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CRITICAL FACTORS FOR BUSINESS INTELLIGENCE SUCCESS

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Abstract

Business intelligence (BI) is a strategically important tool for organisations. Numerous studies have attempted to investigate the factors that contribute to BI success. However, an overview of the critical success factors (CSFs) is lacking, as is an understanding of the gaps in the extant research. After examining 444 articles, we integrated the findings of 29 studies. We used the framework of information system success to identify the CSFs and to analyse how researchers identify information system success. We identified 36 variables related to BI success in the extant literature. The distinct CSFs relate to project management skills, management support, user involvement, the external environment and management processes. In the articles in which BI success was operationalised, we found several distinct factors: system quality, information quality, use, service quality, user satisfaction and net benefits. We extended the framework of information system success to include three additional factors: strategy and vision, organisational form and competency development. We contribute to the extant research by extending the framework of information system success and identifying the gaps in the extant research. We contribute to practice through an enhanced understanding of the CSFs related to BI success.

Keywords: Business intelligence, critical success factor, BI success, information system success.

1 Introduction

Business intelligence (BI) is an umbrella term for the technologies, applications and processes associated with collecting, storing, using, disclosing and analysing data to facilitate sound decision making (‘Business Intelligence—BI—Gartner IT Glossary,’ 2017). Chief information officers (CIOs) rank BI first when asked to prioritise technology investments (Gartner, 2014). This ranking indicates BI’s strategic importance. In today’s highly competitive world, BI quality and accuracy are important factors in the generation of profit or loss (Gonzales, Wareham, and Serida, 2015). Moreover, public organisations have shown increasing interest in implementing BI (Wixom and Watson, 2010). According to Hartley and Seymour (2011), BI plays an important role in addressing the need for service delivery in the public sector.

Several articles have highlighted the advantages of using BI. Organisations can improve business processes and, thereby, their performance by making decisions based on business analytics (Bronzo et al., 2013; Popovič, Turk, and Jaklič, 2010). The ultimate aim of BI is to build shareholder value (Dawson and Van Belle, 2013). However, the success of BI varies across organisations and industries. BI implementations are complex, and this complexity carries a cost (Yeoh and Koronios, 2010). The cost of BI technologies is high because implementation requires infrastructure, software, licenses, training and wages (Watson and Haley, 1997). Moreover, the literature indicates that a significant number of organisations fail to realise the expected benefits of BI (Chenoweth, Corral, and Demirkan, 2006; Dawson and Van Belle, 2013; Hawking and Sellitto, 2010; Olbrich, Poeppelbuss, and Niehaves, 2011; Riabacke, Larsson, and Danielson, 2014; Xu and Hwang, 2005).

Between 2008 and 2015, numerous studies addressed critical success factors (CSFs) for BI (e.g. Arnott, 2008; Dawson and Van Belle, 2013; Gonzales et al., 2015a; Grublješič and Jaklič, 2015; Hawking and Sellitto, 2010a; Naderinejad et al., 2014; Nasab et al., 2015; Olbrich, Poeppelbuss et al., 2011; Olszak and Ziemba, 2012; Presthus et al., 2012; Yeoh et al., 2008). There are many definitions of CSFs. The concept was originally introduced by Daniel (1961) and was later further developed by Rochart (1979) and others. One of the most frequently used definitions refers to CSFs as: 'the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation. They are the few key areas where "things must go right" for the business to flourish' (Rochart, 1979, p. 85) Although many organisations view BI solely as a technological investment, many internal and external factors affect its business value (Olbrich et al., 2011). CSFs are used to identify and prioritise both business needs and technical systems (Flynn and Arce, 1997).

Several studies have investigated the CSFs in relation to the challenges ensuring BI success. Although numerous studies have been published on this subject, existing literature reviews either build upon industry presentations (e.g. Hawking and Sellitto, 2010) or analyse research papers published before the time window investigated in the current review (e.g. Lönnqvist and Pirttimäki, 2006). This paper aims to synthesise the extant research by investigating recent knowledge on CSFs for BI. We find, classify and analyse papers using Petter, DeLone and McLean's (2013) theoretical framework for information system (IS) success. Through our analysis, we identify distinct CSFs and point to areas of the BI field in which more research is needed.

In the next section, we present the theoretical framework developed by Petter et al. (2013). In the third section, we explain the methods used to detect and analyse the articles in our review. The fourth section is divided into two parts: a classification of the papers and the analysis. In the fifth section, we discuss the results. The last section presents our conclusions and outlines the study's limitations.

2 Theoretical framework

2.1 The search for dependent variables in IS

At the first International Conference on Information Systems in 1980, Peter Keen asked six questions, including 'What is the dependent variable?' (Keen, 1980). To address this question, DeLone and McLean (1992) proposed a model based on Shannon and Weaver's (1948) three levels of communication and Mason's (1978) information influence theory. DeLone and McLean's (1992) IS Success Model (D&M IS Success Model) had its roots in communication theory. It was, therefore, both comprehensive and integrated.

IS success is based on many interrelated factors. The D&M IS Success Model originally comprised six dimensions: system quality, information quality, use, user satisfaction, individual impact and organisational impact. All of these dimensions are treated as dependent variables. An IS system is characterised by system quality and information quality. The system is operated by users with different levels of satisfaction and different individual impacts. These impacts have effects at the organisational level. In the original theory, system quality was classified as occurring on the technical level, where information quality is semantic. The other categories evaluate the effectiveness of the system (DeLone and McLean, 1992, 2003).

Following the publication of the D&M IS Success Model, several scholars suggested improvements. These improvements primarily aimed to resolve the confusion about the dependent and independent variables. For example, some researchers asked for clarification of such factors as management support and user involvement. While these variables are correlated with success, they are not part of success itself (DeLone and McLean, 2003). In 2003, DeLone and McLean (2003) revised their work and presented an updated model. The revised model included service quality and combined individual impact with organisational impact to form a net benefit category. This net benefit category was also extended to include other types of impacts. Moreover, use was expanded to include intention to use.

2.2 The search for independent variables in IS

DeLone and McLean did not identify the relevant factors included in the Updated D&M IS Success Model until 2013 (Petter et al., 2013). To classify the independent variables in the updated version of the model, they used Leavitt's (1965) Diamond of Organisational Change, which includes four independent variables: tasks, people, structure and technology. The model explains sociotechnical IS and the interrelationships between IS and other aspects of the environment (Bostrom and Heinen, 1977). In the original model, the technology dimension represents IS success and is the dependent variable. In this context, IS success is equal to BI success. As discussed in the previous section, the independent variables are causes of but not part of IS success. The antecedent categories are sub-categorisations of each construct, as illustrated in Table 1 below.

Leavitt's (1965) constructs	Antecedent category (Petter et al., 2013)	Related variables (Petter et al., 2013)
Task	Task characteristics	Task compatibility, task difficulty, task independence, task significance, task variability, task specificity
People	User characteristics	Attitudes toward technology, attitudes toward change, enjoyment, trust, computer anxiety, self-efficacy, user expectations, technology experience, organisational role, education, age, gender, organisational tenure
	Social characteristics	Subjective norms, image, visibility, peer support
Structure	Project characteristics	User involvement, relationships with developers, third-party interactions, developer skill, development approach, IT planning, project management skills, domain expert knowledge, type of IS, time since implementation, voluntariness
	Organisational characteristics	Management support, extrinsic motivation, management processes, organisational competence, IT infrastructure, IT investments, external environment, IS governance, organisational size
Technology	IS success	System quality, information quality, service quality, intention to use, use, user satisfaction, individual impact, organisational impact

Table 1 Mapping between Leavitt's Diamond and antecedent categories (Petter et al., 2013).

3 Method

We identified the BI success factors covered in the literature by conducting a systematic literature review. In this section, we outline our search criteria. We then explain our process for classifying papers and describe our content analysis and mapping process.

3.1 Identification of relevant papers

We conducted an organised search for the articles to be included in literature review. We searched databases, reference lists and citations (Papaioannou, Sutton, Carroll, Booth, and Wong, 2009). According to Zins (2000), a good search process involves a combination of systematisation and creativity. We used the following academic databases with advanced search interfaces: Web of Science (ISI), Scopus (Elsevier), ACM Digital Library, EBSCOhost and ABI/INFORM Complete (ProQuest).

To focus our review, we included only peer-reviewed papers published in English between 2006 and 2015. This 10-year time window was chosen to ensure the recency of the reviewed papers. The query comprised two parts: one for the CSFs and one for the technology. The search for CSFs was based on the following terms: 'success factor', 'success factors', 'IS success', 'information system success' and 'information systems success'. The other part of the query searched for the following technology keywords: 'data warehouse', 'data warehouses' and 'business intelligence'. According to Wixom and Watson (2010), data warehouses are part of BI; therefore, we have included 'data warehouse' and 'data warehouses' as synonyms. In sum, the queries considered the following search components: subject ('CSF' AND 'technology'), document type, publication year and language. The first group of results included 444 papers. Then, we removed 68 duplicates. In cases in which researchers had published findings from the same study in more than one publication, the most extensive paper was chosen. After reading the abstracts, 340 papers that fell outside the BI success and CSF domain were eliminated. This left 36 papers, of which two were inaccessible through the used university libraries. After reading the remaining 34 papers, 8 papers were excluded based on the following three exclusion reasons: they were not based on empirical evidence, they disseminated ongoing research, or they were not published in peer-reviewed publications.

Next, we conducted a reference list check to ensure that all relevant articles published from 2006 to 2015 were included. The references of the 26 articles were examined to identify papers that were not present in the searched databases. All additional articles uncovered in this step were reviewed. If a paper fit the set criteria, it was included in the literature pool. Of the 1,184 references, 2 were added to the literature review. To ensure the inclusion of the most recently published articles, a citation search was also performed in Scopus, Web of Science and Google Scholar. A total of 445 references were assessed to determine whether they should be included in the literature review. This step led to the addition of 2 new papers to the literature review. This produced a set of 30 papers for the review before the quality assessment process.

In addition to the selection criteria discussed above, all papers selected for the review underwent a quality assessment: 'the process of assessing and interpreting evidence by systematically considering its validity, results and relevance' (Parkes, Hyde, Deeks, and Milne, 2001, p. 3). To assess the quantitative studies, we used the 'BestBET Survey worksheet' ('BestBET Survey worksheet,' 2016). To assess the qualitative studies, we used the 'BestBET Qualitative worksheet' ('BestBET Qualitative worksheet,' 2016). Each author reviewed the selected papers according to the chosen guidelines. Then, we discussed all papers. Based on this review, both authors independently agreed that one quantitative study did not meet the criteria; this paper was, therefore, excluded. Ultimately, 29 papers were included in the review.

3.2 Classification of papers

For the analysis and coding, we completed a one-page template for each paper, which covered bibliographic information, abstracts, coding results and notes. These data were then collected in a database and subsequently analysed at an aggregated level in Tableau.

In the database, the papers were mapped according to methods applied, focal areas and types of respondents. The classification of methods followed the framework developed by Schlichter and Kræmmergaard (2010) in their review of research in the enterprise resource planning field. The framework includes such methods as case studies, archival studies, theoretical studies, surveys, experiments, descriptive studies and design science studies, as well as various combinations. As discussed in the introduction, BI is interesting for both the public and private sectors. Therefore, we included a categorisation based on this aspect as well, recording the types of respondents that the researchers used in their studies. In the first round, all types explicitly expressed in the articles were categorised. Thereafter, they were classified within the categories listed in Table 2.

We used content analysis to map the CSFs (Krippendorff, 2013) and carried out four stages of analysis. This process allowed us to identify the manifest variables (for which authors had concluded that CSFs existed). In the first analysis iteration, the authors' own wordings of the CSFs were used, resulting in 335 antecedents. In the second iteration, card sorting was applied to identify identical CSFs (e.g., 'information quality' and 'quality of information'). In the third iteration, the CSFs were mapped using Petter et al.'s (2013) theoretical framework. We chose this framework because it entails a single, original model. The high number of modified models within the technology acceptance approach makes this approach less suitable for mapping. In the final round, relationships among the CSFs were identified. Two raters participated in each iteration to ensure interrater reliability of the categorisations. The iterations identified distinct CSFs, which were defined as factors occurring in more than 20% of the selected papers (i.e., in at least six papers).

4 Findings

This section is divided into two parts. First, we present the general characteristics of the selected papers. Second, we present the CSFs for BI, categorised according to Petter et al.'s (2013) model. We review task characteristics first, then structure, user and technology. Finally, we summarise the CSFs, suggest additions and modifications to the framework and highlight gaps in the research.

4.1 General characteristics of review papers

We analysed 29 papers for our review based on the criteria presented in section 2.2. The papers represented almost all years of the selected period, although the number of papers varied by year. There were more journal papers (19) than conference papers (10). The majority of the papers were based on survey research (20), but some papers were based on case studies, combined methods, theoretical studies and descriptive studies. The most common target groups for investigation were employees (29) and managers (20), though some papers focused on consultants (5) and vendors (4). An overview of the bibliometric characteristics appears in Table 2.

Publication years	2008 (2), 2010 (1), 2011 (5), 2012 (7), 2013 (4), 2014 (2), 2015 (8)
Publication channels	Conference papers (10), journal papers (19)
Applied research methods	Descriptive (1), theoretical (1), combined (2), case study (5), survey (20)
Target groups	Consultants. (5), employees (20), managers (20), vendors (4)

Table 2 Bibliometric distribution of review papers

4.2 Identified critical success factors

This section presents the findings in relation to the four constructs identified in Petter et al.'s (2013) framework: tasks, people, structure and technology. More specifically, we present the distinct CSFs identified in the extant research and highlight areas in which further research is needed. Furthermore, we discuss possible modifications to the framework and identify CSFs within the framework that are not covered in the extant BI literature.

4.2.1 Tasks

Tasks are activities that support an organisation and are introduced to increase the completion of assignments (Leavitt, 1965). BI is used to automate or inform tasks (Zuboff, 1988). In this regard, BI relates to a system's ability to provide better information.

Variable (CSF)	Papers
Task compatibility (4)	Arnott, 2008; Khojasteh et al., 2013; Olszak and Ziemba, 2012; Ravasan and Savoji, 2014

Table 3 Identified CSFs for the task construct (number of papers in parentheses)

The analysis reveals that task compatibility is a CSF for BI (Arnott, 2008; Khojasteh et al., 2013; Olszak and Ziemba, 2012; Ravasan and Savoji, 2014). This supports the relevance of task–technology fit (TTF), which suggests that when a technology is compatible with a user's tasks, efficiency will be high

(Goodhue and Thompson, 1995). Grublješič and Jaklič (2015) include TTF in their research, but do not find it to be a distinct factor related to BI success.

4.2.2 People

BI can be a resource for any organisation, but the users and the use of information may affect the success of IS. The people construct comprises two categories: user characteristics and social characteristics. User characteristics are the most frequently studied. The most distinct variable in this regard is users' technology experience. As Grublješič and Jaklič (2015) note, achieving success with even the best BI system is difficult if employees do not have experience with the technology. Thus, users' technology experience is an important factor because it can alter perceptions of usefulness and ease of use (Grublješič and Jaklič, 2015). User expectations represent a distinct variable that is closely related to users' technology experience. It is difficult to adjust a BI system to user expectations if there is no knowledge of those expectations (Olszak and Ziemba, 2012). If users have unrealistic or implausible expectations or if the implementation of a BI system fails, then users will resist using it (Ravasan and Savoji, 2014).

In terms of social characteristics, two studies discussed subjective norms. The level of perceived social pressure related to the use of an IS affected a system's use if the users perceived the data quality as high (Kohnke, Wolf, and Mueller, 2011; Kokin and Wang, 2013).

Variable (CSF)	Papers
Technology experience (4)	Dawson and Van Belle, 2013; Grublješič and Jaklič, 2015; Nasab, Selamat, and Masrom, 2015; Olbrich et al., 2011
Attitude toward change (2)	Grublješič and Jaklič, 2015; Ravasan and Savoji, 2014
Trust (1)	Bischoff, Aier, Haki, and Winter, 2015
User expectations (1)	Olszak and Ziemba, 2012
Subjective norms (2)	Kohnke et al., 2011; Kokin and Wang, 2013
Image (1)	Grublješič and Jaklič, 2015
Peer support (1)	Bischoff et al., 2015
Visibility (1)	Grublješič and Jaklič, 2015

Table 4 Identified CSFs for the people construct (number of papers in parentheses)

4.2.3 Structure

The structure category, which contained 23 papers, is composed of two antecedent categories: project and organisational. Organisational characteristics are part of the structural elements of an organisation (Leavitt, 1965) and they directly and indirectly affect the technology used (Bostrom and Heinen, 1977).

Variable (CSF)	Papers
Management support (13)	Arnott, 2008; Dawson and Van Belle, 2013; Green, Rutherford, and Turner, 2009; Grublješič and Jaklič, 2015; Hasan, Lotfollah, and Negar, 2012; Hawking and Sellitto, 2010; Kohnke et al., 2011; Nasab et al., 2015; Olbrich et al., 2011; Olszak and Ziemba, 2012; Popovič et al., 2010; Sparks and McCann, 2015; Yeoh, Koronios, and Gao, 2008
Vision and strategy* (7)	Adamala and Cidrin, 2011; Bischoff et al., 2015; Hasan et al., 2012; Kulkarni and Robles-Flores, 2013; Ravasan and Savoji, 2014; Sparks and McCann, 2015;

	Yogev, Even, and Fink, 2013
External environment (6)	Arnott, 2008; Dawson and Van Belle, 2013; Gonzales et al., 2015; Grublješič and Jaklič, 2015; Hawking and Sellitto, 2010; Nasab et al., 2015
Management processes (6)	Dawson and Van Belle, 2013; Gonzales et al., 2015; Grublješič and Jaklič, 2015; Hasan et al., 2012; Hawking and Sellitto, 2010; Olbrich et al., 2011
IT infrastructure (5)	Arnott, 2008; Grublješič and Jaklič, 2015; Hawking and Sellitto, 2010; Olbrich et al., 2011; Woodside, 2011
IS governance (4)	Arnott, 2008; Gonzales et al., 2015; Ravasan and Savoji, 2014; Woodside, 2011
Organisational structure* (2)	Hasan et al., 2012; Yeoh et al., 2008
Organisational competences (2)	Kokin and Wang, 2013; Wieder, Ossimitz, and Chamoni, 2012
Organisational size (1)	Yeoh et al., 2008
Project management (13)	Adamala and Cidrin, 2011; Arnott, 2008; Dawson and Van Belle, 2013; Gonzales et al., 2015; Grublješič and Jaklič, 2015; Hawking and Sellitto, 2010; Nasab et al., 2015; Olbrich et al., 2011; Olszak and Ziemba, 2012; Ravasan and Savoji, 2014; Wieder et al., 2012; Woodside, 2011; Yeoh et al., 2008
User involvement (11)	Bischoff et al., 2015; Dawson and Van Belle, 2013; Eybers and Giannakopoulos, 2015; Grublješič and Jaklič, 2015; Hasan et al., 2012; Hawking and Sellitto, 2010; Kulkarni and Robles-Flores, 2013; Nasab et al., 2015; Olbrich et al., 2011; Olszak and Ziemba, 2012; Ravasan and Savoji, 2014
Competency development* (5)	Gonzales et al., 2015; Grublješič and Jaklič, 2015; Kohnke et al., 2011; Ravasan and Savoji, 2014; Woodside, 2011
Third-party interactions (5)	Hasan et al., 2012; Hawking and Sellitto, 2010; Nasab et al., 2015; Olszak and Ziemba, 2012; Ravasan and Savoji, 2014
Developer skills (4)	Kulkarni and Robles-Flores, 2013; Olbrich et al., 2011; Ravasan and Savoji, 2014; Yogev et al., 2013
Development approach (4)	Arnott, 2008; Hawking and Sellitto, 2010; Nasab et al., 2015; Ravasan and Savoji, 2014
Expert domain knowledge (1)	Eybers and Giannakopoulos, 2015
Voluntariness (1)	Grublješič and Jaklič, 2015

*Table 5 Identified CSFs for the structure construct (number of papers in parentheses). * indicates new variables added to the framework.*

Management support is the most studied variable in this stream of literature. This variable reflects the degree to which management supports IS as a champion, sponsor or promoter, as well as management's willingness to allocate resources for IS use (Petter et al., 2013). Olszak and Ziemba (2012) point to the importance of anchoring BI in top management, since management must ensure the allocation of necessary resources. Similarly, Olbrich, Pöppelbuß and Niehaves (2011) note that strong management support is the most important factor in BI success and that it is controllable. However, management support from can vary widely over time. Furthermore, top management can transform BI through organisational strategy (Olszak and Ziemba, 2012).

Petter et al.'s (2013) theoretical framework does not include strategy or vision as variables. However, our content analysis found that seven papers identify strategy or vision as a CSF. Many of the variables in the 'organisational' antecedent category are consistent with the variables typically found in contingency theory, which often references strategy and vision (Otley, 2016; Reinking, 2012). Organisations that achieve BI success have a clear BI vision and strategy (Adamala and Cidrin, 2011). The strategy ensures alignment between business and technology (Ravasan and Savoji, 2014). If a BI system meets operational requirements, then it will be used and will have an impact.

'Management processes' refers to the implementation of strategy. It can be defined as the politics and procedure management processes (e.g., culture, change processes, bureaucracy) used in an organisation to support BI users (Petter et al., 2013). Organisational culture, which is preferably used as an independent variable, includes analytical culture. This means that an organisational culture in which decisions are based on analysis is a distinct factor in BI success (Adamala and Cidrin, 2011; Dawson and Van Belle, 2013; Grublješič and Jaklič, 2015; Hawking and Sellitto, 2010).

In terms of independent variables, the extant research has focused primarily on factors internal to the organisation. However, just as research shows that investments in BI can lead to greater competitiveness, several studies view the external environment as a distinct independent variable. Such research generally focuses on market dynamics (Arnott, 2008; Gonzales et al., 2015) and competitors (Dawson and Van Belle, 2013; Hawking and Sellitto, 2010). However, since two studies found that these were not distinct variables (Grublješič and Jaklič, 2015; Olbrich et al., 2011), we cannot conclude that they are distinct.

Project management determinants are related to the processes established to identify, develop and implement BI (Petter et al., 2013). Therefore, this category includes ongoing operations and maintenance. The project management variable is included as a distinct factor in 13 studies. Project management is more operational than management support, and it includes coordinating, scheduling, scope and monitoring activities, as well as resources related to project objectives (Woodside, 2011). It is important because many projects fail to adequately account for the organisational elements, resources, time, and funding needed to support a project and ensure BI success (Olszak and Ziemba, 2012; Woodside, 2011). Furthermore, project management helps ensure user involvement in the process (Olszak and Ziemba, 2012).

Of the papers in this category, 11 conclude that user involvement is a distinct factor in BI success. The primary purpose of involving the user is to ensure alignment between business processes and BI development (Nasab et al., 2015).

Developer skills and competency development are closely related. Five papers focus on technical capabilities: the use of in-house know-how for the implementation and maintenance of BI systems (Olbrich et al., 2011). Kulkarni and Robles-Flores (2013) point out that BI capabilities are developed and improved through user involvement and use. Five papers emphasise training and competency development. Training serves two purposes. First, it strengthens a manager's beliefs in the system, creating and maintaining management support (Ravasan and Savoji, 2014). Second, it helps users become familiar with the system, thus increasing use of the system (Grublješič and Jaklič, 2015).

4.2.4 Technology (BI)

Some articles operationalise BI success in relation to the variables in the Updated D&M IS Success Model, while others use categories of BI success. Twenty-eight articles focus on system quality as a CSF. Grublješič and Jaklič (2015) use DeLone and McLean's (1992) definitions of data quality, infrastructure and usability. They conclude: 'Since BIS should provide competitive information based on which users can help improve the performance of the organization, the accessibility of information is the most pressing determinant of system quality and not the traditional determinants of reliability and complexity' (Grublješič and Jaklič, 2015, p. 311). Yeoh, Koronios and Gao (2008) emphasise that the technical framework for a BI system should be scalable (e.g., with regard to additional data sources, attributes and dimensions). In addition, a BI system should accommodate data from both industry and the public sector. The aim is to create a long-term solution capable of meeting an organisation's changing needs.

Variable (CSF)	Papers
System quality (28)	Adamala and Cidrin, 2011; Arnott, 2008; Bischoff et al., 2015; Dawson and Van Belle, 2013; Eybers and Giannakopoulos, 2015; Gonzales et al., 2015a; Grublješič and Jaklič, 2015; Hackney et al., 2015; Hasan et al., 2012; Hawking and Sellitto, 2010b; Isik et al., 2011; Khojasteh et al., 2013; Kohnke et al., 2012; Kokin and Wang, 2014; Kulkarni and Robles-Flores, 2013; Nasab et al., 2015; Nemec, 2011; Olbrich, Pöppelbuß et al., 2011; Olszak and Ziemba, 2012; Popovic et al., 2012; Ravasan and Savoji, 2014; Shatat et al., 2013; Sparks and McCann, 2015; Tona et al., 2012; Wieder et al., 2012; Woodside, 2011; Yeoh et al., 2008; Yogev et al., 2013
Information quality (16)	Adamala and Cidrin, 2011; Bischoff et al., 2015; Eybers and Giannakopoulos, 2015; Gonzales et al., 2015a; Grublješič and Jaklič, 2015; Hackney et al., 2015; Hawking and Sellitto, 2010b; Kohnke et al., 2012; Manh Nguyen et al., 2007; Mudzana and Maharaj, 2015; Olszak and Ziemba, 2012; Popovic et al., 2012; Shatat et al., 2013; Sparks and McCann, 2015; Tona et al., 2012; Yeoh et al., 2008
Net benefits* (15)	Dawson and Van Belle, 2013; Eybers and Giannakopoulos, 2015; Gonzales et al., 2015a; Grublješič and Jaklič, 2015; Hawking and Sellitto, 2010b; Isik et al., 2011; Kokin and Wang, 2014; Kulkarni and Robles-Flores, 2013; Mudzana and Maharaj, 2015; Nemec, 2011; Sparks and McCann, 2015; Tona et al., 2012; Wieder et al., 2012; Woodside, 2011; Yogev et al., 2013
Use (11)	Bischoff et al., 2015; Eybers and Giannakopoulos, 2015; Gonzales et al., 2015a; Kohnke et al., 2012; Mudzana and Maharaj, 2015; Nemec, 2011; Popovic et al., 2012; Sparks and McCann, 2015; Tona et al., 2012; Wieder et al., 2012; Yeoh et al., 2008
Service quality (8)	Bischoff et al., 2015; Hawking and Sellitto, 2010b; Mudzana and Maharaj, 2015; Nasab et al., 2015; Nemec, 2011; Olszak and Ziemba, 2012; Ravasan and Savoji, 2014; Shatat et al., 2013
User satisfaction (6)	Gonzales et al., 2015; Hackney, Dooley, Levvy, and Parrish, 2015; Kulkarni and Robles-Flores, 2013; Mudzana and Maharaj, 2015; Tona, Carlsson, and Eom, 2012; Wieder et al., 2012
Intention to use (2)	Kohnke et al., 2011; Nemec, 2011

*Table 6 Identified CSFs for the technology construct. * indicates new variables added to the framework.*

Olszak and Ziemba (2012) find that 'integration between BI system and other systems', 'data quality' and 'BI flexibility' have the highest impact on small- and medium-sized companies. These factors are related BI's objective of consolidating data from multiple sources and providing information to support decision-making (Watson and Wixom, 2007). Grublješič and Jaklič (2015) point out that good infrastructure is a prerequisite for effective BI functioning. A lack of integration produces poor data quality, inconsistent data definitions and formats, incoherent business professions and little access to information due to a variety of user interface design issues. It also prevents business process improvements and effective decision making (Hawking and Sellitto, 2010). Moreover, complex source infrastructures with systems that have little technical compatibility can involve high costs, and out-of-date legacy systems are often difficult to connect to innovative BI systems (Olbrich et al., 2011). Data quality issues related to the source system are a variable in the CSF infrastructure (Hawking and Sellitto, 2010). According to Hawking and Sellitto (2010), there may be a relationship between infrastructure and data quality, and BI systems that suffer from problems with data quality have limited credibility. Arnott (2008) suggests that good data quality can be ensured through effective data management and access to the data source. Extract, transform and load (ETL) processes ensure currency, consistency and accuracy. Furthermore, the data model must be flexible and expandable.

Gonzales, Wareham and Serida’s (2015) research focuses on information quality and suggests that information should be up-to-date. Grublješič and Jaklič (2015) define information quality in line with DeLone and McLean (1992). Though they do not include up-to-date information as a separate factor, they include it in ‘information quality’. Their article also refers to output quality, which they define as ‘the degree to which an individual believes that the system performs his or her job tasks well’ (Venkatesh and Bala, 2008, p. 277). Grublješič and Jaklič (2015) conclude that there are two important factors in information quality: output quality and the relevance of the available information. If business processes are unstructured, these two factors can pose a challenge.

In Petter et al.’s (2013) framework, the impacts of IS are divided into individual impacts and organisational impacts. DeLone and McLean (2003) combine these two variables into net benefits, which can be positively or negatively influenced by BI. More than half of the reviewed articles discuss net benefits. Grublješič and Jaklič (2015) include both financial and non-financial net benefits, while the rest discuss one or the other. Notably, the non-financial BI indicators are related to the tasks and how it supports process automation. Only one indicator focuses on knowledge. Moreover, the non-financial net benefits are not specified as success criteria. The researchers conclude it is a CSF, but they do not explain how it should be measured. Several papers operationalise non-BI success, while others use logic to demonstrate that use leads to individual impacts and, in turn, organisational impacts. A final set of articles uses only one success factor (e.g., use or net benefit).

4.2.5 Summary of CSFs

In the previous section, we focused on the CSFs identified in the literature. The table below presents an overview of these CSFs. The distinct CSFs are factors that we identified in six or more papers, while the non-distinct CSFs are factors that we identified in fewer than six papers. The third group of CSFs are factors that add to Petter et al.'s (2013) framework. The last column shows the CSFs in Peter et al.'s (2013) framework that are not investigated in the 29 selected papers.

Leavitt’s (1965) constructs	Distinct CSFs in BI	Non-distinct CSFs in BI	BI CSFs adding to Petter et al.’s (2013) model	CSFs not covered in BI
Task		Task compatibility (4)		Task difficulty, task independence, task significance, task variability, task specificity
People		Technology experience (4), subjective norms (2), attitudes toward change (2), image (1), peer support (1), visibility (1), trust (1), user expectations (1)		Attitudes toward technology, enjoyment, computer anxiety, self-efficacy, organisational role, education, age, gender, organisational tenure

Structure	Project management skills (13), management support (13), user involvement (11), external environment (6), management processes (6)	IT infrastructure (5), third-party interaction (5), IS governance (4), developer skill (4), development approach (4), organisational competence (2), organisational size (1), domain expert knowledge (1), voluntariness (1)	Vision and strategy (7), development of competences (5), organisational structure (2)	Relationships with developers, IT planning, type of IS, time since implantation, extrinsic motivation, IT investment
Technology	System quality (28), information quality (16), use (11), service quality (8), user satisfaction (6)	Intention to use (2)	Net benefit (15)	

Table 7 CSFs. Parentheses show the number of papers addressing each specific CSF.

5 Discussion

In line with DeLone and McLean (1992), this literature review shows that there is no clear measure of BI success within the technology construct. Some papers refer to BI success as an antecedent category, while others define it in terms of quality, use or net benefit. Furthermore, there is no consensus on whether BI success should be measured at the individual or the organisational level. Several success factors have consistently been found to enhance BI performance, while other potential success factors are understudied and represent gaps in our knowledge. These factors suggest opportunities for future research.

The identified distinct CSFs belong to the structure construct. In relation to this construct, it is interesting to note that management support plays a major role in BI success. Within IS, management support is generally the most studied determinant and a significant predictor of success, since management is responsible for allocating resources, time and encouragement to IS use (Petter et al., 2013). Project management skills and user involvement are also distinct factors related to success. This finding matches Petter et al.'s (2013) findings for IS in general. Since the combination of project management skills and user involvement creates user satisfaction, user satisfaction is one measure of success. We also found management processes to be a distinct factor in BI success. This result is in line with other studies in the IS success literature that show that management processes affect use (Petter et al., 2013).

For the task and people constructs, we identified CSFs, but none of them were distinct. Interestingly, within the task construct, we identified only one CSF out of the seven in the framework. This contradicts Petter et al.'s (2013) study of IS success in general, which they identify all CSFs in the construct. One explanation could be that these authors examine 140 studies involving different technologies over a 15-year period gies. There is insufficient research on the factor of task significance to draw any firm conclusions about it as a distinct CSF. However, the importance of a task most likely influences IS success, especially since the argument for investing in IS technology is that business analytics can improve business and decision processes and, thereby, enhance business performance (Bronzo et al., 2013; Popovič et al., 2010). Although many studies include the user as a factor, few studies research the user as an independent variable. In most cases, the user is included as a control variable (Petter et al., 2013). Differences among users can affect IS success (Keen, 1980).

Although there numerous studies have examined the factors leading to BI success, there are still many unanswered questions. Researchers have focused primarily on the relationships among CSFs in structure and technology; however, further research is needed to investigate the people and task constructs and their relation to success. The studies included here examine the relationships between the independent variables and the dependent variables. Further research should support an understanding of the interactions among the many critical and control factors that determine the effectiveness of certain system designs. An understanding of the interrelationships among multiple independent variables may lead to a better framework for analyses of CSF determinants. Another area to develop in relation to the constructs mentioned by Petter et al. (2013) is the sociotechnical perspective. In terms of IS success, we add three new CSFs to Petter et al.'s (2013) framework: strategy and vision, development of competences and organisational structure. To develop a full picture of these three CSF, additional studies are needed.

6 Conclusion

In this literature review, we have confirmed and identified the independent variables that affect BI success. In other words, we have explored the determinants related to actual BI measurements. By integrating 29 BI success studies conducted between 2006 and 2015, we identified 36 variables as determinants of BI success. We expanded the original 43 variables in Petter et al.'s (2013) framework to 46. This expansion led to the creation of new categories: strategy and vision, form organisation and competency development. Of the 46 variables indicated in the framework, 36 were studied and compared to BI success. The most-used category was technology, followed by structure, people and task. Moreover, we identified several CSFs that require further research. In addition, we discussed the factors in relation to their roles as dependent or independent variables. An investigation of the interactions among the variables would also be fruitful in increasing our knowledge of the factors that affect BI success and supporting organisations in achieving success and reaching their goals through BI use.

The literature review incorporated a wide array of previous research on business intelligence and success. Our study focused on the term 'business intelligence', and we did not use synonyms. Therefore, we may have missed some relevant papers. The same limitation applies to the keywords we used in relation to IS success. Moreover, since we considered both qualitative and quantitative studies, we can say little about cause and effect. The purpose of the study was not to test cause and effect, but to identify the CSFs related to BI success.

This literature review not only contributes to the academic literature, but also benefits organisations interested in implementing or maintaining BI. Organisations need a better understanding of the CSFs of BI in order to prioritise the use of their limited resources and achieve more value. The study also uncovered more CSFs and described various indicators that can be used to measure them. We welcome further input from scholars on these issues and will gladly share our data for further analysis upon request.

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