making interviews highly personal. Therefore, it is important to consider ethical aspects when conducting qualitative research (Patton, 2015). Prior to interviews an informed consent needed to be given by the participants who were be asked again at the start of the interview, since it is a key ethical principle in qualitative research to secure the permission of all the participants in the study (Recker, 2013). Before the interview started, participants were informed about their rights, what the study was about, how the interview would be conducted and how the principles of anonymity and confidentiality would be handled (Patton, 2015; Recker, 2013). The principle of anonymity covers how the researchers would work to ensure that the participants' names, or the names of the companies they work for not would be included in the transcripts or study, to protect their integrity (Patton, 2015). Respondents received information on confidentiality and how generated data would be protected, stored, and not be shared with anyone, but the researchers involved in the study (Patton, 2015). Furthermore, participants were informed about potential risks and their rights to stop the interview at any time, along with having their answers withdrawn from the study prior to conclusion,

without them suffering any consequences (Recker, 2013; Patton, 2015). At the start of the interview, participants were asked if the interview could be recorded to aid transcription. If consent was given, the interview was recorded. After the interview were conducted the respondent was asked if they wanted to get a copy of it, for member-checking and verification, giving participants a chance to review their answers and correct any misinterpretations (Patton, 2015). Furthermore, ethical aspects and issues also needs to be assessed during the process of writing the thesis, such as avoiding plagiarism (Vetenskapsrådet 2017), recognizing co-authors contribution, and using an appropriate language that fits the studies purpose without containing any biases towards specific groups of people (Recker, 2013).

4 Empirical findings

This chapter presents the findings of the conducted study and is structured according to the different themes that emerged during the data analysis process. Four major themes were created according to the different overarching challenges identified, several of which consist of several sub-themes. All the information and quotas presented in this chapter are based on the interview transcripts of the conducted study, that can be found in full in the appendix.

4.1 Users struggle to work with SSBI in a self-reliant manner

This overarching theme, identified from the empirical study covers the fact that many users struggle to work with SSBI in a self-reliant manner, because the lack of the right skills and knowledge, users need to rely on support, and struggle to use the SSBI tools. This theme is divided into three sub-themes each covering one of the following categories in some way related to users not being able to be self-reliant: users ack appropriate skills and knowledge, users are still reliant on support, and users struggle to use the SSBI tools. Each sub-theme is covered more in detail in the following sections.

4.1.1 Users struggle to work with SSBI tools

Table 8: Key findings: Users struggle to work with SSBI tools

Key findings
Main challenges
- Users lack the knowledge and skills needed to work with and use SSBI tools properly   - Some SSBI tools seem easy to use, but require skills to use properly, resulting in users creating errors   - Users struggle to understand the syntax of SSBI tools
How to address challenges
- Users need training and education to use tools   - Users need continuous support   - SSBI tools needs to be user-friendly   - SSBI tools needs to fulfil users' requirements and needs, and it is important to find the right tool.   - Make use of predefined calculations, metrics, and dimensions

Another theme that emerged during the data analysis covers the fact that many users struggle to work with and use their designated SSBI tools. Users sometimes lack the right knowledge on how to use SSBI tools in their work and create their own dashboards (R6:12). At first glance, many SSBI tools seem easy to use, but R3 explains that it is easy to create a brief analysis with many tools but using the tools for their intended purpose requires more skill and going deeper and creating real analysis often require more in-depth knowledge (R3:12).

"I think, almost the case with self-service tools in general that the very first look or very first side, it seems to be easy, but it is a pretty high learning curve to use the tool in the sense it is meant to be." (R3:12).

The fact that some tools, at first glance, are perceived as easy to use can also pose some challenges, since this means that users will be able to perform analysis without knowing what they are doing or if it is correct (R3:30). Many users struggle to work with the tools because they do not understand their syntax, since many tools have specific syntaxes that can be complicated to understand for an inexperienced user, such as DAX in Power BI (R3:12). This can be especially hard for casual users since they often lack the technical knowledge, and the syntax is often too complex for them to simply understand and write, especially since many of the casual users are managers and they lack the knowledge on how to write expressions, since it's not their job to do so (R2:26). R1 further stated that many users can struggle to understand how to get the tools to do what they want (R1:36). R4 highlighted that users sometimes struggle with basic tasks as well (R4:44). R2 asserts that these users often know what they are looking for, but do not understand what syntax will give it to them (R2:28). If users do not have the right competencies and skills to use SSBI, this will put an increasing pressure on expert users and IT-departments, since they will be getting a lot of calls (R2:20). If users find a tool as hard to use, not user friendly or intuitive, this may not encourage users to use that tool or service (R6:40).

Several recommendations and ways of managing these challenges emerged during the interviews and the following data analysis. R1 thinks that it is crucial to choose an SSBI tool that is easy to use and intuitive for users to be able to work with successfully, and further states that these are available and easy to get a hold of (R1:34). R2 further states that it is important to find the right tool for SSBI (R2:40), which is similar to what R4 argues, stating that the tools and environment used needs to be user-friendly (R4:34). R6 further thinks that it is important to choose a tool that fulfills the needs of the users to encourage them to use it (R6:40). Several users therefore seem to think that the choice of tool is an important factor.

R2 asserts that users need to get the right training and education on how they can use the specific SSBI tools and what they can use them for to gain an understanding of how they will use it in their work (R2:20). Users need to be trained in how the tools work, how they can use it to create reports, what things work together and can be combined, but also the limitations of the tools and what they cannot do (R4:44). Gaining more knowledge about how the tools work will, according to R5, also help them to identify and solve problems on their own, without support from experts (R5:18). Even though users should get training to handle some issues, there still needs to be a team of experts that can support them when they need help, and that also are responsible for installing and managing the SSBI tools (R6:26,28). R1 adds to this by stating that it is important that there are established processes in place so that users can get help when they need it (R1:36). Several respondents further argue that tools should include predefined calculations, metrics, and dimensions since this could make them easier to use (R4:46; R2:28). This could include drag-and-drop functionality with predefined metrics created by experts (R4:46), to create a standard way of doing things and make the tools easier to use (R4:52). R2 also says that tools should have predefined metrics and dimensions that users can choose between that are stored in the backend of the system (R2:28).

"So, basically, you create all these common dimensions items and then you give it to them. OK, so what do you tell them that you don't need to run those queries by yourself? You just

load these common dimensions and you just focus on your area and not the common queries" (R2:32).

Structuring it like this would minimize or eliminate the need for users to write their own queries and know the syntax of the tools, which could make the tools easier to use (R2:28).

4.1.2 Users lack the appropriate skills to work with SSBI

Table 9: Key findings: Users lack the appropriate skills to work with SSBI

Key findings
Main challenges
• Users lack knowledge and skills on how to work with SSBI tools, increasing the pressure on experts • Users struggle to understand how data and data models work • Users struggle to perform data analysis, use dimensions and metrics in an appropriate manner
How to address challenges
• Provide users with education and training on how to work with SSBI • Train users with the actual data they will work with • Provide users with continuous support

A recurring theme that emerged during the interviews and data analysis covered the fact that many users of SSBI lack the appropriate skills and knowledge for how to work with, and use, SSBI in their daily work in an efficient and appropriate manner. Several of the respondents highlight this as being a challenge (R6:12; R2:12; R4:44; R1:20; R3:32; R5:8), since a lack of knowledge amongst the user can result in them getting stuck, not knowing what to do, and resulting in an increased pressure being put on expert users, by being asked for help more frequently (R2:20). This can in the long run result in more pressure being put on IT-departments and experts, requiring organizations to have bandwidth required to cope with this need (R2:18). Many business users are keen on getting the results from the analysis performed with SSBI, but they lack the technical know-how to understand what is going on in the background, with the data governance, data models and the efforts needed to make data accessible (R2:12). R2 further highlighted that many users struggle to understand the syntax and technical functions of SSBI tools, which requires that the user has some technical skills, therefore sometimes being too complicated for casual users (R2:26,28). R6 has a similar opinion on this matter and states that users without the right knowledge will struggle to create their own dashboards and analysis:

"If you have business teams with no knowledge and experience manipulating the business intelligence tools, it will be complex for them to create their own dashboards." (R6:12).

R1 adds to this by explaining that many users struggle to understand how data models work, but also how different dimensions and metrics can be combined and used in different ways to get the desired insight instead of an error-message or faulty answer, which can further complicate and make it harder for users to perform data analysis using SSBI (R1:18). R4 states that it

is important that users have some knowledge and understanding about how data and tools works to make use of any self-service capabilities (R4:18).

"Even if you have the best self-service services, you cannot really do anything with the data if you don't understand how it works" (R4:18).

Getting users to understand how the data model works and what specific dimensions and metrics that can be combined are according to R1 a substantial challenge (R1:18), which R5 agrees with by stating that getting users to understand the data is sometimes challenging (R5:10). R4 further highlights that user do not always get stuck on technical challenges, but sometimes have problems with smaller issues as well, such as with filtering data (R4:44).

Many of the respondents found that a lack of both technical and general knowledge amongst users is a substantial user-related challenge since this in many cases can inhibit the user's ability to work with SSBI to conduct data-analysis (R3:30; R2:28; R6:12; R5:8) However, many recommendations and success factors covering how many of these challenges could be managed emerged during the data analysis, where two general categories of solutions surfaced. Firstly, all the respondents highlighted in some way that users need to get the right education and training to gain the knowledge required to use SSBI in their work (R5:20; R6:16; R1:42; R3:14; R2:20; R4:44). Secondly, several respondents also highlighted that users need to get continuous support while they work with SSBI to get help to solve problems and help them with ad hoc requests (R2:40; R1:68; R5:32). Users need to receive appropriate training and education for how to work with specific SSBI tools to be able to work with them in a self-reliant manner (R1:42), since they need the right knowledge to work with a specific tool and to leverage SSBI (R6:12) and create their own dashboards (R6:24). R1 states that one of, if not the only way to make users truly self-reliant is by educating them while being asked how to make users more self-reliant (R1:42). R2 adds to this by stating that users need to get the right education to understand SSBI tools and data models and what they can do with these different things, otherwise they will need to rely more on the support from experts (R2:20). R5 states that education is important so that users get the right skills and knowledge to identify issues and to some degree fix these themself, and if they break sometime be able to fix it without the help of an expert (R5:18). R4 provides some insights and tips on things to consider during education and training:

"The training from our part is more like how to use the service, how you can create the reports, maybe something about the relationships between the tables, what fields can be put together. What things you cannot do. How to use it. How to save it. Those basic stuff". (R4:44).

The education can be structured in many ways, as implied by R5 who explained that education should be performed without considering the users previous experiences, and instead provide all users, regardless of their area of expertise, with the same basic training. The focus should be put on understanding the tool itself and be like how you would teach someone to use Microsoft Excel, where they learn the basics of the tool so they then themselves will be able to personalize it through their own data areas and use it in their specific work cases (R5:22). R5 suggests that these educations should be performed in the shape of workshops held both virtually and in person, and that these should be done continuous (R5:20). It is also important to support users in this process and walk them through everything to ensure they truly understand what different things mean (R5:10). R3 puts emphasis on the importance of

doing everything from scratch during the education and to not expect users to have any prior knowledge about the topic, R3 puts further emphasis on the importance of supporting them continuously throughout this process (R3:14).

R1 states that providing users with good training is one of the most important things to consider (R1:66). R1 have worked with the development of a training set-up for a client, which follows a three-step structure, where each step is specifically designed for a certain type of user and focuses on how they will use the tools and their previous knowledge (R1:46). The first step is created for business users and primary focuses on teaching the basic functionality of SSBI tools, such as how to find and access reports, how to report errors and get help (R1:46). The subsequential step, or step two is specifically designed for superusers who are more skilled than the regular end user, where they learn things such as, how to build reports, use metrics, find datasets, and access data, but also what the best practices are when designing a report (R1:46). The final step is created for the expert users and focus more on the technical aspects, such as creating new data sources and building data models (R1:46). R6 further highlights that user during their education should work with the tools and use the same datasets and models that they will work with in the future so they learn how this specific data can be used in their work (R6:16). R6 argues is the main difference between the training that is provided by the company he/she is working for, compared to training other companies provide (R6:16).

Several respondents furthermore highlight the importance of offering continuous support to the users (R1:66; R5:20; R3:14). This could be done by establishing guidelines for how and where users can access data, what a dataset is and how they can use tools (R2:20; R3:16). Casual users need to be able to get support when they run into problems or need help with ad hoc analysis (R2:40; R1:68; R5:32). This support can come from more advanced users (R3:34) or from an IT-department (R2:18). This is important to ensure that end users do not go their own way, but instead follow established guidelines (R1:68). R6 highlights the importance of establishing a good communication channel between the IT-department and users to be able to provide support (R6:26).

4.1.3 Users are still reliant on support

Table 10: Key findings: Users are still reliant on support

Key findings
Main challenges
- Users do not always get the support they need   - Users lack the right skills to use tools properly, putting an increasing pressure on experts and IT-departments   - Users are still reliant on support from experts
How to address challenges
- Provide all types of users with continues support   - Train and educate users so they can work efficiently with SSBI and are able to identify and solve some problems on their own.

> - Make us of superusers, or extra skilled users, in each business area to support the regular users.

This theme covers the fact that users still need to get support even though the main premise of SSBI is to make users more self-reliant, which sometimes can be challenging for users since not all organizations have set up proper guidelines for error-management and support. R1 has as a consultant encountered several organizations that lack structured processes for error handling so that users can get support (R1:36). Users can often run into problems while working with SSBI, where they do not really understand why the data is not shown as they want it to (R1:36). Many users may also run into other problems related to data, since they often lack appropriate knowledge and skills and do not know what they are looking for, or what dataset to use to find it (R2:20). R2 states that SSBI is primarily made for business people, but these often lack technical skills needed to perform certain tasks and solve problems, increasing their need for support (R2:18) and subsequently puts an increasing pressure on experts and IT-departments (R2:20).

"If you get a lot of frequent new customers and need to support our customers and their request, then it's actually piling up a lot of work for your organization, you need a lot of bandwidth to cater those requests". (R2:18).

Several respondents highlight the importance of providing users with support to help them when they run into challenges, get stuck or need some extra help (R2:18; R4:44), and some see this as a challenge for the users if there is a lack of established processes (R1:36). R1 argues that if users do not get the right support this might encourage users to go their own way and start using alternative solutions (R1:66). During the interview and subsequently the data analysis, several recommendations, and ways of managing these challenges emerged. Several respondents argued that a proactive way of mitigating the need for support is to offer the users basic education and training on how to work with SSBI, since this otherwise will increase the number of support requests (R2:20). The main way to enable users to be more self-reliant is according to R1 to educate them (R1:41). R2 thinks that users do not have to be experts, but they should have enough skill, so they know how to get data, clear the layout, create charts and those basic things (R2:18). R2 further states that companies still need to be able to provide users with support with more technical things such as ad hoc functions and technical problems and should therefore have a dynamic back-end team to be able to provide frequent support when needed (R2:20). R6 adds to this by stating that it is important to establish a good relationship between the users of SBBI and the IT department to help monitor the tool and provide support when users face more technical challenges (R6:26). The company R5 works for uses a platform called ServiceNow, which is a support network where their users can get support if they get stuck, produce something that looks weird, or need some extra help (R5:42). R5 argues that this type of support is important since everyone can get lost sometime and need some help (R5:42), and organizations therefore need to provide continuous support to users (R5:20). R6 further highlights that even if the main premise of SSBI is to allow for self-service, there is always a need for an IT team that can help to monitor and support the tool (R6:28).

R3 thinks that in an ideal scenario, there should be one SSBI expert in each area or team that can help to enable the normal users and support them when needed (R3:34). R1 has a similar view and have during previous work made use of superusers, who are regular users, but that are particularly good, more skilled, and know the tools better than everybody else (R1:38). These superusers can be direct support to the other users and help them solve problems and

assist them with ad hoc functionality (R1:38). Users can go and ask these superusers and get help directly since they are more skilled and have more experience, instead of having to contact the support team (R1:38).

"Then of course you can have experts on top of that who might be able to help with technology and you might need to have people who have worked with data models who can explain how it works in detail if you come across things like that as well. But just this idea of letting skilled users help other users is a good model that tends to work well in many places" (R1:38).

R1 states that the superusers are the main users of SSBI, and the end users are to a much lesser degree (R1:40). On top of this, there are experts that can help superusers with the more technical challenges that are related to data models. R2 further highlights that even more experienced and advanced users sometimes need support (R2:40).

4.2 Users struggle with data-related challenges

This overarching theme covers the user-related challenges that in some ways are data-related and can create problems for the end-users, since many users struggle to find and access data, understand, and use it properly, and to assess the quality of data. The theme consists of three sub-themes: Users struggle to access data, Users struggle to use and understand data, and Data quality and reliability issues can constitute a problem for users. Each sub-theme is covered more in detail in the following sections.

4.2.1 Users struggle to access data

Table 11: Key findings: Users struggle to access data

Key findings
Main challenges
- Users do not know what data sources that are available   - Users do not know how to find the right data sources   - Users are not able to access the data they need   - Findings the right balance of data governance: Too strict data access and governance may prevent users from working with SSBI effectively, too loose data access and governance leads to a loss of control and chaos
How to address challenges
- Have guidelines and documentation for how and where to get data   - Understand user's different needs and give the right data to the right user   - Set up role-based access   - Have a clear and centralized governance model   - Data governance should fulfil end-user goals and needs

A recurring theme that occurred during the interviews that most of the respondents raised is derived from access to data, where various issues associated with access of data emerged that might constitute a barrier when using SSBI. R2 describes that many users are unaware of what data sources are available within the organization for analysis. If they need certain information to answer a business question, they do not know which data sources contain needed information and where the data containing the information is located (R2:20).

"*Most of the users are not aware of the data, what exactly they are looking for. They are looking for some of that information, but that suddenly they don't know which dataset will provide that information, and where the dataset is located*" (R2:20).

On top of this, R5 adds that the main technical challenges that constitute the most significant issue when end-users should become more self-reliant with SSBI are related to data use and access (R5:18). When discussing access to data, respondents also highlight that users are not able to access the data needed because of data centralisation, restrictions, and strict data governance models, which prevents the idea and hinders the use of SSBI, leading to frustration among users (R3:20; R2:16). In alignment with R3, R1 states that too much data centralization leads to poorer drive among users (R1:58). However, several respondents mentioned that decentralization and open access to data is impossible since not all users should have access to all data. It is a difficult balance between data security, data governance and providing data to everyone. Moreover, the organizational structure in many organizations makes it impossible to achieve complete decentralization of data (R3:22; R2:16).

"*I think the most common issue right now is this problem between data security and data governance on the one hand and the willingness to provide data to everyone. Because. It is faster and it is easier if everyone can do their own analysis. But of course, you don't want everyone in the company to see every piece of data… I personally think that complete decentralized data management is possible, but not in, I think, around 90, 95 percent of the existing companies because of this organizational structure behind*" (R3:22).

Respondents further argue that having too relaxed data governance and letting everyone access data freely in a self-reliant and decentralized manner leads to an uncontrolled environment (R2:12; R3:28; R6:44).

As the scope of this research concerns user-related challenges and how the challenges can be handled, the respondents were asked how the problems that emerged related to access to data could be managed. Multiple respondents return that not all individuals should have access to all data but that it is crucial to understand what part of the data should be accessible to who (R4:38; R5:28; R3:22; R6:44). R2 suggests that it not only implies that there are private and sensitive data that not everyone should see but also that business users do not need to see all data as it is not manageable or serves any purpose for them (R2:40). R2 elaborates and describes that the BI/IT team needs to consider and understand the user's different needs and provide the right data to the right user, which should initially be done by interviewing businesspeople or conducting surveys to understand the users' different needs (R2:44). R6, further emphasizes the importance of understanding who should have access to data and at what level and points out the importance of having a stated strategy for accessing data (R6:36).

R2 mentions that an approach for giving the right access of data to the right user is to create data marts in the DW environment and only showing the data that is of interest to the user.

This makes it easier for them by minimizing the amount of data they can see and need to manage (R2:40). R2 further explains that role-based access is an important factor for managing access to data (R2:40), which is also supported by R4, who describes that organizations need to have access management in place to manage what data should be accessible to who (R4:38). Regarding the problem that users do not know which data sources are available and how they can be accessed, R3 describes the importance of having a clear and centralized governance model that defines who is able and allowed to access data, how to get data, and where to get the data from (R3:22, 16). R3 describes that it can go against the real purpose of SSBI when introducing comprehensive access and data governance restrictions (R3:16, 22). In response to data restrictions, organizations should have a flexible and fast responding group that provides access to data needed for users (R3:22). Having a good data governance model in place for data access is something that most respondents mention as a crucial factor in managing how data can be accessed and by whom, as well as in avoiding loss of control and chaos in the organization and for the end-user who tries access the correct data (R2:12; R3:16.44; R6:14).

4.2.2 Users struggle to use and understand data

Table 12: Key findings: Users struggle to use and understand data

Key findings
Main challenges
- Users do not understand data definitions   - Users have difficulty understanding data, the data model, and how it can be used   - Users use incorrect data, leading to incorrect results   - Ambiguous and unclear data definitions give users problems
How to address challenges
- Keep a good naming standard and name data (metrics, dimensions, and attributes) using business terms   - Use documentation, and a data catalog to explain data and its definitions   - Create a map with guidelines for how data is associated and how the data can be used   - Create a data model targeted for a specific group or use case   - Train users with real business data   - Present data in a user-friendly and structured way for end-users   - Have a metrics architect who ensures that the data is correct and has understandable names   - Provide users with pre-prepared data   - When creating a data model include people who understand the business

Users seem to struggle to understand what certain data means and the naming standard can be vague with an ambiguity regarding what certain data actually represents, which can lead to misunderstandings when users are not sure about data definitions (R4:46). Unclear data definitions or the same name can have different meanings, leading to confusion among users who must ask for additional support from experts (R2:22). However, R1 says that it is not only the terminology that can constitute a problem when using data, but also that users do not

understand how the data model works, which measures work with which dimensions, and which do not work together could also be a problem for users when it comes to the use of data, leading to faulty results (R1: 18,20). R4 describes that if users do not understand data and how data can be combined, it is difficult to be self-reliant and use SSBI, no matter how good the SSBI solution is (R4:18). R1 further states that a common problem for users related to the use of data is that data models are too extensive and too little focused on a specific group's individual needs, which makes it more challenging to use data (R1:42).

To overcome some of the obstacles with vague and confusing definitions for end-users, re-spondents describe that one must establish a good naming standard where data only exists with one definition (R1:18; R4:28; R5:26). Organizations should name data to reflect the business and the terms commonly used within the organization so that users can easily under-stand the meaning of the data (R1:16; R5:26).

"*What do we call the metrics so that they are understandable to the business? What do we call the dimensions and the dimension attributes so that they are in such a language that the business uses itself so that they describe the real business terms and nothing else. That's what I mean by the terminology, I call things the same thing that they say in the business and not something else.*" (R1:16).

R1 further elaborates and remarks that naming things in business terms is not always that sim-ple. Therefore, it is vital to create easily accessible documentation that explains the concepts and definitions that the data contains (R1:22).When discussing terminology, data definitions, and users' difficulties in understanding what data means and how it can be used, multiple other respondents also highlight what R1 mentions regarding the matter of having clear docu-mentation to explain data and its definitions, as well as establishing guidelines for how data can be used. R4 mentioned that data definitions need to be explained somewhere (R4:46), and R5 that documentation must be available to minimize the margin of error when people with less BI experience should produce their own analysis (R5:52). Organizations should create a data catalog that users can access, including data descriptions (R2:24; R5:10). R5 also argues that one should go through the data model with users, so they understand the data model and the meaning of associated data (R5:10). R2 comment that organizations should have a space or area where users can go and find guidelines and maps for how data is associated, how the data can be used, and the meaning of data (R2:22).

"*So, you need to have a proper map or guideline in your organization, when you have imple-mented self-service BI, you can use a tool like a confluence or those kind of pages or tools where you have proper guidelines and maps where you explain, OK, this is the dataset, and here is the related dataset. And this is the hierarchy. So here you can make the queries, not here. So, B is related to A, C is related to B, B is related to C. So, if you are looking for data at the D level, you should run the query at the D level on the B or C level. So, this kind of clarity you need... So basically, everything should be clear with clear instructions, with the data sets and everythin*g" (R2:20).

R1 and R4 both discuss the problem that data models are far too extensive for users' actual needs and suggest to only keep and show the parts of data relevant to the specific user (R1:42,44; R4:20). The data model should be smaller and adapted for a target group or based on use cases, as stated by R1.

"*By making them smaller, targeting them to just a particular target group need, just this information this target group needs it also becomes easier to use and less to search through then and things like that. So, I guess that's also part of making easy and intuitive models to make as small and limited as possible for only a certain target group and users*" (R1:42)

Not only should the data, and data model be limited to the specific needs of a group or individual. The data presented to the end-user must also be clearly structured, appropriately prepared beforehand, and presented in an easy and user-friendly way (R4:20,22). Moreover, R1 adds that creating the data model should be done in close collaboration with business-savvy people and process owners, who have good insight into the business's daily operation and understand what data and decision support is essential to support the business processes (R1:58). As stated earlier by R4, if users do not understand data and how data can be combined, it is challenging to be self-reliant. R3 claims that business users should not have to perform complicated data operations such as combining different data sources, data manipulation, and data transformation. Rather, business users should receive already prepared data ready for analysis with the SSBI tools (R3:28). Somehow in line with this, R1 states that organizations should have a central function or a metrics architect that ensures that the data business users receive is suitable and understandable to be included in analytics (R1:62). Several respondents further highlight the importance of providing users with proper training so they understand how the data, and different data models can be user, and R6 states that users during this process should train with the actual business data they will work with to better prepare them (R6:16).

4.2.3 Data quality and reliability issues can constitute a problem for users

Table 13: Key findings: Data quality and reliability issues can constitute a problem for users

Key findings
Main challenges
• Data quality issues can be more challenging within SSBI, since business users need to understand the aspects of data quality issues and how to manage it • Users are not informed about the latest available and updated data • Users use outdated, erroneous and unreliable data, leading to inaccurate results • Multiple versions of the truth exist • Users create multiple versions of truth
How to address challenges
• Establish a communication channel that informs about data updates • Correcting data at the source • Centralising data • Create a single source of truth • Utilize Master Data Management

Many respondents have described that, similar to problems within traditional BI, data quality deficiencies can also constitute a problem for users within SSBI (R1:24.30; R3:22; R6:12). However, even though there is always an imminent problem with data quality in data analytics, it can be more challenging in SSBI since business users may have difficulties understanding what data is low-quality and how to manage it (R1: 24). Several respondents mentioned

the problem that multiple versions of the truth exist within organizations. The same dimensions and measurers appear in different systems but with multiple different versions of them, leading to erroneous results and reliability issues (R1:60,62; R5:14). R1 describes that the problem may be due to decentralized ownership of data models, leading to users creating their own versions of the truth (R1:62), which results in the organization in general, or other users getting that person's version of the truth versus some other version that the rest of the business use (R1:66). Since SSBI allows more people to use data, the risk of users creating multiple "own" sources of truth, including inaccurate, unreliable, and low-quality data that other users later consume increases (R5:14). Reliable and up-to-date data are essential factors in achieving high data quality. In connection with this, R6 states that users within SSBI might not be informed about when data change and do not receive information about the latest updated version of data. Not receiving updates about the latest version leads to the use of outdated, erroneous, and unreliable data that have already been exported to other tools that do not include the most recently updated and modified data (R6:20). R6 elaborates on the issue regarding users in an SSBI environment not receiving information about the latest version of data and describes that organizations need to establish a communication channel to inform users what data is relevant and updated.

"*The end-users or business users need to be aware that the historical data may change. And I think that we need to have a communication way among the company to inform the user that some historical data changed, so, they need to update their reports*" (R6:22).

Related to data quality issues, respondents were further asked how these issues could be addressed to reach and maintain good data quality in the organization and the available data sources. A preferred choice, but somehow complicated to achieve, is to correct data at the source and thus avoid business users getting and managing low-quality data. However, as stated by R1 it is easier said than done (R1:26). Several respondents return to the importance of having a single source of truth (SSOT) for data to avoid users being able to obtain different and unreliable results.

"*From my experience, it would be really establishing, good data source and maintaining it as well as possible, so to really create this single source of truth. And format it as well as possible… your basic goal is to create like one single source of truth, which then branches out to different reporting or different data models*" (R5:52,16).

One approach to achieve SSOT is to have a more centralized data management and have data stored in only one place to ensure data quality (R3:16). R1 adds that centralized data management can ensure only one consistent picture of the organization and one version of dimensions, so users can not see it in different ways and get different results.

"*You want to be able to make coordination gains and there is a lot to be gained from centralising things like data warehouses, for example, that can collect information from a lot of different business systems where you can keep together dimensions that occur in many different business areas, so there is only one version of them, for example. So that you don't have three different ways of looking at your organisation in three different places, for example, but there's one picture of the organisation and things like that*" (R1: 58).

In addition to centralized data management, both R1 and R2 state that having master data management is an excellent approach to ensure the quality of data by creating one version of the truth and ensuring that the data that gets in only exists in one version (R1:62; R2:14).

4.3 Users struggle to create reports

This overarching theme consist of two sub-themes and covers the challenges many users face of producing high quality and reliable reports, and the challenge of knowing what reports already exist, often resulting in redundant reports being produced. The two sub-themes are: Users struggle to create reliable and high-quality reports, and User struggle to know what reports already exist leading to the creating of redundant reports. Each sub-theme is covered more in detail in the following sections.

4.3.1 Users struggle to create reliable and high-quality reports

Table 14: Key findings: Users struggle to create reliable and high-quality reports

Key findings
Main challenges
- Users struggle to create reliable and high-quality reports   - Reports created by different users to answer similar questions come up with different results   - Users base their reports on outdated or low-quality data   - Users do not have the right knowledge and skills to use SSBI tools and data models to perform analysis properly
How to address challenges
- Train and educate users to use SSBI tools and understand data models   - Create guidelines for how reports should be created and designed   - Provide users with documentation that state how they can use different metrics and dimensions.   - Create a centralized repository with pre-defined calculations, dimensions, and metrics made and tested by experts   - Only give users access to data that is relevant for them   - Set up a strategy for who should be allowed to use SSBI   - Set up a validation process to verify the content of produced reports, create certifications for certified reports.

During the interview and data analysis a theme emerged, covering the fact that reports created by business users using SSBI sometimes lack both in terms of quality and reliability. One of the challenges users' faces is to create reports that are reliable, accurate and of high quality. Several respondents highlighted that it is not uncommon for reports created by different users or departments within the same company, that aim to answer similar or the same questions using analysis, to come up with different numbers and answers (R2:34; R6:12). It is, according to R2, not uncommon that arguments of whose data is correct emerge during meetings in big

companies that include different departments, where these different departments have tried to answer similar questions but come up with different answers (R2:34). R3 thinks this problem is common within SSBI where different areas have the same questions but perform their own analysis from their own point-of-view or angle, resulting in different conclusions in the reports (R3:30). R6 states that these problems also can arise within the same team, where different people try to answer the same questions but use slightly different approaches, and define things differently, resulting in different results.

"So maybe if I was creating my own dashboard and you are creating your own, if we are on the same team, sometimes we don't define exactly the same way, the same indicator. After that, I'll be creating a report, you will be creating a report that will have different results" (R6:12).

Another problem that can affect the quality of reports is according to R6 related to data quality, where users sometimes, without knowing, use outdated or inaccurate data in their reports, affecting the overall accuracy of the produced analysis and report, which users need to be aware of (R6:20). Reports and analysis produced that prove not to be trustworthy or faulty can further impact the user's perception and trust in the SSBI tool (R3:36).

"When it first happens that wrong numbers are provided, the trust in the tool is lost a bit, and every single time that happens again, the trust is lost more and more. a situation can be created where every single report that is presented is critically seen. So, the very first question that people are asking is, is the data correct? And this is a situation you would never want to get into because data should be reliable". (R3:36).

Other factors have also emerged that can affect users' ability to produce reliable reports, such as a lacking understanding and ability to use the SSBI tool (R5:8; R6:12) and struggle to understand data (R4:18). Since many of these tools are easy to use, some users with a lack of understanding and skills in SSBI might perform analysis and create a report that is then widely used within the organization, without anyone checking if it is accurate and reliable (R3:30).

During the interviews and analysis, several approaches, and ways of managing these challenges emerged. R5 suggests that users should get education, in the form of workshops, on how to use the specific data models and tools, since this will help them understand how to use data, and what they can use specific data for, what information the data model holds, and how different parameters can be used, which can increase the overall quality of produced reports (R5:36,10). R1 thinks that one way of managing this problem is to establish sound guidelines for how reports should be created and how specific data should be visualized, since this knowledge would increase the quality of produced reports (R1:51). R3 has a similar view on this:

"The very first step I would recommend is having governance, for how reports should look like, how they should be named, and how things should be organized, shown, and presented. Some people might say this is just making it clean looking, but it helps to assure things" (R3:36).

Users also need to have easy access to documentation that explains what different metrics and dimensions can be used for, and what different definitions mean to help them understand what they are doing (R1:22). R1 adds to this by arguing that designing the data model in an appropriate way can further help to minimize the chance of faulty reports being created and it

should be designed in a way so that users cannot make that many mistakes (R1:54). This goes in line with R2 who argues that users only should be able to see data that is relevant to them, therefore minimizing the risk of them using the wrong or faulty data (R2:40). R6 further highlights the importance of setting up a strategy, and regulating who gets access to SSBI, so that not everyone is able to create reports, minimizing the risk of reports coming from everywhere (R6:6,44). R3 adds to this by stating that not everyone is a real technician has the skills to create reports and manage data (R3:32). R1 has a similar view and argues that many problems can arise when the possibilities of creating reports are given to everyone, since not everyone has the right knowledge.

"When you release those possibilities to end users to do their own reports then it can be harder for them to understand what's then low-quality data. It might be particularly relevant there." (R1:30).

R3 also highlight the importance of having a single source of truth where everyone gets their data from to ensure they all have access to the same data, minimizing inconsistent and faulty data (R3:16). It is important to have a central business area or unit that provides correct and reliable data, that users can use to produce reports themself (R3:22). A further approach that can help mitigate these challenges is to create and use a centralized repository where all the different calculations and metrics that the end-users have access to and can use are located (R5:38). These predefined metrics should be created by experts that users can use in their own analysis, where users can simply drag-and-drop the specific predefined metrics and dimensions they want to use, without interfering with the syntax themself (R4:46). End-users should use these common metrics and dimensions instead of creating their own, since this can help avoid, users making mistakes when writing the queries, and therefore help ensure the quality of the reports (R2:28,32). These dimensions and metrics developed by experts have already been tested and the reports produced using these are therefore more reliable (R2:34). Same thing can be done with standard reports with benchmark numbers that are tested and validated that user can use (R2:36). This also makes it easier to check the quality of a report when it has already been created, since everyone uses the same set of predefined metrics and dimensions, making it easier to detect faults in the reports (R2:34). A few respondents also discussed the benefits of implementing some sort of validation process that could be used to help ensure the quality of produced reports (R6:30; R5:36).

"The way how we are dealing with it now is that each time the user creates its own report, the central IT team still has an administrative role on the workspace that the report is in, so that we are able to actually check the quality of the report and sort of see if we are not reporting a different revenue across 10 different reports and if we still maintain the single source of truth principle" (R5:36).

R6 argues for a similar concept, where a central team or a person validates the content of the reports that have been created using SSBI, to ensure that they are reliable, and all the figures are correct (R6:30). In the case of R6, the person validating will not be an IT expert, but instead a business expert (R6:32). R3 states that a sort of certification mark could be used on reports issued by users with authority to do so.

"It is a certification mark on reports. So, when the report is created, a certain amount of users that have the right to do so can license that report. So, they can say, I saw that report and I can approve the data that I provided are correct" (R3:36).

This approach would, according to R3, increase the overall trust put in reports, since the quality of it has been checked by someone with the ability and skill to determine its quality (R3:36).

4.3.2   User don't to know what reports already exist leading to the creating of redundant reports

Table 15: Key findings: Users don't know what reports already exist, leading to the creation of redundant reports

Key findings
Main challenges
• Users do not know what reports already exist • Users do not have access to reports previously made, leading to a lacking transparency regarding what reports exist. • Users create duplicated reports • Users work in an inefficient and costly way
How to address challenges
• Create a central repository where all the created reports are stored and accessible • Create guidelines for how reports should look and be created • Use a rating system and certification marks to promotes the re-use of reports • Have a repository where predefined dimensions and calculations are stored, that can be used to retrieve common information and KPIs.

A theme that emerged during the interviews and data analysis covered the fact that many users do not have the possibility to find and see reports that have previously been created, which can result in duplicated work and many new redundant reports being created. R2 highlights that the use of SSBI can result in duplication of work within organizations, often because there is a lack of communication between different people, teams and what they are doing (R2:30).

"So, when you have a Self-service BI, you are focused only into your stuff, and you don't really bother or care about what the other part of the team is doing" (R2:30).

People and teams do not share with other teams what they are doing, what reports they have created, resulting in a sort of blindness with a lot of duplication of work and several reports being created that contain similar, or the same information, which is time inefficient (R2:30). According to R3, it is not rare within larger companies that different departments perform similar analysis and create reports coming up with similar answers (R3:30). Reports are often with SSBI creatively fast to answer a specific question, and sometimes this same report can be used by top management for many years, without anyone really knowing or checking why it was made, what question it set out to answer and maybe the results of that report are not even answered because they did that with a completely different question in mind (R3:30). SSBI can create in-transparency within organizations since it often is hard, or impossible to know what reports already exist, which can lead to a lot of duplicated work being done.

"This self-service BI approach is also bringing some kind of intransparency of what kind of reports are existing. So, if I am from the one area are searching for something, I don't even know that another area already provided that. So, I am just doing it. So, you don't have any transparency". (R3:40).

R3 further highlights this issue by giving an example from the organization he/she is working for.

"I think what the company I'm working on, I don't know. We have more than 100000 reports and I'm pretty sure that I think 70, 60000 that is not even used anymore. So, it is just being created. It's an ad hoc analytics. It's like, OK, I have a question, I want it to be answered. And now the report is just laying there. but maybe another area has the same question three months later again, and no one is aware the same question is answered a lot of times". (R3:40).

One of the challenges users who work with SSBI face is simply knowing and getting access to reports that have previously been made, since this often results in duplication and inefficient work (R3:40). During the data analysis, several recommendations emerged on how these challenges can be managed. R3 highlights the importance of having a good governance model that allows for transparency regarding what reports that already exist. There should be a common place within organizations where all the related reports are stored in a transparent way for everyone to see (R3:36), where each report has a brief description of what they contain (R3:42). A key factor to make this work is to have guidelines for how a report should look, be named, dated, and what the description should include (R3:40). This does not mean that everybody gets access to the full reports, but everyone should be able to see what reports that exist and then request access if it seems relevant for them (R3:42). R3 thinks this approach could stop or minimize the issues of everyone with SSBI continuously creating new and redundant reports (R3:40). R3 adds that having a rating system for different reports would be beneficial where each created report can be rated and received a rating, which then would be visible to everyone, which could potentially increase the number of reports that are reused. Having some sort of ranking system along with having some type of certification mark could potentially increase the trust and reusability of reports (R3:36,40,42).

4.4   Users do not see the benefits of SSBI and use other solutions

This theme covers the challenge of getting users to see the benefit of using SSBI, since this otherwise can result in users not using the tools and rely on other methods instead, which can cause several issues.

Table 16: Key findings: Users do not see the benefit of SSBI and use other solutions

Key findings
Main challenges
• Users don't see the benefits of SSBI • Users don't feel encourage to use SSBI tools • Users are still reliant on old tools and habits • Users create their own solutions using their own business logic

How to address challenges
• Work actively with change management • Sell in SSBI as a concept • Launch a first project that gives a quick win • Show users that the same functionalities used in other solutions to perform the tasks is still possible to perform in the SSBI solution • Show that SSBI can improve the way work is done • Turn of old systems and force users into SSBI • Provide users with support and allow them to give feedback

During the interviews, it emerged that users do not always see the benefits of SSBI versus the tools and working methods they have relied on in the past to perform their tasks and decide to go back to old habits and tools. R5 describes that users are initially optimistic about SSBI and using the tool, but it later turns out that they have gone back to using old tools because they are more used to them and know them better (R5:44). R5 further implies that it may be because the SSBI tools can be perceived as more constrained in flexibility and that users do not see all the benefits that exist with the new tool (R5:30). According to R6, tools that are not perceived as easy to use and intuitive can lead to users not feeling encouraged to use these self-service tools (R6:40). Since users are accustomed to working in a certain way, do not see the benefits of SSBI, or feel encouraged to use SSBI tools, it has emerged during the interviews that users create their own isolated solutions and ecosystems using their own business logic. According to R1, this may be because users do not receive the needed support.

”*What you often see is organisations that don't have it that can't give good support to end users and don't train them so, it's that people make up their own solutions. That damn decision support, he says. It doesn't work that it's so slow, so I build stuff into Excel myself instead and then you often end up going down this road*” (R1:66).

Related to what R1 describes regarding lack of support and training leading to users creating their own solutions, R3 adds that business users within SSBI often see themselves as more knowledgeable than they are and start creating solutions without really knowing what they are doing, resulting in users creating independent ecosystems in the organization (R3:12,32).

To address issues related to users not seeing the benefits of SSBI and using other solutions and practices, several different approaches were suggested by the respondents. R5 says that it can be good to show and present to users that it is possible to replicate and achieve the same results with the SSBI tool as with previous tools, and at the same time demonstrate that SSBI can replace the old and inefficient way of doing it (R5:46; R5:48). R5 elaborates and describes that it is about working actively with change management and selling the advantages of SSBI to the users.

"*So we have a dedicated change management team, so their responsibility is really like selling the advantages of Power BI and the reporting that we create and it is all sorts of things like regular emailing to the users and reminding them that some reports has migrated from the old source to the new source and into the new platform, or we have like promotional videos that play on screens in each office that sort of describe what power BI does*" (R5: 32).

When people have been working in a certain way for a very long time and are used to following that process, and suddenly a new tool and approach is presented, it is about constantly reminding users that this is the new approach, but also to include users in the transformation and let them provide feedback (R5:34). Moreover, it has emerged that it is vital to have explicit support for users where they can get help and provide feedback for something that does not work as it should (R5:32). R6 suggests that it could be a good idea to launch a first project that gives a "quick win", so that management sees that SSBI as a concept works, leading to them providing more resources and time to educate and train users so that they better understand and can use SSBI (R6: 40, 42). R5 further proposes a more drastic and more controversial resolution to address the problem of users returning to old habits and tools. The respondent suggests forcing users to use SSBI by shutting down old systems so that users have no choice except to use the SSBI solution and the new approach (R5:44,46,48).

5 Discussion

In the following chapter, the empirical findings generated from this study, are compared, and discussed with findings from the literature. This chapter is structured into several sub-sections, each related to some area from the empirical findings that was deemed interesting for this study.

5.1 Creating reports and working with SSBI tools

Much of the study's empirical findings are directly related to the tools that users work with to perform analysis and create reports. The findings highlight the importance of SSBI tools being easy to use and intuitive for business users to be able to work with them in a self-reliant manner, which is further supported by much of the presented literature (e.g., Imhoff & White, 2011; Stodder, 2015; Daradkeh & Moh'd Al-Dwairi, 2017; Passlick et al. 2020; Alpar & Schulz, 2016). This is not strange considering that one of the main goals of SSBI is to allow business users without the technical know-how to perform analysis, it is therefore, as Bani-Hani, Tuna and Carlsson (2018) argues, crucial that tools are able to break down this complexity to make it understandable for business users. However, our empirical findings suggest that many users still struggle to create reliable and high-quality reports and sometimes find the tools challenging to use, which Lennerholt, Van Laere and Söderström (2020) also highlighted as a challenge. There are however many different SSBI tools on the market, many of which may offer different analytical capabilities, with different levels of usability and ease of use. It is beyond the scope of this study to analyze and compare the usability of different SSBI tools, but the researcher wants to highlight this point since this could be interesting for future research.

Several respondents stated that most SSBI tools in fact are easy to use, but at the same time highlighted problems related to this, such as business users being able to perform analysis without knowing what they are doing or if it is correct. Also highlighting the importance of users possessing appropriate skills and knowledge, as discussed in section 5.3, to ensure that users know what they are doing and reducing the chance of mistakes while increasing the overall quality of reports. The study also showed that many users struggle to use tools because of their lacking technical know-how, making it challenging for them to write queries and understand the tools syntax, a problem that is further highlighted by Weiler, Matt and Hess (2019). Using tools incorrectly can result in faulty analysis being performed, which was shown both in our study and in the related literature (Lennerholt, Van Laere & Söderström, 2020). A consequence of this, as derived from the study, is that users' trust in the SSBI tools dwindles and that the quality of each report gets questioned. The same problem was also presented in the literature, where it was argued that a low trust in SSBI tools can severely harm the success of any SSBI initiative (Weiler, Matt & Hess, 2019; Lennerholt, Van Laere & Söderström, 2018). This can result in users turning to alternative tools and solutions instead, which accentuates the importance of managing these challenges.

Another aspect of this highlighted in our study and the literature is the importance of giving users tools that are both easy to use and intuitive, while still providing them with a sufficient level of analytical capabilities. Eckerson (2012) follows up on this by stating that it can be

hard to satisfy different user groups, such as business users and power users, with different information needs, using the same tool. If users do not find the tools useful, and easy to use, this will decrease their willingness to use them (Daradkeh & Moh'd Al-Dwairi, 2017).

A number of ways of ensuring the quality reports also emerged, such as establishing general guidelines for how reports should be created and providing users with easily accessible documentation for how tools and data models work. Another way is to make use of predefined metrics and dimensions made by experts that users can apply to perform analysis through the tools, an approach which is further discussed by Alpar and Schulz (2016). This would minimize the need for users to write their own queries and help ensure the quality of the produced reports and make it easier to detect and track errors, which is further strengthened by Eckerson (2012) and Abelló et al. (2013). However, since one of the main premises of SSBI is to enable users to create their own analysis and find new and interesting relationships in the data on their own, would an approach of using predefined metrics and dimensions not potentially limit the scope of SSBI, since users then are restricted to perform analysis in a certain way? If users are limited to perform analysis in a couple of predefined ways, what is then the point of giving business users the ability to perform their own analysis compared to the traditional BI approach, where they are given readymade reports? Or should it be seen as a necessity to limit the flexibility of the tools since this otherwise could cause complete chaos and the overall quality of reports would suffer because business users do not really understand what they are doing and have no safety rails to hold them back? Alpar and Schulz (2016) states that tools that offer a higher level of analytical capabilities and an increasing level of flexibility also require the users to have more skills to use them properly and create reliable reports. Considering this, should predefined metrics and dimensions that users can use to perform data analysis be seen as a prerequisite to increase and ensure the quality and reliability of produced reports, by not allowing business users to write their own queries and risk making mistakes. Based on this, an argument could be made that organization have two major choices, either further educate their business users to ensure they have the correct knowledge and skills needed to perform data analysis on their own, or make the tools easy enough, using predefined metrics, dimensions and restricted data models, so the users do not need the same level of skills, since the tools are designed to be less flexible, but also to make it harder for users to make mistakes. It could be argued that organizations need to find a balance in terms of providing business users with education and limiting their flexibility using predefined metrics, dimensions, and strict data models. Both the results from this empirical study, and the results from previous literature points in this direction, although giving a definite answer to this question is beyond the scope of this study, but the researcher considers this an interesting and important point to raise.

Further suggestions emerged on how to ensure the quality of reports, such as having people or departments that worked with controlling the reliability of each produced report. This approach was suggested several times during the study, where it was argued to either have departments working with quality assurance of reports, or that qualified users could assign a certification mark to reports they had taken part of, which then would serve as a stamp of approval, increasing the trust put into specific reports and encouraging the reuse of reports. A similar approach is promoted both by Abelló et al. (2013) and Alpar and Schulz (2016) who supports the idea of using a rating system, where users can rate reports based on their usefulness and quality to increase the trust put into produced reports and increase the chance of them being reused. Having departments that work with quality assurance of produced reports is a questionable approach, since this does not seem to align with the purpose of SSBI, but making use of a sort of collective intelligence where good reports receive a high rating and

gets reused, and reports of lower quality get a lower rating and do not get reused, is arguably leaning more on the self-service approach where consumers are part of service delivery, as described by Scherer, Wünderlich and Von Wangenheim (2015). However, to make this a reality, both the empirical findings of this study and the findings of Abelló et al. (2013) imply that guidelines for how to work with SSBI are needed.

This leads into the next challenge that emerged from the study and previous literature, which concerns the fact that many organizations have a lack of transparency, where users are not aware of what reports already exist and how to access them, leads to duplicate reports being created (Alpar & Schulz, 2016; Lennerholt, Van Laere & Söderström, 2020). To manage this, organizations should have a centralized repository where users are able to find and access reports as highlighted in the study, since this could further promote the reuse of reports instead of constantly creating new ones, which would result in ineffective and costly work. Eckerson (2012) further argued that when more people get access to and the possibility to create their own report, this can cause report chaos making it impossible to keep track of which reports already exist and if they still are relevant. One respondent highlighted this problem by stating that the organization they worked for had produced over 100 000 reports, and 60-70% of which were not used anymore (R3). Several respondents highlighted this issue and raised the importance of also limiting who gets access to the SSBI tools, and simply not releasing the possibilities to create reports to everyone, since reports otherwise would come from everywhere making it challenging to know which ones are trustworthy. However, does not limiting the access to SSBI go against its main purpose of making data analysis available to everyone, or should it instead be seen as a necessity to make it work, since giving everyone this possibility can evidently result in problems. When choosing who gets access to SSBI, organizations should consider the users' different information needs and if it would benefit individuals or groups work, as further suggested by Eckerson (2012). Limiting who gets access to SSBI, having a centralized repository for the created reports combined with using a certification mark or rating could have great potential to increase the reusability of produced reports and minimize redundant and costly work.

5.2   Facilitating an environment that enables and promotes the use of SSBI

Based on the results, key factors that play an important role in enabling a functioning SSBI environment can constitute problems in introducing and using SSBI if not appropriately considered and managed. The ability to access and use the data needed to make data-driven decisions has been described as a core function of enabling SSBI easily and efficiently (Imhoff & White, 2011). In line with what has been described by Lennerholt, Van Laere, and Söderström (2020), our study showed that this is often not the case. Users of SSBI have low awareness of available data sources, which data sources contain the information needed to answer a specific business question and where the data is located. The findings moreover show that even if users know which data sources are available, they cannot access the data needed, which has also been demonstrated in existing literature (Lennerholt, Van Laere & Söderström, 2020). Furthermore, the empirical findings indicate that the accessibility constraints are derived from data centralization, user restrictions, and strict data governance models within organizations, which is related to the fact that not all users should have access to all data. The study's respondents have highlighted the importance of having proper access management, role-based access, and ensuring who has access to what data. One suggested approach is establishing

data access teams or providing dedicated areas where users can go and ask for permission to access certain data.

On the one hand, this makes one question the concept of SSBI, since advocates of SSBI proclaim that the technology shall allow business users to become more self-reliant by accessing data needed to create reports containing the information they want, when they want it, without the involvement of the IT department or other BI specialists (Alpar & Schulz, 2016). Respondents openly state that centralized data governance, with implemented user restrictions to data, opposes the idea of introducing SSBI. This is in line with the literature, as Weber (2013) states that strict data governance where users cannot serve themselves in a self-reliant manner can contradict the purpose of implementing SSBI, resulting in users having less interest in using the technology. The researchers agree with these statements were limited access rights based on user roles or positions and having dedicated teams providing access to specific data sources sounds like a step back towards the approach and problems that the literature has described with the traditional BI environment. In traditional BI, casual users must rely on power users to provide the data needed to create reports and perform analysis (Ponniah, 2010; Bani-Hani, Tona & Carls-son, 2018; Lennerholt, Van Laere & Söderström, 2018; Michalczyk et al. 2020; Weiler, Matt & Hess, 2019). These problems with access and use of data implies that many casual users still are not self-reliant, and the bottleneck that exists in traditional BI that SSBI is intended to solve still exists and is a widespread problem within the SSBI environment.

On the other hand, contemporary research describes the importance of finding the right balance in data governance within SSBI (e.g., Stodder, 2015; Weber, 2013; Clarke, Tyrrell & Nagle, 2016). In contrast to strict data access, data governance that is too lax, and giving users access to all the data, and letting them do whatever they want, can result in a lack of control and SSBI initiative that fail (Weber, 2013; Lennerholt, Van Laere & Söderström, 2018). Moreover, the presented literature describes that data governance is needed to ensure data privacy, data security and that regulations are complied with (Stodder, 2015). The result confirms the importance of balancing data security, data governance, and providing data to everyone. Too strict data governance will undermine the SSBI initiative and more reflect the traditional BI environment, and too relaxed data governance leads to an uncontrolled environment. It is therefore essential to find the balance when it comes to data governance within SSBI.

Like finding the balance of data governance, data quality is an important factor and a cornerstone when enabling SSBI (Passlick et al. 2020). The presented literature argues that data quality issues can be a significant problem within SSBI when business users who are not used to handling data need to decide if the data is of sufficiently high quality, accuracy, freshness, completeness, and reliability (Lennerholt, Van Laere & Söderström, 2018; Imhoff & White, 2011). The findings seem to confirm that data quality deficiencies and reliability issues may be more problematic with SSBI than traditional BI. SSBI allows more people to use and manage data. There seems to be an imminent risk that these business users have difficulties understanding what low-quality data is and how it can be handled, leading to inaccurate, unreliable, and low-quality data being used. In this context, several respondents discussed how data quality issues could be managed, and the majority returned to the importance of having a single source of truth (SSOT). One alternative approach proposed to achieve SSOT is to have centralized data management and implement master data management, which minimizes the risk that business users may include unreliable data and thus remove the concern that business users themselves need to assess and manage low-quality data. However, this discussion once

more underlines the importance of well-functioning data governance (Weiler, Matt & Hess, 2019; Eckerson, 2012; Alpar & Schulz, 2016).

The empirical findings of this study further show the importance of considering and understanding the user's different needs and providing the right data and access to the right user. Existing literature describes that it can be achieved by implementing a robust data management environment, with data warehousing (DW) and data marts for each department, fulfilling individual departments' needs (Eckerson, 2012). Our research confirms the idea of creating data marts in the DW environment and only showing the data that is of interest to the individual department or user, but also shows that there are various other strategies for fulfilling the goal of giving the right data to the right user. On a less technical level, the empirical findings show that interviewing businesspeople or conducting a survey to understand the users' needs and establish a centralized governance model, which defines who has access to what data and how the data can be accessed, is another promising approach. Moreover, creating the data model in collaboration with businesspeople and adapt the model for a target group or based on use cases that fulfil the need and facilitate the use of SSBI for the specific group is another proposed method.

To facilitate an environment that enables the use of SSBI, the literature further states the importance of providing a unified and standardized view of the organization's data that is expressed in business-related terms (Schlesinger & Rahman, 2016). In contrast, inexplicit data definitions, where data sources have a different meaning or an unclear naming standard for business users, lead to erroneous results since business users are guessing what the data object represents (Schlesinger & Rahman, 2016; Stodder, 2015). The empirical findings revealed that users still struggle with data definitions and what certain data represents, leading to business users needing additional support from expert users. The literature argues that organizations that use, or plan to use, SSBI need to implement a semantic layer for SSBI, which means to name data more understandably by using common business terms instead of data language, leading to a standardized view of data across the organization (Schlesinger & Rahman, 2016; Eckerson, 2012). The findings confirm the need to establish a good naming standard where data only exists with one definition. The data naming should also reflect the business and the terms commonly used. However, the empirical findings indicated that naming it in business terms is not simple and that ambiguity can still exist. Therefore, it is also essential to create easily accessible documentation that explains the data and its definitions. Moreover, respondents emphasize the importance of establishing guidelines and designing a data catalog, including descriptions of data, how data is associated, and describing how data can be used, leading to more clarity for business users and an SSBI environment that facilitates the use of SSBI.

5.3   The importance of education and support in an SSBI context

From the empirical findings, several challenges related to users lacking appropriate skills and knowledge emerged that could inhibit them from working with SSBI. The findings indicate that many users lack the right skills and knowledge on how to use SSBI tools to get specific results, but also struggle to understand how to access different data sources and appropriately use data, which is described as one of the core functions within SSBI (Imhoff & white, 2011). This challenge has also shown in the presented literature where both Lennerholt, Van Laere and Söderström (2020) and Eckerson (2012) argue that many casual users lack the appropriate skill and knowledge to use SSBI properly, and that this can create problem for users in term

of their ability to work in a self-reliant manner (Lennerholt, Van Laere & Söderström, 2020). This does seem to be a well-known issue as highlighted by Lennerholt, Van Laere and Söderström (2020) who states that many users struggle to understand how data works and can be used, but also how the tools work and can be used. The empirical findings suggest that users who lack the right skills and knowledge will struggle to work with SSBI in a self-reliant manner without relying on help from more advanced users, and most of the respondents highlight the importance of users having the right skill and knowledge. A lack of skills amongst the users can result in them getting stuck with problems more often and are less likely to be able to identify and solve the problem on their own. This can increase the pressure put on power users and IT departments since they are required to allocate more resources to help solve problems and assist the casual users with ad hoc functionality since they do not have the skills to do this on their own. The severity of users not having enough knowledge and skills is further stressed by Lennerholt, Van Laere and Söderström (2020) and Imhoff and White (2011) who both argue that this can pose a serious threat to the success of any SSBI initiative, which further indicates the importance of ensuring that users have the right skills to work with SSBI.

Ways of managing these issues also emerged during the study, where the importance of providing the users with continuous support, education, and training for how to work with the SSBI tools, i.e., how to create reports, how to access data, what they can use the tools for, what they cannot use the tools for. One of the respondents (R1) further implied that education is one of the only ways to make users self-reliant, since they need a certain level of knowledge to work with the SSBI efficiently. This is further highlighted by Lennerholt, Van Laere and Söderström (2020) who argue that education can be seen as a prerequisite for being able to work in a self-reliant manner, which is also stated by Imhoff and White (2011). It therefore seems clear that education should be seen as a prerequisite for the success of an SSBI initiative since all the respondents and much of the presented literature highlight the importance of educating the users (e.g., Stodder, 2015; Weiler, Matt & Hess, 2019; Lennerholt, Van Laere & Söderström, 2020). Considering this, providing the users with education seems to be a key factor for the success of any SSBI initiative.

Furthermore, several recommendations emerged during the study on how education can be structured, a topic that was found to be absent in the related literature, where education several times was mentioned as a prerequisite for success (e.g., Lennerholt, Van Laere & Söderström, 2020; Eckerson, 2012; Imhoff & White, 2011), but not much information is provided on what the education should include and be designed, which is therefore seen as important to highlight. No real consensus can be drawn from the results, where some respondents argued that education should be structured to give a general introduction to the tool which would allow the users to apply their acquired knowledge to their own area, while others suggested that the education should be tailored according to the users' different needs and how they would use the tool in their work. One respondent highlighted an interesting point by stating that the user should train on the data they will use in the future (R6), which might make it easier for them to apply their knowledge acquired during training in a real scenario. Several other ways of structuring the education also emerged, and it was suggested that it could be split into three different steps, where each step was specifically designed for a specific type of user, which would help satisfy different users' needs and ensure that everyone gets education on a sufficient level to perform their future tasks correctly. This is seemingly important to consider since Eckerson (2012), Lennerholt, Van Laere and Söderström (2020) and Passlick et al. (2020) all argues that it is important to consider users' different needs and that there is no standard user of SSBI, therefore implying that tailoring the education towards users' specific

needs might be the more appropriate way. The authors want to add to this by highlighting that how the education should be structured might also differ between cases and depending on the level of skill that users will require.

A lack of skills and knowledge means that users will have to rely more on the support from more experienced users and IT-departments, and the findings indicated that users do not always get the support they need. Providing users with continuous support has from the study shown to be an important factor to achieve success and setting up guidelines that clearly state how users can get support is a key factor, as supported by Weber (2013). The importance of having a support function that can help users was also made clear and making use of more advanced users or superusers in each department that can help casual users with problem and ad hoc functionality was also suggested. The very same suggestion is made by Eckerson (2012) who argues that each department should have a superuser who can provide the casual users with direct support and help with ad hoc functionality. It was further stated during the study that the superusers are the main target and users of SSBI (R1), which is further argued by Eckerson (2012) who states that these are the main target for most SSBI tools.

From the empirical findings it seems evident that users are still reliant on the support from IT-departments and experts both with ad hoc functionality and to solve problems while working with SSBI. This raises the question if the focus of the power-users and IT departments with the shift from BI to SSBI has gone from producing reports that casual users can use to make decisions, to instead assisting casual users in the process of producing their own report that they can use for decision making? If this is the case, then this could go against the main purpose of SSBI, as stated by Imhoff and White (2011), by replacing the time IT-departments and power users spend creating reports, with helping users to create their own reports instead of being able to focus on other value adding projects. Considering that many users struggle with SSBI, and the fact that some argue that SSBI is primarily made for superusers, further raises the question if SSBI is too complex for casual users to grasp and work with in a self-reliant manner without support. If so, what is the real benefit and difference of SSBI compared to traditional BI, if casual users still need education and continuous support to derive value from the tools? These questions have no direct answer, but the researcher of this study finds it necessary to highlight this as the related literature on SSBI praises its benefits, but sometimes seemingly without taking into consideration the challenges that needs to be overcome, that otherwise might hinder a successful initiative.

5.4 Implication for practitioners

Based on the empirical findings and related literature, several challenges as well as recommendations for practitioners have been formulated. The identified challenges can give practitioners an increased awareness of the existing pitfalls, where the recommendations could serve as practical guidelines for organizations that already use or plan to use SSBI, focusing on how user-related challenges can be tackled and prevented.

The following implications can be derived for practice. Foremost, organizations should create and promote an SSBI environment and lay a foundation that fulfils users' goals and needs to ensure an environment that enables users to work effectively with data and be self-reliant. A major barrier that can inhibit users from working effectively with SSBI is derived from the fact that it is difficult to access and know which data sources are needed to answer a business

question (Lennerholt, Van Laere & Söderström, 2020). Organizations need to establish clear documentation and guidelines that define how and where users can access data. Suppose users cannot identify suitable data sources to use on their own initiative. In that case, they will be dependent on the expert user or the IT department and thus not be self-reliant. Moreover, organizations need to design a strategy for the level at which the organization should provide self-service capabilities, including an understanding of the users' different needs (Alpar & Schulz, 2016; Eckerson, 2012). As mentioned, interviewing users, or conducting surveys is a proposed approach to identify users' different needs. After mapping out and creating an understanding of different users' requirements and needs, it is important to provide the right data to the right user and give users access to relevant data. It is about finding a balance between the level at which the organization is willing to provide access to data and user restrictions (Stodder, 2015; Weber, 2013; Clarke, Tyrrell & Nagle, 2016). A recommended and suggested solution is to create data models adapted for an individual user, use cases, or specific groups and only show the parts of interest and relevance to them. This makes it easier for users to access the data needed and less data to process and facilitate the development of a clear governance model for how data can be accessed and by who. Furthermore, the data model should be created in collaboration with businesspeople who have insight into the business's daily operation and understand what data is needed to fulfil end-users needs. Organizations should carefully choose SSBI tools, so they are accepted by the users and can deliver on the expected contribution to the user's information needs (Bani-Hani, Tuna & Carlsson, 2018; Passlick et al. 2020). The selected tool must be easy to use and intuitive for users, with a user-friendly interface that encourages them to use it. Organisations could further work with change management to help sell the benefits of SSBI and promote how it can support users in their daily activities.

An important factor to consider to achieve a functioning SSBI environment is to be aware that users will make mistakes or get stuck and thus need support. Therefore, it is relevant for organizations to establish options for support even if SSBI's main premise is to make users self-reliant. One proposed approach is to employ superusers (Eckerson, 2012), which can provide direct support to other users, help them solve problems, and assist them with ad hoc functionality.

A further implication for practice is that organizations need to ensure that data is easy to utilize for users. Inexplicit data definitions can make it difficult for users to be self-reliant, leading to erroneous results and mistrust in SSBI (Schlesinger & Rahman, 2016; Stodder, 2015). Organizations need to pay attention to how data is named and keep a relevant naming standard using business terms commonly used within the organization. Moreover, provide users with documentation or create a data directory that explains the meaning of data and guidelines that describe how data is associated and how the data can be used to avoid ambiguity and mistakes. Data quality and reliability issues can be problematic when more users without the technical know-how gain access to data (Lennerholt, Van Laere & Söderström, 2018; Imhoff & White, 2011). To counter this issue, organizations must ensure that there is only one consistent picture of the organization and one single source of truth, which can be achieved by centralized data management and storing data in only one place with one version of it. Additionally, provide users with already prepared data that is of sufficient quality.

This study also brings up what has already been discussed in contemporary research, the importance of quality assurance of reports (e.g., Lennerholt, Van Laere & Söderström, 2020). Organizations should design guidelines for how reports should look, be named, organized,

shown, and presented to ensure quality. It is also crucial to establish documentation for how different metrics and dimensions can be combined to avoid mistakes. However, the results show that users have problems writing complex operations and creating reliable and high-quality reports. Therefore, we propose two different approaches for organizations. Either educate users to ensure they have the proper knowledge and skills needed to create high quality reports and perform analysis independently. Or, let expert users create a centralized repository where all the different calculations, metrics, and common KPIs are stored that users have access to and can simply drag and drop these predefined functions into their reports. Several strategies can be taken to avoid the problem that users do not know what reports already exist, if the reports are still relevant, and that users create redundant reports and perform inefficient duplication of work (Eckerson, 2012; Alpar & Schulz, 2016; Lennerholt, Van Laere & Söderström, 2020). Organizations should have a shared space where reports are stored transparently for everyone to see, including a brief description of what the report contains. Furthermore, implementing a rating system or a certification mark on reports lets users see which reports are of high quality and credible. This can probably raise the standard of reports and, at the same time, increase the reuse of valuable reports (Abelló et al. 2013).

The result also confirms the need for education and training for SSBI users (Passlick et al. 2020) and that SSBI requires more training than anticipated (Eckerson, 2012). Users can only be truly self-reliant if they get sufficient education and training since they often lack the appropriate skills to work with SSBI in a self-reliant manner (Lennerholt, Van Laere & Söderström, 2020). If users have been insufficiently trained or have not received a formal education, it will inhibit the user's ability to work with SSBI and increase the need to ask expert users for assistance. Organizations should address this by arranging education and training tailored to the different needs of user groups, preferably continuously through workshops held both virtually and in person. Furthermore, users should be trained with real business data and the tools that the user will employ in the future.

5.5 Summary of challenges and recommendations

The final version of identified challenges and associated recommendations are summarised in Table 17. The final set of challenges and recommendations has been grouped into five over-arching categories based on the empirical findings and the related literature. This set of challenges and recommendations is the final product of an iterative funnelling process which started when reviewing the related literature, continued during the data analysis and empirical findings, with the final iteration takin part in the discussion. For each category of challenges, several recommendations have been formulized that can help to overcome or avoid some of these challenges. The recommendations are meant to be general to be more applicable in different contexts, with the aim to provide guidelines and on factors that are important to consider to succeed with an SSBI initiative.

Table 17: Final list of challenges and recommendations

Name	Challenges	Recommendations
User skills and knowledge	• Users lack appropriate skills and knowledge to work with SSBI • Users struggle to work in a self-reliant manner • Users struggle to solve SSBI related problems themself and are reliant on support	• Provide users with education on how to work with SSBI • Education should be tailored to users' specific needs • Train users with real business data • Provide users with continuous support • Make use of experts/superusers • Establish guidelines for how users can get support • Establish communication paths between the IT department and users
Using SSBI tools	• Users lack appropriate skills and knowledge to work with SSBI tools • User do not understand the syntax used in SSBI tools • Users are not encouraged to use SSBI tools if they are difficult to use or not user friendly	• Choose tools that fulfills users' different needs • Provide users with tools that are user-friendly and intuitive. • Provide users with tool specific training • Utilize predefined metrics and dimensions • Provide users with continuous support
Creating reports	• Users struggle to create reliable and high-quality reports • Users use outdated and low-quality date • Users don't know what reports exist because of a lack of transparency • Users create redundant reports • Users struggle to determine the quality of previously made reports. • Users lack skills and knowledge leads to them creating faulty reports	• Provide guidelines for how reports should be created and look • Provide users with documentation for how they can use different metrics and dimensions • Provide users with a centralized repository including predefined metrics, KPIs and dimensions • Implement a validation process to ensure the quality of produced reports • Implement a rating system for produced reports • Create a centralized repository where previously produced reports are accessible • Create a strategy for who gets access to SSBI

Access and use of data	- Users struggle to find and access data - Users do not know what data sources are available - Users have difficulty understanding data, the data model, and how it can be used - Users struggle to understand data definitions - Users struggle to understand and manage data quality issues - Users use incorrect data, leading to incorrect results - Users create their own versions of truth	- Provide guidelines and documentation for how and where to get data - Create an understanding of user's different needs and give the right data to the right user - Find the right balance of data governance - Set up access management - Create clear data definitions using commonly used business terms - Create a data catalog explaining data definitions - Provide guidelines for how data is associated and can be used - Create a data model targeted for a specific group or use case - Provide users with prepared data - Include businesspeople when designing data models - Provide a single source of truth
Users not seeing the benefits of SSBI	- Users don't feel encourage to use SSBI - Users are still reliant on old tools and habits - Users create their own solutions using their own business logic - Users often see themselves as more knowledgeable than they are - Users do not always see the benefit of SSBI and go back to old tools and habits.	- Work with change management - Provide users with education to sell the benefits, and encourage the use of SSBI - Include users in the SSBI process, and let them provide feedback - Provide users with support - Launch a pilot project to achieve a quick win

6 Conclusion

6.1 Research questions and purpose

The purpose of this study was to identify what user-related challenges practitioners face while working with SSBI and fill the research gap identified in the related literature by creating general recommendations for how these challenges can be managed, which led us to formulating the following research questions:

- What user-related challenges do organizations face when using Self-Service Business Intelligence?
- What factors are critical for managing identified challenges associated with the use of Self-Service Business Intelligence?

To answer these research questions a thorough literature review was conducted to identify challenges and critical success factors related to the use of SSBI that had been previously covered in the literature. Thereafter, a qualitative interview study was conducted, where 6 professionals from different user groups were interviewed to collect interesting and rich data that could help us answer the research questions.

6.2 Key findings

What user-related challenges do organizations face when using Self-Service Business Intelligence?

The study has revealed several user-related challenges, that were grouped into five main categories, summarized in section 5.5: "*User skills and knowledge*", "*Using SSBI tools*", "*Creating reports*", "*Access and use of data*" and "*Users not seeing the benefits of SSBI*", which have been discussed thoroughly from different perspectives and how they can affect the use of SSBI. Although the main premises of SSBI is to enable users to create their own analysis without having to rely on the IT department or expert users, the key findings from the study indicate that this is not always the case and that numerous users are not able to work in a self-reliant manner. Many users of SSBI are still reliant on support from more experienced users, which can be associated with them lacking the right skills and knowledge. Since users lack appropriate skills, they have difficulties using data, the SSBI tools, and creating reliable reports on their own, leading to much of the work being preconfigured by experts. Moreover, limited access rights make it difficult for users to access the data needed. If users need continuous support, preset tools, and cannot work in a self-reliant manner, the overall concept of SSBI could be questioned.

What factors are critical for managing identified challenges associated with the use of Self-Service Business Intelligence?

The second research question was answered by creating and presenting a number of general recommendations for how identified challenges can be managed, summarized in section 5.5.

The recommendations provide a better understanding of important factors to consider dealing with user-related challenges and could serve as guidelines for managing and preventing problems users face while working with SSBI. The key findings indicate that it is essential for users with limited skills to receive the proper education and training so they can work more independently and solve problems on their own. However, there is still a need to provide users with support once they make a mistake or need help with ad hoc functionality, especially in the initial phase. Therefore, organizations should provide users with continuous support until they are sufficiently self-reliant and can solve problems and overcome obstacles independently. To help users become self-reliant, organizations need to establish comprehensive documentation and guidelines to enhance users' ability to overcome challenges independently and create valuable reports on their own initiative. Moreover, organizations need to facilitate an environment that promotes the use of SSBI by finding the right level of data governance, providing the right data to the right users and equip users with tools that gives them an appropriate level of self-service capabilities while still fulfilling their individual needs and goals. Furthermore, business users need to be included in this process, both to draw on their knowledge and to further help them see the benefit of SSBI, which would encourage them to adopt the concept.

This study has highlighted that implementing and using SSBI tools is not always plain sailing, and that there are many challenges and factors that needs to be considered to achieve success. Many of the identified challenges and recommendations are in line with existing literature and can be further confirmed by the findings of this study, which helps strengthen their credibility. Newly identified factors that emerged from this study can help to complement existing theory with challenges and recommendations that may be important in overcoming user-related challenges. We see a great potential in SSBI, by democratizing data analysis within organisations and offering more employees the possibility to perform their own analysis, containing the information they want, and when they want it. Finally, the results of this study can benefit both practitioners who should consider the formulated recommendations to avoid problems and further enhance the performance of their SSBI initiative, and researcher by filling the research gap and laying the foundation for future research on the topic of SSBI.

6.3 Future research

Future research should continue building on the recommendations developed in this study, and further strive to test and scrutinize these findings using different approaches to develop even more precise recommendations and critical success factors. Future research could test the identified challenges and recommendations using a quantitative or mixed method approach, to generate more statistically generalizable results. This study focused specifically on user-related challenges, and future studies could therefore focus on identifying challenges and recommendations for successful implementation of SSBI initiatives, and not only considering the user perspective. Future research could furthermore compare differences and similarities between available SSBI tools, to uncover design-features and approaches that can make data analysis easier for novice users and to further help make these tools more user-friendly and intuitive, while minimizing the risks of users making mistakes. This could aid practitioners by uncovering which specific tools are more suitable for certain types of user groups, depending on their skill level, analytical needs and on what types of tasks they are expected to perform, making it easier for organizations to choose the most suitable tool.

Appendix A – Interview guide

Introduction questions

1. What is your name and the name of the organization you are working for?

2. What is your position within the company?

3. How much experience do you have from working with Business intelligence?

4. How much experience do you have from working with Self-service business intelligence?

5. How would you define Self-service business intelligence (What does it mean to you)?

Key Questions

Technical context

6. One of the main purposes of SSBI is for users to become more self-reliant without support from power users. What technical challenges/barriers have you experienced that can prevent a user from successfully working with an SSBI tool and becoming self-reliant?

    What factors do you consider critical for managing these challenges?

7. In your experience, have you encountered any data-related challenges that can hinder users to work in a self-reliant manner? What?

    What factors do you consider critical for managing these challenges?

8. What would you say are the technical requirements necessary to make SSBI useful/usable for the user?

Organisational Context

9. From your experience, what operational and organizational challenges do users face while working with SSBI?

    0. What factors do you consider critical for managing these challenges?

10. How would/could you ensure that the quality of reports produced by you/casual users are reliable and of sufficient quality?

11. From your experience, what organizational and managerial factors do you think can create challenges for the end-users of SSBI?

12. How can organizations manage these challenges?

13. What factors should an organization consider to create/ensuring a functioning SSBI environment for the end-user?

Final questions

14. What advice would you give other companies that are in the processes implementing and using SSBI?

15. Is there something you feel we haven't gone through or that we should have asked?

16. Do you have any questions for us?

17. Do you want us to send you a copy of the transcription of this interview afterwards for review?

Appendix B – Interview 1, Transcription

Row	Person	Content
1	Inter-viewer	What is your position in the company?
2	Re-spon-dent 1	I'm a consultant at Company x and I work with business development and decision support, you could say, and I work quite a lot with management and governance. And management that controls processes should help customers, but how to manage the board in a business and in with that how to use decision support for that.
3	Inter-viewer	How long have you been working with BI in general?
4	Re-spon-dent 1	Yes, how long have I been working with BI, just over ten years now.
5	Inter-viewer	How long have you been working with SSBI approximately
6	Re-spon-dent 1	So it's a little bit of a fluid limit. It's hard to draw any line for what is SSBI and what is not I think. But it's been more now when I've been working as a consultant and helping clients with how they should work with BI. So to say that the last four years without maybe even using that term that much.
7	Inter-viewer	Then we kinda got into the next question really. How would you define SSBI based on how you work with it?
8	Re-spon-dent 1	Based on how we work, I would define it as decision support that enables end users to put together reports themselves that you publish and make available, good and easy to understand analysis models that describe the business in a good way so that people who need information can get it and create their reports themselves.

9	Inter-viewer	So the end user or the regular user can use it to become a little bit more self-sufficient really in being able to use analysis and reports really.
10	Re-spon-dent 1	Yes exactly.
11	Inter-viewer	Then we thought we go into a bit more core questions in the interview that we split it into two different sections where the first one touches on technical, user related challenges and by that we mean a bit more hands on challenges that users may encounter when using the SSBI tools, systems and how that may affect users to see how the technical may affect how they can be self-reliant in working with BI and Analytics. Also, as we mentioned earlier, one of the cornerstones of that is being able to be more self-reliant, without really a lot of support from IT departments for example, or the department that previously handled the reports BI parts. So what technical challenges or barriers and obstacles have you experienced that can prevent a user from working successfully with SSBI?
12	Re-spon-dent 1	Oh that was a broad and good question. But I'll say a technical limitation might well be the licensing model, I don't know if it's a technically limited really, but something that makes it, that there is a barrier to getting started with SSBI having to pay for licenses. If it's technically I don't know. Then of course, we really work with two main end-user tools for SSBI, and they are Power BI and Excel really and Power BI is very easy to use, most people that we come across that use it think so, whereas Excel can be a bit axed and there are a lot of choices and that can be considered a technical limitation maybe.
13	Inter-viewer	Okay are there any other technical challenges with how users can cope with using the systems. If there are any challenges related to using the tool maybe?
14	Re-spon-dent 1	We don't come across too many technical barriers really. I come across many more barriers that are about how you design your data models and how you design and use the terminology that you use. That's where I see the big challenges, not in terms of technology really, not that we encounter anyway.
15	Inter-viewer	When you say terminology what do you refer to?
16	Re-spon-dent 1	Well then I'm referring to when you're going to have SSBI and you're going to have an end user do their own report you have to give them a model, a data model that you can use, and usually a data model consists of a set of measures and a set of dimensions that you can use, and the terminology that I'm referring to is what you call these things. What do we call the metrics so that they are understandable to the business? What do we call the dimensions and the dimension attributes so that they are in such a language that the business uses itself so that they describe the real business terms and nothing else. That's what I mean by the terminology, I call things the same thing that they say in the business and not something else.

17	Inter-viewer	Okay so would you say using business terms is an important factor in dealing with that kind of problem?
18	Re-spon-dent 1	Well that's the most important one I would say, and then there are other difficulties as well there, which may not have to do with the terminology, but more how you build a model, how to get end users to understand how the model works. Which measures work with which dimensions, for example what is not working? How can I combine different things and make it work and give me the insight that I need? And what things can I not combine, but I just get crazy Mattias as an answer or no answer at all.
19	Inter-viewer	Okay, so really, what kinds of terms can be used for calculations which can be used to possibly see trends maybe, so really use business terms to understand. This is a term that is used for a calculation to get a final value, and if you don't have clear terms then users might mix it up and get incorrect calculations. Is that what you're referring to?
20	Re-spon-dent 1	No that's not really what I mean, but more how, we can take some extreme examples. Take an example from a university that I work with. Where for example you have information from their HR system where you can have metrics that are the number of employees that can cut across different departments in different dimensions, like organization, for example in time and others. And then we have the other side, so we have a measure that is about students. How many students have registered for a course, for example. If we take this measure, which is the number of employees, then we may not be able to cut it by education, it is not possible to see the number of employees for civil engineering programmes, for example. It doesn't work and maybe that was an extreme example with just that kind of combination was which metrics for and which dimensions and which ones don't work. That is also a challenge.
21	Inter-viewer	And how would you say you best handle a challenge like this? As you just mentioned
22	Re-spon-dent 1	well, by making easily accessible and easily understandable documentation, is one such thing that needs to be done. We've been working a lot with some clients to have easily accessible documentation on metrics, so explaining the metrics available in a report and for the person doing the report so that they can see a clear definition of this metric means just this, in case it's not described as terribly well in business terms as you might want. But sometimes it's not so easy to do that, so easily accessible documentation is a key factor.
23	Inter-viewer	Okay, if we go into the next question is a little bit more about data. Data is obviously one of the most important building blocks to make it work, have you encountered any data related challenges that pose to the end users. How to have access and use data?

24	Respondent 1	But so it's almost always that there are challenges with data quality. Like it might be easier for somebody who is a technologist to understand that this is data quality issue than for a business person to understand that this is showing not right. It can go both ways, it can go just the other way too that it's a business person who has an easier time understanding that this is unreasonable what we're getting. There must be errors in the data, there must be quality deficiencies in the data, but when you work with BI, quality deficiencies are something you work on all the time, trying to detect them and trying to deal with them in different ways. There is an extra dimension, I would say, when you work with self service, to get the end users to understand this as well, what is correct and what is not correct.
25	Interviewer	Data quality then, have you come up with any way to manage this in a good way, so that you can maintain some of the data quality in the organization and the data sources that are available.
26	Respondent 1	Well there are some principles you can lean on, of course. Correcting at source for example, is one such principle that everybody wants to do and everybody thinks it's absolutely right of course to not correct things in a data warehouse in an ETL flow but try to do it in the source systems instead. But usually it's easier said than done because correcting things in the source may require the people who record things to work in a different way than they do today, maybe the business systems need to be redesigned so that they limit what information can be entered, and things like that. Often you run into trying to correcting data at source thing, it's not very easy and then you often fall into correcting by using the decision support and maybe in the ETL flows instead, because it's much easier. It's much faster, but often it leads to leaving the errors in, so to speak. But that's a challenge for any BI to implement such processes that allow you to, when you detect errors get it fixed right from the start by getting people to work in a different way and maybe by getting business systems better designed as well
27	Interviewer	So really, ensuring data quality right from the source systems so that the end user doesn't have to keep doing it themselves, maybe not cleaning the data but correcting the data as they use it. So really go back directly to the source and fix what possibly is a problem when you retrive the data from the source to where you work with it.
28	Respondent 1	Yeah, exactly. That's a great principle as well, but what I'm also saying is that it's not that easy to apply always.
29	Interviewer	But they also sounded on you like it's not just a problem for SSBI, but also for regular BI?
30	Respondent 1	Well absolutely, it's just that when you release those possibilities to end users to do their own reports then it can be harder for them to understand what's then low-quality data. It might be particularly relevant there. Now I'm speculating a little bit when I say that, not that I can say that this is something we've encountered a lot of. There is so little reasoning, high thinking.

31	Inter-viewer	Exactly, and if it's not targeted have encountered it, theoretically how would you deal with those kinds of issues when they come up with end users within SSBI.
32	Re-spon-dent 1	Well, we'll have to speculate on that further then. I think what a lot of people would need to do is have structured processes for how they deal with end users discovering errors, that they have a good way of being able to report errors or just suspected errors, that they have good ways that someone actually takes care of that and investigates and feeds back to whether it was an error or not. And fix it if it's fixable. At least take that into consideration up front that I think a lot sits in the management working practices to make it work in a good way.
33	Inter-viewer	What would you say are the technical requirements with SSBI and SSBI tools for it to be useful to an end user who might not be that used to using BI?
34	Re-spon-dent 1	The technical prerequisites. To start with, as I said earlier, you need to have a good end user tool that's easy to use and intuitive. To start with, and those are available and it's easy to get hold of. But then the second piece, you have to have an easy to understand and intuitive data model with business terms, and that you have to do yourself as a developer. It's not ready-made like these end-user tools, so that's really the hard part, but the most important part I would say. Just a few more aspects on it, as I felt like I was giving you the same answer twice.
35	Inter-viewer	No, not really. I guess what we're looking for is that it had something more add there on how to deal with that kind of problem really. It's l more about how to work with a system within the operational context and within an organization fo-cusing more on that than the technical part. What have you found to be the chal-lenges, but in that perspective instead when using or you work with SSBI?
36	Re-spon-dent 1	I think what we have encountered a lot is how to organize and how to set up pro-cesses just for error handling and to get help and support. Now as an end user I'm going to do this, but I have some problems with the tool that I don't really under-stand how to use or? I don't really understand why it doesn't show data like I want it to, and then having processes in place so that end users can get help with that is maybe something that you don't think many people might not set up properly, and you need to do that to make it work in a good way. That's one thing.
37	Inter-viewer	What would such a process look like to deal with that? When the end user doesn't really understand and needs help is it to be able to ask someone who is better for help or how do you deal with that kind of problem really?

38	Re-spon-dent 1	We've worked a little bit like this with some customers that we have end users and then we have super users and then when it comes to BI we have super users who are users themselves, they do reports themselves, but they're particularly good at that they know the tools better than everyone else. They know the data models better than everyone else as well and these super users can be a direct support to other users, something that you can go and ask about such things that another, though more skilled, more experienced user can answer. So that's the kind of solution that you can get in general to have super users who are regular business people but extra skilled. Then of course you can have experts on top of that who might be able to help with technology and you might need to have people who have worked with data models who can explain how it works in detail if you come across things like that as well. But just this idea of letting skilled users help other users is a good model that tends to work well in many places. It doesn't just apply to BI, it applies to all kinds of IT systems,
39	Inter-viewer	So that's something you've applied a little bit in, SSBI in the context as well, in that case?
40	Re-spon-dent 1	Yes, exactly. At the same time, it gets a little bit that often the super users are the ones who are really doing the self-service and the end users to a much lesser degree. So you put together, you build a decision support for self service and where most users maybe the main target group for self service as well.
41	Inter-viewer	Is there anything you could do to help casual users or the regular users to become even more self-reliant and self-sufficient just like superusers are today then?
42	Re-spon-dent 1	Yes, of course you can educate them, explain how it works but that's probably the only way. Well,it might not be the only way, but it's a way anyway. It's back to the basics of making everything intuitive in what things are called and connected and, but also limiting supply. A common problem that I think you see with data models and that they're too big they're way too little focused on a particular audience. By making them smaller, targeting them to just a particular target group need, just this information this target group needs it also becomes easier to use and less to search through then and things like that. So I guess that's also part of making easy and intuitive models to make as small and limited as possible for only a certain target group and users.
43	Inter-viewer	So determine a little bit who gets access to what kind of data then as well?
44	Re-spon-dent 1	Yes exactly, to actually based on use cases or maybe grouping of use cases based on a user group with specific needs make smaller models or just outlier models, I guess you could say, that fit and meets just their needs and doesn't contain anything else. Then it becomes much more easy to use and easy to understand as well
45	Inter-viewer	Okay, I have two follow-up questions to what we just talked about the first one was you talked a little bit about training. What would that kind of training look like to help end users move forward with the use of SSBI?

46	Respondent 1	Well, I've actually just developed a training set-up for a client. I can tell you about it, that's an example. Does It answer the question what could it look like? Not necessarily, what does the perfect training look like? But in it we do a three step training where each subsequent step builds on what was done before and where step one is really for the end user which is about understanding the end user tools. In this case, Power BI is the end user tool so it's all about how to use it? How do I find reports? How do I use and navigate reports? How do I get report parts and interact with each other. How do I get help? How do I report the wrong typical, end user things? So that's step one and then step two is focused then on super users and it contains two parts where the first part is about generally, how do I build reports how do I get the data? How do I find my datasets that I'm going to use? How do I use reporting tools and in this case where we're talking about if you're talking about Power BI it's about how do I use Power BI's authoring tools to create reports. What are the best practices when it comes to designing reports so that they're easy to use and a little bit more things. So that the first part is that and the second part is about the data model itself, this group of super users that work in this area to go through with them like this in your data model out or the part of the data model that concerns you. Here are these metrics, they mean these things, here are these dimensions are these attributes. They mean these things. This stuff works with each other. You can't do this. The two parts in it for the Super User and the third step for those who like to call expert users they are the ones who are going to not only use ready-made data sets or data models, but create their own as well so taking data that is in ready-made data models combined them with their own data, for example, if I take that exists so have this Excel file on the side and so I want to write this together and maybe make a prototype or see how things are connected. In a training like that, it includes a lot more technical sections about how to actually build models yourself and how to combine computers from different places and things like that. So that's an example of what a training package might look like that covers a bit of different needs and different levels of self service as well.
47	Interviewer	Okay so really three different user groups where it really goes down to the different individual's knowledge regarding the training. Different circumstances I guess?
48	Respondent 1	Yeah exactly, and different needs.
49	Interviewer	Yeah, so really it's the regular user, or casual users who don't have that much knowledge, they, are excluded a little bit from being able to but access and add their own data and those parts of it are moved more over to Superusers and Expert users.

50	Re-spon-dent 1	Yes but exactly, so if you look at this first group in much more Managers that are included in it, the one that needs information quickly for their decision making and where you might have in place a management process. It could be like this we are a management group. We meet every two weeks at our management group meeting and we go through these and these reports with these KPIs and see is something we need to do something about right now. Those kind of users they mostly just need to be able to use ready-made reports that look a certain way. They do the same thing over and over again, whereas superusers or people who maybe more in controller functions need to be able to do analysis, need to be able to understand what we've seen now, that things are not going well in this area, what's the reason for that? They need to be able to dig into the data as a first step and maybe produce reports that look completely different than what these managers need. And then the third group who might want to explore and see. But what if we were to combine these two information teams coming from different directions. What could we then learn from our businesses? What conclusions could we draw from it? And would we be able to manage and direct our activities differently if we had that information too?
51	Inter-viewer	We were getting a little bit into the report creation earlier? How do you ensure the quality of reports that are produced by the ordinary users who may not really have the expertise to ensure that they are of high enough quality and that they are accurate as we talked about earlier as well?
52	Re-spon-dent 1	Terrific question. Useful for me and with this interview and reflecting on things like this can certainly take with me in my job then if I come up with something clever, otherwise you'll have to tell me something clever,
53	Inter-viewer	Just if we will get something in the result later.
54	Re-spon-dent 1	Yes exactly. Yes, how can we ensure the quality of reports. I think one such thing is to teach best practices on how to build reports, both how to build in such a way that you can have different parts and interact with each other for different purposes. But then also I can think of pure knowledge of how do I visualize data so that it's both understandable and so that it shows what I want to show that the person reading the report can also understand what I want to get out of it. That kind of knowledge could also help to get higher quality reports. But then I also think that there's a lot in the data model itself behind the fact that it's designed so that you can't really make too many mistakes, but whatever you do, it will be right anyway. Maybe a bit understandable, because it gets a bit wrong anyway.
55	Inter-viewer	Okay, so the data model is the core of this solution really?
56	Re-spon-dent 1	Absolutely the most important thing, I think.
57	Inter-viewer	From your experience, do you have any other organizational or managerial factors that might create problems for the users of SBBI?

58	Respondent 1	But absolutely. I think that too much centralization, for example, moving control over, for example, data, models and things like that too far away from the business, that's something that can lead to poorer drive, for example. I can turn it around and say that a good model is one where you put the drive and the decision-making about how things should be done and what should be done as far out in the business as possible and preferably let the head of the business be the driving force. Whoever owns the business, whoever owns a process and whoever wants to lead and control that process, let them determine the decision support for that process as much as possible. I think that is definitely a good principle to apply in order to get a good drive and to do the right things and also to get quality in what you do. At the same time, you want to be able to make coordination gains and there is a lot to be gained from centralising things like data warehouses, for example, that can collect information from a lot of different business systems where you can keep together dimensions that occur in many different business areas, so there is only one version of them, for example. So that you don't have three different ways of looking at your organisation in three different places, for example, but there's one picture of the organisation and things like that. A balancing act in between centralizing certain things that are important is that we stay together and that affects everyone. But then to decentralize the decision making of driving everything else, including making reports and making data models those things also out with it in the business as far as possible.
59	Interviewer	Okay, when you said that with a source of truth or something similar, do you mean like if you have several different business systems, for example where several different departments are using different business systems, so really that the same type of data should show the same or have the same concepts and names in the end as well
60	Respondent 1	Yes and they mean the same thing as well. It's not uncommon in an organization of several different business systems, but you have the same dimension appearing in several of them, but they're not connected in any way. You often don't have a master data system or master data thinking. Conceptually it's the same thing, but there are still differences in it. I can just take an example from a university that we worked with, who had information about their organization, partly from their financial system, that was one version. From their HR system, it was another version. from the student administrative system Ladok as you probably know, it was a third version to get these to hang together and become the same thing and mean the same thing, whether you look at HR data or finance data or education data. Is one such thing that is good to centralize and have in one place and not let each business decide, how should we look at the organization? Because the organization is the same everywhere, it should be the same everywhere.
61	Interviewer	Okay, so really having a working, or keeping track of their master data would during a decision of the concepts should be the same all the time.

62	Respondent 1	Yes, but absolutely. A lot of what you do in decision support and data warehousing is kind of creating master data, creating a version of the truth. And if you have that outside of your decision support in a good master data management, then you don't have that decision support itself. Then everything that comes in is good. There's only one version of everything. Another thing that I want to add to the question that you said about how you organize and work this thing of having one version of all the dimensions, that's one side of having a vision of the truth. Another side of it, it's just having a version of all the dimensions as well, that one dimension that's supposed to express a certain aspect of the business. It's only in one place. It only exists with one definition. It's called only one thing. If you then have a decentralised ownership of data models and therefore measure definitions, then there is a risk that you will have multiple versions of the same measure. Two different businesses doing their own version of this, then we have for some customers sketched out. We have not implemented it, but that you have a central function a kind of metrics architect that holds together all the metrics across the organization and ensure that there is only one version that also ensures a good naming standard and things like that so that you use business terms and that you express things in such a way that it is easy to understand that you can make a difference between such things that are different as well.
63	Interviewer	What factors would you say an organization should consider in the quest to create a working SSBI environment for the end user themselves? In addition to the missing ones we've just talked about here?
64	Respondent 1	Didn't we talk about everything now
65	Interviewer	I'm thinking if there's anything purely tangible that can affect the end user themselves in the SSBI environment that organizations should be thinking about. Especially the regular users who may not have sole expertise.
66	Respondent 1	No but I think that's one of the most important things for them, they're getting good training and good support in how to go about it. It's readily available to them. I can say this. What you often see is organisations that don't have it that can't give good support to end users and don't train them so, it's that people make up their own solutions. That damn decision support," he says. It doesn't work that it's so slow, so I build stuff into Excel myself instead and then you often end up going down this road. Then you get that person's version of the truth versus some other version that the rest of the business uses, so that's also really important to catch people's needs quickly and early to prevent them from going their own way and making up their own things that make you get multiple versions of the truth.
67	Interviewer	So what advice would you give to other organizations that are in the process of starting an implementation and use of SSBI?
68	Respondent 1	If we summarize the advice, well but, what can I say. I would say, decentralize and centralize based on what I said earlier, this combo of the two things it's an important thing around the organization. Put a lot of focus on getting easy-to-use data models that use business terms, number two, and number three. Make sure

		you have quick support for the end users so that they continue and use this as it's intended and don't go their own way
69	Interviewer	So that they can get help when they need it really?
70	Respondent 1	So that they can get help and guidance as well. Help with doing the right thing too
71	Interviewer	Okay, is there any question that you came up with that you think we should have asked you or?
72	Respondent 1	No, I don't think so. I think I've been harping my mantra about data models for a while now, so I thought, they need to ask that. But then I answered it anyway.
73	Interviewer	Great and we have everything. Do you have any questions for us?
74	Respondent 1	Yes, but can I see the report when it's finished?
75	Interviewer	Of course. We'll be happy to send it.
76	Respondent 1	Yes, very nice. Very interesting to see what you come up with in this.

Appendix C – Interview 2, Transcription

Row	Person	Content
1	Interviewer	We want to start with some general background information just to get to know you a bit better. See who you are and your experience. So would you mind stating your name and the name of the organization you are working for?
2	Respondent 2	OK. So my name is Respondent 2, and I'm working with Company X in Sweden. It is in City x and my work location is City x. We have various clients that we work for. So it's basically an IT service company and we have different projects from different client and business. And then we just try to provide a solution which is not limited to a particular technology or specific technology. So, what I work with is like more of the data engineering and it is also my specialty and my skill is in data engineering and coding in Python, working with Databricks, and as you know, also with analytical tools, I do functions, i do those sorts of things. I have a strong background with Power BI and also Qlikview, which is one of the self-service tools.
3	Interviewer	OK. And you mentioned that you're a data engineer. That is your position within the company.
4	Respondent 2	Yeah. So basically, I'm working as a senior consultant in this company, and it is my current position. What I'm doing is data engineering and the role is data engineers. I have total around 16 years of experience to be precise, and most of the experience is on business intelligence, before I moved to data engineering a couple of years ago. So, this is my career so far.
5	Interviewer	OK. How many years of experience do you think you have with business intelligence?
6	Respondent 2	Well, I have almost like 13, 14, 14 years of experience, almost so close to 14 years of experience between 13 and 14.
7	Interviewer	And how many years do you have with self-service business intelligence?
8	Respondent 2	Well, that is, as you know, the SSBI concept itself is very, very new and it's not that old. So when I started, it was more on the traditional BI. So I have almost like four years or five years of experience with different SSBI tools. And one of those i development myself. I developed one of the tools, which was for one of the companies that I will explain later.
9	Interviewer	And how would you define SSBI? What does it mean to you?
10	Respondent 2	Well, so you have different level of information flow in in your organization. So if you consider in my eyes, we used to take these terms as MIS, Management Information System and this in my eyes, this is, you can say, is the father of modern BI. How the company is performing, how different areas of business are doing. You

		can only know by touching or reading the MIS, you know that is the idea. But this MIS, management information system, as it is called, means It is flowing through the management hierarchies, so you have like lower-level managers, mid-level managers and high level managers in a organization. And it start with, let's say, for low level managers and mid-level managers or even the High-Level managers. I'm in the CEOs or CTO or other people. So we then need to read the information, but it's very difficult because they're not the tech savvy guys, and you have a technical team which is actually making the reports and giving that to delivering those to these people. So all this until 2010, 11, 12, it was going very smooth. But suddenly, in 2010, 2011, it was a concept like everybody needs data and you don't have that much capacity. You don't have those big teams in our organization. So how you will gather all those requests, you are getting hundreds of thousands of requests for data. Everybody needs data, as I say It's like the low level managers, the mid-level managers, the high level managers. Everybody needs the numbers. They want to see some analytics numbers. Then some companies, they look into those problems, how they can address those things because you have to. If you have to depend on this reporting team or BI team or management information team. Then you have to wait till the report is being made. It is tailor made for you and then you read it. So they were looking for something between these. So you have these tech savvy guys that were expert on the reports and everything, but they don't know the business and you have this business. People know the business from their hearts, but they are not tech savy guys that cannot prepare the reports. They cannot run a SQL query like this. So there is something required to create the breach in between these two set of people, and that was actually impacting huge the time and the money. And that is the time when these companies try to create some sort of ready made tools with some sort of data, mostly on the dimensions and the measures. So what they're doing, they were actually preparing the dimensions and measures and giving it to you. And then you can play around with these dimensions and measures and you can create your own analytics. You can create your own reports. You don't need to be tech savvy, you don't need a computer science background. You can just simply go around it and click and find it out by yourself. You can create a chart very quickly. You can create an intimate query, just clicking on some buttons very quickly and just play around with these dimensions and measures, as I said. So this part of solution is called self-service BI, which many companies introduce. So, you see, they actually try to create a bridge between this gap of the tech-savvy guys and the business people. And often they use this. So until now CEO and all those high level managers. They will have a readymade team who were always there to just, OK, you need this data will give it to you, and the marketing managers unit , we will give it to you. But that doesn't work because if your offline, he cannot access to the network. You need something where he can, create some sort of small things and with the small effort and they can make the things out of it. So this is what SSBI is.
11	Interviewer	All right. It seems like you have a lot of experience with this. We have divided the next part of the interview into two major sections covering different kinds of challenges, with more user related challenges with SSBI. So the first one is the technical challenges, and with technical challenges, we mean challenges that users face while working with SSBI and the tools such as like system functionalities, for example, that could affect them negatively and make them less self reliant. So as you stated, of course, one of the main purposes of SSBI is for users to become more self-reliant without support. So what technical challenges or barriers have

		you experienced that can prevent users from successfully working with SSBI and becoming self-reliant?
12	Re-spond-ent 2	the number one challenge, what I found is the data governance in SSBI. So what happened really is, you have a set of data and you need to classify it and you need to have a target. You have a target audience for this, for those data. So this is this part of data where you have this target audience and the data is flowing into various levels. You have a set of technical people who have access to all sorts of data, but they're not that business savvy. They don't have that deep business knowledge. But these managers with SSBI of course they are this descriptions because there are for different purpose. Like the sales managers, the marketing managers, they don't need to look into the HR data, right? The HR managers, they don't need to look into the production data. So there are different departments and all these things. So thats really challenging in the data governance. So, if you don't have a very seamless, efficient data governance for self-service BI, then it's bit challenging and a bit difficult for managing because every now and then, these business people don't really understand the technical know-how and the effort that is needed to put the data in the background. But they are very keen and interested about the result. So what really happened is like, if you don't have a very sound governance, then it's all chaos across the department and you cannot manage the data flow very efficiently. So you need to have a very sound data governance. So that is the number one challenge.
13	Inter-viewer	Can I follow up on that one just quickly? So you talk about get different access to data and just having a sound data governance process implemented in your organization, like how can you reach a good and sound data governance in a organization?
14	Re-spond-ent 2	So you have some tools that you can enable. You know, you have this master data management MDA and all these tools that you can leverage for data governance, like if your data is in the cloud, you have a data governance layer in the cloud as well. So suppose you have another layer of self-service BI in your company, which is with the tool Qlikview or Tableau or Power BI. In that case, you also take care of this data governance from the cloud so that you know you don't create a mess around the access to this portion of data. So you have different tools that you can work with. So that is relevant in this case.
15	Inter-viewer	So with those tools, you basically give different user different access to specific data that is just for that specific department, for example?
16	Re-spond-ent 2	Yes and it also addresses another problem which is called role based access. You know RBI, so in self-service BI, It is also very important that you have a proper role based access defined. Let's say in a sales hierarchy, you have a sales director, then the sales manager, then the sales executives. So suppose there is some sensitive data which is really sensitive to the organization. You will not open that data for the sales executives, but those data will be open for, Sales directors and sales managers. So you have a role based access as well. So, those things are really important and you can also create a role level security. So in your traditional database, if you have the data in the role level, you have role level security. So let's say it's a chunk of data. Let's say you have thousands of rules and you need to filter it out every time. Instead of filtering out you just create a role with security for those role levels. And then when you run, you pretty quickly can pick up based on

		the access. So let's say Albert has certain access, then it will go and pick up those queries and retrieve the data.
17	Inter-viewer	OK. Is there any other technical challenges that you have encountered from the user perspective, that can be a problem for the user?
18	Re-spond-ent 2	Yes. So there are some other challenges like what I have seen. As I said, the self service BI is actually related to those people, the business people who have less technical expertise and skills. So what happens many times is you actually get a very frequent request from them to customize something. So this customer service and support actually takes a lot of time. So they will say, OK, I like this one. But you know, I would like to see if I can see the data for only North America or and the southern part of Europe. So that's the southern part of Europe, but not the rest of the world can you make it for me. So the customer service or support, it's im-portant because they don't have direct access to the core data, your core database. They're not touching the code that was there. They are only playing around the query level, so they really cannot make those changes from there end. So it is your responsibility to make those changes. But if you get a lot of frequent new custom-ers and need to support our customers and their request, then it's actually piling up a lot of work for your organization, you need a lot of bandwidth to cater those re-quests. And another technical challenge is lack of basic skills. So let's say you have given a Qlicsense report to someone. Qliksense is a heavy self-service BI tool and in Qlicksense you can actually have like additional ad hoc page where you can go and just draw your own chart based on the available dimensions and measures. So let's say you are not habituated with those things, how to drag and drop and make those checks. Then of course you will try to get in touch with those expert people in your organization and that caused some problems. And I mean, this is also expected when you have given a subset of this tool and you created a self-service BI. So your users skills are a little bit elevated. You know, I'm not saying that they have to be experts on this, but at least they should know how to get the data and how to, clear the layout, create the charts. So those things basi-cally.
19	Inter-viewer	Just to go back to what you mentioned before. This problem with business skills, and what you mentioned about access to data. So to summarized that part you're saying that it can become a problem that users don't have the ability to access the data they need?
20	Re-spond-ent 2	Yes. So basically, what happened, like most of the users are not aware of the data, what exactly they are looking for. They are looking for some of that information, but that suddenly they don't know which dataset will provide that information. So you need to have a proper map or guideline in your organization, when you have implemented self-service BI, you can use a tool like a confluence or those kind of pages or tools where you have proper guidelines and maps where you explain, OK, this is the dataset, and here is the related dataset. And this is the hierarchy. So here you can make the queries, not here. So B is related to A, C is related to B, B is related to C. So if you are looking for data at the D level, you should run the query at the D level on the B or C level. So this kind of clarity you need. if you give it to them and if they don't understand, and don't go through that before they start working with SSBI, then it introduces a lot of pain. So basically, when you empower someone with some specific tools. Let's say tableau or Qlik sense, or maybe Power BI, then it's also needed some basic training for them because other-wise it is very difficult. You will get a lot of calls, and a lot of questions every day and you will have a very difficult time to make them understand. So

		basically, everything should be clear with clear instructions, with the data sets and everything. You have to transfer the thoughts at a very high level to those people and then they are able to do the self-service BI.
21	Inter-viewer	So, what would you say are the technical requirements that are necessary to make an SSBI solution usable and useful for the user
22	Re-spond-ent 2	Yes, you need some basic training. So basically, when you introduce Self-service BI, then you have to give training for the tools to those users. And then you need some governance area from where you can, you know, direct them to a different set of data. You can let them understand the meaning of the data, how they can read that, how they can use and what are the meaning of those dimensions? I'm giving you an example. So you are working in a company called IKEA, and for IKEA, they have many stores in different countries and what to call those stores is the country's full retail unit. So basically if you are working and then using a self-service BI. Then suppose you have a dimension called RU retail unit. Then you know, the other mean of RU is a country. You know, the country itself is actually, if you called RU, you see the country names. So suppose there is another word for that particular term. So this is going to be BNM. And then suddenly someone comes and asking you, I don't find the country BNM. Then you tell them what you need to look into RU, not in country, the country, which is very fancy one. It is not used, but the RU is the correct one to this kind of like transformation. You know, information and the and jargons. You need to clear it up before you sell them that SSBI.
23	Inter-viewer	So basically, having defined business terms that represent specific data, so the whole organization uses the same business term, basically?
24	Re-spond-ent 2	Yeah, you can use a data catalog basically, and hand it over to them, and keep it in a centralized location. And from there, they can access those. Because while they are on the SSBI, it's really means self-service. You would expect these managers that they will not call you now and then. They are so self-sufficient with all the ac-cess and understanding of the BI part and the data part. So for that, you need to make it possible.
25	Inter-viewer	Have you noticed any challenges that users face while working with the tools themselves, for example, power, BI, Qlik or Tableau etc.?
26	Re-spond-ent 2	Yeah, many examples. So let's say example for any competitive start, so let's say you are doing a comparative studies in Qlik view. And you know, it is done with a particular type of expressions, like set analysis. So the set analysis is, little bit complex in how it is written because you provide a set of data and then you com-pare with another set of data, like that. But the syntax is a little bit complex how it is written. So example one, particular manager, he has a need to understand to compare this year data compared to the last year data. It comes that you have to write a set expressions, and it is definitely not a manager's job.
27	Inter-viewer	So for example, Syntax can be the problem for the end user like Set expressions in Qlik and Dax expression in power BI. So that's a struggle for normal users?
28	Re-spond-ent 2	Exactly, exactly. That is what I was trying to say. So writing those technical stuff could be painful for them because they understand what they're looking for, but they do not understand what syntax will give that to them. So the tool, which I de-veloped back in 2014, that was a quite easy one, I developed it for Company y. So

		we had a requirement from company y that were like 400 people. They needed to do some analysis based on tabular data, tabular database. So what we had, we had tabloid q at that time and they were looking for some sort of excel addins which will, enable one dialog box in front of them and they will have the measurement and the dimensions that they can select from and choose and then they can get the whole bunch of records from TablouQ. So, so that was the thing. This is a Self-service BI tool I developed and given to them. So they don't write anymore queries. They just drag and drop those measurement and the dimensions. And then create a record query at the back end, which is called Dax query. That's excel based or a power Bi base. That things is heavily used in Microsoft technology. So that is actually another form of writing Excel formulas. So, it will create a DAX query, and it will eventually give the record set on the next page. So that was quite a good example of Self-service BI, because you don't have the opportunity to write anything else, anything extra. You don't have to do anything extra. You just select your dimensions and measures. You'll get your records. So that is super quick and easy. Yeah. So those things.anything else, anything extra. You don't have to do anything extra. You just select your dimensions and measures. You'll get your records. So that is super quick. Yeah. So those things.
29	Inter-viewer	OK, so if we're moving on to the next part covering more of the non technical aspects of SSBI related challenges. So what we mean by this is more of operational and organizational challenges. So I would like to ask you. From your experience what operational and organizational challenges do you think users face while working with SSBI?
30	Re-spond-ent 2	Well, basically, you know, the organizational challenges with SSBI is very funny. So basically you have something like IKEA. I guess two parts, one is Ingka, one is Inter. So Ingka they have many people employed. It's a huge because that is handling the sales. But the Inter is the brain of IKEA, which is actually handling the designing of the products. Now what happened exactly in Ingka? as I said, is very big, because it doesn't do sales and you have many managers, many people, you know? So what really happened then problematic is you create a duplication of data in many levels. How it happens, let's say you have five sales managers, you know, not sales managers, let's say you have five Supply similar to supply chain managers. They're seeing the data and reporting out the data in from their level. So with the SSBI all this managers try to articulate the numbers and information in various levels. So basically, I'm a manager, Albert is a manager and you manage the three managers. So I articulated my first numbers, Albert, articulated his numbers and you have articulated your numbers but some information remained the same. So it is creating duplication of work. So basically what happened when this goes to a horizontal level, when it reflects into a horizontal level, you see, many people has done the same thing because they don't have any communication in between. So this is one of the problem with SSBI. So when you have a Self-service BI, you are focused only into your stuff and you don't really bother or care about what the other part of the team is doing. And if there is any similarities, if you have arrived into a number, you have created one number from your SSBI, you don't really share that with another team and the same things happening from another team perspective. So what exactly happened is like, you are blind with your numbers and because it is not here on the horizontal level before any sort of global meeting or any online meetings. Until that time, it's a duplication of effort. So also putting the same effort to extend the same number and also putting the exact same number. So it's actually wasting a resource and cost at the end of the day, and it happens in a big companies.

31	Interviewer	OK. And how can you manage like duplicate and redundant reports that are created within the organization? Do you have any best practice for that?
32	Respondent 2	Good question. Yes. So what we do basically, you know, we try to create a centralized repository of data, and we try to provide all the standalones, dimensions and measures there itself. So that all the basic things. Like if you query for what are our sales storewise? What are the customar returns storieswise? Verry common query. So all these common things, so basically those common dimensions, like article name, article colors, those common dimensions and, introduction date. So those information, you keep it in a common repository so that is not created by many people. You loaded these common dimensions every time from a common query. Let's say you have a common query for item. You have a common query for countries. You have dimensions like country, province, states, cities, stores, stores names and then you have like build business units. So, basically, you create all these common dimensions item and then you give it to them. OK, so what do you tell them that you don't need to run those queries by yourself? You just load these common dimensions and you just focus on your area and not the common queries. So that way you address those problems.
33	Interviewer	OK. And how do you think that you could ensure that quality of reports that are produced by the casual users, so to speak or the business users, so they are reliable and of sufficient quality?
34	Respondent 2	Very good. This is another good question, because I often found that, you know, in a big meeting or all hands meetings from different departments, you have different numbers. And then suddenly they start fighting with the numbers. Someone say, OK, this is right. This is my numbers, this is right and someone said, This is my number. This is right. You know, I drive to this number from these business equations. So then, you know, as I said, you need to have a centralized repository. So basically in the SSBI what is happening, is like, you have given the access of data, you know, and they can make expressions x plus y, x plus z, x plus eight x plus B, and they can create those results because you have created and given the access of data to them. And you know very well that, OK, from this data, you can derive these numbers only. OK. You cannot derive anything else. OK. So that is always there. So the trust is built into or through a backtesting. So if you say suddenly to me, OK, this x plus y equals c. I will just have a look in the in my query, which is already predefined. Is this x plus y qual to c? Yes fine, then the numbers are correct. So basically, you have some standard reports in your organizations, and those standards reports are always there. Nobody changing them. And that is developed by professional people, those skilled people, and this is already tested and evaluated along that and all these self-service BI numbers when it is coming to try to fact check with those numbers. By some means, and when they see this is not matching somehow, then say, OK, maybe this is not the correct number, we have to look into the number. And so that is how you can address those problems.
35	Interviewer	OK. So basically also having some guidelines for how to work with the reports that are created?
36	Respondent 2	Yes, and also have some benchmark numbers. You know, there's some standard reports where you already have tested and it is validated. And that is actually giving you the confidence, because see, for any data, trust is the most important thing and that comes with accuracy, so any numbers in BI, anything you exchange it need to have some accuracy. And this is the problem. Another problem with the self service BI, as you said, like five people, is coming with five different

		numbers. It is difficult to understand at point. What is the right one? You know, let's say I'm a CEO, and there are some people coming to me and they're saying, OK, this is my numbers, this is my numbers, this is my numbers. This difficult for me to publish the right number of product. It's not possible. So for that reason, you tell them, OK, boss, when you're ready with new number, we have these things that go an fact-check your numbers. Everybody's got it when I speak to the people.
37	Inter-viewer	Ok, I see that the time is kind of running out, but do you have a couple of more minutes?
38	Re-spond-ent 2	Yeah, I have.
39	Inter-viewer	So I would like to ask you, what factors do you think an organization should con-sider to both create and ensure a functional SSBI environment for the end user? What are the key factors here, do you think?
40	Re-spond-ent 2	First thing is that you have the right tools of course. You need to have the right tools for the SSBI. And you need to have proper training done and all those things. Second things is your data governance is enabled, third is role based access, and this is very important. And fourth is customer use and support, how frequently you can support your people for any ad hoc request or customer request. You know, your backend teams should be very dynamic to provide support and role things frequently. So basically in SSBI you will have some people who are really ad-vanced, So you call them advanced users, so how you are going to meet the needs of those people? Like what sort of data layer you will provide to them, if it is clearly defined? So, those things. So basically these are the key things like your tools and your data catalog, data governance, role based access, data security, ad hoc customarys and supports. So these are the key things that you need to address and also prototyping support, So what is the prototype support. Support is in case you have those power users or advanced users and they want to clone the existing analytics artifacts in the order environment, literally in the cloud or somewhere. So you need to support those things at times. So that is also what i call prototyping support. So basically, what I'm trying to say, like you have big data, you have a big queue for big data warehouse, you are getting a frequent data. I'm a manager, I come to you, and I place requests in that, OK, I don't need it so very big. I don't understand, and I don't, I cannot read this much big data. I need to see a portion of data. Can you give it to me? So then you create a smaller amount for me and give it to them. So need to have that capability doing those things. So you create the data mart and create a prototype and give it to me and I am playing around those that I'm not. I'm happy at the end of the day.
41	Inter-viewer	OK, so basically creating data marts or views in that database for specific user needs?
42	Re-spond-ent 2	Exactly. prototyping support.
43	Inter-viewer	OK, so what advice would you give to other companies that are in the process of implementing, but also using SSBI, let's say, your top three?

44	Re-spond-ent 2	Yeah, yeah. So basically, oh, first of all, you need to do a survey within the company before you implement SSBI, like what exactly is your customer consumer level. You know, what are the kind of people who you have in your company. how many are mid-level managers and what is their expertise and skills? What are the low-level managers? What are the expertise and skills? And then the high level managers, what are the expertise and skills? So those things and then what sort of data they are really interested into? You know that gives a lot of information to you. What sort of data, because if you have like a company which is recruiting people, then of course you are focusing on some people or some sort of database. If you are having like a sort of agile sort of company, then of course, production, supply and a lot of its original database that you are looking for. So this is really important. What sort of data, what are the set of data that your people are interested into. So you want to interview those people, your managers and all, and then you understand what exactly they are looking for from SSBI, because what exactly you would like to do is, let's say, with the SSBI, you also would like to minimize that use of Excel, Microsoft Excel and other sort of clerical work that they do every day. So let's say I have a business and I come to office. I open my laptop, take it out on Excel, had a PowerPoint from last week and does another PowerPoint for the last two months before to call the PowerPoint got the number putting into my excel, making some calculus and giving to the, that's not the way actually. So with the self-service BI, you'd like to minimize the use of excel and clerical stuff. So basically, for that thing, you need to understand what exactly they do on a day to day basis, to reporting the numbers. So you need to understand their habit, the factors and you want to attack those ideas. Then you actually can implement a successful SSBI. So basically, it is your objective is to minimizing the dependency on your centering on your BI teams. And that is how the people are enabled, empowered for SSBI. So you have different specific spoke or people what were responsible
45	Inter-viewer	Perfect. I think that's it. OK. So is there something you felt that we haven't asked that we should have asked?
46	Re-spond-ent 2	Not really, so one objective. You can find it out because everything is time and money. So basically, what is the objective of SSBI? It's not only empowering the business people with the sort of data querying any eligibility or skills, but also, you know, reducing the cost. So example, as I was saying that MIS team or the BI team, let's say you have five managers, they're asking five set of data and you have a team of you MIS guys were working day and night to prepare that data and giving it to them. You said how much salary you were giving to them. Right? You were keeping 50 people in your team. So here it is. The scope of cost, reducing the cost. So of course, the objective of SSBI, it's not about only empowering people with BI eligibility, but there's also another human aspect of reducing the cost. The more people doing the BI on their own, the more you will have not need to keep a big BI team for reporting teams. So that is great. And also, you get faster analytics and faster analyzes from all the inputs from the subsidies behind things. And then it's also helping to get faster decisions eventually, you know, it also helps you to improve your companies and get people whole achieve the goal.
47	Inter-viewer	Okay, thank you, and do you have any questions for us?
48	Re-spond-ent 2	No, So I wish you all the best and I hope you, you have a fair idea and they were because you were looking into these things and this is actually there is no definition. Basically, it is not very much framed stuff this self-service BI. So there are many objective, many angles, many aspects, you know, so and you should be very

		sensitive, very vibrating approach that you can take while nurturing those aspects and then you can put it together to see what exactly work for your organization? Yes.

Appendix D – Interview 3, Transcription

Row	Person	Content
1	Inter-viewer	Let's start with some formal questions about you and your organization. So just for the record. What's the name of the organization you're working with currently?
2	Respon-dent 3	Its company x, it is a French-based company, but I think spread all over Europe more or less.
3	Inter-viewer	OK. And what is your position within the company?
4	Respon-dent 3	Currently, I'm a senior consultant.
5	Inter-viewer	And how much experience do you have from working with BI?
6	Respon-dent 3	With BI in general, around three years, I would say three and a half, maybe.
7	Inter-viewer	And more specifically about SSBI, for how long have you worked with that?
8	Respon-dent 3	It started around one and a half years ago.
9	Inter-viewer	OK, so around one and a half years of experience, with SSBI. And how would you define SSBI? What does it mean for you? When we discuss SSBI?

10	Respon-dent 3	Compared to the common, or traditional BI architecture I would define SSBI as more like enabling the users to do their own analytics, decentralizing the BI in general. Being a bit more. Oh, I don't want to say the word agile, because it's used too much too often used in different scenarios, be more flexible and be more self-reliant.
11	Inter-viewer	Then we are on the same page here, ok, so let's dive into the main question that we have divided into two different parts, and the first one is about technical issues that users can have when using SSBI, more like hands on technical issues. So as we said before about the definition, the main purpose of SSBI is for the user to become more self-reliant without the support from power users, for example. So what technical challenges or barriers, have you experienced that prevent the user from working with SSBI and becoming more self reliant?
12	Respon-dent 3	First of all, it is, I think, almost the case with self-service tools in general that the very first look or very first side, it seems to be easy, but it is a pretty high learning curve to use the tool in the sense it is meant to be. So of course, it is pretty easy. Let's just use power BI as an example. It is pretty easy to do. Very, very brief and analysis that is scratching the surface. But going deeper into real analysis, for example, DAXs need it when we talk about Power BI, and this is the pretty important step here to differentiate too, like making something very fastly and on a high level and going too deep into analysis where your data, need some help from technicians or more skilled people and. Another barrier or technical issue I experienced in the last year is I don't know if you would categorize it as a technical issue. It is the question of the single point of truth. So. It is that what happened with the clients I work with using self-service BI is that a lot of people started with the tool and feel like they understand what they are doing. And after a while. A lot of analyses are spread all over the company, which might present the same numbers with different results because they did that with their own business logic and did it with their own understanding of the tool. So it happens pretty often that, it comes up a lot of inconsistency regarding data.
13	Inter-viewer	OK, so the first challenge was more about how to write queries, the Dax calculations, from the technical side, problems like that, how would you encounter and manage that kind of challenge?

14	Respondent 3	I think it is important, it's like when it comes to tools and stuff in general, it's always important to enabling them correctly, not just giving them a tool, saying do it on your own desk and training course on the internet, and hopefully, they're doing it. I think that it has to be, you have to support them actively. And what is pretty important, I think, is that you, do it from scratch. So you don't expect the people to understand what they are doing on a certain level already. So you just assume that no one is knowing anything and bringing them from the very first step to the tool, explaining to them what it is for. That's that is something I have experienced a lot with SSBI, and they didn't even know what to do. But the root use of the tool is some of them are using that for I don't know. Those are different use cases that were sometimes pretty ridiculous. So bringing them from their first step and training them and doing it actively. I think it is not the right idea like it is done with attitudes from a different area like Salesforce and so on that, you use these training areas and they have to do it on their own. I think this is going in the wrong direction when you're doing it as a company.
15	Interviewer	OK. And for the second one, with the data access and a single source of truth. How can you manage that kind of problem when users accessing different data that actually mean the same thing, for example? So you can achieve one single source of truth.
16	Respondent 3	What we are currently doing at a client because they came into that situation where everyone was doing their own things and everything got out of hand and out of the control from any area, we are trying to get back a bit more centralized, providing one single point of truth, one data lake and joining all the data in one server, bringing up regulations and a governance model that is defining how to get data with the tool, where to get that from and how to document what you are doing with it. So that even if it comes up the situation where the same number appears and a different result, you can kind of recreate the route and find out where someone did something wrong. It is In my personal view, a bit, um, getting away from the real meaning of self-service BI because you are creating a lot of restrictions and a lot of governance and that, but at our current plan, it's the only way to get back to some kind of negotiating and talking about why are the numbers what they are and not what is the right number.
17	Interviewer	Okay. So basically leave it to consultants or professional users for the BI tools to build the actual data foundation, like the Data Lake Data Warehouse, and also create the restrictions, the data models so that casual users or normal business users can access the data when it's already cleaned and stored correctly in the lake?

18	Respondent 3	Yes
19	Interviewer	So have you experienced or encountered any data-related challenges that can hinder the users to work in a self-reliant manner?
20	Respondent 3	Yeah, I think what pretty common thing is that there is no data warehouse existing and the people are trying to get the data from wherever they can. And in most companies, there are firewall issues that are restricted data access to some source tools. And it's. When you're starting with this SBBI tool and the first two or three try out and in the situation where you can't get the data because of any restrictions, that's pretty frustrating, and when the SSBI tool is implemented in a pretty centralized and governed organization it can hinder the process and the idea of SSBI
21	Interviewer	So what is the ideal way of managing the data-related or data restrictions problem?
22	Respondent 3	That's the big and interesting question. If I already knew that I would be in a different position right now. It's. what I could say about that. I think the most common issue right now is this problem between data security and data gov-ernance on the one hand and the willingness to provide data to everyone. Because. It is fast-er and it is easier if everyone can do their own analysis. But of course, you don't want every-one in the company to see every piece of data. I think it is pretty important to have a very clear governance model, how and who is able to and is allowed to use and connect to data, and it has to be centralized, I think. I personally think that complete decentralized data management is possible, but not in, I think, around 90, 95 percent of the existing companies because of this organizational structure behind. So, Decentralization of the governance model of centralization, sorry centralization of the governance model compared, or con-nected with some flexible and fast responding group or area that is providing the data, so I think it is the best way if someone that is willing to do an analysis on this SSBI tool that they go to or come to the centralized data model area, and just asking for the data needed there provided and then they can work with it. It is slowing down the process, but it is assuring the data quality and this is the main issue I am experiencing the data quality.

23	Inter-viewer	So, in general, have a team that controls and governs the data where a user can ask for permission for certain data that they can work with from that point?
24	Respon-dent 3	Yeah, I think so. I'm sure there are a lot of people thinking differently, but I personally think so. Yes.
25	Inter-viewer	It also sounded like it could be a challenge to find the balance between like giving access or giving data access to everyone but also managing access rights and security. So is it like finding a balance between these two? Is that also kind of an issue?
26	Respon-dent 3	Totally. SSBI tools are not commonly, transparent. So I have to start differently, so just thinking of a source tool where some credentials and data access restrictions are included, so me as a person have access to certain data. And when I'm trying to connect those data from this SSBI tool, in a lot of companies, that is an issue with these credentials. So it is not properly transported from one tool to the other. And it is not that easy to have some kind of control of all the data access for one single person and all the data sources bringing it to this are self-serviced BI tools and this is something I am struggling with at my client right now. That's why we are using this data warehouse as a step in between to say, OK, all the data are brought up to the data warehouse, and in this data warehouse, the governance is placed. So, as the owner of the data warehouse, we decide who's able to see what and in which amount. So this is something to make it a bit easier, even if we know that there is. It is slowing down a lot of things because we are just bringing up a new step, which is a pretty huge step with steps in between. But it is the main thing with data access.
27	Inter-viewer	Ok. So what would you say are the technical requirements that are necessary to make sure that you have a useful and usable SSBI environment that is easy to use for the SSBI user?

28	Respondent 3	First of all, I think it is. Important that you at the very first step realize what are your data sources, you are in general working with. So is it a more homogeneous ecosystem? Is it based on I don't know how many systems can be the rest of it? That's the very first step I would think of. And then the question of. What is the reason you are willing to use SSBI, because pretty often companies try to use SSBI because they want to. They don't want to have this central area of providing data, providing analytics, and so on. But they. Don't have in mind all the governance issues afterward. So that's what I said before, so they're just thinking of, OK, let them do it on their own and everything is fine. And then a few years later, they realize that they really lost control of everything. And I think it is important that you really think of the structure, the architecture, and the way you are willing to provide data. And the SSBI tool, in my opinion, should really be a front-end-based tool. It should not be used for, not that much used for data manipulation, data transformation, and so on. It should be a front-end tool where the people get prepared data and they are able to do their own analytics with some features, maybe some joins or something like that, but not that they really have to combine different data sources in the tool and so on. So this is getting out of hand, I think.
29	Interviewer	Okay. If we move on to the next section. We call it operational or organizational use-related challenges. So those are more like non-technical issues and instead focuses on how SSBI influences users and organizations, whether it can be useful or not for the user. So from your experience, what operational or organizational challenges have you faced or the users that you have seen working with SSBI? What kind of problems have they faced?

| 30 | Respondent 3 | The first thing that comes to my mind is connected to the technical issue of a single point of truth. It is the question of who is providing the analytics for a question. So. With SSBI, it is pretty common that different areas have the same question doing their own analytics, but looking at it from a different angle and when they do their analytics and the reports, they are just having their own view on it presenting that. It is not that rare that in a meeting, two different people from different areas come up with the same analytics, and now it is the question who is responsible for doing it afterward and continues doing it? And. It is. Pretty easy just to create your own report, it is pretty easy to do your own analytics and it is fast, you just have a question, and you just want it to be answered ad hoc and not regularly. It's wonderful. But if that has to be a report and analytics on a regular basis, it is often the case that it's like these work around things. So just starting with a workaround and you never change that network around it and the workaround is just the common thing in the future. And that's what I'm seeing with SSBI very often. So it is just and very fastly done report that is just to answer a question and that is becoming a management report for the next two years. And no one really asked, who did that? Why did she do that? What was the question that she was answering? And maybe the results of that report that analytics are not even answered so because they did that with a completely different question in mind, and they had a very specific use case, but that's not suitable for a regular case, so this is one aspect, I think, another aspect is and this is a bit more critical, I think. In many companies you have these employees that have some technical skills, but they are not experts and they start using SSBI and they feel like experts more and more, and they might not even know what they are really doing when they create their own ecosystem, so they start bringing up data into the cloud, whatever they are working on and working with the data, joining the data, manipulating them, and they don't even know what kind of ecosystem they're creating there. And a few years later, it's pretty hard to resolve and trace that because they are the experts, no one is knowing what they have done there, and it's even the case in a very simple scenario where they are creating a report and that can be. It can be complicated what they did, and it can be pretty complicated to recreate what they did. And if or when they are leaving the information is lost. Obviously, that is happening with centralized BI solutions as well. But it is more often happening because more and more people are the single point of truth for the report of what the data they were providing. So there is a centralized issue of the past that is getting decentralized and appearing in very different and in all of the areas in the company. |

31	Inter-viewer	All right. And what would you say, which factors are important to consider for managing these kinds of problems?
32	Respon-dent 3	I think, first of all, it's coming back to one of the first things I said. enable the people correctly and understand that not everyone is a real technician and not everyone has the skill set to do reports and manage data. So if you are willing to bring SSBI into the areas, you have to have at least one person that is really able for that so that the person is knowing what it is doing. And it's not just trial and error and finding out what the tool is able to do and bringing everything into the area and afterward, it is pretty hard to resolve the issues they created. So I think with sharing the tool into the areas, you should also consider having the experts in the areas as well or making the people experts beforehand.
33	Inter-viewer	OK, so having some sort of expert user that is a bit better than the other casual users, that the regular users can rely on for help?
34	Respon-dent 3	Yeah, yep. Yep, that's perfect. In yeah, an ideal scenario, you have one expert in every area and they enable the normal users and being supportive for them, so it is like an. I don't know if you could say some kind of a network organizational structure when it comes to the SSBI system. So you have this central intelligence area where the data is provided in general and to real experts of the data are sitting in, and you have experts in every single area that are getting the data being some kind of acting as an excellent help, maybe to say I'd like that, to spread it in the whole company.
35	Inter-viewer	OK, so the next question is about the reports. So how can you ensure that the quality of the reports that are produced by these normal business users are reliable and of sufficient quality, so you can actually trust the reports that are produced?

36	Respondent 3	There are many possibilities and options. The very first step I would recommend is having governance, for how reports should look like, how they should be named, and how things should be organized, shown, and presented. Some people might say this is just making it clean-looking, but it helps to assure things. And the second is I saw that with the tool MicroStrategy. It is not, really an SSBI tool in general. I would not see it as one. But there is a feature they are using that is pretty nice and I think SSBI tools should adapt it. It is a certification mark on reports. So when the report is created, a certain amount of users that have the right to do so can license that report. So they can say, I saw that report and I can approve the data that I provided are correct. And this is something I would really love. For example, I am currently using and working with Power BI, and this is something that would help me on a daily basis a lot. Because if they provide data, and if someone is providing the report and the central area, a central person would say, OK, I saw that it's certified. Everything's OK with it. We can. Get rid of a lot of trouble and a lot of issues when talking about the data because this is something when it first happens that wrong numbers are provided, the trust in the tool is lost a bit, and every single time that happens again, the trust is lost more and more. a situation can be created where every single report that is presented is critically seen. So the very first question that people are asking is, is the data correct? And this is a situation you would never want to get into because data should be reliable. You should look at the report and say, OK, these are the data, fine, and this kind of certification, I really like that
37	Interviewer	Is this some sort of like rating system on their report that are produced by the users?
38	Respondent 3	Yes
39	Interviewer	Would this also allow for more reports to be reused? Do you think? Like having a rating system on them with this also allow for, Instead of creating a new report, you just go and maybe find an old report, but has a good rating.

40	Respondent 3	Yeah, I'm pretty sure that would. Your question just showed me a completely different aspect that I wasn't thinking of before, because just talking about Power BI right now. This self-service BI approach is also bringing some kind of in-transparency of what kind of reports are existing. So if I am from the one area are searching for something, I don't even know that another area already provided that. So I am just doing it. So you don't have any transparency, what is really existing and with a good governance model, for example, how a report should be named. What the description should include. You could add an ranking. Of course, you could easily find analytics and report that is helping you with the question you are currently having. And you are obviously stopping the issue of everyone, just creating new reports and new reports. And I think what the company I'm working on, I don't know. We have more than 100000 reports and I'm pretty sure that I think 70, 60000 that is not even used anymore. So, it is just being created. It's an ad hoc analytics. It's like, OK, I have a question, I want it to be answered. And now the report is just laying there. but maybe another area has the same question three months later again, and no one is aware the same question is answered a lot of times
41	Interviewer	So basically having some sort of rating on the reports and also the naming of the report so that other departments, and other users can find the report that someone else basically created before.
42	Respondent 3	Yeah. Good governance of how it should be named a rating and a place where you can have an overview on all the reports that are existing. Of course, not all the reports, because there's always the the governance issue of who is able to see something but a place where you can find which reports are existing, maybe the name, the description, what is shown in the report, even if you are not able to see the date on it, you can maybe you just asked for something and ask for the report and let them provide you if they are OK with that.
43	Interviewer	So what factors would you say an organization should consider to create and assure a functioning SSBI environment?

44	Respon-dent 3	Yeah. On an organizational level, I would again say you should have one centralized business area that is responsible for the administration and is assuring a good and working governance model. I think without you just creating a mess in the whole company and you are just realizing what you created, I think five to 10 years later, and I think the SSBI topic is pretty new. So the companies right now don't really know how to deal with the situation. So they're just letting everyone run and see where it is going. So a centralized business area is still essential, I think. And governance model is pretty. It is crucial, I think so the naming governence, even how the report should look like it. There are some, some very small regulation that can make things pretty easy. So for example, where are the filters placed? How are they used? What information should every single page include, for example, the last date of data provision when we had the data last refreshed? Is there a difference between the name of the page in the report or the report in general? Where should it be named? How should it be named? So all these things are like in the and the first side. When you talk about SSBI, it sounds a bit weird because it sounds some kind of the wrong direction, but giving people a certain flexibility always has the. It's always working on the foundation of some regulations and governance to make them, to make sure they do it correctly. So this is the most important advice I would give a company so pretty centralized business area and very worked out governance model.
45	Inter-viewer	This leads into our final question, which you touched on, I guess, like what advice you would give to other companies that are in the process of implementing and using SSBI.
46	Respon-dent 3	They should start conceptually. Don't just bring the tool inside the company and see how it is going on and try to resolve it afterwards. Start with the real plan and follow that plan strictly. I think this is pretty crucial because. This is what we are most of the time doing. Cleaning up the mess they're provided with SSBI, just trying to get back to a certain kind of status quo where we can start again from scratch
47	Inter-viewer	So is there something you feel that we haven't gone through that it's important that we should have asked you or something you want to add on?

48	Respondent 3	I don't think that you missed something that's just one thing I would like to add. Well, as SSBI is, something completely new appeared, I think. And this is some kind of operational analytics, so just like using a SSBI tool as some kind of corporation/operational controlling instrument. So having that, let me give you an example to to get a bit better. If there are products that are delivered to a warehouse and people are using, for example, power BI to be able to really track on a basis what kind of what amount of product are in the warehouse, how they how many are going in and how many are going out and expectation, how many they might need in the future. And they are using it very much operationally and completely split up from that. There are management reports. And. When you are doing a decentralized. And in most of the cases, the people that are doing the management report are not connected to the people using the operational reports because maybe they're in different business areas, maybe they are in just not talking to each other. Happens a lot and. This always brings up a difference. So the people from the operational base and the management reports, it is a wonderful chance to consolidate that to bring some kind of breakthrough techniques to come from the management report to the operational basis and vice versa. And I think this is again the big problem of the SSBI approach in general, so you don't think of the synergy effects that you have in different areas and different questions that are coming up. And currently, I don't have a real idea how to deal with that. So consolidating answered questions and reports. I think this is something to providers of SSBI tools have to work on to create transparency and to give more. Let's just stop that sentence because I had an idea to bring it up. So Selona is process mining tools. That's. not BI, but it is closely connected. So in that program and in process mining, you start with something pretty operational. So you start with understanding the process from the data and you based on those, you create new reports that are more on a management level. So it is more an inclusive and in in the common BI and SSBI, this inclusivity is not existing right now. I realized that Power BI is some kind of copying. Some things from that right now with this KPI dashboards in the cloud and so on. So the chance to create new reports based on the data in existing reports. This is something I think can increase the inclusivity of reports and data based on a operational basis to management people's.

49	Inter-viewer	very interesting. Yeah, I don't think they have any more questions. So thank you for taking this interview with us. Sure. Well, we will, of course, send you the final report when we are done with it.
50	Respon-dent 3	That's wonderful. Thank you for that.
51	Inter-viewer	And do you want us to send the transcriptions of this interview when we're done with it as well so you can look through it?
52	Respon-dent 3	If you want to if if it's in your interest.

Appendix E – Interview 4, Transcription

Row	Person	Content
1	Inter-viewer	So let's start with some introductory questions to now some more information about you and your company and your experience with BI and SSBI. So for the records, what's the name of the organization you are working for.
2	Respon-dent 4	Company x.
3	Inter-viewer	And what is your position within the company?
4	Respon-dent 4	I'm junior I.T. application specialist.
5	Inter-viewer	And how much experience do you have from working with business intelligence?
6	Respon-dent 4	Two years here.
7	Inter-viewer	Okay. And your experience with SSBI.
8	Respon-dent 4	Same, We mostly do BI but we also launch self-service BI and I use it to create my own analysis.
9	Inter-viewer	Okay, So you have some pre-knowledge about the concept of SSBI?

10	Respon-dent 4	Meaning. How people are using it?
11	Inter-viewer	Yeah, exactly what it is, how it works?
12	Respon-dent 4	Yeah.
13	Inter-viewer	Perfect. So, from your perspective, how would you define SSBI. What does it mean for you?
14	Respon-dent 4	It's an interactive experience that allows you to discover, understand the data, be visual and visualize it for your needs to help you make business decisions. And help you with your daily activities. Basically, it allows you to access data faster and more efficiently.
15	Inter-viewer	Okay. So if we move on to our core questions, we have divided it into two differ-ent parts. One that is more from like a technical perspective, but it's all related to the end-user. So yeah, we agree with your definition. Letting people be more self-reliant by accessing data and creating reports by themselves. So from your perspecitve, what technical challenges would you say can prevent the user from successfully working with SSBI and becoming more self-reliant?
16	Respon-dent 4	You mean the obstacles that we can face, right?
17	Inter-viewer	Exactly.
18	Respon-dent 4	I think the most important thing is to understand the data, because if you don't understand the data, how it works, how it's connected, it's hard to do any self-ser-vice. So you need to have some basic knowledge about it, because if you don't, then even if you have the best self-service services, you cannot really do any-thing with the data if you don't understand how it works.

19	Inter-viewer	Yeah, exactly. and, how can you reach that point from an end-user perspective, so you can fully understand the data? What the way to go, to understand the data, to learn to understand the data.
20	Respon-dent 4	It's probably even on the developer part. Like you need to ensure that the data is like presented in a way. It's like, how do you know they are connected. That it is user-friendly, that you don't have to really think twice about it. Like it's, you know, package it really user friendly, let's say. And also like maybe train the users how to use it. I would say only keep the parts of data that are relevant and have everything properly connected.
21	Inter-viewer	Okay. So it's in general pre-defined from a development perspective. So everything should be fixed for the end-user when it comes to data. So users don't really need to work with it themselves?
22	Respon-dent 4	You need to work with the data yourself. But like who have, like, you know, the architecture needs to be in place, it needs to be created in a way that it's really easy and user friendly.
23	Inter-viewer	So basically creating the data model and probably the more difficult parts for the end-user so they can just jump in and access and use it.
24	Respon-dent 4	Exactly.
25	Inter-viewer	Okay. So what would you say can be some data-related challenges that can hinder the users in their daily work and may be an issue when users should become more self-reliant?
26	Respon-dent 4	I think that data needs to be standardized and you need to have like, I would say one, not one data source, but not to confuse the user to just have a few tables or a couple of tables that would have to be the same data and they would have to choose between one and the other, like to have it again, clearly structured. And the data needs to be prepared properly beforehand. You need to think about the process.

27	Inter-viewer	Okay. And what is the best way to structure that data so that users understand it? and how can you manage problems related to that?
28	Respon-dent 4	Like. Yeah. Using the proper terms and being user-friendly with naming is one thing, but also having the structure in the tables, standardized. So you have like a logic behind all, like the whole architecture. It's not like every table has a different structure.
29	Inter-viewer	So. Except for naming the data in a proper way. What would you say are the technical requirements that are necessary to make an SSBI environment useful and usable for the end-users?
30	Respon-dent 4	You mean like hardware or?
31	Inter-viewer	It can be everything that you think is important in order to have it as user-friendly as possible for the end-user.
32	Respon-dent 4	But we're also talking about different applications?
33	Inter-viewer	Yeah, it can be Qlik, Tableau, Power BI, everything that tis used as a self-service tool.
34	Respon-dent 4	The program and environments that is used for presenting the data should also be structured in a user-friendly way. with descriptions etc.
35	Inter-viewer	If we move on to organizational issues, that might affect the user. So basically issues that are non-technical and more on an organizational level. So what would you say can be organizational challenges that can hinder the users from becoming more self-reliant when working with SSBI?

36	Respondent 4	Probably like, set the proper accesses and like think where you need to have what access, how to limit the data, what the users should see. Also the licenses. They could test if the environment can stand the amount of users, all that kind of stuff. Managing that and you need to also upkeep the environment to like see if there are no errors if something hasn't failed.
37	Interviewer	Okay. You mentioned limited access to users. Could you, provide some more information on how that could be done?
38	Respondent 4	Yeah. Like you need to have access management in place because like in the model you will have all the data and you don't want everyone to see everything. So you need to keep in mind what part of the data should be accessible to who.
39	Interviewer	So in SSBI, the end-user is supposed to create different reports by themselves. So how can you ensure and trust the quality of reports?
40	Respondent 4	I would go back to something I said before that you need to ensure as the developer that the model is created properly and the data quality beforehand is also checked and it's standardized. If you have those things in place, I think you should be good to go.
41	Interviewer	Okay. So it all goes back to managing the data?
42	Respondent 4	Yeah, I would say that's the most important part. But yes, the end-user needs to be trained beforehand. But if the data behind the model is fine and the connections, basically. But yeah, the whole model.
43	Interviewer	Okay. You mentioned training. What do you think training should look like? And what is the point of training the users you think?
44	Respondent 4	I think like one part is understanding the data, but I think if the end-user has access to the data, he should understand the data, like the data that's in the system. Right. And the training from our part is more like how to use the service, how you can create the reports, maybe something about the relationships between the tables, what fields can be put together. What things you cannot do. How to use it.

		How to save it. Those basic stuff because like people tend to have issues even with small things like filtering.
45	Inter-viewer	So like joining tables etc, the foundation that you need to be able to access and use data is a problem. Have you faced any other organizational and managerial management issues that can affect the user when they are using SSBI?
46	Respon-dent 4	I think it could be some misunderstandings. Like people wouldn't really not be sure about definitions. So that need to be explained somewhere because they could also have some predefined metrics, I believe that you can just drag and drop. So some issues with people that are not sure about everything and how it works.
47	Inter-viewer	Okay. And when issues arise, how, for example, with users not knowing how to perform a specific task, how would you go about solving that?
48	Respon-dent 4	That usually, like with our current reports that are pre-made by us, what we do is we either contact those people by email and they're trying to provide us with some screenshots, or preferably we make a call and we are guiding them through the dashboards and they're like showing us step by step what they're doing, and we're trying to assist them based on what they are showing us and what we see on our side. Yeah, we see their accesses and all this stuff.
49	Inter-viewer	Okay. So basically a lot of support from expert users, helps business users to progress or solve the problems that they might encounter?
50	Respon-dent 4	Yes. Yes, exactly. If we have any issues other than like technical issues, we also often involve people that are like managing this, source systems. So we also in-volve those people, some people from business sometimes. So it is like a joint effort most of the time
51	Inter-viewer	Okay. And just going back to one of your answers before about creating some predefined matrix and I guess measurements and dimensions for users. Did I un-derstand it correctly that it's better to let the expert uses create all this matrix be-fore?

52	Respondent 4	I wouldn't say all but like some basic ones. Definitely. Like we know that what people are looking for, they're probably wanting to see sales or revenue or net income. So those basic ones, I think should be predefined by us because we also know the definition that is used and the standards reporting and the standard approach. But if they want to create some metrics of their own, I think if they know how to, they can do so.
53	Interviewer	Okay. And that's where the problems might be? them trying to join different tables and perform Calculations, understand the different measures in the data, etc.?
54	Respondent 4	Yeah, but there are some people that really know what they are doing and I think they can do it, but definitely it's not for everyone.
55	Interviewer	Okay. We just have some final questions. So what advice would you give to other companies that are at the beginning of the process of implementing and using SSBI? What is the best approach for a company?
56	Respondent 4	I would say, like, first of all, like try to like clean your data, standardize the data, have all like the backend stuff sorted because if the backend stuff is fine, I think we can manage the self-service, but it's the most important to have that all the backend stuff.
57	Interviewer	Okay. So having the architecture in place behind it and laying the foundation?
58	Respondent 4	Yes.
59	Interviewer	Okay. So we don't really have that many more questions. Do you feel that we have to ask something that you feel might be important to bring up?
60	Respondent 4	Not really.

67	Inter-viewer	Do you have any questions for us?
62	Respon-dent 4	No, I hope the thesis goes well, and thank you. Yeah. And you find some people because I know it's hard. I know it's hard to find people.
63	Inter-viewer	Yes it is, and thank you.

Appendix F – Interview 5, Transcription

Row	Person	Content
1	Inter-viewer	All right. So, for how long have you worked with the business intelligence?
2	Re-spon-dent 5	So currently, I would say four years.
3	Inter-viewer	And how much experience you have working with the SSBI?
4	Re-spon-dent 5	Two years.
5	Inter-viewer	OK. And from your side or your perspective, how would you define SSBI? What does it mean for you?
6	Re-spon-dent 5	So to me, it's basically granting the ability to build reporting to the client, to the users, so to some degree, it's like delegating the responsibility for reporting designed for business intelligence design to the hands of the clients. Because, partly the IT team doesn't have as much business experience as the business users, and it creates like a disconnect between what the business needs and what the It team delivers, and the self-service can partly bridge that gap. Because the BI tools is the general mainly power BI now becomes easier and easier to get into. And I think it can be managed by people who don't have much experience. So this sort of lends itself to the opportunity to really put today's tools into the hands of not IT users and to let them start their own reporting.

7	Inter-viewer	OK, yeah, I guess this goes in line with our definition as well. Like just making business users more self-reliant. So we have divided the interviews into different parts for the first one. It's more about like technical issues that users can face when they are working or using a SSBI system. So more hands on technical problems that you might have encountered and seen when you have been working with the power BI, for example. So, what would you say are like the main challenges or barriers that users can experience when they are working with SBBI and that may hinder them from being self-reliant?
8	Re-spon-dent 5	Well, the biggest obstacle to overcome, I think, is creating like a path between users and the raw data, because every company has the data and different structure. Some you know have data warehouses some rely on tabular models, some have even some cloud crop data lakes etc. It's really like a question of the architecture and the way that you enable these business users to connect to this data. Because if you, for example, if you are a bank and you have a large database full of hundreds and hundreds of tables and the data updated every second, it's a for business users to connect directly to this table, it would be more confusing than a value adding because, you know, in like the role tables, you have ideas everywhere or some technical columns, etc. and they just don't understand it. So the first obstacle is to kind of design the proper database architecture for the user to be able to connect to.
9	Inter-viewer	OK, so like the main issue might be that business users want to access certain data and is making sure that it's an easy way for them to do that. Is that correct?
10	Re-spon-dent 5	Partly, I mean, you want them to have the connection, you know, reliable and easy. But the main problem I was talking about is more to make the data understanding as easy for the user as possible. So, you know, you need to have the data documented, you need to basically describe what the data means. So that goes, you know, hand-in-hand with creating some data catalog. And basically, like take the user by the hand and sort of walk them through the data model so that they understand it as much as possible
11	Inter-viewer	OK. So this is like data catalog that's like, common business terms that are used for the data.
12	Re-spon-dent 5	Yeah, exactly.

13	Inter-viewer	OK. So basically explicit describe a certain data really means in that specific business. OK. Is there any other obstacles you can think of from a technical point of view?
14	Re-spon-dent 5	Yeah, well, I mean, you know, in every bigger company, you kind of have that central IT Team, which supports the company through some business intelligence, they send out reports and maintain a warehouse, etc. But since, you know, if you have thousands of employees and hundreds of people who are consuming reports, you cannot avoid a situation where some business user has his own team, which creates their own reporting for specifically for this user. And what that creates is sort of like multiple sources of truth in which one person consumes data that are created in other way than the data that are supplied by the central IT team and this can cause a lot of discrepancies and a lot of inconvenient conversations, let's say. So, good self-service design is also aiming to reduce this problem so that if the user isn't happy with the reporting that they receive from the central team, they will need to go into the data source to the central IT-team uses and build the report on the data source so that the outputs are aligned.
15	Inter-viewer	OK, so just go into the source and get reliant output is like a way for managing multiply source of truth?
16	Re-spon-dent 5	Yeah, your basic goal is to create like one single source of truth, which then branches out to different reporting or different data models.
17	Inter-viewer	OK, perfect. So, would you say that the main technical challenges for users to create their own reports and be self-reliant is related to data and data access?
18	Re-spon-dent 5	Well, yeah, I would say that this is like 65 percent and then the rest is education about the BI tools themselves, you know, so you have to ensure that if you hand over the data that they know what to do with it and if they break something that to some degree they will be able to identify the issues and work themselves them.
19	Inter-viewer	OK, and what can be important to include in that kind of education. So the user understand, for example, power BI?

20	Re-spon-dent 5	Yeah. So there you have like multiple strategies, but what we are going with is building again, this comprehensive data catalog and the education of the users via the workshops, so we are planning to build the set of workshops both live and as well as video recorded for future us, but that's basically it, continuous education, continuous life support.
21	Inter-viewer	OK, so just a follow up question on that. Since different users have different backgrounds, Is this something that needs to be considered in the education or should everyone just get the same education?
22	Re-spon-dent 5	Oh, I would say that this isn't something that we fight with that, you know, if you are an HR person or a finance person that we would sort of personalize this education because this is really focused more towards understanding the tool itself, so the same way that you would teach somebody to use Microsoft Excel is the same if they are going to be working with employee data or with macros etc. Basically, you teach them everything that they need to know. So then they personalize it through their own like data areas.
23	Inter-viewer	OK. And what would you say are the technical requirements that are necessary to have a working and usable SSBI environments for the business users.
24	Re-spon-dent 5	Well, again, like you know, different companies can approach it differently. But the basic technical requirement to me is to have the single source of truth of some data model and then we can talk about like on what layer this source of truth is sitting. But this is to me like the domain requirement really to have a good data model which can support the tens and hundreds of people at the same time.
25	Inter-viewer	OK. So it all goes back to the data model. Just have a clear data model that everyone understands.
26	Re-spon-dent 5	Yeah, because you need to you need to sort of reduce the company and make it make the entire business of the company as understandable as possible for a different users and that's what the data model is.
27	Inter-viewer	So, should different users get different access to data as well then, or should they all have the same access, do you think?

28	Respondent 5	Well, definitely you need to differentiate the accesses. I mean, I guess it depends on the company, but I think that the majority of companies will have some sensitive data, you know, whether it is salaries or even gender, etc, you know, very comprehensive and guidelines for what sort is private and what is not. But you need to basically ensure that each person sees only the slice of the data that they are supposed to see. OK. That is like in Company X, we have this need to know basis. So it's like the guiding principle. So if you need to have this information for your business, you know, continuance, then we need to supply to you, but nothing on top of that.
29	Interviewer	Ok, And do you have any organizational issues that can be a problem when users are working with SSBI?
30	Respondent 5	Well, I mean, the main issue is really this change management aspect of it, because you are basically transferring the entire company from one reporting solution to another and if currently or in the past, if the reporting solution was excel and excel is like the most flexible sort of bullshit tool that is on the market for the last 30 years and you can do anything with excel. And you are now presented with something that is much more constrained in the flexibility. But it's like, hundreds of other advantages for them and for their clients. So the main issue is really the change management aspect and selling the people on using the new platform.
31	Interviewer	OK, so do you want to elaborate on what you include in change management?
32	Respondent 5	Well, yeah, I mean, so we have a dedicated change management team, so their responsibility is really like selling the advantages of Power BI and the reporting that we create and it is all sorts of things like regular emailing to the users and reminding them that some reports has migrated from the old source to the new source and into the new platform, or we have like promotional videos that play on screens in each office that sort of describe what power BI does. We have like a fake use, we have links everywhere that sort of point you to the support team that either can assign new accesses to some reports or collect feedback to the reports and adjust them, etc., etc.
33	Interviewer	So it is everything from stressing like how you can solve a problem using SSBI to trying to change the people that using it or change the culture within the company.

34	Re-spon-dent 5	Exactly, I mean, you basically have people that work on the same chair for 15 or more years, and they are used to some process of their work and you come in and you change it completely, so you need to constantly remind them that this is the new way and that they have options to feedback us on the new way and to sort of be a part of the change. But you need to constantly remind everybody.
35	Inter-viewer	OK, of course a big aspect of BI and the SSBI is creating reports and in this case, letting users create reports by themselves. So what would you say is important to ensure the quality of reports so that they are reliable and of sufficient quality when they are produced by this business users that might be not that used with working with BI.
36	Re-spon-dent 5	So initially these are the workshops. So you need to introduce the people to the to data model that they are using and walk them through and what are the parameters of the model and how it works and what sort of information they can pull from it? You need to have it organized as best as possible so that, so the room for error is minimized, although we will never, never get rid of it. And then the way how we are dealing with it now is that each time the user creates its own report, the central IT team still has an administrative role on the workspace that the report is in, so that we are able to actually check the quality of the report and sort of see if we are not reporting a different revenue across 10 different reports and if we still maintain the single source of truth principle. But you know, you can sort of guarantee by having the single data model. But at the same time, you know, on the report level, you can set up a lot of different filters and a lot of different selection options, etc. which can mess with this. So we just want to make sure that everything is clear and understandable, even for the end users of the SSBI report.
37	Inter-viewer	So you said you have on Central IT Team or something like that that controls the report and compare so the calculations are correct or something like that?
38	Re-spon-dent 5	Well yeah, the calculations come from the central It team so the way that Power BI works is that the you have a repository of all the calculations that are inside the data model, so that we have like a guarantees of these calculations and if there is something to add to these calculations, we are encouraging users to do it through the team so that they don't build the new KPIs inside their own report, but to sort of go through the IT team because then we have really good centralized and again same for everybody.
39	Inter-viewer	OK, so the central IT team is producing and storing the DAX calculations?

40	Re-spon-dent 5	Yes
41	Inter-viewer	A kind of a follow up questions. mean, there will be mistakes sooner or later, I'm guessing from users making mistakes or getting stuck. How do you think these mistakes could be managed? So when a user runs into a problem, how would you best go about managing this?
42	Re-spon-dent 5	Well, we have a platform called ServiceNow for like all IT requests across the across the company and we have links to these, service now tickets, which are sort of like questions to the IT team regarding stuff so if the user is stuck or something they can, contact the team via got this ticket or directly if they know the responsible person, they can contact directly the responsible person. But its important to have this support network because, you know, everybody can get lost, can produce something that looks weird and it is the better case that they catch it themselves. Than to publish it and then have to have the business, you know, catch it.
43	Inter-viewer	All right. Is there any other challenges that you have faced or seen for the end user when they are working with SSBI that we want to highlight.
44	Re-spon-dent 5	Well, the main challenge is really this change management, you know, because again, a lot of people like their own established ways. And even though when we present the new busi-ness intelligence tools, they say they are perfect and I don't need a lot of stuff anymore. But then you check the usage metrics of these reports and you sort of see a different story behind it. And you see that you still are reliant on these old tools because people just use them more out of their habit. So, you know, you can have multiple approaches to this, we haven't gotten there yet, but you can really just turn off the old stuff and then let them scream for a couple of weeks until the rest settles.
45	Inter-viewer	Yeah, but let's say that they create these shadow systems, but like in excel or something that really can turn off. How can you manage that? If they like, OK, I have worked 20 years with Excel, I'm still going to do it.

46	Respondent 5	But I mean, you really have to turn it off. Like in our company, for example, there is a lot of robotics and a lot of teams have sort of created these, you know, robots that click on certain parts of some pages or, you know, the have set up some processes that run automatically and since these are dependent on the old design and old reporting and you basically turn off the subscription to some other, older BI tool then disappears. So, there is just no way around it that this this tool stops working and you need to redesign it, or you need to sort of present the requirements that you have for replicating the functionality of this tool.
47	Interviewer	OK, so basically forcing like the business user to using an SSBI solution instead of these old legacy systems?
48	Respondent 5	Yeah. I mean, you are basically forcing them at the same time, it's an opportunity to standardize the process because these robots are created, you know, it doesn't have to be robots. It can be like even a person doing this, or some other tools. But it comes from like the inefficiency of the old ways of doing stuff. So if you can design some interactive BI tool or dashboard that replaces all of these steps, then it's even better.
49	Interviewer	So creating a better solution, it's like the end goald I guess?
50	Respondent 5	I mean, that's the best case.
51	Interviewer	What advice would you give to other companies that are in the process of implementing and using SSBI that want to start with that?
52	Respondent 5	Yeah, I mean, from my experience, it would be really establishing, good data source and maintaining it as well as possible, so to really create this single source of truth. And format it as well as possible, because if you really want self-service, you will have people that do not have as much BI experience as you would like and you need to to minimize their margin of error. So document everything and have it formatted is as easy as possible. That's the main aspect.

53	Inter-viewer	K. Is there something you feel that we haven't gone through during this interview that we should have asked that you think that we missed?
54	Re-spon-dent 5	I think that the set of questions was well designed and you are focused on like a self-service as a whole. You don't care about which tool is being used. You care about, like the best approaches from a business point of view.
55	Inter-viewer	Yeah, exactly. It doesn't matter if it's power BI, Qlik it's more on the concept itself.

Appendix G – Interview 6, Transcription

Row	Person	Content
1	Inter-viewer	We have the name of your company, but what is your position within the com-pany?
2	Re-spon-dent 6	In fact, I am a manager within analytics and information management team for the company X Consulting in France. I just joined company x one a month ago. So for what we will be discussing, it will be more about my previous experiences than what I have done in company X
3	Inter-viewer	Perfect. And how much experience do you have from working with business intel-ligence?
4	Re-spon-dent 6	Ten years
5	Inter-viewer	And from SSBI?
6	Re-spon-dent 6	I started the first project with that self-service in 2017. But I didn't work all the time on the service projects, so it was among the other projects.
7	Inter-viewer	Okay. And how would you define self service business intelligence? What does it mean for you?

8	Respondent 6	For me, self-service is giving users and mainly business users the ability and the right tool to first explore data from different sources. After that, they can create their own indicators and their own chart and their own visualizations. Uh, so with comparison to the traditional business intelligence, processes, where almost their business came with just their needs and after that, they let the it teams it identify sources, create dashboards and after that showing them the results, maybe they can take some feedback, adapt the the report and dashboards with agile methods. We started more interactions between the IT teams and business. Like a majority of his daily meeting weekly presentation of the report on Dashboard. But self-service BI really gives more power and more freedom for end-users to be more creative and to have more capabilities to create by themselves the analytics that they are needing for their jobs.
9	Interviewer	Perfect. So let's move on to our core questions. We have divided it into two parts. One is about technical user related challenges, and the other one is more about the organizational part. So we are looking into the problems with using SSBI from a user perspective.First, we agree with your definition about SSBI. So what technical challenges or barriers have you experienced when using SSBI that prevents you and other users from successfully working with SSBI tools and becoming more self reliant?
10	Respondent 6	In fact, you are just focusing on the end user site or we need to address challenges as a company to see the risks that can arise with the service. Just to be precise in my answer.
11	Interviewer	Primarily on the end-user side, that's what we're aiming for.
12	Respondent 6	So the first thing is the knowledge and expertize of end users using IT tools. Like to have significant insights, you need some expertize on data on BI tools. So if you have business teams with no knowledge and experience manipulating the business intelligence tools, it will be complex for them to create their own dashboards. This is the first. Second challenge for me is the data quality and the pertinence of the management rules of the indicators. So maybe if I was creating my own dashboard and you are creating your own, if we are on the same team, sometimes we don't define exactly the same way, the same indicator. After that, I'll be creating a report you will be creating a report that will have different results. And if we submit this to the management, they need that to clarify things and to find why we have different figures. Uh, so this is the main challenge. What can I add.

13	Inter-viewer	Maybe we can address, how could you manage problems like that? So, I was going to ask primarily concerning data quality, as you mentioned, because that can be a problem. And how would you go about handling those kinds of problem related to data quality?
14	Re-spon-dent 6	Now we need to have a data governance process. And we need to have. Identify, and well-defined management rules for all the indicators on the company. So even if we will create them by self-service, each one knows the right management rules and the right definition of the KPIs
15	Inter-viewer	And you also mentioned that users lacked the technical IT skills.
16	Re-spon-dent 6	Yeah, training is the key word for them and for example, Company X have some project of accompaniment and training of end users and the benefits of this kind of training versus the typical certifications or training from the editor is the usage of the business data. So they will have their data and they will learn to use the business intelligence tool using their own data. So it will be more, I have to say, more tangible for them.
17	Inter-viewer	Okay. So training should include like real data training, with real business data?
18	Re-spon-dent 6	From the company, yes.
19	Inter-viewer	Have you experienced any data-related challenges that might hinder you as a user from really working in a self-reliant manner?
20	Re-spon-dent 6	In fact, the issue with the self-service, if not well organized among the company, is it's really about the time you are creating your dashboard and the source. For example, If you are using a database and there is some change in historical data, and you did some self-service reports, you extracted the results, and you showed them. But after that, for some reasons, like historical data change, those figures change. And using self-service by like exporting some data or importing Excel files will not show this change in the historical data.

21	Interviewer	Okay, and what are the factors that are important to consider for managing these kinds of problems?
22	Respondent 6	In fact, the end-users or business users need to be aware that the historical data may change. And I think that we need to have a communication way among the company to inform the user that the some historical data changed, so, they need to update their reports.
23	Interviewer	Okay. And what would you say on the technical requirements that are necessary to make SSBI useful/usable for business users, so that they can work in a self-reliant manner?
24	Respondent 6	In fact, the first thing, the choice of the tool, we need to have a tool that really responds to the requirements and needs of end-users. So this is really a very important step. After that, the more technical. As I said, training so that they will be able to create their own dashboards. The company needs to have a secure and reliable architecture to handle all the self-service users because, as you can imagine, maybe we will have a lot of users creating dashboards consuming a lot of the memory of X at the same time. So when we scale in, the number of business users rises. We need to have an architecture that will be able to handle all the requests at the same time.
25	Interviewer	Okay. And if we move on to more of the organizational perspective and look at the problems that are more related to the organizational part when using SSBI, but still problems that can affect the end-user. So from your experience, what organizational challenges have you faced while working with SSBI?
26	Respondent 6	We need to delete silos and really have a common warehouse with all the data needed for self-service. So it would be easier to analyze this data. And for sure, we need to have good relationships and communication between end-users and the IT team because we will be needing the IT team at least for installing the tool, for monitoring the platform when there is an issue with the platform availability or even when end-user faces some verbs are or some really hard technical challenges. So they need the support of IT and business intelligence teams.
27	Interviewer	Okay. So when end-users run into problems that they can't fix on their own, how should they go about managing this?

28	Re-spon-dent 6	As I said before, we need to have support and the help of the IT team. Even if we are on a self-service mode, we always need the IT department to help them and to monitor with the platform.
29	Inter-viewer	Okay. And like a big part of using SSBI is for users to create their own reports. But how could you ensure that the quality of reports that business users produce is reliable and of sufficient quality?
30	Re-spon-dent 6	We need to create a validation process or validation methods even in the business intelligence tools integrate this concept of validation. So, uh, within the organization, you need to have a person or a team that will validate that the content of the reports is created on a self-service mode, are reliable, and the figures are correct.
31	Inter-viewer	Okay. So have some sort of expert team that can approve the reports that are created by business users?
32	Re-spon-dent 6	It will not be an IT expert for me, it's more a business expert that will know that the numbers are correct. That will have the ability to really test and validate the reports. But for me, it's not an IT expert.
33	Inter-viewer	Okay. And from your experience, any other organizational factors that can create additional challenges for the users of SSBI that you might have faced?
34	Re-spon-dent 6	And for the organizational Problems, I don't know. You know, I told you about the ones that I faced.
35	Inter-viewer	Okay. And what factors should the organization consider to create and ensure a functioning SSBI environment or for the end-user?
36	Re-spon-dent 6	In fact, the first thing is to define the strategy. So when you will be implementing the self-service you need to know at which level you will give this opportunity, like for directors, for a manager, for every employee in the company. After that, so after the strategy for using self-service BI, the architecture that will respond to the statute.

37	Inter-viewer	Okay. And you mentioned different levels. Does that imply what access these different users, or access to data these different people will have access to, or could you elaborate a bit more on that, please?
38	Re-spon-dent 6	For sure, we didn't talk about security, but this is also a main challenge. We need to know who has the right to access what. So we need to create levels of security in terms of data and also in terms of objects of your report.
39	Inter-viewer	Okay. Okay. And if we move on to some final questions, what advice would you give to companies that are in the process of starting to use SSBI?
40	Re-spon-dent 6	So, main advises, first thing the right choice of the tool, because if you have a wrong choice and a tool which is not easy to use which is not intuitive, the lack of experience will not encourage the business users to use that service. So this is the first advice. The second advice is, organization, and creating a team between the end-users and IT to really work together and to create a convenient environment within the company, to start self-service and maybe start with a first project that will be important and will have quick results, a quick win as we say. And after that, expand more to the self-service among the content.
41	Inter-viewer	Okay. So just going back to what you said about the quick win. Is that for like sell in SSBI to the users, that it actually works, or what's the reason?
42	Re-spon-dent 6	In fact, I think that the management needs to see that this is a concept that can work, that can have an added value for the company. So they will give a budget and let some time for the end-users to train and to learn how to use self-service.
43	Inter-viewer	Okay, so we don't have any more questions. So if there's something you feel that we haven't gone through, that we should have asked you about SSBI, or something that you want to add in general?

44	Respondent 6	I think that I will talk again about security. So you can't give access to all the data to all your employees, you need, from the beginning define a security model. Another challenge we didn't talk about is the fact of giving freedom for business units to create a self-service environment, doesn't mean that each business unit will have the choice of the tool, will install in some servers a tool and start to create self-service. Otherwise, we will end up with an uncontrolled environment and many installations of tools and many reports coming from every-where. We need more governance, and we need to control the number of deployments and the use of of these tools.
45	Interviewer	So, you kind of have to find the right balance between freedom, but also governance and security?
46	Respondent 6	Yes, that's it.
47	Interviewer	Okay. And how can the governance look like to avoid this loss of control? What is good governance?
48	Respondent 6	In terms of number of deployments, as I told you, the IT team will be responsible for installing the tools and monitoring them. So if we have the IT team, they will validate and advise the business units on the choice of the tool and the way that it will be installed. We will have this governance team that will manage all the deployment.
49	Interviewer	Okay. And I think that's everything. Do you have any questions for us?
50	Respondent 6	No, for me, no question.
51	Interviewer	Okay. Do you want us to send you the transcriptions after we have transcribed it?

52	Re-spon-dent 6	Yes please.

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