Factors Influencing Cloud Business Intelligence Adoption and Use at Organisational Level

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Abstract. The integration of cloud computing and business intelligence enables analytics solutions through cloud environments. Despite the fears about issues such as security, privacy, and loss of data control issue, many enterprises are increasingly adopting cloud business intelligence (cloud BI). The interest in cloud BI is greatest among businesses and organisations. Yet, the extant literature reveals that little research related to the factors impacting the adoption of cloud BI at the level of organisations. This study aims to identify key factors that impact the adoption and utilisation of cloud BI, focusing on organisational level, which will serve as valuable resources for organisations, helping them to implement cloud BI adoption securely and efficiently in business operations. Wymer and Regan's criteria are used as the basis for analysis. From the results of the study, it is evident that there are 18 factors that significantly impact the adoption and continual usage of cloud BI services in organisations: Complexity, Privacy, Competitive pressure, Security, Government support, Availability, Relative advantage, Culture, Management support, Observability, Regulatory support, Technology readiness, Type of system, Organisation size, Trialability, Effective adaptable solutions, Compatibility, and Scalability. The findings can help Organisations, cloud BI service providers, and governments to develop cloud BI adoption strategies.

1 Introduction

In 2018, using Business Intelligence (BI) in the cloud is regarded as a critical factor for success in a variety of fields, with approximately 66 percent of successful BI organisations already utilizing the cloud. Most people who use cloud BI prefer Amazon AWS the most (86%), followed by Microsoft Azure (82%), Google Cloud (66%), and IBM Bluemix (36%) [1]. Both business intelligence and cloud computing have seen dramatic changes and advancements in recent years. Many of the key characteristics of BI systems complement those of cloud computing systems, and vice versa. As a result, when properly integrated, these two technologies can be used to strengthen each other's advantages while eliminating

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each other's weaknesses. Analytics solutions are made possible by the integration of cloud computing and business intelligence.

With the improved IT infrastructure, BI users gain more benefits from analytics solutions through cloud environments. Because of the Compound Annual Growth Rate (CAGR) of 23.0% global cloud BI market size is projected to increase from USD 23.2 billion to USD 65.4 billion (2020-2025). Among the industries, the education industry has the highest level of interest in cloud BI [2]. According to a study from Dresner Advisory Services (2020), there is a barrier to the adoption of cloud BI with a reference to the cessation to the user headcount in two consecutive years between 2019 and 2020 (33 % in 2019 and 33% in 2020) [3].

Adopting systems such as cloud BI is both expensive and time-consuming. Understanding critical factors is essential for successful cloud BI systems adoption. This paper highlights a number of journal articles and conference papers that investigate the effects of adopting cloud BI systems at an organisational level, focusing on the factors influencing the continuous use of cloud BI services. For organisations to successfully adopt and use cloud BI services within their organisations, these factors serve as a set of guidelines. This study attempts to answer the following research question: "What are the main factors impacting the adoption of cloud business intelligence?"

The motivation behind this research stems from the increasing adoption of cloud BI by enterprises despite concerns about issues such as security, privacy, and data control. While there is considerable interest in cloud BI, the existing literature lacks comprehensive research on the factors influencing its adoption at the organisation level. The contribution of this research lies in filling this gap by identifying and analysing the critical factors that significantly impact the adoption and continual usage of cloud BI services within an organisation. By using Wymer and Regan's criteria as the basis for analysis, the study aims to provide valuable insights for organisations, helping them implement cloud BI adoption securely and efficiently in their business operations.

1.1 What is cloud business intelligence?

Cloud BI is a way of using data in the cloud to get helpful information. Businesses can use cloud BI to make smart decisions without needing to buy or handle physical equipment. It's like getting useful insights from data stored in the cloud without the hassle of dealing with computers or servers. [4].

Cloud computing and business intelligence complement each other excellently. The goal of BI is to get precise information to the correct individuals at the right moment, and cloud computing enables you to do just that [5]. cloud BI applications have the advantage of being accessible from a wide range of devices and web browsers [6]. This eliminates traditional software barriers such as the requirement to access the application on-site. cloud BI Systems are divided into two major components, namely cloud computing and business intelligence.

1.1.1 Cloud computing

The concept of “Cloud Computing” extends the concept of distributed computing, which involves running an application or program over a network of computers [7]. Computers or digital phones can access resources, such as software, and information as a service through cloud computing, an Internet-based computing model [7]. Organisations can access free or inexpensive services through cloud computing, such as Dropbox, Google Apps, and YouTube. The cloud offers a variety of services, such as:

- **Software as a Service (SaaS):** SaaS is the best service of the cloud for education. It stores both data and applications which can be easily accessible using only web browsers such as Chrome or Microsoft Edge.
- **Platform as a Service (PaaS):** PaaS provides an environment where we can develop services and applications in the cloud and does not require a specific platform to run the applications. It is also accessible to users widely through the internet.
- **Infrastructure as a Service (IaaS):** IaaS provide storage and processes for rent; the user can use it to run their applications and operating systems.

Using the Internet and cloud computing, users can manage and access data. Users in the majority of the organisations are cloud-connected. A separate login is provided for each user's specific work. Users will be able to access the data via the Internet from home and work using computers and other devices 24 hours a day, seven days a week. Managers can check their team performance in real-time. Organisations will be able to enhance their instructional strategies and businesses as a result.

1.1.2 Business intelligence

The primary goal of business intelligence (BI) is to deliver information at the right time and in the right format so that the organisation can make the best decisions more quickly and accurately. It is a collection of programs and tools that give decision-makers the ability to gather, examine, disseminate, and act upon information pertinent to the operations of the company [8]. BI tools main goal is to turn massive amounts of data into decision-making, and they can offer a systemic view of the business and assist in the uniform distribution of data among users. BI tools enable data exchange, information visualization in various dimensions, and analysis of important performance indicators for businesses. Specifically, transforming the data into reliable information [8].

2 Research methodology and design

In order to ensure that cloud BI services are consistently used by organisations, this study seeks to identify the most important factors influencing the successful adoption of cloud computing and business intelligence or cloud BI. This study reviewed the literature on cloud BI adoption at the organisational level to meet this goal. The factors were extracted from the 15 most relevant research papers using the keywords ((Cloud computing OR Cloud-computing OR Business intelligence OR Cloud BI OR Cloud Business Intelligence) AND (factors OR determinants OR success factors OR critical determinants) AND (integration OR implementation OR adoption)). Wymer and Regan's criteria are used as the basis for analysis [9]. The analysis was done in five steps as depicted in Fig. 1.

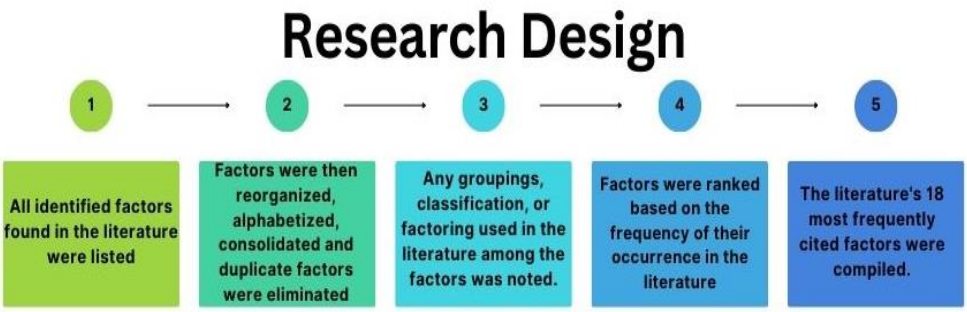

Fig. 1. Research design steps.

A preliminary step in the analysis was to identify and list all of the factors that have been reported in past studies. Through the literature review, 252 factors from several journal articles and conference papers were identified.

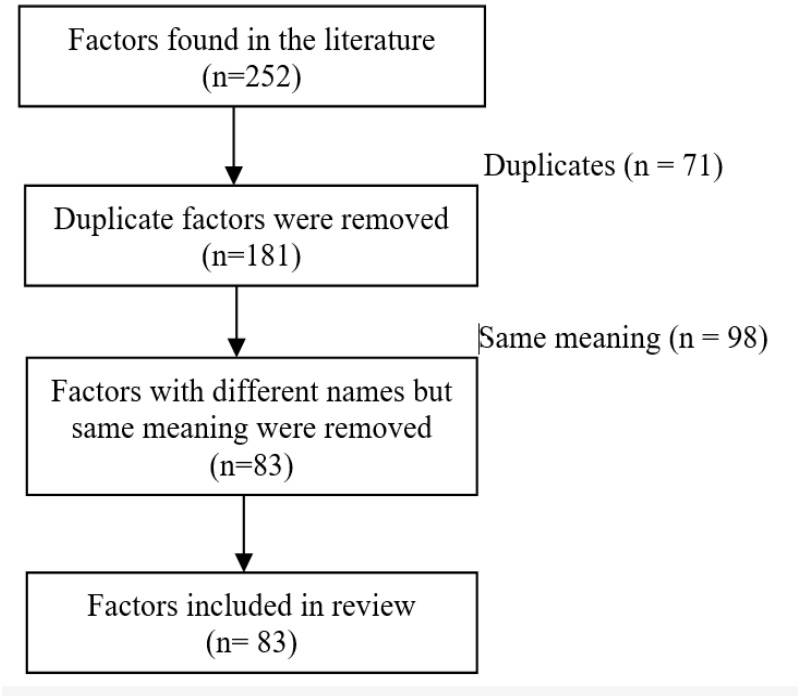

Fig. 2. Flow diagram of the identification of relevant factors

In the next phase, the factors are reorganised, alphabetised, consolidated, and eliminated from other research studies that identified the same factors using different terminology. This process reduced the list to 83 distinct factors as shown in Fig 2. Once the set of consolidated factors had been determined and mapped to the information of all authors (see Table 1).

Table 1. Factors extracted from the literature.

No	Factor	CC†	BI ‡	CBI §	No	Factor	CC	BI	CBI
1.	Absorptive capacity [10]		x		43.	Manager's IT knowledge [10]		x	
2.	Affordability [11]	x			44.	Observability [10]	x	x	
3.	Attitude [12]	x			45.	Organisation size [11]	x	x	x
4.	Automation [11]	x			46.	Organisational legitimacy [13]		x	
5.	Availability [10]	x	x		47.	Organisational readiness [14]		x	
6.	Awareness [15]	x			48.	Ownership structure [13]		x	

† Cloud Computing
‡ Business Intelligence
§ Cloud Business Intelligence

7.	CEO's Innovativeness [16]		x		49.	Peer pressure [11]	x		
8.	CEO's IS knowledge [16]		x		50.	Perceived behavioural control [12]	x		
9.	Cloud BI adoption [17]			x	51.	Perceived benefits [13]	x		
10.	Compatibility [11]	X	x	x	52.	Perceived concerns [18]	x		
11.	Competitive advantage [13]		x		53.	Perceived ease of use [19]	x		
12.	Competitive pressure [10]	X	x	x	54.	Perceived usefulness [19]	x		
13.	Complexity [18]	X	x	x	55.	Presence of champion [20]		x	
14.	Confidentiality [11]	X			56.	Privacy [11]	x		x
15.	Connectivity [11]	X	x	x	57.	Project champion [14]		x	
16.	Control/ Governance [21]		x		58.	Quality of service [11]	x		
17.	Costs [13]		x		59.	Rational decision-making culture [14]		x	
18.	Culture [14]	X	x		60.	Regulatory support [12]			x
19.	Data integration [21]		x		61.	Relative advantage [10]	x	x	x
20.	Data latency [21]		x		62.	Reliability [12]	x		
21.	Data quality [10]		x		63.	Scalability [21]			x
22.	Data sanitization [11]	X			64.	Scope of the system [22]			x
23.	Ease of implementation [21]	X		x	65.	Security [21]	x	x	x
24.	Effective adaptable solutions [21]			x	66.	Privacy concerns [23]	x		x
25.	Elastic resource capacity [11]	X			67.	Self-efficacy [19]	x		
26.	Encryption [11]	X			68.	Skilled staff [11]	x		
27.	Executive support [13]		x		69.	Socio-economic status [11]	x		
28.	External pressure [11]	X			70.	Stakeholder support [13]		x	
29.	External support [14]		x		71.	Subjective norms [19]	x		
30.	Facilitating conditions [10]		x		72.	System quality [12]		x	
31.	Financial support of the system [22]			x	73.	Technology readiness [17]			x
32.	Government support [11]	X	x	x	74.	Trialability [10]	x	x	
33.	Hardware [10]		x		75.	Trust [11]	x		
34.	Integration [21]	X			76.	Type of system [22]			x
35.	Integrity [11]	X			77.	Vendor selection [24]		x	

36.	Intention [12]	X			78.	Vendor support [10]		x	
37.	IT Infrastructure [10]		x		79.	Business-driven, scalable and flexible technical framework [15]		x	
38.	Location and device independence [11]	X			80.	Clear vision & well-established business case [15]		x	
39.	Loss of governance [11]	X			81.	User-Oriented change management [15]		x	
40.	Management support [14]	X	x	x	82.	Business-centric championship and a balanced team composition [15]		x	
41.	Manager's innovativeness [10]		x		83.	Business-driven and iterative development approach [15]		x	
42.	Service provider support [19]	X							

Exploring the literature on critical factors in cloud BI adoption revealed that some organisations suffered from a lack of awareness, leading to negative impacts on their activities and resources. The inefficiency in using cloud BI could be attributed to a fundamental lack of insight into these critical factors. Furthermore, firms that prioritize critical factors remain competitive, despite facing challenges that may hinder or facilitate BI implementation success [25].

3 Findings

Many organisations fail to fully benefit from cloud BI services due to a lack of understanding of the key factors affecting their adoption to meet IT requirements. According to a review of technology adoption theories, organisations may take into account a number of factors when considering the adoption of cloud BI services.

Based on the review and analysis of the past studies in cloud BI, 83 distinct factors have been identified (see Table 1). Meantime, the study has identified 18 factors that have an organisational impact on the adoption of cloud BI services as shown in Table 2.

Table 2. 18 factors that significantly influence BI adoption.

No	Factor	References	*f*	No	Factor	References	*f*
1.	Availability	[10,11]	2	10.	Organisation size	[10,11,13,16,17,19,20]	7
2.	Compatibility	[10,11,16–20,23]	8	11.	Privacy	[11,12,19,23,26–28]	7
3.	Competitive pressure	[10,12,16,20,23,29]	6	12.	Regulatory support	[17,19]	2
4.	Complexity	[10,11,13,16–20,23]	9	13.	Relative advantage	[10,12,14,16–20,23,26]	10
5.	Culture	[11,14,30]	3	14.	Scalability	[21,31]	2
6.	Effective adaptable solutions	[21,32]	2	15.	Security	[10,12,19,21,23,26]	6

7.	Government support	[10,11,19,23,33]	5	16.	Technology readiness	[17,23]	2
8.	Management support	[10,12,14,17,19, 20,24]	7	17.	Trialability	[10,18]	2
9.	Observability	[10,18]	2	18.	Type of system	[22,34]	2

As shown in Table 1, 83 factors have been derived from the literature review process. From the 83 factors, 18 factors (see Table 2) were recognised as the most impactful, and commonly used factors in the literature (based on the frequency of their reporting in the literature and their relative importance as determined by the research findings) that influence the adoption of cloud BI services as illustrated in Fig. 3 and Fig. 4 (word cloud). These 18 factors include Relative advantage, Complexity, Compatibility, Management support, Privacy, Competitive pressure, Security, Government support, Organisation size, Availability, Culture, Observability, Regulatory support, Technology readiness, Type of system, Trialability, Effective adaptable solutions and Scalability.

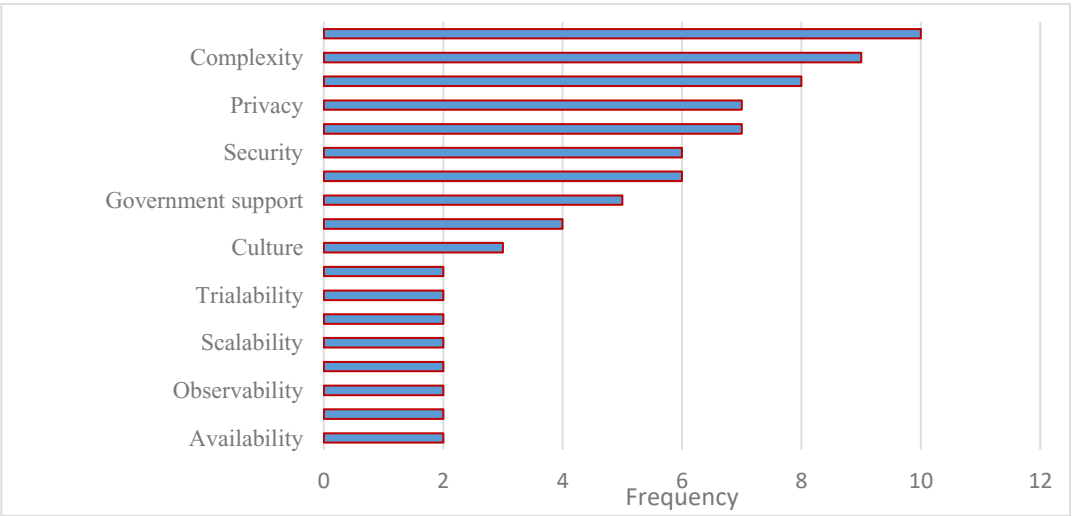

Fig. 3. Frequency of the ranked of the most commonly used factors in BI adoption.

The analysis also found that varying terminology had been used in several past studies to describe two major factors in cloud BI service adoption, i.e. “Relative advantage” and “Complexity” as below:

- Benefits of cloud BI, for example, have been described in a variety of ways by researchers, such as cloud BI benefits [35] and relative advantages [19] [12].
- A number of studies have utilised the term "complexity" to describe perceived difficulty associated with understanding and utilising cloud BI services so that different terminologies such as perceived convenience, complexity and ease of use [11][19] may be represented.

Fig. 4. Word cloud of 83 factors

Besides, it is important to note that some researchers regarded Privacy and Security as separate factors [26][19], whereas others considered both factors to be combined.

The findings in the study conclude that critical factors influencing the success of cloud BI adoption have a direct, positive, and significant impact on the adoption of cloud BI systems at the organisational level.

4 Conclusions and implications

Combining business intelligence and cloud computing can result in a more flexible BI solution that supports organisational goals. Cloud computing has the potential to transform Business Intelligence into Business Intelligence for everyone. Furthermore, cloud and business intelligence enable decision-makers to make quick predictions and decisions that affect business performance [36]. The organisers of many businesses across the globe are increasingly paying attention to and focusing on cloud BI systems as they recognize that they are capable of providing business benefits to their organisations [37]. With cloud BI, complex information can be handled and processed efficiently, resulting in an unpredictable value for businesses [37]. Furthermore, it also assists organisations in increasing profits as well as staying competitive at the same time [38].

This review of 'cloud computing,' 'business intelligence,' and 'cloud business intelligence adoption provides researchers with insights into the depth of study in these fields and the key findings related to factors influencing cloud BI adoption. Researchers, decision-makers, and cloud BI service providers will benefit from the findings of this study in developing better strategies for adopting cloud BI services in an organisation.

Even though many organisations are increasingly adopting cloud BI under the fears of security issues, privacy issues and the loss of data control [39]. Consequently, this study focused on the analysis of critical factors in the past studies affecting cloud BI adoption,

that will be evaluated among experts and professionals, which aims to investigate to what extent these factors influence cloud BI adoption in organisations. The findings from the current attempt will also serve as a basis for developing a conceptual model for cloud BI services and adoption as a whole, particularly in business fields in future research. The implications of these findings extend beyond academic research, offering practical insights for organisations, cloud BI service providers, and governmental bodies. Organisations can leverage the identified critical factors to develop robust strategies for implementing cloud BI adoption securely and efficiently. Cloud BI service providers can tailor their offerings to address the specific needs and concerns of organisations, thereby enhancing their market competitiveness. Additionally, governmental support and regulatory frameworks can play a pivotal role in fostering an enabling environment for cloud BI adoption.

5 Limitations

However, despite the valuable insights provided by this study, several limitations warrant consideration. Firstly, the scope of the study is confined to factors influencing cloud BI adoption at the organisational level, potentially overlooking individual-level and external environmental factors. Future research could explore these dimensions to provide a more comprehensive understanding of cloud BI adoption dynamics. Additionally, the generalizability of the findings may be limited by the specific context and sample of studies included in the analysis. Therefore, caution should be exercised when extrapolating the results to different organisational settings or geographical regions.
Furthermore, the methodology employed in this study relies primarily on a retrospective analysis of existing literature, which may be susceptible to biases and limitations inherent in the reviewed studies. Future research could employ complementary approaches, such as empirical studies or case analyses, to validate and extend the findings of this study. Despite these limitations, this study constitutes a significant step towards elucidating the multifaceted landscape of cloud BI adoption and paving the way for future research and practice in this domain.

6 Future research

In future research, several avenues could enrich our understanding of cloud BI adoption dynamics and inform practice in this domain. Firstly, exploring individual-level factors, such as attitudes and perceptions, can provide nuanced insights into how individual behaviours shape the adoption process within organisations. Additionally, investigating external environmental factors, including market dynamics and regulatory frameworks, can shed light on the broader contextual influences on cloud BI adoption decisions. Longitudinal studies tracking organisations' adoption journeys over time would reveal evolving patterns and trends in adoption dynamics. Cross-cultural studies could provide insights into how cultural norms impact cloud BI adoption across different regions. Lastly, exploring the implications of emerging technologies, such as artificial intelligence and machine learning, on cloud BI adoption could inform future adoption strategies and technological advancements. By addressing these areas in future research, scholars can contribute to the development of effective adoption strategies and bridge the gap between research and practice in the field of cloud BI adoption.

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