The impact of perceived benefits and risks on the current and intended levels of big data analytics adoption in hotels

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Abstract

The adoption of big data analytics (BDA) has become prevalent in many business fields due to its various benefits. However, it has been reported that the hospitality industry is reluctant to adopt BDA. Additionally, precedent studies pointed to a knowledge gap and called for further research in this subject. Hence, this research explores the current and intended levels of adoption of BDA in hotels. It also proposes and examines a mediated-moderated model for the impact of perceived benefits and risks on the current and intended levels of BDA adoption in hotels. This study followed a quantitative approach whereby a questionnaire form was developed and distributed to IT managers/engineers and general/deputy managers in hotels. A total of 265 complete and valid responses were collected and analyzed. PLS-SEM using smart PLS 3.0 was employed to test the model. The results indicated that perceived benefits positively influence the current and intended level of BDA implementation in hotels. Moreover, perceived risks had a negative moderating effect on the linkage between perceived benefits and both the current and intended levels of BDA adoption. This study is among the leading studies that have examined the extent to which the perceived benefits and risks of BDA adoption can impact the current and intended levels of BDA implementation in the hotel industry

1. Introduction

The concept of Big Data Analytics (BDA) has attracted the attention of both academics and practitioners in recent years due to the technological advancement and the popularity of digital platforms which have enabled the generation of huge data in various forms with over 2.5 exabytes of data being generated every day (Mariani, 2020; Mariani et al., 2018; Xiang et al., 2015; Zarezadeh et al., 2022). The tourism and hospitality industry has been gradually adopting BDA in the past five years (Mariani & Baggio, 2022), as the availability of big data alongside the development of various analytical approaches and software has significantly benefited the tourism and hospitality industry in several ways such as improving service personalization, gaining competitive advantage, and supporting decision-making (Lee et al., 2019; Li et al., 2018; Yallop & Seraphin, 2020; Zarezadeh et al., 2022).

However, the adoption of BDA in the tourism and hospitality industry remains problematic at both academic and practical levels. On the industry side, the hospitality industry is reluctant to fully implement DBA for various reasons, including high costs and potential risks. Olufemi (2018) argued that BDA is limited to large corporations and multinational enterprises because of the huge investment required. Gupta et al. (2017) reported that the hospitality industry has not abundantly adopted BDA as a result of several challenges or risks associated with it. On the academic side, several previous studies reported a knowledge gap that requires further investigation. For example, Gupta et al. (2017) stated that the adoption of BDA comes with certain benefits and risks that need to be carefully considered (Gupta et al., 2017). Raguseo (2018) noted that there is a lack of empirical studies that have examined the benefits and risks of BDA adoption. Studies by Mariani et al. (2018) and Mariani (2020) reported that research on BDA in tourism and hospitality is limited, has several gaps, and ignores several areas that require further research. Shahbaz et al. (2020) disputed that business organizations are in the implementation phase of BDA, thereby it is critical to have an adoption model for BDA and to comprehend the factors that influence the implementation. Merhi and Bregu (2020) reported a lack of comprehensive studies examining the critical factors leading to an effective and efficient implementation of BDA. Recently, Mariani and Baggio (2022) conducted a systematic review of studies of BDA from 2015 to 2020 and reported a knowledge gap on BDA capabilities in the tourism and hospitality industry.

Hence, the aim of this research is threefold: first, to explore the current and intended levels of adoption of BDA in hotels; second, to examine the impact of perceived benefits on the current and intended levels of BDA adoption in hotels; and third, to test the moderating role of perceived risks on the association between perceived benefits and the current level, as well as on the relationship between the current and intended levels of BDA adoption in hotels. In doing so, this research fills a knowledge gap and contributes to the growing literature on the application of BDA in hotels. It also contributes to practice by providing some valuable managerial suggestions that support the implantation of BDA in hotels.

2. Theoretical background and hypotheses

2.1. Big data analytics

Relevant literature provides several definitions for BDA (Maltby, 2011; Shahbaz et al., 2020; Zarezadeh et al., 2022). For example, Siemens and Long (2011) defined big data as large data sets that exceed the capabilities of typical software to capture, store, analyze and manage. Similarly, Chen, Chiang, and Storey (2012) explained that big data are large and complex data sets that require advanced technologies to analyze and manage. Yasin (2018) defined BDA as a system that allows for the collection, storage, analysis, and distribution of large amounts of data. Wang et al. (2018) also referred to BDA as the technology used to extract useful information from processing a large volume and variety of data. Big Data is characterized by certain characteristics known as 3V, including volume, variety, and velocity. That is, volume refers to a huge amount of data sets, variety indicates different types or forms of data produced (text, audio, video, photo, etc.), and velocity refers to the swift creation of large amounts of data (Laney, 2001; Raguseo, 2018; Zarezadeh et al., 2022). Recently, another 2Vs have been added to big data, one stands for the value and emphasizes the importance of big data management (Laney, 2001; Zarezadeh et al., 2022) while the other represents the veracity, consistency, and reliability of big data (Merhi & Bregu, 2020). Likewise, Kitchin (2014) described big data as being large in volume, high in velocity, rich in variety, exclusive in scope, accurate, relational, and flexible.

A typical BDA system uses several technologies and analytical techniques to process big data and extract relevant information (Maltby, 2011). There are various analytical techniques used for BDA, depending on the type of data being analyzed and the expected outcomes of the analysis, such as crowdsourcing, data mining, text analytics, cluster analysis, and machine learning. Similarly, several technologies or software are used in BDA such as content-based analytics software to process social media content, predictive analytics software to project trends and behavior patterns, text analytics software to summarize texts and answer questions, machine learning software to conclude a model that fit the data, and visual analytics software to visually display the results in graphic forms (Maltby, 2011; Raguseo, 2018). Commercially known BDA technologies include Hadoop, MapReduce, Cassandra, NoSQL, etc. (Zakir et al., 2015).

2.2. BDA in hotels

In tourism and hospitality settings, big data is generated from three main sources: users, transactions, and devices (Li et al., 2018; Mariani & Baggio, 2022; Mariani & Borghi, 2020; Zarezadeh et al., 2022). The first source is User-Generated Content (UGC) and includes various forms of data (photos, videos, texts, etc.) shared by customers on social media platforms and travel/tourism review websites (Mariani & Borghi, 2020; Peterlin et al., 2021; Zarezadeh et al., 2022). UGC is the primary data source for tourism and hospitality enterprises to explore visitors' feedback, preferences, behavior, and satisfaction (Peterlin et al., 2021; Zarezadeh et al., 2022). Transactional data includes customers' online bookings and purchases, website visits, and web searches that help to understand consumers' preferences and behaviors and to predict the volume and flow of market demand (Mariani & Borghi, 2020; Ogbeide et

al., 2021; Zarezadeh et al., 2022). Device data comes from various devices such as GPS, Bluetooth data, and mobile roaming, which helps to understand customer behavior over space and time (Mariani, 2020; Mariani & Borghi, 2020; Ogbeide et al., 2021; Zarezadeh et al., 2022).

BDA can be used in various fields and operations in the hospitality industry. For example, BDA can be used in hotel revenue management, by using occupancy statistics, reservation data, and demand forecasts to achieve optimal revenue (Evans, 2015; Yallop & Seraphin, 2020). BDA can also be applied to several hotel marketing activities including: market research through tracking market trends/changes and identifying market opportunities; reputation management through handling social media comments and online reviews; customer relationship management through performing customer segmentation and profiling as well as managing customer experience and satisfaction (Evans, 2015; Lee et al., 2019; Maltby, 2011; Mariani & Baggio, 2022; Ogbeide et al., 2021; Yallop & Seraphin, 2020). Additionally, BDA can also be used to create marketing strategies and influence customer purchasing intentions and behaviors (Mariani & Baggio, 2022; Tao & Kim, 2020). Human resources management, especially in chain hotels with a large number of employees, can also use BDA in certain practices including compensation, training, and performance management (Martin-Rios et al., 2017). Mariani and Baggio (2022) suggested other areas for BDA applications in hotels, such as behavioral analysis, crisis management, online marketing, and capacity management.

2.3. Perceived benefits of BDA

The adoption of new technology such as BDA brings many benefits to business organizations (Mcneely & Hahm, 2014; Raguseo, 2018). Gregor et al. (2006) categorized the benefits of implementing new technologies into four main aspects: strategic, informational, transactional, and transformational. Strategic benefits ensure the continuity and future success of business organizations. Adopting BDA offers several strategic benefits, such as gaining a competitive advantage, enabling personalized services, and supporting decision-making (Yallop & Seraphin, 2020). It also supports corporate sustainability and operational efficiency (Nadkarni et al., 2020) and provides the sufficient knowledge to develop informed policies and long-term strategies (Mariani et al., 2018; Merhi & Bregu, 2020). Likewise, there are several transactional benefits associated with using BDA, such as increased sales, customized product/service, decreased operating costs, improved performance, and up-to-date pricing (Ogbeide et al., 2021; Peterlin et al., 2021; Yallop & Seraphin, 2020). The informational benefits of BDA include extracting meaningful insights from large and diverse data (Xiang et al., 2015), providing invaluable information about people's opinions, ideas, and behaviors (Mariani et al., 2018), and enabling governance and strategic management of data (Abraham et al., 2019; Yallop & Seraphin, 2020). Lastly, there are several transformational benefits associated with BDA, such as attracting new customers, developing new or customized products/services, identifying emerging market trends, and exploring new market opportunities (Ogbeide et al., 2021; Peterlin et al., 2021).

Since the adoption of BDA appears to be beneficial in several aspects of business organizations, hotel managers are more likely to adopt it. In other words, the perceived benefits of BDA by hotel managers can positively influence their attitudes toward BDA and encourage them to fully embrace and apply BDA in various hotel operations. It may also influence their intentions to expand or upgrade BDA application in the future. Therefore, this study assumes a positive impact of perceived benefits of BDA on the current and intended levels of BDA adoption and argues the following hypotheses:

H1: perceived benefits positively influence the current level of BDA adoption in hotels

H1: perceived benefits positively influence the intended level of BDA adoption in hotels

H3: the current level of BDA adoption positively impacts the intended level of BDA adoption

H4: the current level of BDA adoption mediates the linkage between perceived benefits and the intended level of BDA adoption.

2.4. The moderating role of perceived risks

Adopting BDA is also associated with several potential risks (Maltby, 2011; Mcneely & Hahm, 2014; Raguseo, 2018). Privacy issues are among the top risks of BDA as it involves personal information about customers whom may not comfortable with this information being known or used by others (Blakesley & Yallop, 2020; Maltby, 2011; Merhi & Bregu, 2020; Nadkarni et al., 2020). Moreover, security concerns and data breaches are serious risks that accompany the adoption of BDA (Blakesley & Yallop, 2020; Merhi & Bregu, 2020; Nunan & Di Domenico, 2013; Yallop & Seraphin, 2020). BDA also involves certain risks that arise during the different phases of data analytics (Waterman & Bruening, 2014). Some risks arise during the data collection process, such as corruption or distortion of data and errors in data entry (Mariani et al., 2018; Waterman & Bruening, 2014). Certain risks can also emerge during the data processing phase including selecting inadequate analytical tools and algorithms, misunderstanding and misinterpretation of analytics outputs, system failures or errors, and the inability to process huge unstructured data in various formats (Maltby, 2011; Mcneely & Hahm, 2014; Raguseo, 2018; Waterman & Bruening, 2014; Yallop & Seraphin, 2020). Furthermore, some risks may arise in the application phase such as providing false or misleading data outcomes in addition to concerns pertaining to data reliability and visualization (Mariani et al., 2018; Mariani & Baggio, 2022; Waterman & Bruening, 2014). Additional risks of BDA include high costs of BDA systems, resistance to change, and lack of appropriate infrastructure and experts (Maltby, 2011; Mariani & Baggio, 2022; Merhi & Bregu, 2020; Raguseo, 2018; Yallop & Seraphin, 2020).

Such risks or challenges can hinder or limit the adoption of BDA in business organizations. Maltby (2011) argued that certain challenges or risks should be addressed for BDA to reach its full potential. Merhi and Bregu's (2020) study on BDA in the public sector reported that technological advancement and privacy and security concerns are the main factors influencing the effectiveness and efficiency of BDA. Likewise, Gupta et al (2017) claimed that the hospitality industry has not fully embraced BDA

due to the various challenges associated with it. Accordingly, the current study argues that the extent to which hotel managers perceive BDA adoption as risky will negatively moderate the relationships between perceived benefits and both the current and intended levels of BDA adoption. This assumption is stated in the subsequent hypotheses:

H5: perceived risks negatively moderate the association between perceived benefits and the current level of BDA adoption

H6: perceived risks negatively moderate the association between the current level and intended level of BDA adoption

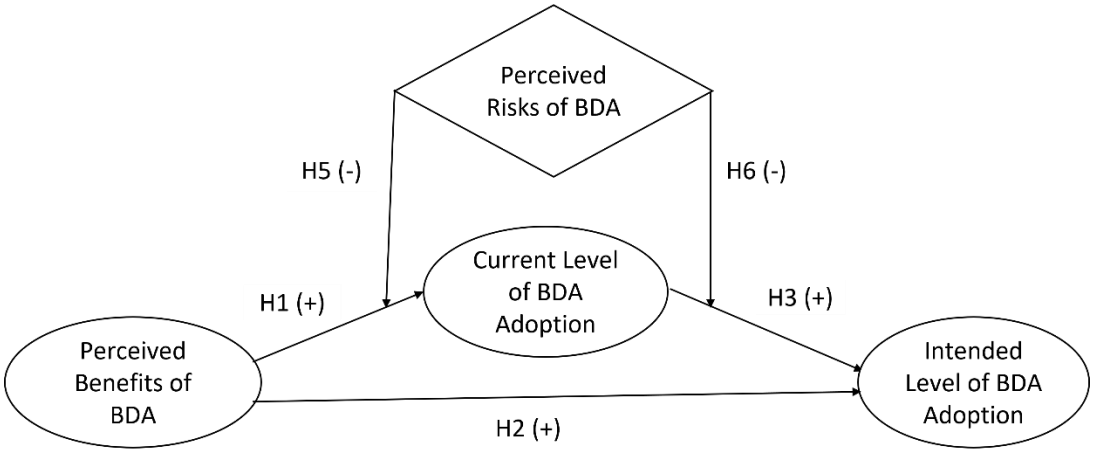

Figure 1: proposed model of the study

3. Methodology

3.1. Instrument

This study followed a quantitative approach and used a questionnaire form with six sections as a tool for collecting primary data. The first section presented the purpose of the study and addressed the consent and anonymity of the participants. Section two captured the profile of the respondents, mainly gender and job position, as well as the main features of the hotel including type, grade, size, and location. The remaining four sections presented the measures of the study variables. That is, section three presented the scale of the current level of BDA adoption, section four explored the intended level of BDA adoption, and sections five and six covered the perceived benefits and perceived risks of BDA, respectively.

All measures used in this study were developed based on the relevant literature. The measures of the current and intended levels of BDA adoption were developed based on the fields of BDA applications in hotels and business enterprises suggested by previous studies (Mariani, 2020; Mariani et al., 2018; Raguseo, 2018; Zarezadeh et al., 2022). Each of the two constructs included 12 statements classified into 4 main categories covering the four major areas of BDA application: marketing, revenue management, operation management, and property management. The statements were measured on a

three-point Likert scale (1= Not at all, 2= Partially, 3= Completely). The scale for perceived benefits of BDA was also developed in light of the prior research (Gregor et al., 2006; Raguseo, 2018; Yallop & Seraphin, 2020; Zarezadeh et al., 2022) and included 4 dimensions (strategic, informational, transactional and transformational) with a total of 12 statements. Lastly, the measure of perceived risks of BDA was taken from several previous studies (Merhi & Bregu, 2020; Raguseo, 2018; Waterman & Bruening, 2014; Yallop & Seraphin, 2020; Zarezadeh et al., 2022) and involved five main statements. Measures of both perceived benefits and risks were operationalized on a five-point Likert scale (1 means strongly disagree and 5 means strongly agree).

3.2. Participants and procedures

This study investigates the adoption of BDA in hotels, thereby the suitable participants would be hotel IT managers/engineers and general managers/deputies. The survey was administered among three, four, and five-star hotels as they are more likely to adopt BDA. Accordingly, a list of 350 potential respondents was developed using the convenience sampling technique to involve participants from several hotels covering the major tourist regions in Egypt. Details of the study participants are presented in Table 1. The data collection process was accomplished through certain steps. First, an online survey was designed using Google Forms services. Next, targeted participants were approached and invited to fill out the survey. Then, the hyperlink of the survey was sent to the target participants. Some of the participants were contacted more than once and reminded or encouraged to fill out the form. Out of the 350 forms, a total of 265 were completed. All responses were checked for completeness and accuracy and set for analysis.

3.3. Data analysis

PLS-SEM was adopted to test the study model using smart PLS 3.0 software. The model included four variables that were reflectively measured by a total of 41 indicators. First, descriptive statistics were extracted to measure the current and intended levels of BDA adoption in hotels. Next, to examine the study model, the consistent PLS algorithm and consistent bootstrapping technique were utilized. Both the measurement model and the structural model were examined, according to the procedures proposed by Hair et al. (2016). Specifically, the reliability and construct validity of the outer model was evaluated by looking at some statistics, such as Average Variance Extracted, Composite Reliability, Cronbach's Alpha, and heterotrait-monotrait. Furthermore, Beta, *t*-statistic, and *P*-value were used to assess the structural model. Details of statistical tests are presented in the results section.

4. Results

4.1. Characteristics of the study sample

The results showed that the sample was dominated by male participants (81.9 %) while females represented a slight portion (18.1%) of the sample (Table 1). In the same way, most of the study participants (92.5%) were IT managers/engineers and only 7.5% were general or deputy managers. In respect of the enterprises' type, more than half (nearly 51%) of the enterprises involved in this study were hotels, whereas resorts and cruise hotels composed the other half of the sample (24.9% and

244.2%, respectively). The study focused on the highly ranked hotels with a significant number categorized as three-star hotels (165) followed by four-star hotels (58) and then five-star hotels (42). Also, a large portion of the investigated hotels can be classified as large enterprises with a room capacity of either between 200 and 299 guest rooms (71.3%) or over 300 guest rooms (14.3%), while a few enterprises were categorized as small with room capacity less than 100 guest rooms (10.6%) or medium-sized hotels with room capacity between 100 and 199 rooms (3.8%). Lastly, the study sample has a reasonable geographical representation as it covered the major tourist regions in Egypt, including Cairo (31.3%), Hurghada (24.1%), Sharm El-sheik (18.5%), and Luxor (26.1%). In sum, the sample included suitable participants who represented various hotel sizes, grades, types, and tourist cities.

Table 1: Characteristics of the participants (N=265)

Gender	**Freq.**	**%**	**Job position**	**Freq.**	**%**
Male	217	81.9	IT manager / engineer	245	92.5
Female	48	18.1	Manager / deputy	20	7.5
Total	*265*	*100*	*Total*	*265*	*100*
Enterprise type	**Freq.**	**%**	**Enterprise grade**	**Freq.**	**%**
Hotel	135	50.9	Three-star	165	62.3
Resort	66	24.9	Four-star	58	21.9
Cruise hotel	64	24.2	Five-star	42	15.8
Total	*265*	*100*	*Total*	*265*	*100*
City	**Freq.**	**%**	**Property size**	**Freq.**	**%**
Cairo	83	31.3	Less than 100 rooms	28	10.6
Hurghada	64	24.1	100 to 199 rooms	10	3.8
Sharm El-sheik	49	18.5	200 to 299 rooms	189	71.3
Luxor	69	26.1	More than 300 rooms	38	14.3
Total	*265*	*100*	*Total*	*265*	*100*

4.2. The current and intended levels of BDA adoption

Participants were asked to specify the extent to which their hotels are currently adopting BDA in various operations in the hotel, as well as the extent to which they intend to adopt BDA in the future (within the next three to five years). On one hand, the results (Table 2) revealed that the four major areas of the current level of BDA adoptions recorded a mean score that ranged between 2.13 and 2.31 on a three-point scale. This indicates that investigated hotels were at a modest or a partial level of adopting BDA in their operations (where the overall attitude of the scale is 1.00 to 1.67 = not at all, 1.68 to 2.67 = partially, and 2.68 to 3.00 = completely). On the other hand, the intended level of BDA adoption recorded some significant variations in the mean scores of the four areas of adoption when compared to their current level of adoption. That is, certain fields of BDA will be upgraded or expanded while other fields will be downgraded or limited. Specifically, hotels tend to upgrade or expand the applications of BDA in marketing and revenue management in the future as their mean scores (2.15 to 2.35) either equal or exceed their means of their current level of adoption (2.13 to 2.31).

On contrary, the application of BDA in operations management and property management will be shrunken or decreased where their mean scores are significantly lower (ranging between 1.63 and 1.92) compared to their mean scores of the current level of adoption (2.13 to 2.31).

4.2. Measurement model

4.2.1. Common method bias

Common Method Bias (CMB) can represent a serious issue that threaten the integrity of data, particularly in cross-sectional research. CMB occurs when the measurement scale impacts participants' responses, causing indicators to share some common variations (Kock, 2015). To confirm that CMB did not contaminate the quality of data, this study performed a full collinearity test. The findings (Table 3) revealed that the outer values of the Variance Inflation Factor (VIF) are less than the threshold of 3.0 ($1.17 \leq VIF \leq 2.98$) which ensures that CMB was not an issue for this study, as suggested by Kock (2015).

Table 2: Current and intended levels of BDA adoption in hotels

Areas of BDA adoption	**The current level of adoption**					**The intended level of adoption**				
	Not at all	**Partially**	**Completely**			**Not at all**	**Partially**	**Completely**		
	Freq. (%)	Freq. (%)	Freq. (%)	**Mean**	**SD**	Freq. (%)	Freq. (%)	Freq. (%)	**Mean**	**SD**
Marketing										
Managing guest experience and satisfaction	49 (18.5)	104 (39.2)	112 (42.3)	2.23	0.742	42 (15.8)	125 (47.2)	98 (37)	2.211	0.695
Tracking customer behaviors and market changes	60 (22.6)	106 (40)	99 (37.4)	2.14	0.760	18 (6.8)	134 (50.6)	113 (42.6)	2.358	0.605
Developing marketing campaigns or activities	46 (17.4)	110 (41.5)	109 (41.1)	2.23	0.727	44 (16.6)	109 (41.1)	112 (42.3)	2.257	0.723
Revenue management										
Dynamic pricing across distribution channels	56 (21.1)	95 (35.8)	114 (43.1)	2.21	0.770	32 (12.1)	116 (43.8)	117 (44.2)	2.321	0.678
Demand forecast and management	54 (20.4)	101 (38.1)	110 (41.5)	2.21	0.758	56 (21.1)	112 (42.3)	97 (36.6)	2.155	0.744
Reservation and capacity management	52 (19.6)	117 (44.2)	96 (36.2)	2.16	0.729	30 (11.3)	132 (49.8)	103 (38.9)	2.275	0.653
Operation management										
Control of internal operations and activities	32 (12.1)	118 (44.5)	115 (43.4)	2.31	0.676	90 (34)	104 (39.2)	71 (26.8)	1.928	0.776
Employees' performance management	50 (18.9)	98 (37)	117 (44.1)	2.25	0.753	112 (42.3)	100 (37.7)	53 (20)	1.777	0.757
Accounting and financial control	58 (21.9)	113 (42.6)	94 (35.5)	2.13	0.745	122 (46)	89 (33.6)	54 (20.4)	1.743	0.774
Property management										
Organizational performance management	38 (14.3)	128 (48.3)	99 (37.4)	2.23	0.681	108 (40.8)	93 (35.1)	64 (24.1)	1.834	0.788
Strategic planning and management	44 (16.6)	120 (45.3)	101 (38.1)	2.21	0.708	145 (54.7)	42 (27.2)	72 (18.1)	1.634	0.771
Decision support system	58 (21.9)	110 (41.5)	97 (36.6)	2.14	0.750	132 (49.8)	90 (34)	42 (16.2)	1.664	0.74

4.2.2. Reliability and construct validity

Reliability of the measurement scales was assured based on several statistics that are presented in Table 3. The values of Cronbach's alpha ($0.801 \leq \alpha \leq 0.976$), Rho A ($0.854 \leq \rho A \leq 0.978$), and Composite Reliability ($0.846 \leq CR \leq 0.979$) significantly exceeded 0.70, which ensured the internal consistency of the scales. Also, convergent validity was established as the outer loadings of all indicators were significant and surpassed the threshold of 0.7 ($0.722 \leq \lambda \leq 0.942$; $13.10 \leq t \leq 88.34$). Likewise, the Average Variance Extracted exceeded the value of 0.5 ($0.542 \leq AVE \leq 0.838$) which revealed that the measures of the study are convergently validated.

Table 3: reliability and construct validity

Constructs	**VIF**	**loadings**	***t*-value**	***α***	**Rho A**	**CR**	**AVE**
Perceived benefits				0.976	0.978	0.979	0.792
Strategic benefits							
Creating competitive advantage	2.88	0.839	29.52*				
Improving customer service and relationship	2.68	0.855	42.38*				
Enabling quick response to market changes	2.26	0.815	39.18*				
Providing better services and products	2.22	0.911	65.49*				
Informational benefits							
Enabling faster and easier access to data	2.89	0.906	68.20*				
Improving data accuracy and management	2.86	0.898	65.74*				
Providing useful information in user-friendly forms	2.26	0.894	58.29*				
Transactional benefits							
Enhancing employee productivity	2.89	0.935	13.10*				
Reducing costs and increasing profits	2.91	0.898	82.97*				
Decreasing required workforce	2.67	0.898	59.99*				
Transformational benefits							
Developing new products and services	2.57	0.904	77.73*				
Supporting business development and expansion	2.97	0.919	88.34*				
Perceived risks				0.952	0.958	0.963	0.838
Security breaches and privacy concerns	2.77	0.895	56.96*				
Technical uncertainty and system faults	2.77	0.932	27.67*				
Large financial investment with uncertain returns	2.43	0.942	13.39*				
Implementation reluctance and resistance to change	2.98	0.928	82.91*				
Unreliable data outputs or projections	2.44	0.880	51.71*				
Current level (R^2 =0.312; Q^2 =0.139)				0.893	0.895	0.911	0.563

Continued

Constructs	VIF	loadings	*t*-value	*α*	Rho A	CR	AVE
Marketing							
Monitoring guest experience and satisfaction	1.70	0.733	18.51*				
Tracking customer behaviors and market changes	2.07	0.722	19.51*				
Developing marketing campaigns or activities	2.02	0.781	17.25*				
Revenue management							
Dynamic pricing across distribution channels	1.96	0.767	16.29*				
Demand forecast and management	2.14	0.745	25.85*				
Reservation and capacity management	2.16	0.708	19.55*				
Operation management							
Control of internal operations and activities	1.86	0.711	19.44*				
Employees' performance management	1.82	0.785	18.42*				
Accounting and financial control	2.56	0.736	26.48*				
Property management							
Organizational performance management	2.36	0.786	19.74*				
Strategic planning and management	1.52	0.714	12.50*				
Decision support system	1.38	0.703	9.73*				
Intended level (R^2 =0.709; Q^2 =0.236)				0.801	0.854	0.846	0.542
Marketing							
Monitoring guest experience and satisfaction	1.96	0.767	14.20*				
Tracking customer behaviors and market changes	2.46	0.805	37.83*				
Developing marketing campaigns or activities	2.75	0.789	17.14*				
Revenue management							
Dynamic pricing across distribution channels	2.37	0.774	16.62*				
Demand forecast and management	2.81	0.758	27.67*				
Reservation and capacity management	2.40	0.839	34.69*				
Operation management							
Control of internal operations and activities	1.30	0.763	8.94*				
Employees' performance management	1.27	0.728	5.38*				
Accounting and financial control	1.37	0.734	8.60*				
Property management							
Organizational performance management	1.43	0.786	4.71*				
Strategic planning and management	1.30	0.723	5.04*				
Decision support system	1.17	0.721	5.01*				

*$p < 0.001$.

Moreover, discriminant validity was asserted by examining certain statistics (Table 4). Specifically, the correspondent square roots of AVE were significantly higher than the correlation coefficients ($0.381 \leq \phi \leq 0.489$; $0.585 \leq \sqrt{AVE} \leq 0.891$) (Fornell & Larcker, 1981). Additionally, there was no heterotrait-monotrait (HTMT) ratio greater than the threshold of 0.90, as recommended by Henseler et al. (2015).

Table 4: Discriminant validity of the constructs

Constructs	Perceived benefits of DBA	The current level of BDA adoption	The intended level of BDA adoption
Perceived benefits of BDA	**0.891**	0.519	0.483
Current level of adoption	0.489	**0.681**	0.961
Intended level of adoption	0.442	0.381	**0.585**

Note: bolded values are the square root of AVE, upper triangular presents HTMT ratios, and bivariate correlation coefficients are in the lower triangular.

4.3. Structural model

4.3.1. Direct and mediated paths

The results showed that perceived benefits of BDA had a significant and positive influence on the current level of BDA adoption in hotels (β= 0.281; t=2.97, $P < 0.005$) which provides strong support for hypothesis number 1. However, the perceived benefits of BDA had a positive (β= 0.208) but nonsignificant (t=1.70, $P > 0.05$) impact on the intended level of BDA adoption. In addition, the current level of BDA adoption positively and significantly impacts the intended level of BDA in hotels (β= 0.811; t=24.45 $P < 0.001$). Consequently, hypothesis 2 was not accepted whereas hypothesis 3 was supported (Table 5). According to Cohen's (1998) guidelines for F^2 values for effect size, the perceived benefits of BDA had a positive and large effect on the current level of BDA adoption (F^2=0.351) and no effect (F^2=0.018) on the intended level of BDA adoption. In the same context, the current level of BDA adoption had a medium effect (F^2=0.0.286) on the intended level of BDA adoption. Additionally, a mediation analysis test was conducted to teste the mediation effect of the current level of BDA adoption on the linkage between the perceived benefits of BDA and the intended level of BDA adoption in hotels. The findings showed that the mediation effect was positive and significant (effect= 0.227; t=2.788, $P < 0.005$). This provides sufficient support for hypothesis number 4.

Table 5: Results of structural model test

H#	Paths	β	t-value	F^2	Result
H1	Perceived benefits → current level of BDA adoption	0.281	2.79**	0.351	Accept
H2	Perceived benefits → intended level of BDA adoption	0.208	1.70	0.018	Reject
H3	Current level of adoption → intended level of adoption	0.811	24.45***	0.286	Accept

**= P-value < 0.005; *** = P-value < 0.001

Predictive power (R^2), predictive relevance (Q^2), and the model goodness of fit (GoF) were also assessed. The results showed that the study model has a substantial predictive power as the value of R^2 revealed that perceived benefits counted for 31.2% of the variance in the current level of BDA adoption (R^2=0.312). Approximately 71% of the variance in the intended level of BDA adoption was also explained by its antecedents (R^2=0.709). The predictive relevance of the model was evaluated using Stone–Geisser's Q^2 by performing blindfolding technique with cross-validated redundancy. According to Henseler et al. (2009), a value of Q^2 for the endogenous variables higher than zero indicates a sufficient predictive relevance. The outcomes indicated that the Q^2 values for both the current level of adoption (Q^2=0.139) and the intended level of adoption (Q^2=0.236) were considerably higher than zero, which ensured the predictive relevance of the model. Lastly, the model's goodness of fit (GoF) was confirmed through considering the values of the Standardized Root Mean Square Residual (SRMR = 0.073) and the Normed Fit Index (NFI = 0.961) (Henseler et al., 2014; Hu & Bentler, 1999).

4.3.2. The moderating effects of perceived risks

A moderation analysis using product-indicator approach of smart PLS was employed to examine the moderation effects of perceived risks of BDA adoption. The findings (Table 6) showed that perceived risks of BDA had a significant negative moderation role on the relationship between perceived benefits of BDA and the current level of BDA adoption (β= – 0.322; t=4.366, P < 0.005). Likewise, perceived risks of BDA negatively and significantly moderated the relationship between the current level of BDA and the intended level of BDA adoption (β= – 0.095; t=2.641, P < 0.001). The values of F^2 indicated that perceived risks of BDA had a small moderating effect where the F^2 values for both hypotheses were below 0.15 (Cohen, 1998). In sum, these findings strongly support hypotheses 5 and 6.

Table 6: Results of the moderation effects

H#	Paths	β	*t*-value	F^2	Decision
H5	Perceived benefits x perceived risks → current level of adoption	- 0.322	4.366**	0.094	Accept
H6	Current level of adoption x perceived risks → intended level of adoption	- 0.095	2.641***	0.029	Accept

**= P-value < 0.005; *** = P-value < 0.001

5. Discussion and conclusion

5.1. Findings and theoretical implications

Although BDA is widely adopted in several industries, it has not been fully adopted and embraced by the hospitality industry (Gupta et al., 2017). This poses an interesting problem for investigation to identify the latent reasons that hinder the full implementation of BDA in hotel operations and activities. Additionally, previous studies on BDA in the hospitality industry have pointed to a lack of knowledge in this area and endorsed a further investigation into the issue (Mariani, 2020; Mariani et al., 2018; Mariani & Baggio, 2022; Mariani & Borghi, 2020).

Therefore, this study responds to that call and seeks to fill such a knowledge gap. In particular, the current study explored the current and intended level of BDA adoption in hotels and examined the impact of the perceived benefits and risks of BDA adoption on current and intended levels of BDA adoption in hotel operations.

The findings of this study revealed that hotels were partially adopting BDA in four main operations, namely marketing, revenue management, operation management, and property management. That is, hotels are only adopting BDA on a partial basis in certain activities. This result agrees with Gupta et al. (2017) that the hospitality industry has not fully adopted BDA. Interestingly, the hotels surveyed are planning to upgrade or fully implement BDA in two operations, namely marketing, and revenue management, while they tend to rely less on BDA in operations management and property management. This indicates that hotels have found BDA to be more useful and effective in marketing and revenue management activities than operations management and property management. Accordingly, the usefulness, effectiveness and efficiency of BDA can vary across various operations and activities in hotels.

The primary theoretical contribution of this study is being among the few, if any, studies that have examined the extent to which the perceived benefits and risks of BDA adoption can impact the current and intended levels of BDA implementation in the hotel industry. In this context, the results highlighted that the perceived benefits of BDA had a positive impact on the current level of adoption of BDA in hotels, but not on the desired or intended level of adoption. In other words, while hotel managers have found the adoption of BDA beneficial in many ways, they have only been motivated to adopt BDA to a certain extent in the current time whereas they have no intentions to expand or fully adopt BDA in the near future. On contrary, hotels tend to minimize the adoption of BDA in certain activities. This can be attributed to the notion that BDA is either ineffective or has some potential risks.

The findings also indicated that the perceived risks of adopting BDA had a negative moderating effect on the associations between the perceived benefits of adopting BDA and both the current and desired levels of BDA adoption. In other words, the extent to which hotel managers viewed BDA as risky has limited the implementation of BDA in hotel operations in the present and confined any further adoption or expansion of BDA in the near future. That is, the perceived risks of BDA outweigh its perceived benefits and hinder the full application of BDA in hotels.

5.2. Practical implications

Based on the empirical findings, this study provides some practical implications for hotel managers. Since the adoption of BDA in hotels is considered beneficial in several ways, hotel managers are encouraged to appreciate and implement appropriate BDA techniques and technologies in various hotel operations. In this context, hoteliers can start with preliminary or partial applications of BDA and then gradually update and expand their implementations. This allows hotel managers to take advantage of BDA and manage any issues or risks that may arise.

Moreover, in order to ensure successful, beneficial, and effective implantation of BDA, hoteliers are advised to avoid the indiscriminate introduction of BDA. Instead, they are advised to develop and implement a long-term plan or strategy for BDA adoption.

The adoption of the BDA in hotels appears to be associated with several risks that limit the inclusive or comprehensive implementation of the BDA in hotel operations. Therefore, hotel managers need to be alert to these risks and understand how to overcome or address these potential risks upon emergence. In this regard, several practices can be undertaken to reduce the potential risks of adopting the BDA in hotels. Such practices include directing and qualifying designated employees to use the BDA system to achieve better outcomes and avoid any resistance to change. Also, creating a robust and secure system for BDA and hiring IT experts enables a hotel to ensure data security, prevent data breaches, and handle any technical errors or system faults. Performing a cost-benefit analysis also assists hotel managers to determine the feasibility of the investment in the BDA system and ascertain the extent to which they can implement BDA. Lastly, using adequate analytical technologies and techniques is strongly advised to provide reliable and accurate information that supports decision-making.

5.3. Limitations and future research

This study has some limitations. First, the empirical evidence of this study was based on the hotel industry in Egyptian settings. Thus, the findings of the study may be influenced by national economic and technological aspects and thereby the conclusions of this research can be cautiously generalized to hotels in similar settings. Future studies, therefore, can adopt a cross-country approach to investigate the adoption of BDA in multiple countries and provides more generalizable results. Moreover, the sample of this study only included hotels in its empirical investigation. Further research can investigate the applications of BDA in the broader field of the tourism and hospitality industry and involve various types of enterprises such as restaurant chains, tour operators, airway carriers, etc. Doing so can provide rich information that enables a better understanding of DBA adoption in the tourism and hospitality industry. Another interesting issue for further exploration is to empirically evaluate and compare the efficiency of BDA adoption across various hotel operations and activities. Lastly, future research can examine the moderation effects of other variables on the adoption of BDA in hotels, such as resistance to change, self-efficacy, personal innovativeness, gender, job position, or educational background of hotel managers/IT engineers.

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الملخص العربي

تأثير الفوائد والمخاطر المُتَصورة على المستويات الحالية والمرغوبه لإستخدام تحليل البيانات الضخمة في الفنادق

أصبح إستخدام تحليل البيانات الضخمة من الممارسات السائدة في العديد من منشأت الأعمال نظرًا لفوائدها العديدة. وعلي الرغم من ذلك، فقد أشارت الدراسات السابقة إلى تباطئ صناعة الفنادق في تطبيقها لتحليل البيانات الضخمه إضافة الي قصور الابحاث التي تناولت هذا الموضوع. ومن ثم، تسعي الدراسه الحاليه الي إستكشاف المستويات الحالية والمرغوبه او المستقبليه لتطبيق تحليل البيانات الضخمة في الفنادق. كما تسعي ايضا الي دراسة تأثير الفوائد والمخاطر المتصورة على المستويات الحالية والمرغويه لتطبيق تحليل البيانات الضخمة في الفنادق. إتبعت هذه الدراسة منهجًا كميا حيث تم إعداد استبانه لقياس متغيرات الدراسه وتم توزيعها على مديري او نوابهم وعلي مهندسي تقنية المعلومات في الفنادق. شملت عينه الدراسة 265 إستبانة كاملة وصالحة للاستخدام وتم تحليلها باستخدام برنامج PLS 3.0 لاختبار تأثيرات متغيرات الدرسة. أظهرت النتائج أن الفوائد المتصورة تؤثر بشكل إيجابي على المستوى الحالي والمستوى المرغوب لاستخدام تكنولوجيا تحليل البيانات الضخمه في الفنادق. إضافة الي ذلك، كان للمخاطر المتصورة تأثير مُعدل سلبي على العلاقة بين الفوائد المتصورة والمستويات الحالية والمرغوبه لتحليل البيانات الضخمه في الفنادق.

الكلمات الدالة المُفتاحيه: تحليل البيانات الضخمة، الفوائد، المخاطر، الفنادق.