Research Article

Business Intelligence Challenges: Case Studies of Saudi General Agencies

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Abstract

The aim is to research organizations that want to implement self-service business intelligence, to discuss and validate the ten predefined challenges and explain their own challenges. Three Saudi sectors with business intelligence at different maturity levels were selected for qualitative case studies to examine the challenges they faced. As a result, the researchers in this paper proved only two challenges out of ten. The major challenges are summarized by the absence of data policy, data ownership, a lack of support from information technology, the absence of data regulations in Saudi Arabia, and a lack of awareness about the value of business intelligence. Organizations should identify data governance across the entire organization and get support from top management, which would help distinguish between the roles of Information technology and business as well.

Keywords: Business Intelligence challenges, BI, Self-Service BI, SSBI.

Introduction

Business intelligence (BI) is defined as "a set of methods, technologies and associated tools to improve business decision-making" (Delen et al., 2018), starting with collecting data and supporting decision making based on the results. Most companies need to make time-critical decisions, and it is important to think about time when a department needs to access data. As a result, self-service business intelligence (SSBI) provides a solution to such needs by encouraging casual users to create reports and custom analyses without a BI specialist (Passlick et al., 2017).

BI faces two main factors that affect its work methods. The first factor involves the generation of new data that are different

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from traditional data in terms of structure, growth, and volume. The second factor is the scope of BI, which has been extended and not only covers strategic needs—it is also used for operational tasks, which increases the need to apply BI. Moreover, requests for changes have increased, and BI specialists or users experienced in BI (also known as power users) have come to an impasse due to these frequent change requests, while inexperienced users (also known as casual users) need to make critical business decisions without utilizing all available data. Therefore, to respond to these needs and improve the ways of working, SSBI should be implemented rather than traditional BI (Alpar and Schulz, 2016).

In traditional BI, power users serve casual users by collecting and analyzing data to accomplish the reports requested by causal users (Lennerholt et al., 2018), while the new approach of SSBI encourages casual users to make their own reports whenever they want to, without needing to refer to power users. Power users can also accomplish their tasks by using SSBI in an easy and quick way. There are no differences between the terms SSBI and BI—both have the same goals, but SSBI provides new features to achieve traditional BI goals by allowing causal users to create their own reports. The SSBI architecture has changed from client/server to Web applications, so users do not need to install the software; rather, they can access resources via an interface (via Web browser) (Alpar and Schulz, 2016).

In a research study by Lennerholt et al. (2018), they found that the implementation rate of SSBI is low, as compared with the traditional approach, even with advantages and features that SSBI provides. For that reason, they identify SSBI implementation challenges to help organizations understand the potential challenges of and better prepare for implementing SSBI. They summarized the challenges in two categories. The first is challenges involving access and use of data, which include the challenge of making data sources easy to access and use, identifying data selection criteria, using correct data queries,

controlling data integrity, security and distribution, defining policies for data management and data governance, and preparing data for visual analytics. The second is challenges involving self-reliant users, which include the challenge of making BI tools easy to use, making BI results easy to consume and enhance, giving the right tools to the right users, and educating users on how to select, interpret, and analyze data for decision-making .Thus, depending on future research, the researchers decided to perform further research on organizations that want to implement SSBI, discuss the ten predefined SSBI challenges, and validate them by conducting qualitative case studies of how organizations explain the identified challenges.

The rest of the paper is organized as follows. The next section includes an overview of the literature on BI and SSBI and explains essential concepts related to SSBI. Then, the methodology is presented, and how the data were collected and analyzed is explained. Lastly, the research findings and recommendations are discussed.

Literature Review

BI is a roadmap used to measure performance and identify new business opportunities. It involves gathering and analyzing information to understand customer behavior and making decisions accordingly (Ramesh and Ramakrishna, 2018). This section will discuss many of the challenges found by researchers when constructing and managing BI. Most studies agree upon the two main challenges: limited knowledge and lack of skills to use BI (Gudfinnsson and Strand, 2017 ; Ramesh and Ramakrishna, 2018 ; Johannessen and Fuglseth, 2016 ; Gounder et al., 2016 ; Skyrius et al., 2016). Evidence clearly shows that the characteristics and quality of data, large volumes of data, and gathering structured and unstructured data in different formats are considered challenges (Gudfinnsson and Strand, 2017 ; Sivarajah et al., 2017), although other researchers did not face any challenges with semi-structured or unstructured data (Johannessen and Fuglseth, 2016).

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Moreover, Sivarajah et al. (2017) divided the challenges into three categories: the data themselves (their characteristics), including the variability of data, meaning that the data always have a different meaning; the complexity of data structures; and the high flow rate of data. The second category is processing and analyzing the data, which includes the following steps:

Step 1: Getting data from different sources and storing them in a data warehouse (Sivarajah et al., 2017).
Step 2: Extracting and cleansing large-scale unstructured data (Sivarajah et al., 2017).
Step 3: Data aggregation and integration (Sivarajah et al., 2017).
Step 4: Analyzing and modeling data (Sivarajah et al., 2017 ; Johannessen and Fuglseth, 2016).
Step 5: Interpreting data to make them comprehensible for user (Sivarajah et al., 2017 ; Johannessen and Fuglseth, 2016).

The last category is data management challenges related to database, as data warehouses store a huge amount of sensitive data. Thus, organizations need a robust and secure infrastructure and must provide their staff with an appropriate level of access for each unit. Under this category, the authors identify five issues: security; privacy; data governance, covering data quality, leveraging information, and maintaining value (Sivarajah et al., 2017 ; Ramesh and Ramakrishna, 2018); sharing data; and data ownership. The last one is a critical issue as it focuses on who owns the data (Sivarajah et al., 2017).

In addition, it is difficult for an IT team to choose which BI tools will meet their needs because of challenges related to the tools' availability, including whether they support the current infrastructure, their scalability, and their ease of use (Gounder et al., 2016 ; Ramesh and Ramakrishna, 2018). Also, the authors Gudfinnsson and Strand (2017) studied the challenges of adopting BI in four small- and medium-sized enterprises (SMEs). The researcher found issues regarding their current IT support, especially when IT is outsourced, and of having correct information, such as accurate information about products in storage.

Additionally, all four companies lacked knowledge about how to use BI correctly to increase revenues through decision support, and staff did not perceive the importance of the BI or the value to be gained in their activities and management (Skyrius et al., 2016; Gudfinnsson and Strand, 2017). Executives and owners showed limited interest (Gudfinnsson and Strand, 2017).

Consequently, the challenges can be classified into two types. On one hand, organizational challenges include a lack of skilled or available staff, no methodology or concepts for releasing software, and no comprehension of the importance of using the meta-data. On the other hand, analytical challenges include difficulties with creating a common BI platform and applying standardization. It is important to understand the current state of the BI environment and also that if the BI is not standardized, it will not be scalable. Another challenge is the lack of effective change management and ways to measure whether the work is going according to plan (Ramesh and Ramakrishna, 2018). Similar challenges include integration (Muntean, 2018 ; Ramesh and Ramakrishna, 2018) and data integrity challenges as well as insufficient software functionality (Ramesh and Ramakrishna, 2018).

Furthermore, some companies aim to reduce operation time and cost, so they outsource BI from an external firm, which leads to inflexible and lower-quality of BI that creates challenges in evolving BI systems according to changing business needs. It is important to have a consistent and a detailed document regarding intelligence strategy and to give attention to human factors in order to promote BI and achieve a company's strategic goals (Skyrius et al., 2016).

Methodology

The research and results of this paper came from qualitative case studies, complemented by earlier findings from a literature review focusing on BI and SSBI challenges. The case studies were conducted with three agencies in Saudi Arabia, and the information was collected from semi-

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structured interviews. The researchers conducted three interviews with interviewees in managerial roles only. All of the interviews were recorded and then transcribed down. The results of the interviews regarding the ten challenges identified by the authors Lennerholt et al., (2018) were inspected, and additional challenges of implementing SSBI in Saudi Arabia were provided.

Authority A is a Saudi general authority established in 2016 to organize, develop, and sponsor the SME sector to increase Saudi Arabia's GDP from 20% to 35% by 2030. This authority was selected because it has implemented SSBI for one year and is considered a new authority in the industry, with an age of two years. Authority B is Saudi authority under the Ministry of Finance. It was established in 1936 but was converted into an authority in 2017. Its role was activated when the tax was applied to achieve Saudi Arabia's 2030 Vision. This authority plays a main role in collecting taxes and zakat from taxpayers, and it was selected because it has a new vision and affects Saudi economy. Also, it recently built a data warehouse and BI section but has not implemented SSBI yet.

Company C was started in 2007 and has areas of expertise including Internet of Things, information technology and telecommunication, artificial intelligence and BI, and digital marketing. It has about 1,600 employees in different areas. The company was chosen since it provides BI services for agencies across Saudi Arabia, which gives it great experience in this area, in terms of having different challenges in implementing BI and SSBI as well as success stories.

Finally, an interview was conducted with the general director of Authority A's information center. For Authority B, an interview was conducted with the big data and analytics director, and in Company C, an interview was conducted with the director of the data analytics department.

Results and Discussions

This section presents the findings of the three interviews and discusses the ten predefined SSBI challenges (Lennerholt et al., 2018), validating whether they actually exist. The ten challenges are identified as follows:

ACCESS AND USE OF DATA *(Lennerholt et al., 2018)*

This section describes six challenges under the "access and use of data" category:

CHALLENGE 1: MAKING DATA SOURCES EASY TO ACCESS AND USE *(Lennerholt et al., 2018)*

One challenge of implementing SSBI is that access to data sources must be simplified, accelerated, and facilitated to increase users' productivity, rather than asking power users for help (Lennerholt et al., 2018). Moreover, many SMEs face challenges with adopting BI regarding their current IT support (Ramesh and Ramakrishna, 2018). Data ownership is a critical challenge, in terms of who is responsible and accountable for data (Sivarajah et al., 2017).

The general director of Authority A's information center said:

> Yes, it is true, and data ownership is the number one challenge because IT is hosting the data. They think the proprietary data belongs to them, and this is not true, so sometimes they protect the data from other departments, while the main role of IT is to just be responsible for operations. This is due to the absence of policy and data governance in the Kingdom of Saudi Arabia.

He further said, "Building BI is considered a business responsibility, while IT is responsible for giving access to business users to the data they have."

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The director of the data analytics department in Company C agreed that the first challenge is data governance and that one cannot build SSBI without proper governance. However, he considered data governance to be a prerequisite for SSBI, including data authorization and data quality controls. He also said, "Today, we have a data warehouse that includes facts and dimensions, with different levels of access for each department. The second challenge is the culture: do these departments have the culture to use the data and make decisions?".

In Authority B, the big data and analytics director said:

> The challenge here is how to make data understandable and easy to access by business users that will be prevented by building semantic layer, but building semantic layer for traditional data warehouse takes a long period of time, efforts, and it slows down the deployment of BI.

All of the interviewees agreed that making data sources easy to access is a challenge. Clearly, any company that wants to build effective BI should ensure that its IT department supports the idea of building BI and SSBI, understands its responsibility in running operations, provides required data when needed, and provides levels of access for each department.

The challenge here is the absence of data governance to manage data availability, integrity, usability, and security. Also, the organization must identify how the data will be stored, retrieved, and archived and how it will be used by authorized users. At present, Saudi Arabia still lacks rules and policies, as no general data-protection regulations exist to explain how organizations should handle personal and sensitive data and share it between parties.

CHALLENGE 2: IDENTIFYING THE DATA-SELECTION CRITERIA *(Lennerholt et al., 2018)*

The challenge here is about how to ensure the quality of data from different sources. Data must be collected based on specific quality criteria, to avoid mistakes and incorrect results (Lennerholt et al., 2018). The quality of data used in BI is considered a challenge in many industries, including the processes of extracting and cleansing large volumes of data in different formats (Gudfinnsson and Strand, 2017 ; Sivarajah et al., 2017), although others have had no challenges with different data structures (Johannessen and Fuglseth, 2016).

The general director from Authority A said:

> We already built a key performance indicator (KPI) dictionary with criteria that include all departments' needs and what data they need to make a decision, such as KPI definitions, how to perform calculations, and the data sources that the KPIs are based on, as well as a data dictionary for database tables including all related information that would help both IT and business users to understand the data from internal and external sources and thus make it easy to select the required data.

He does not consider this a challenge in implementing SSBI because the authority has already defined these criteria.

In Company C, data quality is a collaborative task between IT and specialist departments. Cleaning and checking the data quality are the responsibilities of IT, and it is important for IT to ensure that mistakes will not occur in the database. The big data and analytics director of Authority B did not consider this to be a challenge that could affect the implementation of SSBI. Authority B already has the criteria, and this is not a challenge from his point of view.

Therefore, companies that identify clear quality criteria will be able to work with different patterns of data by ensuring the data's consistency, completeness, and accuracy across various data sources. The data quality includes a common element known as data cleansing, or removing

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duplication in the data. Data can be improved by restricting data entry and collaborating with other external sources to improve the data quality and selection criteria. The interviewees all agreed that they did not consider this a challenge in implementing SSBI because they already have criteria for data selection.

CHALLENGE 3: USING CORRECT DATA QUERIES (Lennerholt et al., 2018)

Once the data are ready and available, the challenge is to write queries without mistakes to access and extract data correctly, which is considered as a complex process (Lennerholt et al., 2018).

The director from Authority B laughed and then said, "Not a challenge because business users will not write a query. There are different easy tools that allow for drag and drop only, without the need to write complex queries these days! Who considers this a challenge?"

The director from Company C faces this challenge, but he tries to minimize the use of queries through tools. The general director of Authority A did not face this challenge, as causal users usually extract data and make their own analyses to find insights; after noticing gaps, such as the retail sector having an issue, they should check and validate the insights with the research and studies department. In general, casual users still need to validate their queries.

Thus, the interviewees from Authorities A and B agreed that data querying is not a challenge, while Company C faced this challenge but was able to overcome it by using tools to minimize the need for queries. In order to facilitate access to data, companies attempt to replace the need for queries by providing users with specific user-friendly tools that facilitate access to the data that provide the ability to select columns from specific tables without the need to write a query.

CHALLENGE 4: CONTROLLING DATA INTEGRITY, SECURITY, AND DISTRIBUTION (Lennerholt et al., 2018)

In order to implement SSBI, it is critical to address the integrity, security, and distribution of the data, or else there will be problems with incorporating data into data warehouses (Lennerholt et al., 2018). In addition, Ramesh and Ramakrishna (2018) addressed number of analytical challenges found by Pyramid Analytics that include the lack of integrity of stored data as well as other challenges related to standardization as it is hard to apply on BI platform.

The director in Authority B said this was not a challenge because if an integrity problem exists, then the company already has a problem in the data warehouse. In terms of security, Authority B already provides levels of access to limited users. In addition, many tools provide levels of access, so it is not a challenge to Authority B as the business will help to assign the authority.

In addition to that, the director from Company C did not see this a challenge but found it important to consider. If he has 100 users working in different places, he should give the right data to the right people with the correct level of access.

The director from Authority A said:

> The challenge here is the data integrity with other external parties and usually the problem is from the data source queries they have, I meant from their query. Also, the data itself has flows or bad quality data, but this is not challenge in implementing SSBI. When we've implemented SSBI, we build it without need to integrate with external parties, it was done by batches that we received monthly.

Moreover, the interviewees from Authority B and Company C did not consider this a challenge, while the interviewee from Authority A explained that the challenge was in dealing with external entities who have problems in their data queries; beyond that, he did not consider it a hindrance for implementing SSBI in his organization.

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CHALLENGE 5: DEFINING POLICIES FOR DATA MANAGEMENT AND DATA GOVERNANCE (Lennerholt et al., 2018)

The challenges involving data management include policies, procedures, and practices, while data governance is the enforcement of data management (Lennerholt et al., 2018). Accordingly, data governance is a fundamental challenge in building BI, including the responsibility for quality and maintaining data value(Sivarajah et al., 2017;Ramesh and Ramakrishna, 2018).

The director from Authority A said:

> We have used SSBI internally without currently having policies and governance. The problem and challenge here is that there is no data governance, but we will have it next year; this responsibility currently is handled by the business unit. We deal with three governance levels—public, internal, and confidential—but it is still a problem because there are no policies or criteria behind these levels. Nevertheless, the lack of policies is not an impediment to building SSBI because we build it to make our life easier.

Authority A was not building data governance for several reasons. According to the interviewee, "It's a new authority that is only two years old. So now, we are thinking about projects more than the controls. Data governance is important to sectors generating data, but we are a data hub, not a generator." He further said: "data policy is the high level, which cascades to data governance; then, data governance cascades to data management. So, the absence of data policy leads to the wrong belief that the data is owned by IT, as it is hosting the data."

The director from Authority B considered data governance and ownership as challenges but not as reasons to stop the implementation of SSBI. The director from Company C agreed that data governance is a prerequisite to SSBI to ensure data quality and avoid garbage-in garbage-out. He added, "To be successful, we should have a data vision, get over data illiteracy, and provide data governance."

Thus, all interviewees agreed that it is a challenge and agreed upon the importance of data governance, policies, and data ownership as well. The organizations should identify data governance across themselves to manage the availability, integrity, quality, and security of data, even when it is not considered a hindrance to implementing SSBI. It is important for managing policies and procedures and making the responsibility and accountability clear to all, especially for organizations that generate and share data with external entities, via batches or Web services.

CHALLENGE 6: PREPARING DATA FOR VISUAL ANALYTICS (Lennerholt et al., 2018)

This challenge focuses on casual users who need to analyze data frequently. They must be able to select and visualize data correctly without help from power users (Lennerholt et al., 2018).

The director from Company C stated that preparing data for casual users usually takes time, specifically to produce and completely build a robust data warehouse. Also, demand for data changes frequently based on business needs.

In regard to this challenge, the director from Authority B expressed that this challenge comes from two main issues. The first is that business users are not mature enough and do not know exactly what they need, so it is difficult to build something to serve them. The second is building a Semantic layer that will serve users and be easy to modify based on users' needs as well as building a single source of truth for data sources to maintain consistency. He further said:

> To handle these two issues, there is a new term emerging these days—which has not been implemented yet in most Saudi organizations—called "data lake." This is a new concept of the data warehouse that summarizes and facilitates jobs. It

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will solve this challenge, but it is still not being applied.

The director from Authority A added:

> Given the fact that [preparation and visualization tools] have been developing considerably in recent years, I would classify this challenge as medium level. For example, Python, R, Tableau, Power BI, Alteryx, and IBM Watson Analytics are all tools that were not only designed to deal with structured data; they can also process unstructured data. ETLs— Extract, Transform, and Load— can also help in perpetrating the data for visualization.

He also said, "Having said that, data quality is a big challenge in the data-preparation stage."

None of the interviewees considered this a challenge. The challenge in this part is not related to the tools, as most of them today provide visualization and allow casual users to create their own stories by extracting the correct data related to the scenario. Authority B's and Company C's interviewees emphasized that the data-preparation process is hosted by IT, so it takes time and effort from data engineers to prepare the data for casual users. Once casual users understand what they need and what types of data are available, they will be able to select the correct data and perform correct analyses as well.

SELF-RELIANT USERS *(Lennerholt et al., 2018)*

This section describes four identified challenges under the "self-reliant users" category.

CHALLENGES 7 AND 8: MAKING BI TOOLS EASY TO USE AND GIVING THE RIGHT TOOLS TO THE RIGHT USERS *(Lennerholt et al., 2018)*

Non-technical users should be able to use BI tools in an easy and flexible way, and should be able to understand users' need to know

their requirements so that they can choose the correct tools, because using the same BI tools for both will lead to failure (Lennerholt et al., 2018). The researchers consider these two challenges as one. Accordingly, the challenge here is how the IT department should choose the correct tools that will meet the company's requirements and needs. The tools should support the company's infrastructure, be easy to use, and be able to expand according to business needs (Gounder et al., 2016 ; Ramesh and Ramakrishna, 2018). Furthermore, many researchers have found that a lack of knowledgeable and unskilled users in dealing with tools is a challenge (Ramesh and Ramakrishna, 2018 ; Johannessen and Fuglseth, 2016)(Skyrius et al., 2016 ; Gounder et al., 2016). Also, challenges may come when executives are not supporting the application of BI and SSBI (Gudfinnsson and Strand, 2017).

For Company C, this is an important point. The director of the data analytics department said:

> There is misunderstanding in the market about the tools that provide the best BI capabilities. All tools provide a dashboard and visualization—even Excel. So, in this case, the important question is: What is the best tool that fits the consumer requirements?

Authority A adapted Tableau after performing an assessment based on some criteria (e.g. time to market, ease of use, customization) without involving business users. Tableau was selected without any resistance, as Business unit saw SSBI tools as a luxury service. Moreover, the director from Authority B explained that before applying any BI or SSBI tools, the authority usually gives the casual users who will mainly use the tool a certain level of access to the data and allows them to access the tool to try it and create their own demonstrations and analyses. After a period of time, they form an impression about the tool and how they feel about it. He further boasted, "This is not a challenge preventing us from implementing SSBI and BI."

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The interviewees did not consider this a major hindrance. A variety of BI tools are available with different features and SSBI capabilities; thus, organizations can choose which tools fit their needs and will be accepted by employees. Tools can be chosen by identifying a list of criteria, as Authority A, did and select the best tools that meet these criteria. Another way is to allow casual users to create a proof of concept by using a suggested tool for a specific period of time and then receiving feedback from them, as Authority B did.

CHALLENGE 9: MAKING BI RESULTS EASY TO CONSUME AND ENHANCE *(Lennerholt et al., 2018)*

The challenge here is that the information presented through BI tools should be easy to understand for the user, with a desirable format and interface (Lennerholt et al., 2018).

None of the interviewees saw this as a challenge. The director from Company C said, "There is a concept in BI called "fifteen seconds" which means that within fifteen seconds, the user should understand the entire dashboard." In other words, the researchers can consider this as a form of challenges 7–8. As seen before, choosing the right tool and making it easy for all users require support from top management and the IT department that is hosting and providing the data and configuring the tool. Further, IT should ensure that casual users are able to work with and understand the data they deal with by providing a data dictionary that explains the meaning of each column in the data warehouse, thus reducing the time required to figure out the data and allowing casual users to perform reasonable analyses. Besides that, the casual users must understand the business and the exact insights they want to extract, build valid scenarios, and make comprehensive analyses.

CHALLENGE 10: EDUCATING USERS ON HOW TO SELECT, INTERPRET, AND ANALYZE DATA FOR DECISION-MAKING *(Lennerholt et al., 2018)*

Challenge 10 is about encouraging, educating, and training users to take advantage of BI tools and validate their results (Lennerholt et al., 2018). A lack of awareness about the importance of BI and a lack of skills in using it are also considered challenges (Gudfinnsson and Strand, 2017 ; Ramesh and Ramakrishna, 2018 ; Johannessen and Fuglseth, 2016 ; Gounder et al., 2016 ; Skyrius et al., 2016).

The director from Company C mentioned that the challenge depends on the consumer company and if it is enthusiastic about building BI. He has not met any resistance from employees because the company hosts an internal workshop every two weeks to increase the employees' knowledge and improve their learning.

Authority A conducted workshops with each department lasting about two hours to allow them to use the Tableau tool. One reason Tableau was chosen was because the authority did not want a steep learning curve. In Authority B, two options were suggested to share knowledge and educate casual users by IT to deal with the SSBI tool. The IT department borrowed a number of casual users for a specific period of time and then returned back to share their knowledge with their team and vice versa.

Nevertheless, the interviewees did not consider this a challenge, and they overcame this challenge by providing frequent workshops and training to improve users' skills and knowledge on how to use BI and SSBI and correctly read the results in order to enhance and improve their work.

In addition, it is crucial for users to understand how to explain their analyses and how to interpret and validate the insights they find after exploring the data as well as allow them to produce precise reports for top management. This journey requires time to provide both casual and power users with the required skills to deal with data.

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Recommendations

Organizations must clearly identify the data governance and ownership, including policies, quality, regulation compliance, and risk management. Also, the roles of IT and business should be distinguished by assigning to the IT department the responsibilities of hosting data, preparing data for business users, and providing proper access to specific users, while business unit should be responsible for extracting insights after analyzing data and identifying gaps in business processes. Moreover, support from executive management, collaboration between the IT and business departments, and improved user awareness about the importance of BI would lead to successful BI and SSBI as well.

Future Work

The researchers want to interview more BI managers to achieve a reliable conclusion to confirm the qualitative cases to verify the ten predefined challenges, then complement this study by applying further research to validate these challenges quantitatively.

Conclusion

The aim of this paper was to discuss the ten previously defined SSBI challenges and validate them through qualitative case studies. The researchers assessed these ten challenges by interviewing three Saudi agencies with BI at different maturity levels. All of the interviewees agreed that the main challenges are summarized as involving data ownership; the absence of data policy and data governance, including the management of data availability, integrity, usability, and security across the organization; and a lack of understanding of BI's critical role in decision making. In addition, it is important to improve awareness about the data and the importance of BI in improving the business's work and decisions. IT plays a main role in adopting new data concepts like data lake and in improving data-engineering processes of extracting, transforming, and loading data from multiple sources into data warehouses to facilitate the implementation of BI and SSBI

and allow authorized users to access data and make proper analyses.

References

1.   Alpar, P., Schulz, M., 2016. Self-service business intelligence. Bus. Inf. Syst. Eng. 58, 151–155.

2.   Delen, D., Moscato, G., Toma, I.L., 2018. The impact of real-time business intelligence and advanced analytics on the behaviour of business decision makers, in: 2018 International Conference on Information Management and Processing (ICIMP). IEEE, pp. 49–53.

3.   Gounder, M.S., Iyer, V.V., Al Mazyad, A., 2016. A survey on business intelligence tools for university dashboard development, in: 2016 3rd MEC International Conference on Big Data and Smart City (ICBDSC). IEEE, pp. 1–7.

4.   Gudfinnsson, K., Strand, M., 2017. Challenges with BI adoption in SMEs, in: 2017 8th International Conference on Information, Intelligence, Systems & Applications (IISA). IEEE, pp. 1–6.

5.   Johannessen, T., Fuglseth, A., 2016. Challenges of Self-Service Business Intelligence. Bibsys Open J. Syst. 24.

6.   Lennerholt, C., van Laere, J., Söderström, E., 2018. Implementation challenges of self service business intelligence: A literature review, in: 51st Hawaii International Conference on System Sciences, Hilton Waikoloa Village, Hawaii, USA, January 3-6, 2018. IEEE Computer Society, pp. 5055–5063.

7.   Muntean, M., 2018. Business intelligence issues for sustainability projects. Sustainability 10, 335.

8.   Passlick, J., Lebek, B., Breitner, M.H., 2017. A self-service supporting business intelligence and big data analytics architecture.

9.   Ramesh, B., Ramakrishna, A., 2018. Unified Business Intelligence Ecosystem: A Project Management Approach to Address Business Intelligence Challenges, in: 2018

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Portland International Conference on Management of Engineering and Technology (PICMET). IEEE, pp. 1–10.

10. Sivarajah, U., Kamal, M.M., Irani, Z., Weerakkody, V., 2017. Critical analysis of Big Data challenges and analytical methods. J. Bus. Res. 70, 263–286.

11. Skyrius, R., Katin, I., Kazimianec, M., Nemitko, S., Rumsas, G., Zilinskas, R., 2016. Factors driving business intelligence culture. Issues Informing Sci. Inf. Technol. 13, 171–187.

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