BIG DATA ANALYTICS ADOPTION INTENTION IN SMEs: A SYSTEMATIC REVIEW

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Abstract: ***With the ability to process a massive amount of structured and unstructured data, Big Data Analytics (BDA) plays an essential role for Small and Medium Enterprises (SMEs) by helping them digitize internal processes and operations, generate valuable information to support decision-making, enhance operational efficiency and performance, and promote sustainable business development. However, the adoption of BDA in SMEs remains limited compared to that of large enterprises, due to various technological, organizational, and environmental constraints. This article examines the intention to adopt BDA as a prerequisite for its adoption. This study focuses on articles published on Scopus and Web of Science (WoS) from 2015 to 2025. By establishing a wide range of criteria, 30 articles were selected from the initial 392 articles for analysis. The findings identify six key factors and synthesize six major themes shaping SMEs' intention to adopt BDA, while revealing the dominant theoretical models employed to explain these behaviors and highlighting avenues for future research directions.***

• Keywords: *big data analytics, SMEs, technology adoption, adoption intention, systematic literature review.*

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Introduction

Big data (BD) and big data analytics (BDA) are important pillars of the fourth industrial revolution (Industry 4.0) and are considered to be innovative applications of information technology (IT) for organizations and companies (Dehe et al., 2025; Mahesh et al., 2018). According to Maroufkhani et al. (2020b), BDA is a game changer in the current technological environment that allows for accurate decision-making and optimal performance.

In many countries, SMEs are regarded as catalysts of innovation and play an important role in the economy (Castillo-Vergara et al., 2025). As part of Industry 4.0, emerging technologies like BDA are helping SMEs optimize their operations (Babalghaith & Aljarallah, 2024; Liu et al., 2020; Mangla et al., 2021). BDA can also improve the market and financial efficiency of SMEs (Maroufkhani et al., 2020b). Furthermore, BDA can enable process digitization and enhance efficiency or redesign business models, all of which have a positive impact on the sustainable development of enterprises (Akpan et al., 2022). In addition, Saleem et al. (2020) pointed out that BDA is a beneficial technology that helps SMEs implement effective strategies and optimize their performance. However, in reality, the adoption of BDA still lacks attention and practical application from SMEs (El-Haddadeh et al., 2025; Liu et al., 2020; Maroufkhani et al., 2020b). Since SMEs and large enterprises differ in terms of size, resources, flexibility, and organizational structure (Dong & Yang, 2020; Lutfi et al., 2022; Maroufkhani et al., 2020a; Perdana et al., 2022), SMEs face unique challenges in BDA adoption compared to large enterprises, with resource limitations and a lack of understanding of BDA being the main barriers (Dehe et al., 2025; Al-Shanableh et al., 2024; Coleman et al., 2016). On the other hand, from a theoretical perspective, investigating the adoption of BDA in SMEs is an important topic (Justy et al., 2023) because currently, studies on the adoption of BDA are primarily focused on large companies (Asiri et al., 2024; Bag et al., 2021; El-Haddadeh et al., 2021; Wang et al., 2018; Wang & Hajli, 2017), and there is still a lack of studies on the adoption of BDA in SMEs (Aldossari et al., 2025; Lutfi et al., 2022; Maroufkhani et al., 2020a; Nasrollahi et al., 2021). Some scholars have also suggested that effectively integrating BDA into SMEs need more support from academic researchers (Al-Shanableh et al., 2024; Mikalef et al., 2019; Coleman et al., 2016).

In summary, from a practical and theoretical perspective, it is evident that the adoption of BDA is significant for businesses, especially SMEs. In this context, investigating the intention to adopt BDA is

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very necessary because the intention is a prerequisite for adoption. To address this gap, we propose the following research questions:

RS1. What is the publication landscape of research on BDA adoption intention in SMEs in terms of publication years, journals, countries, and citation patterns?

RS2. What theories and methods are employed to research the intention to adopt BDA in SMEs?

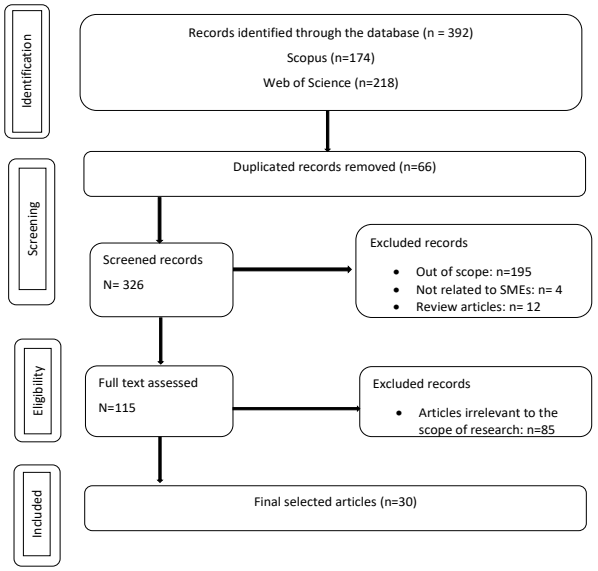
RS3. What factors influence the intention to adopt BDA in SMEs?

RS4. What are common keywords and dominant research topics related to the intention to adopt BDA in SMEs?

Research methodology and data collection

As already mentioned, the systematic review was adopted for this study. A systematic literature review (SLR) is a research method that collects, identifies, and critically analyzes existing research, which sets out a series of steps to methodically organize the review (Carrera-Rivera et al., 2022). This systematic methodology was selected because of its ability to enable high-quality, transparent, and replicable reviews. To achieve the objective of this study, we performed a systematic literature review from the Scopus and Web of Science (WoS) databases using the PRISMA guideline (Page et al., 2021).

Figure 1. Selection research process using the PRISMA method



Initially, four research questions were proposed in the review, and by addressing each question, we have a better understanding of BDA adoption intention and contribute to the body of present knowledge. The databases selected, which encompass all the empirical studies concerning the intention to adopt BDA in SMEs during 2015-2025 (i.e., from January 2015 to December 2025), are indicated, along with search string, as well as inclusion and exclusion criteria used for the evaluation and selection of studies. We then present the publications selected at the end of the process, which was carried out in four phases: Identification, Screening, Eligibility, and Included.

Results and discussion

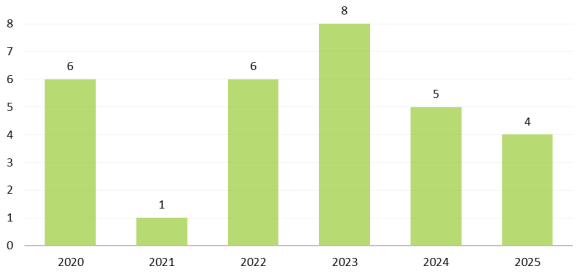
What is the publication landscape of research on Big Data Analytics (BDA) adoption intention in SMEs in terms of publication years, journals, countries, and citation patterns?

We have plotted graphs that demonstrate the number of research articles published in a year in which countries, journals, and the number of citations.

Distribution of articles by year

Figure 2 illustrates the distribution of articles from 2015 to 2025. No eligible studies were found between 2015 and 2019. Maroufkhani et al. (2019) pointed out that future research should focus on factors that drive SMEs to adopt BDA to optimize their benefit, given that SMEs make a significant contribution to the economic development of nations. Indeed, the graph demonstrates that the number of articles has risen over the previous four years and become an emerging trend, with the first research conducted in 2020. There was a decline in 2021 (probably affected by the COVID-19 pandemic), but it has gradually risen in subsequent years, indicating increased interest in this subject.

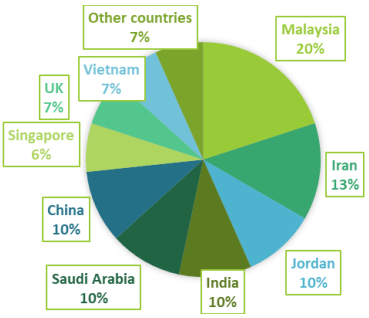
Figure 2. Distribution of articles per year



Distribution of articles by countries

From Figure 3, it can be seen that Malaysia was well ahead of all the other countries where the related studies were conducted. Malaysia was followed by Iran, Jordan, and other countries. The nations that were categorized as "other countries" were those where only one study was conducted. Among these countries were Colombia and France. Meanwhile, China, Vietnam, Singapore, Saudi Arabia, and India had the same ratio.

Figure 3. Distribution of articles by countries



Distribution of articles by journals

Figure 4. Distribution of articles by journals



Figure 4 depicts the distribution of the journal articles and reveals that Sustainability has the highest number of articles (n=3). *Management Decision* and the *Journal of Science and Technology Policy Management* each have two articles, followed by other journals.

Distribution of articles by citations:

Figure 5. Distribution of articles by citations

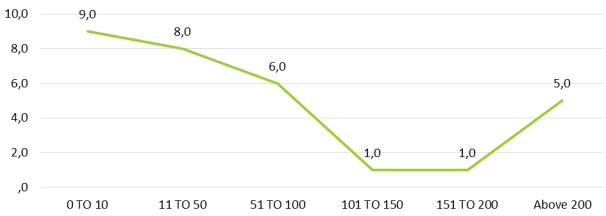


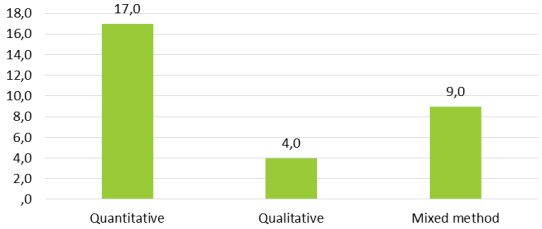
Figure 5 shows the data analysis based on citations. We found 9 articles with citations between 0 and 10, 8 between 11 and 50, 6 between 51 and 100, 1 between 101-150, 1 between 151-200, and five articles have been cited above 200.

What methods and theories are employed to research the intention to adopt BDA in SMEs?

Data analysis based on research methods

Figure 6 presents the findings about the research method used in these selected publications. It is important to note that a significant amount of quantitative research has been used to develop investigations in 17 studies. Compared with quantitative research, the mixed method is lower with nine studies. Meanwhile, qualitative research was quite rare, with four studies. For this reason, we propose that more attention should be paid to qualitative research methods.

Figure 6. Distribution of research methods



Data analysis based on behavioral theories used in articles

In general, the empirical studies examined in the present studies were based on well-known behavioral theories, frameworks, and models to investigate specific factors such as TOE, DOI, UTAUT, TAM and HOT. In particular, the most frequently used approach is the TOE framework (F=7) proposed by Tornatzky et al. (1990) to describe how the firm context influences the adoption and implementation of innovations. The fact that TOE is the top dominating theory used by BDA adoption in previous studies is consistent with the finding of Aldossari et al. (2023). The TOE theoretical framework identifies three contexts that influence the adoption or non-adoption of technology by users: the technological context, the organizational context, and the environmental context. The main advantage of TOE is that it considers both internal and external aspects within a unique model. The TOE provides a more comprehensive insight into technology adoption, whereas other theories only consider attitudinal factors (Awa et al., 2016). According to Khayer et al. (2020), TOE is considered to have more explanatory capacity compared to other adoption models in the literature, such as TAM, TPB, UTAUT, and DOI, in examining the adoption and use of technology, especially in an organizational context. According to the above characteristics, this theoretical framework fitted well and was applied in seven articles of this investigation. Grounded by the TOE framework, five studies have proposed the research model with all three independent aspects: technological, environmental, and organizational factors (Anwar

et al., 2024; Babalghaith & Aljarallah, 2024; Baig et al., 2023; Maroufkhani et al., 2020b). From a different perspective, the independence assumption among TOE factors was challenged by organizational factors as a moderator in the relationship between BDA adoption intention in SMEs and its predictors (Iranmanesh et al., 2023). In another investigation, organizational factors were proposed as a mediator between technological and organizational factors and BDA adoption. Furthermore, the moderating effect of environmental factors on the association between technological factors, organizational factors, and BDA adoption was evaluated (Maroufkhani et al., 2022).

However, TOE was widely applied by being incorporated and combined with other theories such as TOE and DOI (Al-Shanableh et al., 2024; Lutfi et al., 2022; Maroufkhani et al., 2020a), TOE and HOT (Yadegaridehkordi et al., 2020). Since DOI theory (Rogers, 2003) precisely emphasizes technological characteristics as drivers for technology diffusion and the process of diffusing technology adoption throughout the firm, therefore incorporating the technological factors of DOI theory into the TOE model can deliver a comprehensive framework for the study of BDA adoption in SMEs and making Rogers' DOI theory better able to illuminate the diffusion of intra-firm innovation (Maroufkhani et al., 2020b). As opposed to TOE's internal organizational factors, merging the TOE framework with the DOI theory moves beyond those to encompass more technological attributes, a focal point of DOI, which drives technology adoption and gaining a deeper understanding of BDA adoption in SMEs (Al-Shanableh et al., 2024).

The other theoretical model examined is UTAUT, proposed by Venkatesh et al. (2003) to explain user intentions and subsequent use behavior related to information systems. According to this theory, the factors that affect the intention to use technology are social influence, facilitating conditions, performance expectancy, and effort expectancy. Two studies applied this theoretical model to investigate the intention to adopt BDA in SMEs. All modified UTAUT components (i.e. performance expectancy, effort expectancy, social influence, facilitating conditions and technophobia) significantly influence supply chain analytics adoption (Lyu et al., 2024). Perdana et al. (2022) have extended the baseline model of UTAUT by using a multi-level framework of technology acceptance, which considers higher-level contextual factors and individual-level contextual factors as the main drivers of BDA adoption in SMEs.

Proposed by Davis (1989), the technology acceptance model (TAM) is another theoretical model that has been used in previous research to predict users' behavior toward adopting new technology, in which perceived ease of use and perceived usefulness are the most significant determinants of intention to use and of system usage. TAM focuses on an explanation of how to approach the intention to adopt a specific service or technology. In this literature review, TAM in its original form has been examined in one study. In addition to perceived usefulness and perceived ease of use, external factors such as Perceived privacy and security have been added to increase TAM's capacity to predict BDA adoption intention behavior in Jordan's SMEs (Al-Azzam et al., 2023). Because the external variables in the extended models of TAM are not well defined while TOE is more suitable for organizational research but suffers from unclear and general structures, integrating TOE and TAM models increases the predictive capability of the conceptual framework, as well as solving some individual limitations of TAM and TOE (Truong, 2022). Moreover, these theories have been used to examine a wide range of adoption factors, and when combined, they create a robust model for a deep understanding of many factors influencing SMEs to adopt BDA technology (A. Asiri et al., 2024).

Finally, the remaining ten research publications did not employ any theoretical model. Instead, research frameworks for studies have been established by integrating various dimensions and combining a wide range of factors, which have been proven reliable and valid in previous investigations. Although TOE, UTAUT, DOI, and TAM are the typical behavioral theories used in past articles, it should be emphasized that other behavioral theories, such as the Theory of Planned Behavior (TPB) (Ajzen, 1991) and Stimulus-Organism-Response (SOR) theory (Mehrabian & Russell, 1974), need to be examined more in the context of BDA adoption intention research in SMEs.

What factors influence the intention to adopt BDA in SMEs?

To address RS3, we conducted the SLR to identify the key factors influencing SMEs' BDA adoption intention. From the final set of eligible studies, we extracted and recorded all constructs examined as antecedents of SMEs' BDA adoption intention, and we harmonized synonymous labels into standardized factor names to avoid duplication across studies. Next, we calculated the frequency of each factor, defined as the number of primary studies that examined the

factor, and applied a frequency-based winnowing procedure. Using this threshold, we retained as key factors only those with Frequency > 5, meaning that they were examined in at least six studies. Table 1 presents the six key factors retained as determinants of SMEs' BDA adoption intention.

Table 1: Key factors influencing the intention to adopt BDA in SMEs

No.	Factor	Frequency
1	Top management support	12
2	Compatibility	9
3	Competitive pressure	8
4	Complexity	7
5	Relative advantage	7
6	Security	6

Source: The research result

In general, top management support is the organizational factor that plays the most crucial role in driving the adoption of BDA in SMEs. Technological factors within three factors from DOI theory (i.e., Compatibility, Complexity, Relative advantage) and Security are significant concerns when the organization intends to adopt BDA. Moreover, competitive pressure is also a unique environmental factor that attracts the most attention in the adoption process of BDA in SMEs.

Compatibility refers to the degree to which a new system aligns with an organization's existing systems, culture, and business practices. In addition, compatibility is determined by other factors, such as business strategy, organization's preferences, prior knowledge, organizational goals, information systems, employees' capabilities, and characteristics. SMEs will be willing to accept or implement if they perceive that BDA adoption is compatible with current organizational procedures and standards (Babalghaith & Aljarallah, 2024; Maroufkhani, et al., 2020b).

Relative advantage refers to the degree to which technology adoption is perceived as better than other existing technologies and the benefits that the company can obtain from it. On the other hand, perceived advantage to the value of a specific organization can significantly influence the intention to adopt new technology for innovation. Accordingly, the organization has no motivation to adopt and use BDA without distinguishing its values and relative advantage. That is the reason why SMEs have a tendency to adopt BDA if they are persuaded that its advantages surpass those of any other existing technology (Lutfi et al., 2022; Yadegaridehkordi et al., 2020).

Complexity refers to the level to which new technology is perceived as complicated to use and difficult to understand for the organization. For instance, the technology challenge arises when processes of working together are altered, so the new technology has to have ease of use to be adopted quickly. Employees must understand technology innovations such as BDA in a timely manner because sophisticated technologies lead to uncertainty and complexity in their adoption. SMEs may be less likely to adopt BDA if they perceive that BDA adoption needs significant efforts. For this reason, complexity is seen as one of the primary inhibitors of SMEs' intention to adopt BDA (Babalghaith & Aljarallah, 2024; Lutfi et al., 2022).

Security refers to the concern about the risk of data potentially becoming uncontrollable or being accessed and used illegally by another party, which prevents the adoption of innovation within the organization. This is also the top concern of business owners when adopting data-related services. Based on this point of view, due to limited resources, SMEs often have a tendency to outsource entirely or partially because they need more competence to develop a secure data environment. In addition, they require more support because they lack knowledge regarding advanced technology innovation, such as BDA. However, the firm outsources to external providers, which leads to the organization's data being shared. This is one of the reasons that enterprises may lose control over security information. Moreover, SMEs are considered to have lower security procedures than large enterprises. Therefore, security is the top concern and a significant factor influencing the intention to adopt BDA in SMEs (Al-Shanableh et al., 2024; Lutfi et al., 2022; Nguyen et al., 2022).

Competitive pressure is the environmental factor, which refers to the level of pressure that the firm perceives from its competitors, partners, and customers within the same industry. The intensity of competition may motivate SMEs to leverage the advantages of BDA. Because BDA is an advanced technology that can open up a wide range of business opportunities, non-adopters will be afraid to be lagged compared to adopters. It is essential to note that competitive pressure encourages owners and managers to invest in BDA to maintain competitive advantages in the marketplace. As a result, competitive pressure can be seen as a crucial predictor influencing the intention to adopt BDA in SMEs (Iranmanesh et al., 2023; Maroufkhani et al., 2020a).

What are common keywords and dominant research topics related to the intention to adopt BDA in SMEs?

In this section, we investigate word cloud topic modeling, which was generated from the literature.

Initially, we downloaded search results under the BibTex file from Scopus and WoS. Then, we combine it into a unique file using R software and convert it to a CSV format with 30 articles in the document set. Finally, we use Python to extract the corpus or words to discover common keywords and important topics in this field. We employed the "LitStudy" - a Python package using simple scripts or Jupyter Notebook, which enables the selection and evaluation of scientific publications by using visualizations, bibliographic network analysis, and natural language processing (Heldens et al., 2022). Additionally, we used Non-Negative Matrix Factorization (NMF), an unsupervised approach for corpus topic modeling. NMF is a factorization algorithm commonly used for dimensionality reduction. In contrast to supervised methods, NMF does not require labeled subjects for model training. The package "gensim" is employed to train the topic models. We generated author keyword clusters to identify the most frequently used keywords in the literature. We also successfully made six distinct topic models visually represented in Figure 7.

Topic 1 consists of "bda", "companies", "sized", "determinants", "investigate": This points out that SMEs have an interest in the determining factors influencing the intention to adopt BDA. In other words, SMEs intend to adopt BDA when they perceive important factors such as efficiency, potential benefits as optimizing decision-making based on data information flow, and feasibility that is investigated and aligned with the context of their organization.

Topic 2 consists of "capabilities", "operational", "manufacturing", "Malaysia", and "sustainable". This topic captures a stream of research on intention to adopt BDA that focuses on operations and manufacturing. In this stream, SMEs are likely to leverage BDA as an enabling capability to improve process efficiency, productivity, and cost performance, while supporting objectives related to sustainability. The appearance of "Malaysia" reflects the empirical concentration of studies in the reviewed sample (Figure 3) and should therefore be interpreted as a contextual marker rather than the conceptual core of the topic. Overall, the literature suggests that SMEs are more likely to intend to adopt BDA when they anticipate strengthened operational capabilities and the creation of both economic value and outcomes oriented toward sustainability.

Topic 3 consists of "perceived", "sustainable", "usefulness", "significantly", "security": The intention of SMEs to adopt BDA is significantly influenced by their perceived usefulness and security of big data. If security concerns are not addressed, the intention to adopt may decrease.

Topic 4 consists of "compatibility", "relative_ advantage", "relative", "organizational", "pressure": This points out that the intention to adopt BDA in SMEs was influenced by many factors, including compatibility with the current system, the relative advantages of BDA compared to other technologies at the current stage, organizational factors, and pressure from the competitive environment.

Topic 5 consists of "data_analytics", "strategy", "implementing", "drivers", "government": This indicates that government support and a reasonable implementation strategy are frequently discussed as key drivers of SMEs' intention to adopt BDA

Topic 6 consists of "firms", "readiness", "providers", "design", "significantly": SMEs are more ready to adopt BDA when they receive reliable support from external providers in addition to organizational support policies must be designed appropriately.

In summary, there are various factors can affect the intention to adopt BDA in SMEs, such as Technological factors: perceived usefulness, security, and compatibility; Organizational factors: organizational capability, organizational readiness, and implementation strategy; Environmental factors: competitive pressure, government support, and external providers. In addition, SMEs may enhance the intention to adopt BDA when they find that this technology aligns with their requirements and is stimulatingly supported by appropriate and reliable policies from the government and suppliers to solve factors that play barrier roles, such as technical, organizational, and financial issues.

Implications

Theoretical implications

This study can make several critical theoretical contributions to the research on the intention to adopt BDA in SMEs. First, the authors presented an overview of these studies, including publication year, country, journals, and citations by means of the descriptive analysis method of highly ranked articles. These analyses can support academics in general understanding of the distribution of BDA adoption intention research. Secondly, this study conducted a theme-clustering analysis and classified themes into six categories. The scientific classification of studies helps researchers better understand the relationship between studies. Thirdly, the authors constructed antecedents of intention to adopt BDA in SMEs by

ranking the frequency of occurrences in order to disclose important influenced factors used in previous studies, which focus on three aspects: Technological factors, Organizational factors, and Environmental factors. These findings help the researchers embrace the fundamental motivations of BDA adoption in organizations and provide helpful information in establishing a research framework related to promoting the adoption of BDA in SMEs. Fourthly, the authors synthesized the research methods and data-analysis techniques employed in quantitative studies, showing that the current empirical evidence predominantly relies on PLS-SEM, whereas hybrid designs such as SEM-ANN and SEM-ANFIS, along with other nonlinear or predictive approaches, are used infrequently. These insights help researchers identify methodological gaps and provide a rationale for considering multi-stage analytical techniques, thereby validating, reinforcing, and expanding current knowledge grounded in well-established theoretical models. Finally, the authors synthesized famous behavioral theories examined in the previous studies. These results can be used to extend or develop theoretical models and frameworks to understand and predict the adoption of BDA in enterprises with more accuracy.

Practical implications

This finding has some significant practical contributions for owners and managers of SMEs in an all-encompassing approach for analyzing the factors influencing BDA adoption intention, thereby establishing a pathway to evaluate the readiness and viability and create measures and strategies to support the adoption of BDA in the organization. Furthermore, it helps them in the firm. Enterprise managers need to devote more attention to the subjective willingness to adopt BDA within the organization. For instance, if the lack of top management support is seen as a barrier to adopting BDA, it is necessary to implement intervention measures to enhance the advocacy and commitment of the managers. In addition, leaders may focus on technological factors, such as taking into consideration the compatibility of BDA with the existing infrastructure and the advantages of BDA compared to the current technologies being employed in the business. Moreover, it is essential to improve the security of BDA and enhance supervision when using BDA outsourcing services. As an environmental factor, competitive pressure also plays an important role in boosting leaders' ability to make judgments faster and more accurately based on data than their competitors. Consequently, leaders should develop a strategy and roadmap for adopting BDA rapidly and effectively to maintain a competitive advantage.

Conclusion: BDA is widely recognized and is one of the game-changing factors in the current technological environment for making accurate decisions and optimal performance. We conducted a thorough analysis of 30 research publications in our study. We found that the majority of the publications use the TOE framework and DOI theory for models determining the intention to adopt BDA. Besides, we also found that the most frequently considered factors related to the intention to adopt BDA are Top management support, Competitive pressure, and Technological factors such as Compatibility, Complexity, and Relative advantage. We also found that most empirical investigations need more theory to support their findings. Our findings and suggestions will serve to develop the topic and encourage other researchers to address the identified gaps. This study recommends directions related to future research opportunities for scholars interested in adopting BDA in SMEs.

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