From an Information Consumer to an Information Author: the Role of Self-Service Business Intelligence

Full Paper

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Abstract

Self-service business intelligence (SSBI) enables executives, managers, analysts and knowledge workers to access data and build reports based on their needs to support decisions and actions toward business success. From an industrial level perspective, this suggests that business users not only consume information but that they are also able to author information. Yet, there is lack of knowledge on how SSBI extends the role of a business user beyond being an information consumer. Because SSBI falls firmly under the category of self-service technologies (SST) we draw our conclusions based on a literature review on SST. This study highlights ease of use, trust, independence, control and self-efficacy as the main characteristics that are needed to generate outcomes in terms of co-production and time efficiency at an individual level.

Keywords:

Self-service business intelligence, Self-service technology, Information value chain.

Introduction

In 2010, eBay, an American multinational corporation and e-commerce company changed its data warehousing strategy. Through cooperation with Teradata (an international computer company that sells analytic data platforms) eBay extended the functionality of its enterprise data warehouse (EDW) to support data experimentation and analytics for its employees. This extension enabled business users in particular to create virtual data marts where they could run experiments (such as developing hypotheses about eBay's interface and its impact on the sellers' strategies). The latter was mainly developed through report building and analytics based on the dataset from the EDW (internal) in addition to other external data. Cost effectiveness and time efficiency were the main outcomes of the virtual data marts because they can be created faster than traditional data marts and they are effective in transferring new discoveries from the testing environment into production (Goul 2011).

Closely related to business analytics and often used interchangeably, business intelligence (BI) is highlighted as a technology offering self-service capabilities to its users. In this study, BI is defined as "a broad category of applications, technologies and processes for gathering, storing, accessing and analyzing data to help business users make better decisions" (Watson 2009, p. 491, p. 491). Supporting a decision-making process (Kowalczyk et al. 2013; Popovič et al. 2012) is one of the key benefits of BI. For instance, the way information is delivered and its ability to update frequently lead to quicker decision-making (Watson 2009). Used at both managerial and operational levels, BI can generate value in business processes and organizational performance (Elbashir et al. 2008), such as improvements in strategic planning and alignment (Shanks and Bekmamedova 2012). Yet, users play an important role in its success. A good and solid knowledge of the main legacy systems and of the location of information (Deng and Chi 2012) based on users' access level and knowledge (Deng and Chi 2012; Işık et al. 2013) are pre-requisites for BI systems in order to generate the expected outcomes.

BI systems continuously advance. This can be seen, for example, by the introduction of Hadoop clusters in their infrastructure in response to the big data era (Phillips-Wren and Hoskisson 2015) and allowing mobile access to the main BI infrastructure in response to the advancements of mobile computing (Tona and Carlsson 2013). Recently, the self-service capability of BI has become attractive to industries, because it offers executives, managers, analysts and knowledge workers not only customized data access but also the possibility of building reports on a need-basis with the ultimate aim of supporting decisions and actions (Weber 2013). For the purpose of this paper, and as a working definition, we define self-service BI (SSBI) as an instance of BI that provides a self-service capability to its end-users.

SSBI is encouraged in the industry world because it leads the other current trends of collaborative BI (29%) and mobile BI (18%). A recent industrial study (led by enterprise software industry analysts) reported that users appreciate the BI self-service capability because 55% of BI users (in organizations) engage in self-service tasks and 24% are planning to do so in the future (Barc 2014). Users are becoming independent during their task accomplishment mainly thanks to the opportunity they have of being able to build or design their own reports, even when multiple data sources are involved (Barc 2014). Along the same line of arguments, industry plays an influential role in promoting self-service capability as the main competitive advantage of BI, yet organizations are unclear about what and how its benefits are generated. SSBI potentiality remains at the level of assumptions and suggestions because its nature is dominated by confusion. Even though BI is widely spread in organizations (Arnott and Pervan 2014), the scarcity of academic research contributes to the lack of knowledge that prevails about SSBI.

The aim of this study, therefore, is to investigate the main characteristics of an SSBI that make the expansion of a business user's role from an information consumer to an information author possible. Due to the lack of IS academic discussion on SSBI we draw on the literature of self-service technology (SST). The latter choice is based upon two main arguments: first, SST is an umbrella term for technologies that offer self-service capabilities, with SSBI falling firmly under this category. Secondly, SSBI is an interesting instance of SST because it operates inside organizations rather than organization to customers as most SSTs do. Self-service business intelligence (SSBI) brings to the organization a rather similar model compared to SST where the IT department creates and manages a service platform to be used by the organization's employees in servicing themselves. Even though SSBI demonstrates a high similarity with SST at an abstract level, on a deeper level with SST one tries to accomplish a certain well-defined task through self-service (e.g. in online banking), whereas with SSBI one tries to draw conclusions and make business decisions based on data analytics and information extraction (Imhoff and White 2011). This research offers two main contributions: firstly, through an SST literature review, this study will shed light on the main characteristics of an SSBI necessary to generate its promised benefits; secondly the results of this study will support industry by reducing the uncertainties surrounding SSBI.

The Relation of SSBI in the Information Value Chain (IVC)

The past decade has witnessed a big change in services, such as the transformation from non-digital services to digital services (Yoo et al. 2010). The role of technology in allowing information to be repackaged and transferred has led to new opportunities for service exchange and innovation (Vargo et al. 2015). Additionally, technological advances have focused on self-service options and capabilities to improve the way services are delivered.

From a technological context, a widely used definition of a self-service technology (SST) is: "the technological interface that enables customers to produce a service independent of direct service employee involvement" (Meuter et al. 2000, p. 50, p. 50). Additionally, Wang and Namen (2004) define SST as technology based self-service (TBSS) to denote the activity or benefit built on hard technology that a service provider offers to their customers so they can perform their service requests fully or partially by themselves. SST emphasizes the technology itself whereas TBSS focuses on the activities performed directly or indirectly by the customer in order to receive a service (Wang and Namen 2004). Interestingly, these two definitions target a customer-business relationship, ignoring the instances SST can be used within an organizational setting. Furthermore, a self-service technology is even defined based on its application and context, such as internet-based self-service technology (ISST) (Schultze and Orlikowski 2004).

Decision support systems (DSS) in general, and more specifically BI, are integrated into the information value chain with the ultimate aim of supporting decision-makers (see figure 1). The information value chain represents a process and activities that convert data into information and knowledge to be used by individuals, groups or organizations in taking decisions and actions (Fayyad et al. 1996; Han et al. 2012). Characterized by sequential stages, the value chain encompasses an interaction between people, processes and technologies (Chandler 2011).

From a technological point of view, BI is present at the first three stages of the value chain. To prepare data for analysis, first BI has to connect to a variety of internal and external sources (Gibson and Arnott 2005), e.g., enterprise resource planning (ERP), customer relationship management (CRM), supply chain management (SCM) and other legacy systems. Further in this preparation stage, data is extracted, transformed, and loaded (ETL) (Gibson and Arnott 2005) and stored in data warehouses, data marts (March and Hevner 2007; Watson 2009) or more recently to Hadoop clusters (Phillips-Wren et al. 2015). When the preparation stage is completed, data is further analyzed and converted into information. Users, via different devices such as a PC, laptop or mobile device, can access information to derive knowledge necessary for decision-making. In terms of BI users, recent research indicates three main types of user: business users (basic and domain-based skills), business analysts (more analytical skills on how to build ad-hoc reports and what-if scenarios) and data scientists (mathematical and statistical skills) (Phillips-Wren et al. 2015).In a typical scenario, business users consume the information on the BI that is made available to them by the business analysts through a request or based on a regular agreement between departments. Thus, on the information value chain BI users are involved at the moment when information is converted into knowledge. So, through BI they consume information, which they then convert into knowledge based on their intuition, previous experience, task and context. Afterwards, they apply the knowledge produced to take decisions and actions. Interestingly in this phase, a BI supports a business user only in the information use and the rest of the stages will come as a result of the extended benefits of a BI system.

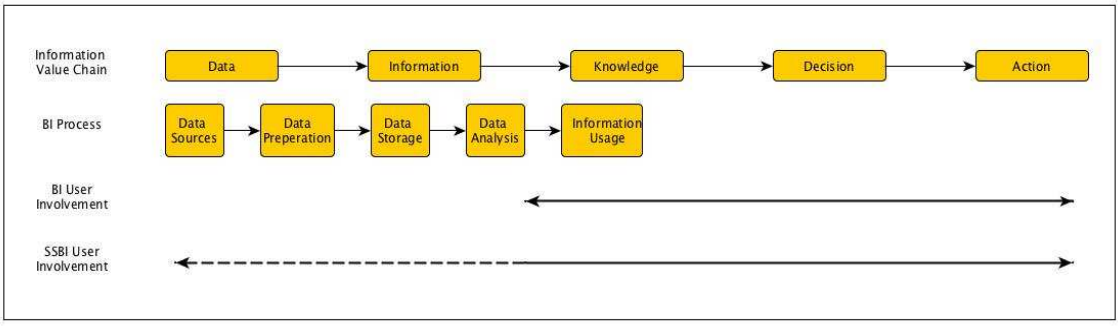

Figure 1. The Role of a Business User (modified from (Abbasi et al. 2016))

On the other hand, an SSBI can expand the involvement of business users allowing them to independently access data and produce information in the form of reports and simple analytical queries without relying on business analysts or data scientists who typically are part of an IT/BI department (Abbasi et al. 2016). Therefore, we would expect a business user to not only consume information but also author it (see the extension through the dotted line in ***Figure 1***). Thus, we argue that a business user's involvement starts from the data up to the action stage of the information value chain. However, how an SSBI supports a user to participate in the conversion of data into information in the information value chain is still unknown. To this end, a literature review on SST will inform the SSBI on the different characteristics that an SST has from a technology and user perspective as well as the expected outcomes.

Method

To achieve the aim of this research we conducted a systematic literature review (refer to ***Figure 2***) following rigorously methodological guidelines in order to ensure validity and reliability (Vom Brocke et al. 2009; Webster and Watson 2002).

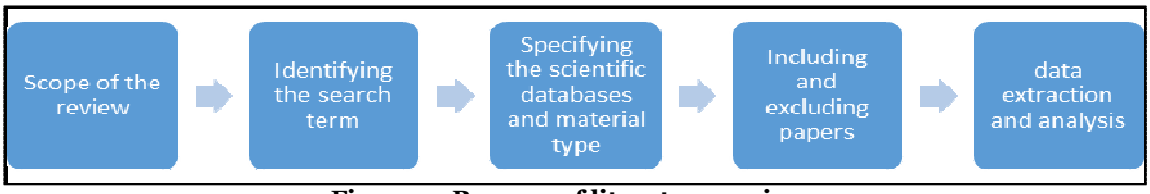

Figure 2. Process of literature review

Scope of the review

As mentioned above, the focus of our review is the investigation of SSBI by drawing, to a large extent, from the SST literature. The aim is to explore the main characteristics of SST and its outcomes, which will later be transferred and adapted to a BI context. To this end, we pre-defined some categories such as: research method, internal/external use of SST, context, IT artifact involved, SST definition and the main research contribution for each article. Furthermore, we delineated the target audience for this study: namely research focused on BI and particularly in its self-service capability.

Identifying search terms and database sources

Prior to our final literature search, we quickly explored the SST literature to gain a preliminary understanding of the domain. Consequently, we aimed to derive meaningful search terms in order to maximize their effectiveness during the search process (Vom Brocke et al. 2009). Three main SST acronyms were deemed suitable to be used for the final literature search: self-service technology (SST) (Meuter et al. 2000), internet-based self-service (ISST) (Schultze and Orlikowski 2004) and technology-based self-service (TBSS) (Scherer et al. 2015). As part of a test phase, we used these three terms in an explorative database search. The initial results were used to fine-tune the search criteria. In our first test, we observed that many articles only mentioned the aforementioned search terms without further elaboration, thus being far from the focus of this study. Instead, we decided to apply our search terms only to the title and abstract of journal articles. The logical operator "OR" was used to include all results from the three acronyms resulting in the below search criteria.

(AB "self-service technology") OR (AB "Internet-Based Self-Service") OR (AB "Technology-Based Self-Service") OR (TI "self-service technology") OR (TI "Internet-Based Self-Service") OR (TI "Technology-Based Self-Service")

One important step in the literature search was to identify the main scientific databases as data sources. The following databases were selected as our data sources mainly because they comprise a relatively comprehensive number of quality journal articles: EBSCSOhost (Business Source Premier and Econlit), Science Direct, and Scopus®. These databases collectively contain the top-ranked journals (basket of eight) stated by the College of Senior Scholars: European Journal of Information System, Information System Journal, Information System Research, Journal of AIS, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems, and MIS Quarterly.

Inclusion and exclusion of articles

Due to the large number of search results, the authors had to agree and make critical decisions on what kind of studies should be included or excluded in the review (Sterne et al. 2001). Since this literature review aims to maintain comprehensiveness, studies that had the SST at its core and contribute to the understanding of the phenomena have been included. Also, industry reports such as Imhoff and White (2011) have also been considered. Furthermore, no selection filter was applied to research methods employed in the studies. The exclusion criteria were specific as the area of SST can be very diverse due to its nature of combining different disciplines such as: service provision, marketing, technology and human interaction design. The studies that dealt merely with aspects related to the Human-Computer Interaction area (design, interface), architecture and implementation were excluded. Also, studies on the validation and verification of a certain SST have been excluded, as being not in line with our study goals.

The first search in the above-mentioned databases resulted in 838 different academic publications including journal papers, conference proceedings, magazines, reports, reviews, books and trade publications. By specifying the three scientific databases mentioned earlier, the number of academic publications decreased to 328. After selecting only journal papers, the number decreased to 206 academic journal papers. This number decreased to 143 after removing duplicated material. Applying the inclusion and exclusion criteria the final number of papers selected for our review was 81 (see ***Figure 3***).

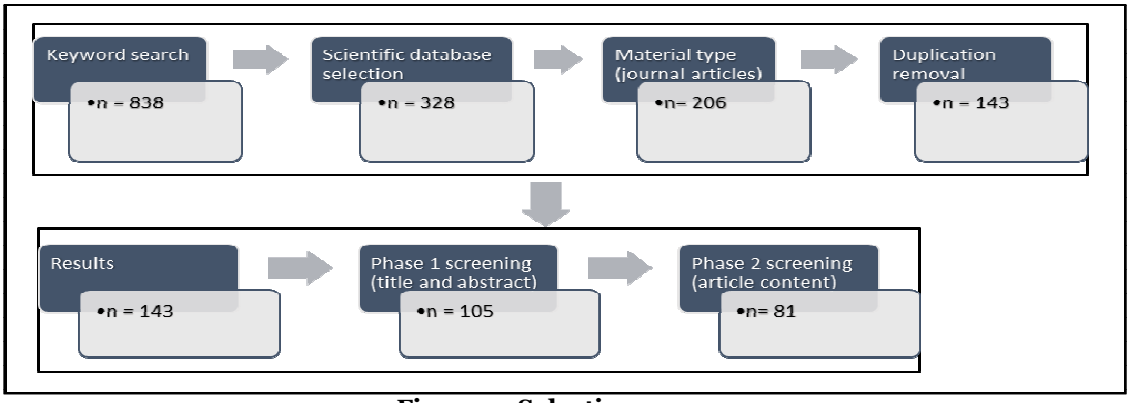

Figure 3. Selection process

Data extraction and analysis

The information extracted from these articles was organized in a table containing information related to the bibliographic facts, the context of the study, research contribution, the nature of the IT artifact and its use - either internal or external - from an organization perspective; dimensions pre-defined during the review scope phase. After the fields of the dimensions were filled in for each individual paper, further analysis of the text under the category of research contribution took place. At this point, the author and co-authors were involved independently in the coding process (see ***Table 1***). Following an extensive discussion where authors presented the rationale behind their choices, the results showed an almost 95% match in terms of codes and sub-codes, which enforces the internal coding reliability. Later, codes and sub-codes were edited, merged, and deleted based on an agreement between the authors. Three main coding categories nesting other sub-codes emerged: user characteristics, technology characteristics and outcomes.

Perspective	Author 1 sub-code	Author 2 sub-code	Adopted codes
User Perspective	Trust, convenience, perceived control, discomfort, insecurity,	Task complexity, trust intention, fun, technology anxiety, control over tech.	Trust, Control

Table 1. Coding example

Findings

This section presents our findings from the literature review together with our discussion, so that we can better relate both SST and SSBI. To this end, we explore the SSBI attributes that contribute to the extension role of a business user in the information value chain (as shown in ***Figure 1***) from both a technological and user perspective.

Ease of use and trust

The main driver behind SST implementation is to enable employees to serve themselves during task solving without the need for human assistance (DABHOLKAR 1999). To do this, research highlights the importance of a pleasant, easy to use SST design, which requires minimal skills to operate (Bobbitt and Dabholkar 2001; Curran and Meuter 2005; Evanschitzky et al. 2015; Gelbrich and Sattler 2014; Narteh 2015). For example, the results of a survey with 771 participants show that customers use internet banking largely due to its easy to use design and interface (Ho and Ko 2008). Moreover users were inclined to depend more on online banking, phone banking and other related products compared

to direct contact with employees unless the interface and the design required a lot of mental effort (Curran and Meuter 2005).

Obviously, even for an SSBI, the ease of use is a crucial part of its design. An SSBI is built on the idea of minimizing the operational complexity so that a business user, who typically does not have analytical or technical skills, can still create a dashboard. Apart from that, the user should also be able to easily access data and transform it into information. To this end, an SSBI should provide a relatively easy to use interface to support not only the creation of reports and dashboards but also the accessing of raw data and transforming it into information. For instance, performing certain calculations (after the data information) through coding should be facilitated for business users by using drag and drop, which would essentially hide a complex operation at the back end that the end-user does not necessarily need to be knowledgeable about.

Yet, an easy to use SST is not sufficient enough to guarantee that users can achieve their goal. An SST should also maintain a feeling of trust for its users at satisfactory levels. Trust can be defined as a two dimensional construct: 1) trust believe - the user perception of the SST in terms of benevolent, honest, competent or predictable and 2) trust intention - the willingness of the user to expose himself to the possibility of loss by using the SST (Lim et al. 2006). Most quantitative research studies show a significant positive correlation between trust and the use of an SST (Evanschitzky et al. 2015) and furthermore, research argues that lack of trust leads to user discomfort and insecurity (Eastlick et al. 2012; Elliott et al. 2008; Evanschitzky et al. 2015; Liu 2012). When an SST like internet banking, phone banking or an online purchase system is used, trust is a paramount factor for its use as it directly involves people's finances. A study, which involved 477 subjects, analyzed several factors affecting the use of an online SST such as online purchasing and concluded that users feel more comfortable in using an SST when trust towards the SST is present (Eastlick et al. 2006).

Given the 'new' extended role of a user to author information and the importance of using the retrieved information as a basis for actions, we argue that trust will also be crucial for an SSBI, especially in the first two stages of the value chain (data to information) where an SSBI user converts data into information that will be used to infer knowledge. Users should trust an SSBI from both a system and information quality perspective. Ultimately, interacting with an easy to use SSBI and trusting the technology during the daily work and routine will result in users who feel more in control over the technology.

Control and independence

Having control over technology can influence both the intention to use an SST (Collier and Sherrell 2010; Shamdasani et al. 2008) as well as customer satisfaction (Johnson et al. 2008; Yen 2005; Zhu et al. 2007). Especially in SSBI, control is of paramount importance for users to gain independence from an IT/BI department. Once they feel that they know 'how' and 'what' they are doing through SSBI, they will feel more in control of the technology and consequently less dependent on their IT/BI staff. By independence, we mean that the user relies on himself, where he is free to engage with data anytime he sees it necessary without going through the bureaucracy of requesting the reports from an IT/BI department.

Freedom is related to the degree to which an SST is used without assistance (Johnson et al. 2008). From an SSBI perspective, users will have more freedom to explore and conduct data analysis based on their needs, thus becoming more independent. However, this independence will contribute to a shifting, to a certain degree, of responsibilities from business analysts (IT/BI department) to business users instead. This means that users would be totally dependent, i.e. enslaved to SSBI to complete their tasks or work duties instead of relying on the IT/BI department. So, SSBI should provide control and independence to its business users during the first three stages of the value chain (data-information-knowledge). When a user has control over the process of servicing himself through SSBI and has the freedom to explore and exploit data and information, a feeling of independence strongly presents itself.

Self-efficacy

From a psychological perspective, control and independence toward SST boosts the self-efficacy of the user. Self-efficacy is strongly connected to the personal capabilities (such as computer and technology

literacy) of an SST user. Once users have control over the SST, they start producing the service they need (Bandura 1997). In an illustrative example, a study targeting young and novice users of online stock investment has argued that self-efficacy positively affects the usage intention of SST. 271 students from a Dutch university participated in the study and it was found that students with a higher feeling of self-efficacy tend to have more motivation to use the SST (Van Beuningen et al. 2009). That holds true, since self-efficacy has a significant positive effect on the acceptance, usage intention and perceived value of SST (Dabholkar and Bagozzi 2002; Hsiao and Tang 2015; Van Beuningen et al. 2009).

Co-production and time efficiency

The introduction of SST into service organization has empowered customers because of the positive changes in the service delivery system, such as time and cost saving, speed of delivery, and control over the service delivery (Meuter et al. 2000). Customers now share the responsibilities in producing the needed service (Eastlick et al. 2012). The co-production of service using SST positively affects customers and organizational efficiency in terms of time saving, convenience and availability (Eastlick et al. 2012). SST generates benefits that target customer value in that they get faster, more convenient, and sometimes cheaper services. Consequently, the organization of staff is more efficient because they have more time to do other tasks, benefitting the organization itself and their customers (Hilton et al. 2013). We would expect SSBI to exhibit the same outcomes of co-production largely due to the fact that an IT/BI department is no longer overburdened by employees' requests for different reports. Instead, an SSBI can be adapted to the flexible needs of employees, leading towards a more efficient and effective IT/BI department in terms of better resource allocation, data quality assurance and improvements to BI platform development.

The use of an SST also minimizes the interaction between a customer and an employee. Organizations aim towards this strategy because of cost reduction and employees' time efficiency. However, the degree to which a customer ignores the human intermediary depends on the complexity of the service. A high service complexity with a high need of cognitive abilities will make an SST less attractive (Simon and Usunier 2007; Wang et al. 2012). One important outcome of using an SST is time efficiency. SSTs are supposed to bring the service into customers' hands and minimize the service encounter and direct personal interaction. Therefore, SST use is expected to reduce the speed of service delivery and waiting time. Several articles have pinpointed the importance of these two benefits in the choice of the customer between the SST and personal service (Collier et al. 2015; Simon and Usunier 2007; Wang et al. 2012) and their intention to use (Gelbrich and Sattler 2014; Oh et al. 2013). For instance, a scenario-based study of 505 college students was conducted regarding of the use of SST in a fast-food chain restaurant and found that with the expectation of a high waiting time customers would rather user SST (Dabholkar 1996).

Having said that, SSBI has the potential to reduce the delivery speed of information in the form of either interactive reports or dashboards to its final users. Users are no longer restrained by the availability of the IT/BI department to direct their requests. Instead they have direct access to the SSBI to fulfill their needs.

Conclusion and Limitation

The aim of this paper was to investigate the characteristics of an SSBI needed to expand the involvement of a business user during knowledge creation. Given the novelty of research on the SSBI area and the fact that SSBI is a typical instance of a SST, we conducted a literature review on SST. The objective of the literature review was to be able to draw parallels and argue about the attributes that SSBI should have to support the shift of the business user role.

We analyzed 81 journal articles and the main characteristics from a technology and user perspective, as well as the possible outcomes and benefits, are discussed throughout this paper. We argue that ease of use, trust towards SSBI, control, independence and self-efficacy are essential for an SSBI to generate benefits in terms of co-production and time efficiency.

However, this study is not without limitation. One limitation is the range of data sources selected for the literature review. Even though we decided to focus only on the high ranked journals, conference papers could have provided other interesting insights considering the novelty of this topic. Yet, that creates another opportunity to extend the results of this study to conference publications also.

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