

5-15-2019

DATA ACCESS AND DATA QUALITY CHALLENGES OF SELF-SERVICE BUSINESS INTELLIGENCE

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Recommended Citation

Lennerholt, Christian and van Laere, Joeri, (2019). "DATA ACCESS AND DATA QUALITY CHALLENGES OF SELF-SERVICE BUSINESS INTELLIGENCE". In Proceedings of the 27th European Conference on Information Systems (ECIS), Stockholm & Uppsala, Sweden, June 8-14, 2019. ISBN 978-1-7336325-0-8 Research Papers.
https://aisel.aisnet.org/ecis2019_rp/37

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DATA ACCESS AND DATA QUALITY CHALLENGES OF SELF-SERVICE BUSINESS INTELLIGENCE

Research paper

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Abstract

Self-service Business Intelligence (SSBI) is an upcoming trend that allows non-technical casual users to use BI in a self-reliant manner without the support of technical power users. Many organisations struggle to utilize the potential of SSBI and experience data-related and user-related SSBI implementations challenges. This study aimed at exploring data-related SSBI challenges by conducting and analysing a total of 30 qualitative interviews with 5 BI consultants and 10 customer representatives involved in 2 SSBI implementation project teams. Analysis of the interviews revealed five challenges related to “Access and use of data” and four challenges related to “Data quality” that differ considerably from SSBI challenges commonly discussed in literature. Awareness of these challenges can help practitioners to avoid unnecessary obstacles when implementing and using SSBI. They can also guide SSBI researchers to simplify the implementation process of SSBI.

Keywords: Self-Service Business Intelligence, Challenges, Data Access, Data Quality.

1 Introduction

Organisations have implemented traditional business intelligence (BI) for decades because it increases their production, innovation and decision-making (Foley and Guillemette, 2010; Kabakchieva et al., 2013). Traditional BI is a collection of technologies and software that uses data as the solid foundation for analysis and decision-making at all levels within an organisation. But not all users have the technical competence to use a BI system. Therefore, there is a request and response relationship between users. In traditional BI, decision-makers issue requests to technical power users, who create standardised reports that visualise data that are needed for analysis and decision-making (Alpar and Schulz, 2016).

Today, there is a fast growing demand for data and analytics, which causes problems for a traditional BI system serving all users. Power users are no longer able to respond to all requests on time (Imhoff and White, 2011; Alpar and Schulz, 2016). The suggested approach to address this bottleneck is self-service BI (SSBI), since it enables all users to be more self-reliant and less dependent on power users (Imhoff and White, 2011; Kabakchieva et al., 2013). With SSBI, users are allowed to access data and conduct analyses for decision making by themselves, without requesting support from the IT department and power users. The main benefit of implementing SSBI is the flexibility it brings all users, which enables decision-making on time. Reports that could take months to deliver can now be produced on the fly (Imhoff and White, 2011; Alpar and Schulz, 2016).

Even though there is great interest in SSBI, the implementation rate is rather low (LogiAnalytics, 2015; Svahn et al., 2017; Svahn and Ax, 2018). In fact, implementing SSBI is not as easy as expected (Eckerson, 2012; Kabakchieva et al., 2013; Weber, 2013; LogiAnalytics, 2015; Stodder, 2015; Alpar and Schulz, 2016).

While traditional BI has been well researched, for instance by identifying challenges and critical success factors for BI implementation, our understanding how to support the implementation of SSBI is limited (Hawking and Sellitto, 2010; Scholz et al., 2010; Lahrmann et al., 2011; Olszak and Ziemba, 2012; Popovič et al., 2012; Ramakrishnan et al., 2012). Several authors indicate that the access and use of data is one of the major challenges to overcome when implementing and using SSBI (Imhoff and White, 2011; Weber, 2013; Meyers, 2014; LogiAnalytics, 2015; Stodder, 2015; Schlesinger and Rahman, 2016). Data is a major component in a traditional BI system and needs to be accessible to all users when implementing SSBI. However, there is no common definition in literature what data access actually means. Although data access is a common challenge in traditional BI (Hawking and Sellitto, 2010) as well as SSBI (Lennerholt et al., 2018), it is likely that SSBI data access challenges faced by casual users with limited technical skills, are rather different from traditional BI data access challenges faced by power users with outstanding technical skills. In addition, few studies exist that in depth discuss how practitioners interpret data related SSBI challenges. In response, a case study has been conducted in this research to identify and explore SSBI challenges for accessing and using data. The purpose is to increase awareness for an insight in the nature of data related SSBI challenges so organisations become better prepared to manage them.

2 Background

There are different user groups of BI based on their interaction with BI and decision-making (Hostmann, 2007; Sulaiman et al., 2013; Alpar and Schulz, 2016). User groups are for example information consumers, analysts or BI specialists. Alpar and Schulz (2016) and Sulaiman et al. (2013) label analysts and BI specialists as power users. Power users have the ability and technical skills to set up and run BI efficiently, involving the access and use of data, visualising data for decision-making and analysing its content. Information consumers consist of operational employees, managers and executives who are defined casual users as opposed to power users since they do not have similar technical BI skills. Instead, casual users often use pre-defined reports or dashboards when making decisions (Sulaiman et al., 2013; Alpar and Schulz, 2016).

The aim of implementing SSBI is to achieve a BI system that offers the ability for casual users to use BI without support from power users. Casual users should be able to access and use data, use pre-defined reports or create new reports by themselves and analyse their content when making decisions more freely compared to traditional BI. Therefore, SSBI users will be more self-reliant and less dependent on power users. In this paper, SSBI is defined as: *“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). Even though SSBI offers many benefits compared to traditional BI, implementing and using it is not as easy as expected (Eckerson, 2012; Kabakchieva et al., 2013; Weber, 2013; LogiAnalytics, 2015; Stodder, 2015; Alpar and Schulz, 2016).

There is relatively limited research literature available about SSBI. There are some state of the art SSBI reports that include challenges associated with implementation and usage of SSBI (Imhoff and White, 2011; Eckerson, 2012; LogiAnalytics, 2015). Accessing and using data is frequently mentioned as a challenge to manage in order to make SSBI efficient. Eckerson (2012) argues that implementing SSBI is more complex than it looks. The state of the art reports discuss SSBI implementation challenges only briefly amongst many other issues. In contrast, Lennerholt et al. (2018) have recently performed a literature review exclusively aiming at identifying known SSBI implementation challenges. Their review was based on 21 peer-reviewed articles published in journals, conferences, state of the art or best practice reports and textbooks. Their findings list six challenges related to *“Access and use of data”*:

1. Make data sources easy to access and use: If users are supposed to be self-reliant when using SSBI, the available data sources must be easily accessible. The first challenge indicates that the process to access and use data must be simplified (LogiAnalytics, 2015; Stodder, 2015).
2. Identify data selection criteria: It is important to ensure that data has sufficient quality when analysing content for decision-making. The challenge is to determine the right quality criteria when selecting and accessing data, especially for data from external sources (Weber, 2013; Schlesinger and Rahman, 2016).
3. Use correct data queries: To access and use multiple data sources requires the correct join of the data. Even the simplest mistake when creating queries has a negative impact on the analysis when making decisions. Therefore, the challenge is to make sure that correct data queries are used, especially when casual users are involved (Weber, 2013; Schlesinger and Rahman, 2016).
4. Control of data integrity, security and distribution: Spreadsheets are the primarily BI tool used today. This can entail a lack of control when distributing data with regard to integrity and security. The challenge is to make sure that data is properly inserted into the data warehouse. Otherwise, analysis and decision-making may suffer from inconsistent data in terms of security and quality (LogiAnalytics, 2015; Alpar and Schulz, 2016).
5. Define policies for data management and data governance: Organisation must define how data can be available and accessible as desired. Policies for data management and governance must be defined to understand the importance and value of the data. There should not exist two different versions of a single truth when using SSBI (Meyers, 2014; Stodder, 2015).
6. Prepare data for visual analytics: The last challenges focuses on users and their ability to select and use data as desired. The aim is to use technology that is easy to operate and that visualises content without help from power users (Stodder, 2015; Johannessen and Fuglseth, 2016).

One future research suggestion of Lennerholt et al. (2018) is to conduct a qualitative case study that explores practitioner perspectives on SSBI challenges, to further validate and extend the identified literature challenges. This research follows this proposed avenue and confronts the SSBI challenges from literature listed above with empirical results gained from 30 interviews.

3 Research method and analysis

Case study research is considered an appropriate method when conducting research within the interpretivist approach (Braa and Vidgen, 1999; Oates, 2006). The main strength and purpose of conducting case study research is to achieve in-depth understanding of a phenomenon by answering how and why questions (Braa and Vidgen, 1999; Oates, 2006; Pan and Tan, 2011; Yin, 2013). The aim of this paper is to collect detailed and perceived experiences of challenges in accessing and using data when implementing SSBI. Therefore, case study research is considered an appropriate research method. An important step when designing case study research, which affects the outcome, is to choose cases wisely (Leonard-Barton, 1990; Pan and Tan, 2011). It is important to choose a suitable case that is able to make significant contribution. Choosing a single case or multiple cases may also affect the outcome in terms of generalizability and biases (Leonard-Barton, 1990). Choosing multiple cases supports validity of the result while avoiding potential biases (Leonard-Barton, 1990; Pan and Tan, 2011).

The chosen research method in this paper is case study research in one BI consultancy firm and two of their main customers. These customers have strong ongoing relationships with the BI consultancy firm focusing on supporting their implementation of SSBI. The companies are medium sized to large, have used BI for a very long time, and are now heavily involved in scaling up their usage of self-service BI. They were chosen since they are two of the most experienced and heavily involved organisations with SSBI in Sweden. Both organisations do not have any previous relations to the authors and they participated in this research voluntarily.

The style of the chosen research method is defined as a soft case that belongs to the understanding part of the three headed framework according to Braa and Vidgen (1999). The consulting firm was founded in 2006, focuses on BI and decision-making and has more than 200 customers. They have experience of supporting customers to implement SSBI and manage the associated challenges. They are considered a typical instance according to (Oates, 2006) since they have developed understanding from many SSBI implementation projects in a large variety of organisations. The other two organisations are included since they are current customers who are in different phases with regard to implementing SSBI. Both customers are organisations within the same area of expertise. One of them has implemented and used SSBI for 4-5 years. They are considered one of the most experienced SSBI adopters and have obtained many benefits compared to what other organisations have managed to achieve today. The other customer is a newcomer to SSBI and has started its implementation of SSBI 18 months ago. They are in the early stages of facing and planning to manage the challenges associated with implementing and using SSBI.

The data collection consists of interviewing experts who have experiences implementing SSBI. By involving consultants and their customers, experienced SSBI users and newcomers, the study aims at collecting a variety of perspectives and more in depth insight in what kind of data-related SSBI challenges can arise.

3.1 Research process

The research process of this paper is mainly inspired by Braa and Vidgen (1999) and Pan and Tan (2011), even though there are other valuable contributions of how to conduct case study research (Eisenhardt, 1989; Walsham, 1995; Oates, 2006; Yin, 2013). Pan and Tan (2011) propose detailed instructions that lower the barrier to achieve a workable approach. The chosen research process is inspired by Pan and Tan (2011) and consists of the following steps:

- 1) Existing Theory: The research process starts by conducting a literature review that identifies the challenges associated with accessing and using data when implementing SSBI, which have been discussed previously in chapter 2.
- 2) Collecting and organising data: The focus of the second step is to collect empirical data that fulfils the aim of this research. The data collection process is finished once saturation is reached, i.e. once there is a sufficient amount of data and when new interviews do not collect any new data that is relevant to the research aim. All collected data is transcribed.
- 3) Confirming and validating data: The third step focuses on to confirm and validate the gathered data by contacting the respondents for a follow-up interview. The idea is to confirm that the transcripts are valid and that nothing is lost or misinterpreted. The coding process begins once all respondents have confirmed and validated the transcript.
- 4) Coding process: Open, axial and selective coding was used iteratively to analyse the collected data (Wolfswinkel et al., 2013), see chapter 3.3 for more details.
- 5) Validate the results: The identified categories and related challenges are validated by the respondents with another follow-up interview. The focus was to present and discuss the result to validate its content. Nothing new was added during this process since all respondents agreed on the result, even though not all respondents were aware of all challenges. Instead of opposing to the result, they found the final challenges, which partly were based on challenges identified by other respondents, trustworthy and reasonable.

3.2 Collecting data

There are several data collection techniques when conducting case study research: interviews, observation, questionnaires and analysing documents (Carroll and Swatman, 2000; Oates, 2006; Pan and

Tan, 2011). Semi-structured interviews are the mainly chosen data collection strategy for this research since the focus is to identify in-depth experiences regarding accessing and using data when implementing and using SSBI. As the interview respondents have different backgrounds and experiences, semi-structured interviews are more appropriate compared to predefined questions or unstructured interviews. Questions within semi-structured interviews are allowed to change depending on the answers. In this case, an in-depth understanding can be achieved since questions can be guided to thoroughly identify answers to the research question central in this study, independent on the background of the respondent. Semi-structured interviews also allow interrupting if answers from the respondent do not relate to the aim.

The case study was conducted during spring and autumn in 2017 and consisted of 30 semi-structured interviews with all consultants and responsible employees that participated in the implementation of SSBI at two customers of the BI consultancy firm. The SSBI project groups consisted of 5 employees from the respective customer and involved five BI consultants, resulting in 15 respondents. The customer representatives ranged from vice president, consultants, analysts, architects, SSBI evangelists, BI developers, business improvement manager, strategists, business controllers, IT specialists, managers to end-users. The respondents may belong to more than one role since they have many responsibilities within their organisation. The respondents from the SSBI project teams also speak for other employees with similar roles and backgrounds. On average, the respondents have between 5-10 years of experience of working with implementation and usage of BI and SSBI within the organisation. All respondents are considered experts with strong focus towards BI and SSBI.

Each respondent participated in an initial contact, a main interview and a follow-up interview. The focus of the initial contact some weeks before the interview was to inform and prepare the respondent for the main interview. The focus of the main interview was to identify challenges related to the aim of the study. The follow up interview (i.e. the data validation interview) focused on including details that were missed or changed during the main interview. The main interview was transcribed and validated by the respondent before entering the qualitative analysis process, which is described in section 3.3. In average, each main and follow-up interview lasted 1 hour. Data collection and analysis aimed for saturation: when no more challenges were identified, the data collection was considered complete.

3.3 Qualitative analysis

The qualitative analysis process applied open, axial and selective coding (Wolfswinkel et al., 2013). The coding process starts to inductively identify a set of main categories and sub-categories that visualise how the collected data portrays the identified challenges, which is defined as theme analysis according to Oates (2006).

The focus is to have an open mind when identifying categories that represent the collected data and to avoid that the previously mentioned challenges from Lennerholt et al. (2018) affect or guide the identification of categories and related challenges. Different segments of text are grouped into categories that represent the related challenges within the category, which is an iterative process. The aim of the open coding was to iteratively identify a set of main categories that can represent all identified challenges within the collected data.

Axial coding found sub-categories that relate to a main category. The purpose with axial coding is to achieve a clarified structure where each identified challenge belongs to a sub-category and main-category. Last, selective coding was used to iteratively go back and forth between all transcripts in order to integrate and refine the identified categories. When all transcripts have been analysed and no new challenges, sub-categories or main-categories were identified, the qualitative analysis process of the collected data was considered complete (Wolfswinkel et al., 2013). The result of the case study is listed in chapter 4. The findings from the case study consist of 9 challenges that are grouped into two main categories.

Finally, the last step was to compare the categories and related challenges mentioned in Lennerholt et al. (2018). Chapter 5 discusses the results of the case study and how it relates to the categories and challenges mentioned in Lennerholt et al. (2018).

4 Results

Table 1 summarizes the results of the case study by listing nine data related SSBI challenges and showing which of the three organisations experienced each of them.

	Consulting organisation	Experienced SSBI adopter	SSBI newcomer
<i>Access and use of data</i>			
#1.1 Not possible to gain access to data	x	x	x
#1.2: Multiple data sources in different environments		x	x
#1.3: Unknown data sources		x	
#1.4: Takes long time to request access		x	x
#1.5: Difficult to make data available	x	x	x
<i>Data quality</i>			
#2.1: Standard reports include faulty data	x	x	
#2.2: Difficult to change faulty data	x	x	
#2.3: No common definition of data	x	x	x
#2.4: No awareness of using faulty data	x	x	x

Table 1. SSBI and data challenges

The remainder of section 4 presents the identified challenges. Subsection 4.1 presents the main categories: accessing and using data and data quality. Subsection 4.2 and 4.3 describe the challenges within each category. Chapter 5 discusses the result and how the identified challenges relate to the challenges from the literature described in chapter 2.

4.1 Main categories of SSBI and data challenges

The first step of conducting a qualitative analysis approach was to identify a set of main categories and sub-categories that portrays the data challenges of SSBI (Wolfswinkel et al., 2013). Open, axial and selective coding was used iteratively to analyse the interview transcripts (Wolfswinkel et al., 2013).

The result from of the coding process identified two main categories: “*Access and Use of Data*” and “*Data Quality*”. Five challenges were identified within access and use of data and four challenges relate to data quality.

4.2 Access and use of data

This section describes the challenges related to the main category: *Access and use of Data*.

Challenge #1.1: Not possible to gain access to data

A major component to run SSBI is to have accessible data that is available to all users (Stodder, 2015; Schlesinger and Rahman, 2016). Otherwise, it is not possible to perform self-service tasks including needed data sources that are used for analysis and decision-making. However, most of the interviews identified that accessing data is a major challenge to manage when implementing SSBI. One respondent says: “*There is a major challenge to access data. It is always an obstacle to overcome and is a di-*

rect bottleneck when using SSBI". Users who are in need of restricted data sources need to ask for permission, which is time-consuming process. It is not obvious to know whom to contact in order to gain access to data. Another respondent says: "*How do I get access to data? Whom do I contact? There is no formal guideline or process that describes how to gain access to data. Instead, I start to call around and ask people*". If data is not accessible to all users when implementing SSBI, the time-consuming process is to wait for gaining access to data instead of waiting for a standard report, which goes in line with the observation of another respondent that wants to use SSBI: "*All of a sudden, I cannot access data that I need. It can take anything from 1 week to 3 months to get the data that I need, even though I am a project leader. It is a very difficult and frustrated process to access needed data*". Therefore, a major challenge to overcome when implementing SSBI is to make data accessible to the users who need it.

Challenge #1.2: Multiple data sources in different environments

Access to different internal and external data sources are vital in order to make SSBI run efficiently (Imhoff and White, 2011; Alpar and Schulz, 2016). Sometimes, many different data sources within different technical environments can cause issues when trying to access and use them. It is not as easy as expected to combine and use data efficiently. Sometimes it requires technical skills that the SSBI user does not have. One of the benefits of using SSBI is to enable users to be more self-reliant and less dependent on the IT organisation (Imhoff and White, 2011). But if the process to access and use multiple data sources requires technical skills that only power users possesses, the benefit of SSBI breaks. Three respondents acknowledge this challenge, for example one of them states: "*It is not easy to access and use multiple data sources. It is not like we have a single main data source. Instead, we have about 5-10 different data warehouses*". If casual users should run SSBI and gain access to the data as desired, the process of using multiple data sources should not require difficult technical skills, which only the power users possesses. Another respondent agrees and says: "*One of the largest challenge to manage is to enable users to connect to all different main data sources and different sources that exist in many different technical environments*". Therefore, organisations need to simplify the process to access and use multiple data-sources within different technical environments.

Challenge #1.3: Unknown data sources

A benefit of traditional BI is to use data for analysis and decision-making. Power users are responsible for including the right data when creating standardised reports that are used for analysis and decision-making. When implementing SSBI, all users have the responsibility to use the right data when making decisions (Kabakchieva et al., 2013; Alpar and Schulz, 2016). However, not all users are aware of the data sources that are available. Four respondents identified that data sources are unknown for users of SSBI, which goes in line with one of their quotes: "*They are not aware of all data sources and that is a problem. Sometimes users forget the data sources. It is not transparent what data actually is available*". This is a challenge to overcome when implementing SSBI. If all users, even casual users who do not have technical skills, should be able to access and use data in a self-reliant manner, they need to understand what data sources that are available. Otherwise, the outcomes of the decisions made are not optimal.

Challenge #1.4: Takes long time to request access

Even if you find available data, it takes long time to request access to it. A respondent says: "*I must request access for every data source that I need*". This hinders efficient SSBI implementations were users could use desired data on the fly. Another respondent says: "*When I request access to data, it can take between 4 hours to two weeks to get an answer*". There is a huge difference to access data on the fly and wait at least 4 hours. Therefore, an important challenge to manage is to plan for what data that should be available to a specific user.

Challenge #1.5: Difficult to make data available

There are reasons why data is not freely available to all users. User restrictions limit the access to data since it includes sensitive details that not all users are allowed to view. Therefore, there is a need for a

common structure that defines all data. A respondent says: *“The IT department cannot open up data to be available and accessible to all users because business users do not know what the data means. We need the IT department as a foundation to set up and maintain some common definition”*. A challenge to overcome when implementing and using SSBI is to define data and make it to be available to the right users. Today, organisations are not aware of what data that should be available for specific users when SSBI is implemented and used.

4.3 Data quality

This section describes the challenges related to the main category: *Data Quality*.

Challenge #2.1: Standard reports include faulty data

Standard reports are commonly used when implementing and using SSBI. Often, it is the main foundation when bringing SSBI to all users within the organisation (Imhoff and White, 2011; LogiAnalytics, 2015). Since more users are working with BI it is important that data quality is achieved. Otherwise, more users will make faulty decision, which goes in line with the following respondent quotation: *“It is common that users make decision based on faulty data. Everything will have some errors, but what level of quality has been decided? Some users only need to see trends while others look for absolute numbers. Then we have different data quality requirements”*. It is not obvious what level of data quality is needed when implementing SSBI. Another respondent says: *“We have routines and processes to manage data quality of traditional BI. But for SSBI, data quality is more in the hands of the user himself”*. Since SSBI targets all users, even the casual user within limited technical skills, it is important to achieve a sufficient level of data quality to increase the possibility to make adequate decisions. Another respondent says: *“If someone creates a report and uses data in another new report, the problem will accumulate”*, especially when another respondent adds: *“It is difficult for end-users to discover errors”*. Therefore, it is important to achieve the right level of data quality within the SSBI standard reports.

Challenge #2.2: Difficult to change faulty data

The right level of data quality is important within all BI systems (Yeoh and Koronios, 2010). Otherwise, the point of using BI may be questioned, which includes SSBI as well. However, it is not easy to change faulty data when identified, which is echoed by a respondent: *“When I find faulty data I am not allowed to change it. The IT department and data warehouse still owns the data”*. Another respondent says: *“Even though you are a senior self-service BI developer within the business side, there is not much you can do to affect low quality data”*. It is not easy to use SSBI efficiently when the IT department is the only one who fixes faulty data. Therefore, to implement and use SSBI efficiently requires that faulty data can be changed more easily.

Challenge #2.3: No common definition of data

When gathering data from many different sources, it is important to understand what the data means. Sometimes, data means the same thing but is named differently within different sources, which causes problems using SSBI. This goes in line with many responses. Here is an example: *“What customer information is the correct one? Where are you going to get it from? It is sort of unclear”*. Another respondent echoes the same thing: *“We have not had discussions in the same manner as we did when creating traditional BI. Now, it can be difficult to start all over when creating things that have different logics in different places. There is not a single digit that match anybody else’s digit out in the organisation”*. If users have a hard time understanding the definition of data and results differ from each other, it may have a negative impact on the trustworthiness of using SSBI. A third respondent says: *“This messes things up and produces a lowered trust in data. If I am able to get the data from the place I have done for many years without problems, why do I have to go to the new place? I am not sure that it works”*. Using data must work without problems. A common definition of using data, including different data sources, is important to manage when implementing and using SSBI.

Challenge #2.4: No awareness of using faulty data

Users of SSBI are not always aware of the data they use when making decisions, which may cause problems. A respondent says: “Sometimes, important digits are missing when decisions are made”. To be aware of the underlying data is a challenge to manage. This goes in line with many respondents. Another quote says: “There are employees that do not have a clue about the deal and its decisions. They can do any number of crazy things. SSBI makes it easier to make them. You get fooled by it”. Even though users want to use SSBI to create visualisations for analysis and decision-making, organisations need to manage the related challenge of users who have no awareness of using faulty data. Otherwise, more low quality decisions will be made.

5 Discussion

The focus with this case study has been to explore the challenges associated with accessing and using data when implementing and using SSBI. Two main categories of challenges were identified: “Access and use of data” and “Data quality”. In this section, the results are discussed and compared with previously mentioned challenges in the literature from Lennerholt et al. (2018).

To our surprise, results from the case study poorly matched previously identified challenges in literature. One reason is most likely that SSBI is a relatively new research area and that related literature is highly limited as of yet. Therefore, all findings from our case study are new contributions that can be added to the existing body of knowledge of challenges associated with implementing and using SSBI. It is noteworthy though that some challenges are closely related, with some minor different perspectives, which are worth discussing in this chapter. For comparison, table 2 confronts our case study results with previous literature.

Data related SSBI challenges Case Study	Data related SSBI challenges in Literature
<i>Access and use of data</i>	<i>Access and use of data</i>
#1.1 Not possible to gain access to data	1. Make data sources easy to access and use
#1.2: Multiple data sources in different environments	2. Identify data selection criteria
#1.3: Unknown data sources	3. Use correct queries
#1.4: Takes long time to request access	4. Control of data integrity, security and distribution
#1.5: Difficult to make data available	5. Define policies for data management and data governance
<i>Data quality</i>	6. Prepare data for visual analytics
#2.1: Standard reports include faulty data	
#2.2: Difficult to change faulty data	
#2.3: No common definition of data	
#2.4: No awareness of using faulty data	

Table 2. Data related SSBI challenges in Case Study versus Literature

Our first identified challenge: “Not possible to gain access to data” within the category: “Access and use of data” is closely related to the previously mentioned challenge “Make data sources easy to access and use” and “Define policies for data management and data governance” in Lennerholt et al. (2018). Here, we argue that the case study findings highlight the challenges even more since it is not even possible to gain access to data when needed due to different restrictions within the organisation. The previously mentioned challenge: “Make data sources easy to access and use” in Lennerholt et al. (2018) highlights the challenge to deal with an increasing large volume of data, which is not the same. Still there is something in common, since users should be able to use data when desired without wait-

ing for a power user to serve, which goes in line with the challenge “*Define policies for data management and data governance*” in Lennerholt et al. (2018). The difference here is that literature focuses more on working with inconsistent data and that data management and data governance is the solution while the case study findings focus more the possibility to actually access the data for usage.

The main category: “*Data quality*” is closely related to the challenge: “*Identify data selection criteria*” mentioned in the literature (Lennerholt et al., 2018). The previous understanding highlights that organisations need to be aware of the quality of the data when selecting data, especially external data. This goes in line with the case study category of “*Data quality*”. However, this case study reveals four challenges of data quality that are missing in SSBI literature. Our findings focus more on how faulty data is used when making decisions and how it is difficult to overcome since it is problematic to change faulty data. The result also indicates that users are not aware of using faulty data, which is not mentioned in the literature.

Whereas the research set-up of including newcomers and experienced SSBI adopters solely aimed at increasing variety, and did not have a comparative purpose, it is of course tempting to look for differences in the answers between the three organisations. Although not all respondents/organisations mentioned all challenges themselves, they confirmed in the third results-validating interview that all challenges were relevant for their own organisation, and they were less aware of the ones they had not mentioned themselves. When an organisation is not aware of challenges, the SSBI implementation process becomes of course even more difficult. Table 2 could generate a hypothesis that experienced SSBI adopters are more aware than SSBI newcomers, but this would require more research with the primary objective to compare more and less experienced SSBI adopters.

6 Conclusion

The aim of this research was to identify the challenges associated with accessing and using data when implementing and using SSBI. The results from the case study presents nine challenges divided into two categories, namely *Accessing and using data* and *Data quality*. To enable all users, even non-technical casual users, to become self-reliant when using BI is not as easy as expected. The results show how casual users are not able to freely use data as desired since they are not able to gain access to data. There is no formal guideline or process that shows how to do that. It becomes even more problematic when data is needed from multiple sources and from different environments. It requires technical skills which casual users are lacking, which breaks the benefit of SSBI. The result also shows that users are unaware of the available data sources when accessing and using SSBI. When important data is omitted due to unawareness when using SSBI, decision-making is affected in a negative way. Another challenge indicates that it is difficult to make data available since there is no common definition what the data mean and consists of. It is difficult to understand what data is relevant for a specific user, when all users are allowed to access data as desired when using SSBI.

Data quality is well-researched area within traditional BI. Inconsistent and faulty data has existed for decades when making decisions. The result in this research show that users have no or limited awareness of using reports that consists of faulty data. Even though faults are identified, it is difficult for a casual user to correct data. It often requires support from power users, which SSBI tries to minimize. Since SSBI enables all users to become self-reliant, they must be able to access and use data as desired and also change faulty data when discovered. The result shows that this process is problematic.

Based on our findings, we conclude that implementing and using SSBI is not an easy process. If users are supposed to be self-reliant and use BI efficiently, the foundation of data needs to be in order. Users must be able to access and use data as desired without support from power users. Even though we list challenges of implementing and using SSBI, the benefits of SSBI is worth fighting for. But, organisations must be better prepared and aware of the challenges that hinder an efficient SSBI implementation. The challenges presented in this paper should increase the awareness of the related challenges of data when implementing and using SSBI.

6.1 Implications for practitioners

Implementing SSBI is not simply a new software installation that offers all promised benefits of SSBI directly. Instead, organisations need to reflect on how SSBI affects their organisation and understand how users are supposed to use SSBI in a smooth and effective way. Therefore, the first step of importance is to understand the challenges associated with implementing and using SSBI. Practitioners who are aware SSBI challenges can better prepare and plan for their journey ahead. It is likely that newcomers to SSBI have limited awareness of the SSBI challenges when starting their journey towards SSBI. Unprepared newcomers will have a more frustrated and costly process to implement SSBI, dealing with hidden and surprising challenges. The result of the case study increases the body of knowledge, which supports both practitioners and researchers to facilitate the implementation of SSBI. The purpose of this paper is to increase the awareness for data related SSBI challenges in order to enable organisations to prepare and manage these.

6.2 Theoretical contribution

Current research on challenges associated to SSBI implementation is relatively limited compared to research on challenges for traditional BI implementation. Traditional BI challenges may not be equally relevant for SSBI. Even if the challenges are similar in name (i.e. data access), the challenges may be different in nature for SSBI compared to BI. For example, SSBI data access challenges for casual users may be different compared traditional BI data access challenges for more technically skilled power users. As argued in section 5, the main theoretical contribution of this case study has been to reveal new data related SSBI challenges that are unique in comparison with data related SSBI challenges discussed in SSBI literature thus far. Revealing more such challenges, specific for the context of SSBI, is a necessary step towards the development of theories for SSBI implementation.

6.3 Future Research

Whereas this study focused on identifying data related SSBI challenges, many of the respondents mentioned other areas of challenges that need to be managed in order to run SSBI even more efficiently. Therefore, one option for further research is to conduct qualitative case studies that seek to identify other areas of challenges that affect the implementation and usage of SSBI. Another option that is interesting to investigate is to explore what kind of challenges exist for newcomers compared to more experienced SSBI users. This knowledge might guide the process to implement and use SSBI over time since newcomers may manage different challenges compared to more experienced SSBI users. A third option is to develop recommendations for how to manage these challenges, which could increase the implementation rate of SSBI even more.

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