

Uncovering the antecedents to the effective use of business intelligence: lessons from a qualitative systematic review approach

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Abstract

Purpose – This study focuses on case studies to identify the antecedents to the effective use of business intelligence (BI). For decades, research has shown that post-adoption behaviour has a critical role in the success of technology adoption. Efforts have been drawn beyond intention and adoption point to the effective use of technology. In the case of BI adoption, its nature of discretionary use adds complexity to the equation. Despite the statistical evidence provided, research has indicated the need for other approaches to shed light on the antecedents of BI's effective use.

Design/methodology/approach – This study employs a systematic review approach to synthesise 20 years of related works from three major research databases. It focuses on qualitative and mixed-method research to identify new avenues in the related topic.

Findings – The findings provide the taxonomy of the antecedents. It identifies 40 antecedents grouped into 8 categories: technology, operational support, resources, governance, strategic, individual behaviour, environment and culture. It also highlights several organisation-specific and individual-specific antecedents, such as analytic leadership, business vision, collaborative working culture, organisational learning culture and user trust.

Originality/value – The study provides insight from interpretative case studies. It leverages the relevance of BI's research to its practices. It offers new avenues in the BI post-adoption studies at the organisational and the individual level of analysis.

Keywords Business intelligence, Effective use, System use, Systematic review, BI

Paper type Research paper

1. Introduction

Business intelligence (BI) offers the potential to support the decision-making process. Data-driven decision-making is critical in the current dynamic and highly competitive market

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(Lim and Teoh, 2020). Business intelligence as a technology-driven process has been recognised as an important part of scrutinising data and information to extract new knowledge. The effective use of BI evidently increases the effectiveness of all managerial practices (Richards *et al.*, 2019). It also increases the decision-making affordances, i.e. the ability to identify problems, develop alternatives and select possible actions that align with the organisation's strategic objectives (Cao and Duan, 2015).

BI focuses on strategic decisions, which are mainly performed by the executives. It is arguably a part of the larger system known as the decision support system (DSS). Arnott and Pervan (2008) states that the main aim of DSS is to support and improve the quality of managerial decisions. They further describe seven major sub-fields of DSS, including enterprise reporting and analysis systems. Based on its functionality, BI falls into this category. Furthermore, Phillips-Wren *et al.* (2021), in the same breadth, explain that DSS covers the transaction processing system, knowledge management and any information processing tools to support decision-making in the organisation. They emphasise that DSS handles a range of decision types by a range of various users, from operational to strategic level in the organisation. BI's main function, however, is to provide an analysis to support the organisation's strategic level. Thus, it is a subset of DSS. The recent development of BI as an IT artifact offers an enhanced analytics capability and a simplified use process. It is progressing toward democratising data analytics, i.e. involving the end user to perform their own analysis (Bani-Hani *et al.*, 2018; Imhoff and White, 2011).

Despite its promising benefits, it is also evident that the value of BI is through its use process, not merely from its adoption. By 2018, more than 87% of the organisations that adopted BI fell into the low-maturity category where BI initiatives happened in silos as a stand-alone project; hence, it struggles to optimise the value of BI investment (Gartner Inc, 2018). In their latest report, Gartner highlights the role of data-centric thinking in accelerating BI uptake. The latter emphasises the missing attention to data and analytics governance practices (James and Duncan, 2023).

The extant literature on BI use is progressing in a similar direction. Grounded on the research on information system use and success, researchers acknowledge the importance of studying *the way of using* the system to gain its net benefit (Seddon, 1997; DeLone and McLean, 2014; Maruping *et al.*, 2016). A stream of research scrutinises the construct of "use" to examine the underlying process better (Burton-Jones and Straub, 2006; Trieu *et al.*, 2022; Venkatesh *et al.*, 2008; Burton-Jones and Grange, 2013). The other stream expands the quest for the antecedents to the actual use (Thatcher *et al.*, 2018; Maruping *et al.*, 2016; Venkatesh *et al.*, 2008; Baird and Maruping, 2021).

The long history of scholarly work in technology adoption blurs the boundary between technology adoption stages. Roger's diffusion of innovation theory suggests that there are stages in innovation adoption and explains the stage of implementation follows after the adoption decision (Rogers, 2003). However, "adoption" and "implementation" are used interchangeably within scholarly works, including in the BI use research. Hence, a recent systematic review still identifies the missing linkage between antecedents and outcomes in the BI use process (Talaoui and Kohtamäki, 2021).

Despite the importance and the effort to study the actual use of BI, little did we know about how to use it effectively (Trieu *et al.*, 2022). The effective use is not a common lexicon in IS research. It refers to the way of using the system to help attain the user's goal of adopting the system, thus leading to a successful implementation (Burton-Jones and Grange, 2013). Other works with a similar breadth might not use the notion of "effective use"; however, they examine multiple dimensions of use, such as infusion, deep structure usage, extent of use, etc. (Grublješić and Jaklič, 2014, 2015; Trieu, 2023; Kim and Gupta, 2014).

Furthermore, there is a call for research on BI business value using case studies (Phillips-Wren *et al.*, 2021). Studying the value generation process of BI utilisation demanded deep insight into organisational context, human factors and their intertwines within the complex implementation process. Qualitative studies are particularly valuable for uncovering such a

rich, contextual understanding of how and why certain factors influence BI effectiveness. Therefore, amidst other reviews of BI's critical success factor, this study aims to answer the following question: "What are the antecedents to the effective use of BI that have been identified in the qualitative approach research?". To answer this question, we developed a rigid systematic review protocol to synthesise research papers focusing on the implementation stage and using a qualitative methodology. We develop a taxonomy of antecedents to the effective use of BI that consists of eight different categories, i.e. technology, operational support, resources, strategic, governance, culture, environment and individual behaviour. The findings shed light on the emerging organisation-specific themes in BI use research, e.g. strategy alignment, organisation's learning culture, and collaborative perspectives. It also identifies individual-specific themes, such as the user's trust and need for motivational support.

This paper is presented as follows. [Section 2](#) explains the background and past systematic reviews on the topic. [Section 3](#) details the systematic review protocol and reports the study selection process. It is followed by the taxonomy of the antecedents to the effective use of BI and its explanation in [Section 4](#). The practical implications and theoretical contributions of this study are explained in [Section 5](#). We then conclude this study in [Section 6](#).

2. Background

BI is well-known as an umbrella term that comprises techniques, processes and technology in the transformation process of raw data into new knowledge ([Trieu, 2017](#)). In a strategic context, BI is understood more as a way of thinking rather than merely a tool. Therefore, an effective use of BI could be measured by examining how it is diffused into the decision-making process. Some researchers look at the level of BI assimilation to measure BI's effective use ([Chaubey and Sahoo, 2021](#); [Elbashir et al., 2021](#)). [Trieu \(2023\)](#) uses the notion of BI infusion to measure the extent to which users adjust their way of performing tasks in response to the implementation of BI and how they innovate the utilisation of BI. Others measure the effectiveness by looking at the extent of BI use, which measures the degree to which user employ BI in their tasks ([Kim and Gupta, 2014](#); [Grublješič and Jaklič, 2015](#)).

Little is known about the linkages between the antecedents and the effective use of BI. Although the utilisation of BI has drawn research interest for decades, previous systematic reviews pinpoint that BI research is fragmented ([Talaoui and Kohtamäki, 2021](#)). [Shiau et al. \(2023\)](#) reviews the literature to identify the core knowledge of BI and suggest that future research should focus on the use process within the organisation. We examine other systematic reviews on BI implementation ([Table 1](#)). By doing so, we aim to complement the extant effort in studying the effective use of BI. We identify the need to depict a taxonomy of the antecedents to the effective use of BI.

The study by [Côte-Real et al. \(2014\)](#) studies the diffusion stages of BI and analytics. Their study suggests that there are four different stages in the scholarship attention, i.e. adoption, implementation, use and impact. Their study suggests that more attention is needed to study the use of BI as their review shows that most research is on the other three stages.

[Trieu \(2017\)](#) also supports the need to study the use process more. The study suggests the value creation process of BI consists of three stages. First is the BI conversion process; it is where the investment happens. In this stage, the financial resources are used to gain BI assets. Second is the use process, where the effective or ineffective use transforms the asset into impact. The last is the competitive process, where the output from the BI system is used to gain a competitive advantage. The importance of the use process in the value creation process suggests the call to examine it further.

Several other systematic literature reviews address the implementation of BI. [Ain et al. \(2019\)](#) synthesise studies on the adoption, use and success of BI. The review identifies key factors and challenges related to the adoption, use and success of BI. However, it does not further relate the factors to a specific topic. It categorises the factors into three categories,

Table 1. Previous systematic reviews of BI implementation

Authors	Review year coverage	Number of studies included	Analysis
Ain et al. (2019)	2000–2019	111	Research methods, theories, and key factors in BI adoption, use and success
Trieu (2017)	2000–2015	106	BI value creation process
Côrte-Real et al. (2014)	2000–2013	30	Diffusion stages of BlandA research
El-Adaileh and Foster (2019)	1998–2018	38	Factors related to successful BI system implementation
Adeyelure et al. (2018)	N/A	88	Determine contextual factors in mobile business intelligence deployment
Alabaddi et al. (2020)	2000–2020	64	Taxonomy of critical success factors of business intelligence implementation
Ali et al. (2018)	2004–2016	41	Identify antecedents to BI implementation that contribute to the organisation's agility
Becerra-Godínez et al. (2020)	N/A	37	Identify benefits and factors that influence the implementation of business intelligence
Kitsios and Kapetaneas (2022)	N/A	87	Propose a framework for BI development in the health sector
Mauludina et al. (2023)	2010–2020	27	Analyse the critical success factors of the self-service business intelligence

Source(s): Authors' own work

which are organisational perspectives, information system perspectives and individual perspectives. [Alabaddi et al. \(2020\)](#) identifies the critical success factors of BI implementation. It identifies the factors; however, no further categorisation is made. A similar work has been done by [El-Adaileh and Foster \(2019\)](#). The study identifies the ten most cited factors that are related to the success of BI implementation. The review also highlights the statistic that most of the studies target developed Western countries. However, it does not provide a complete taxonomy. It also might not report other factors identified as it only reports the top ten factors based on their appearance frequencies.

Several other systematic literature reviews cover either a specific type of BI tool or a specific research context. [Adeyelure et al. \(2018\)](#) review studies on mobile BI. A review of self-service BI has been done by [Mauludina et al. \(2023\)](#). [Ali et al. \(2018\)](#) review the literature in search of antecedents that relate to organisational agility. It assumes that BI implementation leverages the organisation's performance through organisational agility. [Becerra-Godínez et al. \(2020\)](#) focuses on the factors that influence small businesses to adopt BI, not the use of the system. [Kitsios and Kapetaneas \(2022\)](#) focus on the healthcare sector.

We respond to the call for further investigation on the effective use of BI. To deliver new insights for future research avenues, we focus our systematic review on the evidence brought by the qualitative research method. While quantitative studies have contributed significantly to BI research, they are often confirmatory. They statistically confirm a limited number of factors. On the other hand, qualitative research usually runs exploratory research, uncovering many more factors. Our goal was to synthesize not only the identified antecedents but also deeper explanatory insights on how and to what extent those antecedents affect the effective use of BI. Therefore, we could deliver new research opportunities based on the evidence of one specific research method to be examined with other approaches.

3. Research method

This study depicts the current research landscape by implementing a systematic review approach. A systematic review is a research method to synthesise the extant literature.

We follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page *et al.*, 2021) to address the research question.

3.1 Inclusion/exclusion criteria

The literature search is started by establishing inclusion and exclusion criteria. As this study aims to gather qualitative evidence, we include studies with a qualitative or mixed-method approach. We included only articles published in English and available in full length to ensure we could understand the deeper insights explored in the paper. To maintain the quality of the original studies, we decided to focus on peer-reviewed journal articles, and, in consequence, we excluded book chapters and conference papers. Our aim is to identify the antecedents to an effective use of BI. So, we exclude review papers, editorial, conceptual papers, highly technical papers that focus on algorithm development, and studies that do not focus on the causal relationship between BI use and its antecedent. We also excluded studies that do not focus on the actual use of BI. Our interest is in the actual use of BI which happened in the implementation stage. For example, we excluded studies focusing on the intention to use rather than the actual use. Lastly, this review looks for journal articles published in English between January 2000–August 2023 in accordance with this project’s resources and time frame. Table 2 summarises the inclusion/exclusion criteria of this systematic review.

Table 2. Inclusion/exclusion criteria

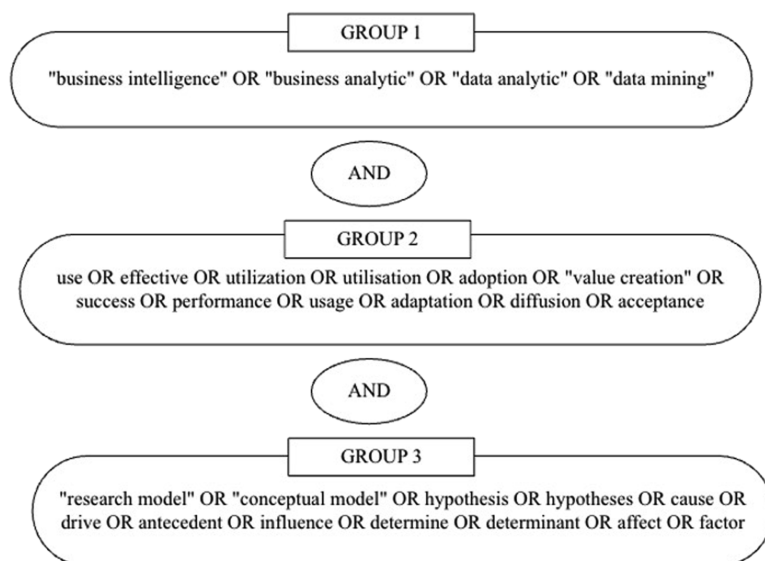
Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> • Full-length journal articles • Published between January 2000–August 2023 • Published in English • Study with a qualitative or mixed-method approach 	<ul style="list-style-type: none"> • Book chapters, review papers, conference papers and editorials • Conceptual papers • Highly technical papers focusing on algorithm development • Studies that do not focus on the actual use of BI • Studies that do not focus on the causal relationship between the constructs

Source(s): Authors’ own work

3.2 Search strategy

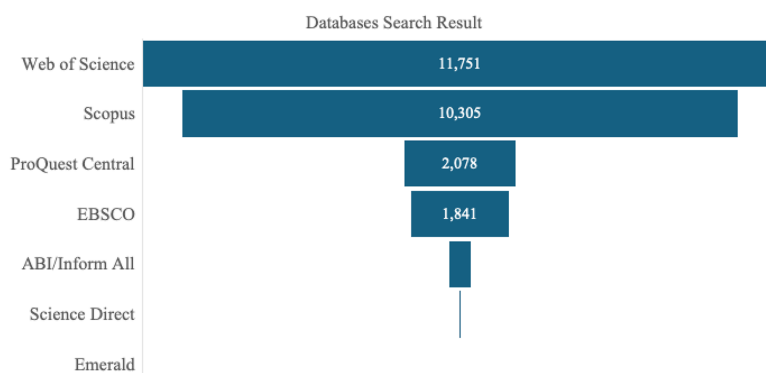
The literature search process started with a scoping review. At this stage, we aim for two major decisions: (1) to establish the keyword groups used to perform advanced search and (2) to identify the potential literature resources. Keywords are firstly taken from the literature. We then performed an advanced search on several databases and examined the search results. We refined the keyword groups based on the database search results and read more relevant literature on the topic. The process is iterative. From the refining process, three groups of keywords were used to identify the potential papers. The Boolean operator “OR” is used in each keyword group, and another Boolean operator, “AND”, combines the three groups. The complete keywords are listed in Figure 1.

Once the keyword set is established, it is implemented in databases of IS research. Then, we took samples from the first 100 search results and identified the number of relevant articles. The search result is depicted in Figure 2. We also run duplicate checks with the search results from other databases. We noticed that the search in Web of Science has a lot of duplications with Scopus. We eliminated databases that provide minimum identifiable results based on the inclusion/exclusion criteria or those that provide too many overlapping results with other databases. Therefore, we selected Scopus, ProQuest Central and EBSCO as the information sources.



Source(s): Authors' own work

Figure 1. Keyword groups

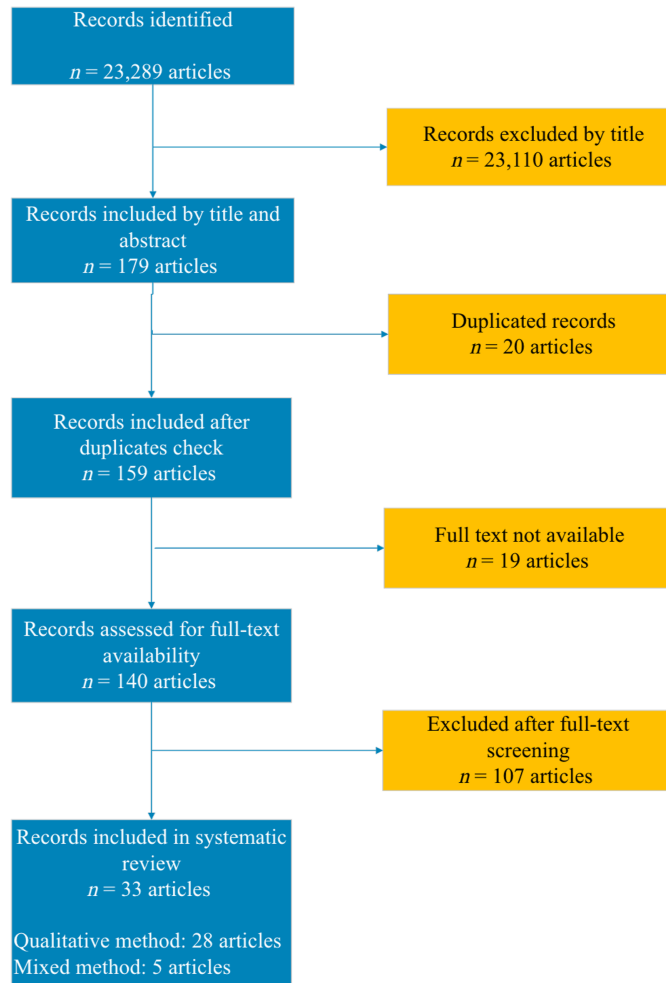


Source(s): Authors' own work

Figure 2. Database search result

3.3 Study selection

The keywords are applied through the advanced search of the databases. It resulted in 23,289 hits (Figure 3). The first screening is by reading the paper's title and abstract, and 179 articles are included based on this process. The next step is running a duplicate check on the 179 articles. This screening resulted in 20 duplicated titles. The remaining 159 articles are included in the next screening, which is the full-text availability. This screening process identifies 140 articles that are available in full length. We then read the full-length article to determine



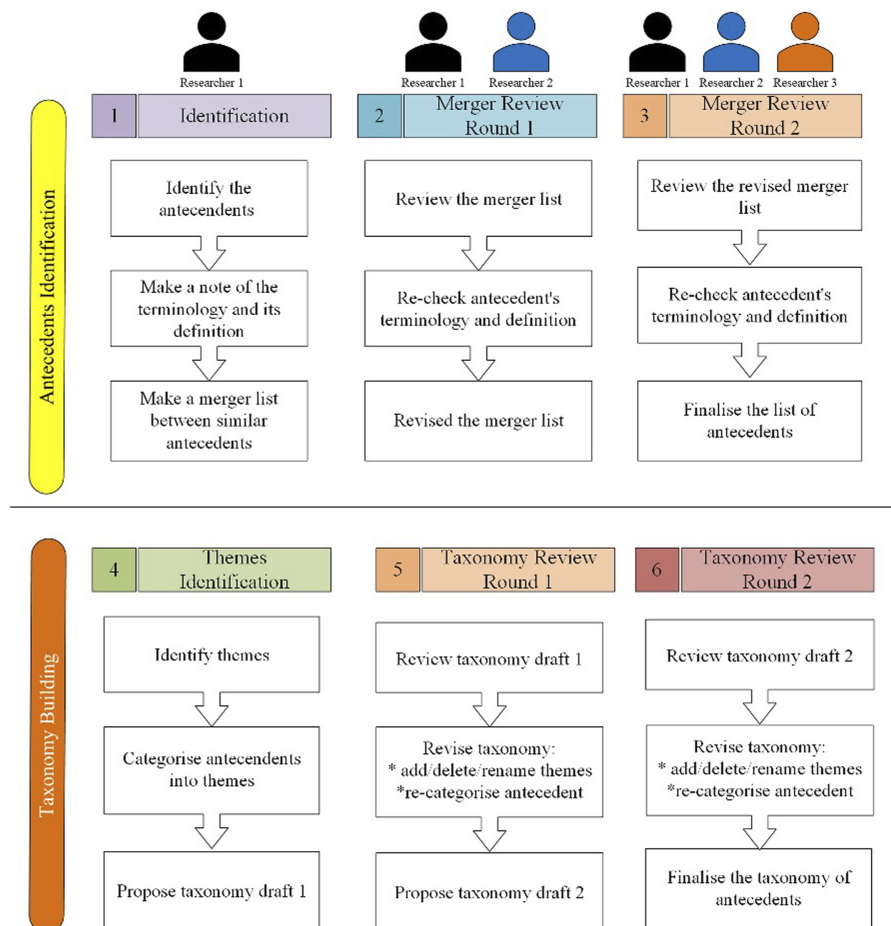
Source(s): Authors' own work

Figure 3. Study selection

whether it meets the inclusion/exclusion criteria. This final screening stage resulted in 33 articles included for data analysis. The article's details and its main findings are available in the [Supplementary Material Appendix 1](#) of this article.

3.4 Data analysis

Data analysis begins with the identification of antecedents and continues with the taxonomy-building process (Figure 4). In mixed-method research papers, data analysis is applied only to the qualitative part. We consider this sufficient because in five mixed-methods research papers in this study, the quantitative data analysis aims to establish the causal relationship between the variables, whilst the qualitative part explains the relationship. Thus, analysing only the qualitative part does not neglect the findings of the quantitative data analysis. This process



Source(s): Authors' own work

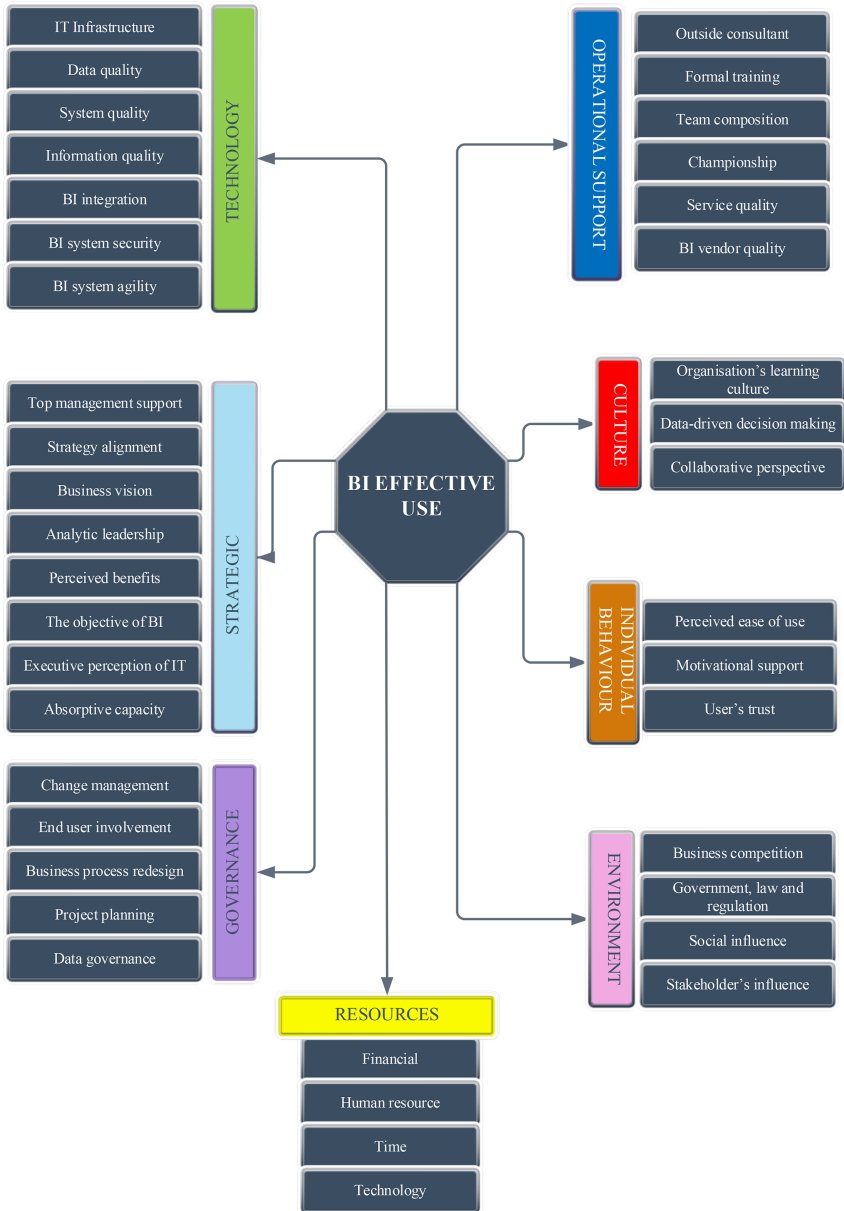
Figure 4. Data analysis process

resulted in 82 antecedents. We then read and focus on the definition or meaning of each mentioned antecedent. This is to saturate the list by merging similar antecedents. The merging process is performed twice to ensure the saturation. Forty antecedents are identified at the end of the process.

The next process is taxonomy building. We establish themes to build a taxonomy of the antecedents to the effective use of BI. We then categorise the antecedents into themes. This is also an iterative process, as depicted in Figure 4. Finally, based on 40 antecedents on the list, we grouped them into eight themes. The eight themes are correlated with BI implementation in an organisational setting. Two themes, i.e. technology and resources, are related to the organisation's readiness in terms of IT infrastructure, financial and human resources. Strategic, governance, operational support and culture are themes that comprise the underlying processes in BI implementation. The theme of environment includes external factors outside of the organisation. The last theme, individual behaviour, is related to individual users within the organisation.

4. Findings

A thematic analysis is used to analyse research papers. 40 antecedents are identified from the articles. Figure 5 depicts the taxonomy of the antecedents to the effective use of BI that has



Source(s): Authors' own work

Figure 5. The taxonomy of the antecedents to the BI effective use

been identified using the qualitative approach. The following sections afterward focus on how each antecedent impact the uptake of BI. To better understand the antecedents, we provide its description in the [Supplementary Material Appendix 2](#) of this article. It is based on the variable definition or description in the analysed research papers. This section will further emphasise how and why each antecedent affects the effective use of BI.

4.1 Technology

The technology theme consists of antecedents related to BI systems' hardware and software. It not only refers to the stand-alone BI system but also other enterprise systems. The literature emphasises the need for integration to enable a timely, fast and accurate analysis (Eder and Koch, 2018; Villamarín García and Díaz Pinzón, 2017; Bordeleau *et al.*, 2020; Gudfinnsson *et al.*, 2015; Abai *et al.*, 2019). The BI integration refers to two dimensions. The first is the BI system's fit connectivity within the whole technological environment (Eder and Koch, 2018; Olszak and Ziemba, 2012; Janyapoon *et al.*, 2021; Moreno *et al.*, 2019). IT infrastructure, therefore, is crucial. The hardware and software framework must be compatible with the BI application to optimise its performance, e.g. processing speed (Eder and Koch, 2018; Hoang and Bui, 2023; Yeoh and Popovič, 2016).

The second dimension is the integration between the BI system and business processes (Gudfinnsson *et al.*, 2015; Potančok *et al.*, 2021). Fink *et al.* (2017) explain that integrating the BI system into operational processes is the first step to gaining a competitive advantage. The degree of integration determines the level of BI maturity in the organisation (Potančok *et al.*, 2021). Data management is the core of this particular dimension. Data not only needs to be integrated but also standardised (Abai *et al.*, 2019). This means that it is necessary to maintain the data quality characteristics, e.g. accuracy, completeness, and relevance, as well as maintain a homogenous dataset across organisation functions (Eder and Koch, 2018; Yeoh and Popovič, 2016). This approach, then, could ensure the quality of the information produced by the BI application.

In terms of information quality, the literature suggests the need for information presentation that can be understood easily by others. A homogenous dataset not only ensures accuracy and consistency but also uniform terminology across different disciplines in the organisation (Gudfinnsson *et al.*, 2015). It reduces the chance of misleading data due to a different understanding of what the data actually measures. The literature also suggests that BI's unique functions in data presentation leverage information quality. Data presentation format, e.g. numerical vs graphic visualisation (Harison, 2012), enables users from different disciplines to understand the information more easily.

BI use is also impacted by the system's quality, as is with other information systems. However, several system quality dimensions have been highlighted in this study finding. First is the functionality. As BI is usually implemented subsequently as a complementary application, users stated that its functionality needs to be superior compared to other alternatives they use (Harison, 2012) or else they will be reluctant to use the BI application. This leads to the second highlighted quality dimension, BI agility. BI agility refers to the possibility of future adjustments in the BI system (Akhavan and Salehi, 2013). Technically, the BI system framework needs to be flexible for the adjustment (Yeoh and Koronios, 2010; Yeoh *et al.*, 2008). In terms of performance, agility refers to the response speed of the system to meet the change in the user's requirement (Olszak and Ziemba, 2012; Rezaie *et al.*, 2017). Without this agility, users might not continue, let alone increase their utilisation of BI.

The third highlighted dimension is BI security. The recent development offers a cloud-based BI application. Thus, security measures are important in collecting and storing the data (Abai *et al.*, 2019). It becomes more crucial when the organisation needs to maintain the privacy of the data they collect, for example, a bank that holds its customers' personal and financial data (Niazi, 2016a).

4.2 Strategic

The antecedents in this theme mention the factors that exist at the executive level. These factors relate to the strategic tasks of the management and underline the importance of top management support. Top management support is essential not only for providing resources in BI implementation but, foremost, to be involved in the overall implementation process. BI application is built on data integration and may require business process redesign. Hence, BI implementation would require a deep knowledge of business needs and involve high-level decisions (Moreno *et al.*, 2019; Villamarín García and Díaz Pinzón, 2017). The involvement also indicates strong sponsorship and legitimation (McCormack and Trkman, 2014), thus, it could help to overcome resistance. Studies show that top management teams with analytic leadership and a positive perception of information technology are present in a successful BI implementation. The leader's role is to drive a long-term strategy (Seddon *et al.*, 2017). They also trigger new performance indicators based on the BI application (Hoang and Bui, 2023).

The next highlighted antecedent is the strategy alignment. Aligning the BI with the company's strategy starts with understanding the needs of information expected from BI. These needs should be derived by linking the goals of BI implementation and the business strategy (Chaudhry and Dhingra, 2021; Sapp *et al.*, 2014). All related parties could then be informed about the expected result of BI utilisation. It would help them drive their effort to create an optimal use of the application (Yeoh and Popovič, 2016; Olszak, 2016). Hence, it highlights the need for a clear business vision.

The owner or the executive team must have a clear business vision before aligning the BI system with their strategic decision. A clear business vision enables the company to have a clear objective for their business (Eder and Koch, 2018) and further a clear strategic plan to achieve the objectives (Olszak and Ziemba, 2012). A BI system is offered as a tool to solve business problems, so it needs to be business-centric from the early stage of implementation (Rezaie *et al.*, 2017; Yeoh and Koronios, 2010; Yeoh *et al.*, 2008). This raises the pivotal role of BI objectives.

The objective of BI is predominantly derived from the previous business vision. Having clear BI objectives means translating the strategic links into tactical objectives. It determines what business problems it is intended to deal with (Eder and Koch, 2018). It could direct the use of BI in users' daily tasks so it could add value through a useable and valuable output (Bischoff *et al.*, 2015; Eder and Koch, 2018). The absence of clear and specific objectives might lead to a misconception of its functionalities and relevancy; thus, ultimately, decreasing users' perception of BI's usefulness and utilisation (Mansell and Ruhode, 2019).

Finally, studies identify an organisation's absorptive capacity as one of the antecedents. BI implementation is an evolving initiative. The ability to absorb and apply new knowledge is seen as a foundation for continuous learning and development within the organisation (Seddon *et al.*, 2017; Villamarín García and Díaz Pinzón, 2017). Thus, the organisation could explore new potentials and possibilities of BI use.

4.3 Information system governance

The theme of information system (IS) governance relates to the controls and management of the information system components through procedures and policies implemented by the company. IS governance is implemented through the information processing cycle, from data input to output dissemination. The importance of IS governance highlights the necessity of project planning. As with many other projects, it needs a qualified project leader, a clear project scope, and effective project planning (Janyapoon *et al.*, 2021; Olszak and Ziemba, 2012).

IS governance addresses the critical role of change management. It highlights the importance of the policies and procedures in the BI implementation. When a new technology is implemented, multiple technical steps are involved in transferring or, in this case, integrating the current system into the new one. It will be followed by changes in routines and, in some cases, even by organisation restructuring. It affects users' trust in BI (Janyapoon *et al.*, 2021).

Effective change management will provide a well-planned transition to reduce confusion in the organisation (Olszak and Ziembra, 2012; Rezaie *et al.*, 2017). Effective change management, as suggested in Yeoh *et al.* (2008) and Yeoh and Koronios (2010), addresses the users' participation in every stage of implementation. Bischoff *et al.* (2015) suggest that all the changes and process adjustments must be communicated and agreed upon beforehand. Thus, the process is transparent to users. Studies show it could deliver a better persuasion so users are willing to change and, at the same time, create a structure to sustain long-term BI use (Moreno *et al.*, 2019; Eder and Koch, 2018; Olszak and Ziembra, 2012).

The next antecedent in this theme, the end user involvement, further emphasises the critical role of the end user in the use process. Interactive user participation could be helpful in acquiring vital information needs and format requirements (Chaudhry and Dhingra, 2021). Participating in systems development also increases users' trust and acceptance (Bischoff *et al.*, 2015; Eder and Koch, 2018). Users' participation could be achieved through regular meetings, constant information exchange and formal training.

Business process redesign may explain why the involvement of the end user is essential. With a new system implemented, some of the operational processes and users' daily tasks will certainly need to be adjusted. The adjustments aim to incorporate BI in relevant tasks while ensuring that the new process still meets the business needs for timely information (Eder and Koch, 2018; Moreno *et al.*, 2019; Olszak, 2016; Olszak and Ziembra, 2012; Villamarín García and Díaz Pinzón, 2017).

Evidently, IS governance also includes data governance. The use of BI enables the utilisation of multiple data sources to create value. It can be an internal and external data sources (Potančok *et al.*, 2021; Ratia, 2018). Insufficient planning to manage and integrate data diversity might lead to suboptimal BI (Sapp *et al.*, 2014). Data management, therefore, is needed to organise and maintain data quality (Janyapoon *et al.*, 2021). Well-structured data enables the information to be reconciled back to the source, indicating that the data flow is complete and accurate. Hence, it will provide the user with confidence that the BI application is reliable (Niazi, 2016a).

4.4 Resources

Resources play an inevitable role in the effective use of BI. The availability of basic resources, such as financial resources and time, and their allocation are standard requirements (Eder and Koch, 2018; Janyapoon *et al.*, 2021). These two fundamental resources enable the acquisition of IT resources. In addition to the mentioned resources, the research emphasises the intellectual resources (Villamarín García and Díaz Pinzón, 2017). In the context of BI, Potančok *et al.* (2021) address the importance of acquiring talents that fully understand the field. This not only refers to the ability to use BI but also to perform the analytics that meet the business needs. The same principle applies to the selection of BI-specific technology, such as BI application. It is best to select applications that functionally fit with the current organisation's requirements (Seddon *et al.*, 2017). BI that is relevant to operational tasks will enable potential direct effects on operational performance (Mansell and Ruhode, 2019; Abai *et al.*, 2019). Therefore, the company needs to determine its sourcing strategy to meet the requirements in terms of quantity and quality.

4.5 Operational support

The antecedents in this theme all support the extent of BI use in day-to-day operations. Support can be both external and internal. From the external, users receive significant support from a high-quality BI vendor and their service quality. The support will help users to gain trust and be willing to learn more about the application. To facilitate this condition, first, users need to select a reliable BI vendor, meaning that the vendor has demonstrated experience in delivering the BI application into operation (Eder and Koch, 2018). Second, the BI vendor is also expected to provide continuous after-sales service, especially for technical troubleshooting

(Harison, 2012). Furthermore, third, it is possible to build a partnership for knowledge sharing to enhance BI utilisation. Users see BI vendors as one of the specific knowledge sources and as more experienced parties. In some cases, however, this role can be facilitated by an outside consultant. A consultant for the initial implementation can support organisations. However, it could be developed into a knowledge-sharing partnership through information exchange and formal training sessions (Farzaneh *et al.*, 2018; Yeoh and Popovič, 2016). It helps users to understand the possibilities of the BI's effective use. Organisations could also consider outsourcing some specific analytic projects that need more advanced skills to the consultant (Ratia, 2018).

In the internal organisation, a mixed-team composition, a “champion”, and formal training are named as the critical antecedents to BI use. Case studies highlight the need for technical and business knowledge when it is related to BI use in decision-making. One approach is to have a team with mixed skills. This is possible in organisations that prefer to have a centralised BI team. A combination of technical data analytics skills and business knowledge could increase BI capabilities in operational tasks (Bordeleau *et al.*, 2020). Another approach is to develop internal expertise through formal training. Training is not just an opportunity to enhance skills but also to promote the potential of BI. It is critical for the users to understand the relevance and importance of BI in their individual tasks. Training, either in the early implementation stage or later, also makes the users feel involved and increases their acceptance (Moreno *et al.*, 2019; Eder and Koch, 2018). Having a “champion” in the BI team or among the entire organisation is seen to be conducive to BI uptake. A “champion” promotes innovation and persuades other individuals about the benefits. To be able to do so, a champion should possess knowledge and experience in BI applications (Villamarín García and Díaz Pinzón, 2017). Even more interesting is one of the studies suggesting that the “champion” would be better to be a business-centric individual. Thus, the “champion” could foresee the strategic benefit of BI rather than focusing excessively on the technical issues in BI use (Yeoh *et al.*, 2008).

4.6 Culture

Culture is a theme related to shared values, beliefs and work systems within the organisation. Potančok *et al.* (2021) mention company culture as one of the prerequisites, as its absence can be a limitation. Culture can be a barrier to leveraging the utilisation of BI, however, it could also be challenging to build (Hoang and Bui, 2023).

The first factor in this category is the learning culture. Learning culture also means there is a continuity in the development approach. An organisation with a learning culture will continuously evolve to sustain the alignment between BI initiatives and business goals (Gudfinnsson *et al.*, 2015). It is an iterative process to nurture a multi-dimensional decision-making process, explore the future application and exploit current practices to leverage the BI use (Bordeleau *et al.*, 2020; Frisk and Bannister, 2017).

The second factor is the culture of data-driven decision-making or analytic culture. Moreno *et al.* (2019) explain this culture as emphasising high-quality data analysis as the basis of every decision-making activity. Abai *et al.* (2019) state that decision-making is a process of information acquisition leads to an analysis. Therefore, decision-making is a fact-based activity (Olszak, 2016). McCormack and Trkman (2014) explain how an analytic culture drives the effective use of BI. An analytical culture will raise the need for information. With a simultaneous increase in the need, the user will change their attitude to meet the demand. Thus, the user will increase their actual use of BI.

The third factor is the collaborative perspective. Frisk and Bannister (2017) suggest the shift from an individual perspective to a collaborative perspective in the decision-making culture might increase the use of analytics. Furthermore, collaboration also means shifting to a more diverse value perspective rather than a single value perspective. For example, the decision that is predominantly based on technology *per se* shifts to be based on multiple

considerations across the organisation. The study addresses a communication transformation as the key to the shift. Other research supports this by addressing the importance of partnerships between IT and business users (Akhavan and Salehi, 2013; Eder and Koch, 2018; Moreno *et al.*, 2019; Rezaie *et al.*, 2017).

4.7 Individual behavioural

The individual behaviour theme includes all factors that affect individual behaviour and attitude when using BI. Perceived ease of use is the first factor discussed in this theme. A user-friendly interface influences the user's behaviour when interacting with the BI system (Bischoff *et al.*, 2015; Mansell and Ruhode, 2019; Olszak and Ziemba, 2012). The user might prefer one system over another based on its usability (Bischoff *et al.*, 2015; Niazi, 2016a) or portability (Niazi, 2016a).

Motivational support is the second antecedent in this theme. Based on motivation theory, an individual has intrinsic and extrinsic motivation to perform certain behaviours (Bargshady *et al.*, 2015). Studies have identified the need for motivational aid or support to encourage the use of BI (Harison, 2012; Olszak, 2016). It indicates the user needs encouragement that could drive their intrinsic motivation to build their analytics habit (Olszak, 2016).

The third antecedent is the user's trust. Field Bischoff *et al.*'s (2015) study suggests that users need to be able to trust the system's analytic output. The result of the analysis needs to be accurate; however, it is also important that the user recognises its value so they can trust the system and rely on it. Olszak (2016) emphasise that all users within the organisation need to have trust in the BI system. Trust, combined with motivational support, is essential in cultivating the organisation's learning culture.

4.8 Environment

The environment theme includes the antecedents that relate to an organisation's external and internal environments. From the external organisation's point of view, a competitive business environment puts pressure on the uptake of relevant technology, such as BI. It is not merely a matter of following the trend but because the organisation realises the necessity to gain a competitive advantage. The other external pressure may come from the government and regulation bodies. The organisation may be required to provide specific reporting and analysis in compliance with the law and regulation. In most cases, it can be beyond the standard reports. Thus, BI can facilitate the need for advanced analytics (Mansell and Ruhode, 2019; Hoang and Bui, 2023; Potančok *et al.*, 2021).

In the organisation's internal environment, stakeholders are critical in the uptake of BI initiatives. Direct and indirect interactions with business partners or other stakeholders could facilitate co-value creation. Business partners can be informed so they can provide the data needed. The analysis could benefit not only the organisation but also their business partners. For example, supply chain efficiencies, customer relationships, etc (Jayashankar *et al.*, 2020; Janyapoon *et al.*, 2021). For individual users, peer influence is an effective driver for enhancing BI use. Research suggests that BI use could be driven by increasing the information needs on the individual level. Hence, executives must maintain BI "visibility" in organisations by making information a basic requirement in every decision-making process (Mansell and Ruhode, 2019; McCormack and Trkman, 2014).

5. Discussion

This systematic review gathers evidence of the antecedents to the effective use of BI from more than two decades of research. Specifically, it focuses on the qualitative research papers on the topic. This approach enables the identification and analysis of nuanced patterns in organisational dynamics and user behaviours in BI utilisation that might not be captured in quantitative analysis. This review covers over two decades of BI research and identifies 33

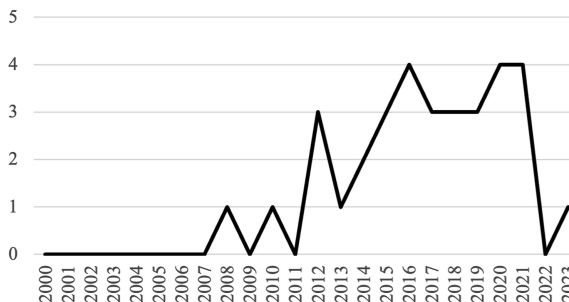
relevant studies. It is worth noting the works of authors with two or more papers. Niazi's two studies focus on the critical success factors in cloud BI implementation (Niazi, 2016a, b). Olszak's two papers provide insight into BI implementation in small businesses (Olszak and Ziemba, 2012; Olszak, 2016). Three studies by Yeoh provide a rigorous critical success factors framework development in BI implementation for organisation (Yeoh and Popovič, 2016; Yeoh et al., 2008; Yeoh and Koronios, 2010).

Furthermore, Figure 6 depicts the number of papers identified in this study by their year of publication. It shows that qualitative studies on the actual use of BI emerged in 2008 and continued a positive trend afterwards. This may indicate the shift of interest from BI adoption to beyond BI adoption, i.e. the actual use of BI in the implementation stage.

The analysis across the two decades of study themes also shows a shift in interest. Before 2014, the research efforts focused on identifying the critical success factors of BI use. However, the interest progressed to understanding more about the BI use process. From 2014 onwards, there has been a rise in BI's continuous and sustainable use. Studies pay more attention to "use" as a construct. For example, conceptualise use as a multi-dimensional construct (Grublješić and Jaklič, 2015) or determine different levels of BI utilisation (Gudfinnsson et al., 2015). Research also tends to understand BI use as a continuous and evolving process. The shifted point of view leads to the discovery of new antecedents and how they contribute to leveraging BI's impact on the business value (Bischoff et al., 2015; Seddon et al., 2017; Bordeleau et al., 2020; Jayashankar et al., 2020). The discovery of new antecedents is also driven by BI technology development, such as cloud-based BI tools (Niazi, 2016a, b; Owusu, 2020).

We identify eight groups of antecedents to the effective use of BI, i.e. technology, strategy, governance, resources, operational support, culture, individual behavioural factors and environment. From a broader view, those are related to the social and technical aspects of BI use. The technical aspects are necessary conditions and also critical to the extent of BI use. The taxonomy shows the established technology variables related to technology adoption are still in place. The highlight in the BI context might be the critical part of the data quality (Yeoh and Popovič, 2016; Yeoh et al., 2008; Seddon et al., 2017). A recent meta-analysis on the Unified Theory of Acceptance and Use of Technology (UTAUT) provides quantitative support for this finding. The meta-analysis shows that performance and effort expectancy are still strong predictors of technology use (Blut et al., 2022). Thus, the technical quality dimensions are a basic requirement in the sustainable use of BI. However, this review reveals more of the social aspects of BI use.

Yeoh and Koronios (2010) explain that social aspects have a greater impact on BI use than technical aspects. A meta-analysis shows that human resources and organisational culture are



Source(s): Authors' own work

Figure 6. Number of identified papers by year of publication

part of the social factors that deliver a greater impact on technology use than technical factors (Oesterreich *et al.*, 2022a, b). BI's effective use is an evolving process that requires a major shift in the organisation's culture. The habit of creating, acquiring, and transferring knowledge significantly impacts BI effectiveness in a positive direction. The organisation has a dynamic capability to modify its behaviour according to the acquired insights (Arefin *et al.*, 2020; Danielsen *et al.*, 2021). Although the aforementioned learning culture is a prerequisite, a data-driven culture is named the ideal environment where BI initiatives could bring their full potential. The absorption of information and its utilisation is enhanced in an environment where the decisions are based on rationality, i.e. on available information (Popović *et al.*, 2012). In the context of BI, data-driven culture evidently has a significant positive impact on the BI use level (Trieu, 2023).

Furthermore, shaping the organisation's culture will most likely correlate to the users' characteristics and behaviour. This study identified trust as one of the antecedents of user behaviour that is worth further investigation. Case studies show that trust in the BI output is crucial in nurturing the new culture (Bischoff *et al.*, 2015; Olszak, 2016). Trust as a construct has been studied in other IS topics, such as accounting information systems and knowledge management. Statistic evidence explains that trust positively affects the intention to use as users with high trust in the particular IS tend to perceive it as useful (Al-Okaily *et al.*, 2023; McKnight *et al.*, 2011; Thatcher *et al.*, 2010). However, to be able to trust BI applications, studies also address the importance of users' analytic skills to justify the BI's performance. The recent findings highlight the sustainable use of BI as a collaborative process, meaning that related skills and knowledge could be co-created in collaboration with external parties (Tsoy and Staples, 2021; Frisk and Bannister, 2017).

In a general view, this study's findings align with previous systematic reviews on the topic. Three general perspectives of antecedents are in the interplay of a successful BI adoption: (1) organisation perspective, (2) IS perspective and (3) individual user perspective (Ain *et al.*, 2019). Given the importance of social-themed antecedents, it is worth mentioning that we know little about the impact of managerial and leadership characteristics on BI uptake. We also need to understand more about how the organisation's external environment differs in the degree of BI use, e.g. developed vs developing economy (Talaoui and Kohtamäki, 2021). The scholarship interest is moving in a suitable direction. Future efforts could fill the gap in BI use research.

5.1 Implications for practitioners

Identifying the antecedents provides critical highlights for the executives or the top management, the IT department and the human resource department. Firstly, a clear objective must be included in the decision to adopt a BI technology. The executive team might need to envision the role of BI in the overall organisation's strategy. The executives might specify the types of decisions that will be supported by BI depending on the business goals. The IT team could further translate it into the operational level through a change management process. It might include documentation of detailed plans for BI implementation, including the expected output, required data input and potentially affected processes. It is also necessary to introduce goal setting to every level so each individual can picture the benefit of BI for themselves and the organisation's performance. For example, the executives could introduce BI in small-scope analytic projects so the involved employees could experience how BI is related to their individual tasks and contribute to the general organisation's goal.

Second, analytic leadership at the top management level might also leverage the extent of BI use. This is highly correlated with the need for a data-driven culture within the organisation. In nurturing this, case studies show that the acceptance of BI is faster with a top-down approach rather than bottom-up. It is suggested that the top management level have relevant IT knowledge in BI and also demonstrate its utilisation continuously. Furthermore, the user needs motivational support to use the system. One kind of support is the encouragement from their superiors.

Third, the user's trust is also important in their continuous use of BI. The user's trust in the general BI performance and its output reliability increases their perception of BI usefulness (Bischoff *et al.*, 2015). Research finds in the high-maturity BI organisations that the users also highly trust the BI system they use (Olszak, 2016). The IT support or the development team could help them acquire an acceptable level of assurance of the BI application performance. The technical aid might also make it easier to use. Combined with the feeling of being supported, it might encourage the user to extend their use. The human resource department could also consider assigning a "champion" to a smaller task group. The presence of a person who shows a deep understanding of the systems and openly shares experience could induce user trust, especially in the lower management team.

Fourth, the organisation's culture is critical in a successful BI uptake. Three major themes have been identified to be correlated to effective BI use. First, the data-driven culture. It refers to the utilisation of data in the decision-making process. However, it does not refer to the absence of heuristic decisions. It is beneficial to build a data-driven culture for operational and tactical decisions, which means every decision is informed by relevant information. The second theme is the collaborative perspective. It nurtures inter-departmental collaboration in problem-solving. It drives the independence of every team member to perform data analytics and gather insights from their unique perspectives. The last theme in culture is the organisation's learning culture. It highlights the reality that an effective use of BI happens in a learning curve. It implies that continuous learning leads to the advancement of use. Thus, it results in a greater impact and benefit of BI adoption.

5.2 Theoretical implications

We systematically review research papers on the effective use of BI that employ a qualitative approach. The taxonomy built on the findings depicts eight different themes of antecedents to the effective use of BI. In addition to the technical-related themes such as technology, operational support and resources, this study highlights other themes related to the organisational and personal characteristics of BI users. We suggest further research agendas based on what has been known about the aforementioned antecedents.

The literature highlights the strategic part of a successful BI implementation. The adoption and implementation of BI must be preceded by a clear business vision. It also indicates that users might adopt and implement BI for different purposes. Future research could investigate to what extent those different purposes lead to the effective use of BI and how it impacts the measurement of an effective BI from the users' perspective.

Research also finds the importance of a collaborative perspective in the work culture. However, it also mentions the critical role of analytic leadership. The latter might hint at nurturing a supportive culture in an effective BI uptake. Future research might investigate the effective use of BI in different organisational structures and leadership styles. Studies found that bureaucratic structure might not be compatible with the BI environment as it usually has a tight chain of command. Reducing the hierarchies in the pyramid organisation structure could increase the use of BI (Zafary, 2020). Organisation structure represents the communication and the authority structure within it. Rather than looking at the structure's form, what really matters is the governance and the culture within the organisation (Oesterreich *et al.*, 2022b). The literature suggests that BI initiatives need to be nurtured in a collaborative work culture. Future efforts might address this opportunity by looking deeper at the organisation structure's dimensions to investigate how the communication style and authority structure affect BI implementation.

A longitudinal study might shed light on the cultural transformation process following the implementation of BI. The evidence shows the critical role of the organisation's learning culture. It indicates the necessity of continuous adjustments to gain value from BI implementation. Studying the cultural aspects in a longitudinal study might explain how an organisation can build its agility to optimise BI's business value.

In addition to the organisation-specific antecedents, the literature identifies the individual-specific factors. One of the interesting factors in this category is trust. This factor gains importance in the upcoming enhanced role of artificial intelligence (AI). Users face the application of AI in various well-known technologies, including BI. The assistance of AI in performing data analytics might be beneficial. However, it also raises the trust issue between users and the BI application. Figalish *et al.* (2022) identify one of the inhibitors of AI-based BI is the scepticism toward the analysis quality. The results are seen as being less useful and even require additional effort. One example of this could be seen in text analysis by Natural Language Processing (NLP). With deep learning put in place, users could not exactly understand the machine learning process that leads to the result. The lack of transparency in the process tends to increase users' doubts. Hence, they tend to hesitate to use it (Kim *et al.*, 2020). A further investigation into this particular factor is needed to understand how AI-embedded BI could benefit users.

5.3 Study limitation

The study utilized major academic databases including Scopus, Web of Science, ProQuest, and EBSCO, which collectively index a significant portion of scholarly publications in this field. While these databases provide comprehensive coverage, we acknowledge that additional relevant papers might have been identified through searches in other databases such as IEEE Xplore, ACM Digital Library or regional databases from emerging economies. However, given resource constraints, including time, budget and personnel limitations, we had to prioritize the most comprehensive and widely used databases for our systematic review. Future studies could expand the search scope by incorporating these additional databases, particularly those focusing on specific regions or specialized subject areas, which could potentially yield valuable insights from previously unexplored sources.

We also acknowledge that even though this study approach allowed us to identify and analyse nuanced patterns in organisational dynamics and individual behaviour in BI utilisation, the chosen approach might limit the generalisability of the findings. A separate systematic review focusing solely on quantitative findings would be a valuable complementary contribution to the field.

Furthermore, there is no rigid distinction between BI's implementation stages. We only include research papers that focus on the post-adoption point or the implementation process of BI as part of the screening process. However, it is not feasible to determine the extent or the level of BI utilisation in the research paper. Thus, it might affect the result.

6. Conclusion

The current research landscape shows that the actual use of BI is a multi-dimensional issue. Business intelligence aims to support decision-making by data-driven insights. Its utilisation is voluntary, and its business value most likely depends on how it is utilised. We posit that the aim is the effective use of BI, i.e. the utilisation of BI to assist the user in attaining their goal. Thus, it involves the interplay between technology and the user. Based on the extant literature of qualitative research, we depict the taxonomy of the antecedents to the effective use of BI. It consists of eight categories, i.e. technology, strategic, governance, resources, operational support, culture, individual behaviour and environment. The findings draw attention to the strategic-related variables, especially at the organisation level of analysis. The effective use of BI is highly correlated with the alignment between business vision, strategy and BI implementation. It also needs to be implemented in a collaborative and data-driven work culture. Following the identification of the antecedents, we propose several research agendas. Future research efforts could provide further evidence on the effective use of BI at the organisation and individual level of analysis.

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Table A1. List of articles

Authors	Year	Article title	Journal title	Database	Main findings
Abai, N. H. Z.; Yahaya, J.; Deraman, A.; Hamdan, A. R.; Mansor, Z.; Jusoh, Y. Y.	2019	Integrating Business intelligence and analytics in managing public sector performance: An empirical study	<i>International Journal on Advanced Science, Engineering and Information Technology</i>	Scopus	The result of the study revealed four integrated factors of the BIA and OPM implementation, such as skill, documentation, visualization, and work culture. Finance, data management, software, strategic planning, and decision-making are other factors integrated with BI, BA, and OPM respectively
Bischoff, S.; Aier, S.; Haki, M.K.; Winter, R.	2015	Understanding Continuous Use of Business Intelligence Systems: A Mixed Methods Investigation	<i>Journal of Information Technology Theory and Application</i>	ProQuest Central	Confirms the significant influence of users level of trust on BI's perceived usefulness. It also confirm the impact of information quality to trust. Introduce new constructs that impact BI continuous use: influence of the organisation, coverage of user requirements, user support, influence of peers, and governance constructs
Bordeleau, F. E.; Mosconi, E.; de Santa-Eulalia, L. A.	2020	Business intelligence and analytics value creation in Industry 4.0: a multiple case study in manufacturing medium enterprises	<i>Production Planning and Control</i>	Scopus	Findings suggest enterprises resources and capabilities are not sufficient to predict business value: organizational learning and organizational culture have a non-negligible influence for MEs
Chaudhry, K.; Dhingra, S.	2021	Modeling the critical success factors for business intelligence implementation: An ISM approach	<i>International Journal of Business Intelligence Research</i>	Scopus	Classifying and categorising dominant and facilitating factors of BI implementation. Driving factors: management support, business goal alignment, project resources, team skills. Linkage factors: system quality and data quality. Dependent factors: user participation, BI implementation

(continued)

Table A1. Continued

Authors	Year	Article title	Journal title	Database	Main findings
Dawson, L.; Van Belle, J.	2013	Critical success factors for business intelligence in the South African financial services sector	<i>South African Journal of Information Management</i>	ProQuest Central	Regarded committed management support and champion; business vision; user involvement; and data quality as the most critical factors in BI implementation
Deng, X; Chi, L.	2012	Understanding Post adoptive Behaviors in Information Systems Use: A Longitudinal Analysis of System Use Problems in the Business Intelligence Context	<i>Journal of Management Information Systems</i>	Business Source Complete	Causal relationship between system-use problem and its causes
Eder, F.; Koch, S.	2018	Critical success factors for the implementation of business intelligence systems	<i>International Journal of Business Intelligence Research</i>	Scopus	There are critical success factors mentioned by experts that have not been mentioned in the literature. Some prominent new factors: usability in term of self-service analytics, data catalogue. Dedicated BI unit
Farzaneh, M.; Isaai, M. T.; Arasti, M. R.; Mehralian, G.	2018	A framework for developing business intelligence systems: a knowledge perspective	<i>Management Research Review</i>	Scopus	Interaction with BI vendor, specifically the knowledge transfer process, has a crucial impact in BI development
Frisk, J. E.; Bannister, F.	2017	Improving the use of analytics and big data by changing the decision-making culture: A design approach	<i>Management Decision</i>	Scopus	Using a design approach (representing-designing-evaluating) to change an organisation's decision-making culture into a collaborative and systematic decision-making process
Grublješić, T.; Jaklič, J	2015	Conceptualization of the business intelligence extended use model	<i>Journal of Computer Information Systems</i>	Scopus	Develop a multi dimension BI use model and its determinants. The multi dimension BI use model includes intensity, extent, and embeddedness of use

(continued)

Table A1. Continued

Authors	Year	Article title	Journal title	Database	Main findings
Gudfinnsson, K.; Strand, M.; Berndtsson, M.	2015	Analysing business intelligence maturity	<i>Journal of Decision Systems</i>	Scopus	Identify common BI implementation pitfalls: conceptual data modelling (data concepts and definition), legal requirement for data storage, analytic culture
Harison, E.	2012	Critical success factors of business intelligence system implementations: Evidence from the energy sector	<i>International Journal of Enterprise Information Systems</i>	Scopus	Established the pivotal role of IT dept. First: develop in-dept knowledge on business process and the decisions made by user. Second: understand user's information needs
Hoang, T. G.; Bui, M. L.	2023	Business intelligence and analytic (BIA) stage-of-practice in micro-, small- and medium-sized enterprises (MSMEs)	<i>Journal of Enterprise Information Management</i>	Scopus	Propose three stages of BIA adoption in MSMEs including enablers and barriers
Janyapoon, S.; Liangrokaptart, J.; Tan, A	2021	Critical Success Factors of Business Intelligence Implementation in Thai Hospitals	<i>International Journal of Healthcare Information Systems and Informatics</i>	Scopus	The study found that the upskilling of the management team in IT skills might be more effective
Jayashankar, P.; Johnston, W.J.; Nilakanta, S.; Reed, B.	2020	Co-creation of value-in-use through big data technology- a B2B agricultural perspective	<i>The Journal of Business and Industrial Marketing</i>	ProQuest Central	Co-creation increase value-in-use of data analytic. Co-creation with any stakeholders could be a direct and indirect relationship
Mansell, I.J.; Ruhode, E.	2019	Inhibitors of business intelligence use by managers in public institutions in a developing country: The case of a South African municipality	<i>South African Journal of Information Management</i>	ProQuest Central	Identify inhibitors of BI use in developing country
McCormack, K.; Trkman, P.	2014	The influence of information processing needs on the continuous use of business intelligence	<i>Information Research</i>	Scopus	Sustainable and optimal use of BI needs a permanent increase of information needs. Thus, it is necessary to nurture a data-driven culture
Moreno, V.; da Silva, V.; Lobo, F.E.; Rodrigo, F.; Filardi, F.	2019	Complementarity as a Driver of Value in Business Intelligence And Analytics Adoption Processes	<i>Revista Iberoamericana de Estrategia</i>	Business Source Complete	IT, organisational capacities, and resources complemented and strengthened each other in BI implementation

(continued)

Table A1. Continued

Authors	Year	Article title	Journal title	Database	Main findings
Niazi, H.; (2016a)	2016	Strategy, action plan and approaches for business intelligence in banking and mining	<i>Asian Journal of Information Technology</i>	Scopus	Analysis on BI's CSF in two different business sectors, banking and mining. Several identical factors found in those sectors are related to BI strategy deployment. The strategy covers processes, technology and governance
Niazi, H.; (2016b)	2016	Critical success factors for cloud BI implementation within a banking organisation	<i>Asian Journal of Information Technology</i>	Scopus	Develop CSFs framework for cloud BI implementation
Olszak, C.M.; Ziemba, E.	2012	Critical success factors for implementing business intelligence systems in small and medium enterprises on the example of upper Silesia, Poland	<i>Interdisciplinary Journal of Information, Knowledge, and Management</i>	Scopus	Identify CSFs of BI implementation in SMEs from organisation, process and technology perspective
Olszak C.M.	2016	Toward Better Understanding and Use of Business Intelligence in Organizations	<i>Information Systems Management</i>	Business Source Complete	BI requires a permanent development. It needs to be assessed scientifically
Owusu, A.	2020	Determinants of Cloud Business Intelligence Adoption Among Ghanaian SMEs	<i>International Journal of Cloud Applications and Computing</i> 3	Scopus	Owner/manager's innovativeness and IS knowledge plays critical roles in SME's BI utilisation
Potančok, M.; Pour, J.; Ip, W.	2021	Factors influencing business analytics solutions and views on business problems	<i>Data</i>	Scopus	Provide taxonomy of key factors, grouped into business environment factor, company environment factor, and market environment factor
Ratia, M.	2018	Intellectual Capital and BI-tools in Private Healthcare Value Creation: EJKM	<i>Electronic Journal of Knowledge Management</i>	ProQuest Central	Intellectual capital (IC) play a major role in the BI value production. The IC source could be internal or external
Sapp, C. E.; Mazzuchi, T.; Sarkani, S.	2014	Rationalising business intelligence systems and explicit knowledge objects: Improving evidence-based management in government programs	<i>Journal of Information and Knowledge Management</i>	Scopus	Provide a rationalisation framework to determine the information and BI requirements in the organisation

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Table A1. Continued

Authors	Year	Article title	Journal title	Database	Main findings
Seddon, P.B.; Constantinidis, D.; Tamm, T.; Dod, H.	2017	How does business analytics contribute to business value?	<i>Information Systems Journal</i>	Business Source Complete	Provide Business Analytics Success Model (BASM). A model of key insights in BA literature
Tsoy, M.; Staples D.S.	2021	What Are the Critical Success Factors for Agile Analytics Projects?	<i>Information Systems Journal</i>	Business Source Complete	Use an agile approach to update the success factors of BI implementation. The factors are related to five dimensions, i.e. organisational, people, process, technical, and project
Villamarín García, J.M.; Díaz Pinzón B.H.	2017	Key success factors to business intelligence solution implementation	<i>Journal of Intelligence Studies in Business</i>	Business Source Complete	Identified “professional network” as one of key CSF identified by experts
Werder, K.; Seidel, S.; Recker, J.; Berente, N.; Gibbs, J.; Abboud, N.; Benzeghadi, Y.	2020	Data-Driven, Data-Informed, Data- Augmented: How Ubisoft’s Ghost Recon Wildlands Live Unit Uses Data for Continuous Product Innovation	<i>California Management Review</i>	Business Source Complete	A case study of data-driven practices in a creative product development
Yeoh, W.; Koronios, A.	2010	Critical success factors for business intelligence systems	<i>Journal of Computer Information Systems</i>	Scopus	Non-technical factors, such as organisational and process-related factors, are more influential to the success of BI implementation
Yeoh, W.; Koronios, A.; Gao, J.	2008	Managing the implementation of business intelligence systems: A critical success factors framework	<i>International Journal of Enterprise Information Systems</i>	Scopus	Develop CSFs framework for BI implementation
Yeoh, W.; Popovič, A.	2016	Extending the Understanding of Critical Success Factors for Implementing Business Intelligence Systems	<i>Journal of the Association for Information Science and Technology</i>	Business Source Complete	Examine how and why organisational, process and technology factors impact BI implementation success. Organisational factors were the most critical in BI implementation success

Table A2. Antecedents description

Antecedents	Description
<i>Technology</i>	
IT Infrastructure	Hardware and software required for BI implementation
Data Quality	Process, storing, maintain and query of data
BI Integration	BI system compatibility to be integrated with other systems
BI Agility	BI systems responsiveness, flexibility, and scalability on users requirement
System Quality	Overall information system reliability and flexibility
BI System Security	Access control, authorisation and authentication of different layers of information in BI system
Information Quality	The way the information is presented
<i>Strategic</i>	
Top management support	The attention and involvement of senior management in the BI uptake
Strategy alignment	The level of alignment between BI implementation and business strategy
Business vision	Business goals that are clearly defined
Analytic leadership	Leadership behaviour that fosters the utilisation of BI initiatives
Perceived benefits	Users' perception of the actual functionality of BI
The objective of BI	Specific, short and long term, goals of BI implementation
Executive perception of IT	Executives' perception of the strategic role on information technology in the organisation
Absorptive capacity	The organisation's ability and effort to absorb and apply new knowledge
<i>IS Governance</i>	
Change management	Approaches used to manage changes due to BI implementation
End user involvement	The way and to what extent the users are included in the BI development and implementation
Business process redesign	Changes of processes in business operation to incorporate the use of BI
Project planning	Planning of the BI implementation and development project
Data governance	Standards and policies related to data source, collection, storage, processing, and disposal
<i>Resources</i>	
Financial	The amount of money available to invest in BI technology
Human resources	Specific skills related to data analytics
Time	Time available to implement and develop BI initiatives
Technology	Specific BI tools and its supporting IT infrastructure
<i>Operational Support</i>	
Outside consultant	Third party that support the initial implementation
Formal training	Scheduled training in using BI tools
Team composition	Combination of skills within a centralised BI team or in overall organisations functions/departments
Championship	The presence of a person who promotes innovation
Service quality	The after sales service provided by BI vendor
BI vendor quality	Reliability of the BI software's provider
<i>Culture</i>	
Organisation's learning culture	Culture to develop staff capabilities
Data-driven decision making	Culture that foster a systematic and data driven decision-making process
Collaborative perspective	Organisation's perspective on sharing information and knowledge within internal organisation or with external parties
<i>Individual Behaviour</i>	
Perceived ease of use	Perception of the BI tool's users interface ease of use

(continued)

Table A2. Continued

Antecedents	Description
Motivational support User's trust	Motivational aid or support from peers or top management to learn The overall trust in BI system general performance and the information provided by the system in particular
<i>Environment</i>	
Business competition	Pressure from competitive business environment
Government, law and regulation	Government policy or other professional body regulation related to standard reporting and analysis
Social influence	Peer/colleagues influence
Stakeholder's influence	Influence from business partners, employees, owners, etc
Source(s): Authors' work	

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