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The effect of organisational factors on adopting big data analytics in supply chain operation among companies in Saudi Arabia: The moderating role of resistance to change

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Background: Big data analytics (BDA) is vital for modern supply chain operations. However, implementing BDA requires significant administrative effort to ensure success, as managers and employees may resist change. A study was conducted on large and medium-sized companies in Saudi Arabia to investigate the impact of organisational factors on BDA adoption and identify potential resistance. (hereafter Saudi Arabia).

Objectives: This study investigate how organisational factors influence the adoption of BDA in medium and large supply chain companies in Saudi Arabia. It also explores the moderating role of resistance to change (RTC) in this relationship.

Method: A survey questionnaire was given to 402 supply chain practitioners working in medium and large enterprises (MLEs) in Saudi Arabia as part of a quantitative study. The collected data were analysed using the Statistical Package for Social Science (SPSS29.0) and SMART PLS (version 4.0).

Results: The findings indicated that organisational factors (top management support, IT expertise, and organisational resources) insignificantly influenced BDA adoption ($p < 0.05$). Furthermore, RTC did not moderate the relationship between organisational factors and technology adoption ($p > 0.05$).

Conclusion: The successful use of BDA is crucial for improving Saudi supply chain operations, with a positive impact on customers, companies, and the country.

Contribution: This study is important for medium and large companies in the Saudi Arabian supply chain. It provides scope for developing innovations in adopting BDA by understanding organisational factors that influence adoption. The results will help push Saudi companies forward in trusting BDA in supply chain operations.

Keywords: big data analytics (BDA); supply chain operations; organisational factors; resistance to change (RTC); Saudi Arabia.

Introduction

Big data analytics (BDA) has improved and developed various business models, including supply chain management (SCM) (Chehbi-Gamoura et al. 2020; Kamble & Gunasekaran 2020). Numerous studies and publications have demonstrated the advantages of adopting BDA in SCM. These benefits include better risk reduction, demand forecasting, batch size optimisation, inventory reduction, and the creation of more innovative solutions to enhance client satisfaction (Hamed & Bohari 2022; Nambisan, Wright & Feldman 2019; Pace 2020; Petersen & Nguyen 2017; Queiroz & Farias Pereira 2019; Tahiduzzaman et al. 2017). Big data analytics enables supply chain managers to optimise supply chain operations and enhance the precision of customer demand forecasting by conducting in-depth data analysis (Maroufkhani et al. 2020).

Companies use BDA and business analytics to make wise decisions. It enhances their product offers, sales, and customer service, eventually increasing company profits.

According to Jayaraman's (2023) report published on the G2 website, he has gathered some recent big data statistics in business; the information shows that BDA is used by 4 out of 10

companies. Also, in 2022, 87.8% of businesses boosted their data investments. However, despite the uncertain economy, 9 out of 10 companies plan to expand their spending in data and analytics in 2023. The top priority for data and analytics investment in 2022 was data modernisation or data migration from older settings to cloud-based environments. Also, up from 41% in 2022 to 82% in 2023, firms intend to boost their expenditures on data transformation. In addition, most large and small firms are concentrating on incorporating big data technology. Furthermore, 19% of chief executive officers (CEOs) claim to have created a data culture within their organisation. Despite promising statistics for using big business data, the big data industry has tremendous challenges and concerns. These statistics explain the problems that companies face with BDA. Statistics indicated that approximately 7 out of 10 C-SUITE executives consider security and risk the most prominent pain points related to BDA. In addition, other concerns about BDA between C-SUITE executives are descriptive data and governance (41%) and swallowing slow data (31%). Moreover, 61% of companies believe that the volume of fast-growing data limits their ability to use their entire data. Additionally, data professionals believe that data volume grows by an average of 63% monthly in their companies. Also, more than 80% of the decision-makers agreed that their analytical projects within their companies will be delayed because of the lack of data in the required format. Likewise, 8 out of 10 companies had to reformulate data analysis projects because of poor quality data. In addition, 49% of CEOs say that current data solutions are not adequately flexible. Only a quarter of companies say they are doing enough to ensure responsible and moral use of data in their business and industry.

Although many studies have shown the advantages of BDA in SCM, research done in developing economies remains uncommon (Hamed & Bohari 2022). Most past research has concentrated on advanced industrialised economies, and limited previous studies have examined the desire to adopt and apply BDA focussing in SCM in Saudi Arabia (Alaskar, Mezghani & Alsadi 2021). Additionally, Choi, Wallace and Wang (2018) examined different big data approaches and strategies for addressing diverse SCM challenges such as forecasting, revenue optimisation, and risk evaluation. Drawing insights from case studies involving prominent brands, they observed that although the use of big data in SCM is increasing, some executives are still reluctant to incorporate BDA into their decision-making processes. Some of the main barriers include a lack of understanding, limited resources for managing big data, fear of change, data quality concerns, cultural resistance, a shortage of skills and resources, a short-term focus, and perceived complexity. These challenges have been identified in various studies including Coleman et al. (2016), Sen, Ozturk and Vayvay (2016), and O'Connor and Kelly (2017). As a result, some executives still refuse to embrace BDA in their decision-making processes. Implementation of BDA may be problematic because of the high cost, liabilities, complexities, and applicability associated with new technological innovation. These factors might contribute to ambiguity in implementing BDA in SCM operations.

With the changing environmental landscape in Saudi Arabia, brought about by initiatives such as Vision 2030 and unpredictable events like the coronavirus disease 2019 (COVID-19) pandemic, Saudi companies may need to re-evaluate their strategies. This could lead them to explore the potential of BDA as a way to either maintain their position in the market or work towards becoming industry leaders (Alaskar et al. 2021). Apart from the aforementioned, resistance to change (RTC) is a significant issue affecting the adoption of many innovative systems, particularly in developing countries (Nejati, Rabiei & Chiappetta Jabbour 2017; Reginato, Fadda & Paglietti 2016). Furthermore, employees and management reduced their willingness to embrace the system to do so (Bartos, Butler & Crowley 2011). Additionally, RTC opposes or slows the adoption of information systems (ISs) (Jiang, Muhanna & Klein 2000).

Therefore, the objective of the study is to investigate the organisational factors that affect the adoption of BDA in medium-large supply chain companies in the Kingdom of Saudi Arabia (hereinafter Saudi Arabia). Additionally, to investigate the effect of RTC as a moderator on the relationship between organisational factors and BDA adoption in medium-large supply chain companies in Saudi Arabia.

The study seeks to answer two key questions. Firstly, what are the organisational factors that affect the adoption of BDA in these companies? Secondly, does RTC moderate the relationship between organisational factors and the adoption of BDA (ABDA) within supply chain operation in these companies?

Literature review

Multiple previous studies and publications (to list a few Tahiduzzaman et al. 2017; Nambisan et al. 2019; Queiroz & Farias Pereira 2019; Pace 2020; Stefanovic 2022) demonstrated the benefits of BDA adoption and use in SCM, including improved demand forecasting, inventory reduction and risk reduction, batch size optimisation, and the development of more innovative solutions to increase customer satisfaction. Notwithstanding these advantages, some researchers have argued that many companies are hesitant to invest in BDA technology. This is because implementing BDA technology can be quite challenging for companies because of the significant upfront investments required in hardware, software, personnel, and training. Furthermore, BDA technology often involves complex algorithms, analytics processes, and integration challenges. Poor data quality, a lack of data governance, and concerns about data privacy can also undermine the effectiveness of BDA initiatives. Resistance to change, a lack of expertise, and scepticism about BDA's potential to deliver tangible business value are other challenges that companies face

when investing in BDA technology (Arunachalam, Kumar & Kawalek 2018; Moktadir et al. 2019; Willetts, Atkins & Stanier 2020; Alalawneh & Alkhatib 2021). Thus, the adoption of BDA requires empirical research to determine the factors influencing and moderating firms' intention to adopt and use BDA in SCM, including in the Saudi Arabia context. Although many studies have investigated the factors that affect the adoption of BDA in different fields, there is a noticeable gap in the literature regarding the empirical evidence of BDA technology adoption in Saudi Arabia. Therefore, this research aims to fill this gap by focussing on medium to large supply chain companies that operate within Saudi Arabia. By concentrating on this segment, the study aims to provide empirical insights into BDA adoption within the context of the Saudi Arabian market and bridge the gap in the existing literature.

In Saudi Arabia, BDA is expected to play an important role in supporting the goals of Vision 2030. As data will serve as the foundation for Saudi Arabia's long-term strategic plan, BDA is expected to open new opportunities, promote economic expansion, and facilitate societal transformation – all the main objectives of the Saudi Vision 2030 initiative. Additionally, Vision 2030 aims to drive investments and drive the digital economy by leveraging technology as a critical enabler. To achieve this, the Saudi government is actively seeking to establish partnerships with the private sector to enhance the information and communications technology (ICT) infrastructure, creating an enabling environment for innovation and growth in the digital space (Alaskar et al. 2021). Additionally, BDA may benefit a supply chain inventory management, demand forecasting, production and service scheduling, and product creation (Sun et al. 2018). In the end, BDA can improve the supply chain performance (Stefanovic 2022), as it contributes to many aspects of it. According to Sun et al. (2018), BDA can positively affect many aspects of SCM including predicting demand, planning production, inventory administration, and product and service creation.

Adoption of big data analytics

Big data analytics is one of the most disruptive digital innovations that can speed up digital transformation (DT) (Jin & Kim 2018; Madhlangobe & Wang 2019; Malaka & Brown 2015; Tahiduzzaman et al. 2017). The use of BDA to alter SCM operations has sparked increased attention in recent years, both among practitioners and academia (Brinch 2019; Cheng et al. 2018; Mishra et al. 2017). The literature and a review of companies' experiences with BDA in manufacturing indicate that there are more applied case studies than academic publications. Researchers are anticipated to discover other unique uses for big data in industrial systems, such as approaches for obtaining high-quality solutions in less time and money (Ghalehkhondabi, Ahmadi & Maihami 2020). The adoption of BDA is described as the process by which an invention changes an organisation's infrastructure (Günther et al. 2017). The ABDA encompasses enhanced information processing techniques and technology that aid decision-making (Raguseo 2018). It allows organisations to exploit information and acquire a competitive edge (Rehman et al. 2019). Adopting BDA increases productivity, improves risk prediction, and satisfies consumers more effectively (Al-Qirim, Tarhini & Rouibah 2017). Adoption in an organisational or business context involves recognising the need for technology, evaluating technology options, decision-making, implementation planning, deployment, monitoring, and adaptation (Agrawal 2015). The ABDA enables organisations and industries to outperform their competitors. While using big data may be time-consuming and costly, the long-term benefits may pave the way to success.

Organisational factors

Organisational factors refer to the internal environment within an organisation and encompass the characteristics and resources that either enable or hinder the adoption of technological innovations (Tornatzky Fleischer & Chakrabarti 1990). To define organisational factors, researchers often rely on descriptive measures identified in the information technology (IT) literature as factors influencing organisational adoption (Alaskar et al. 2021; Maroufkhani et al. 2020; Soon, Lee & Boursier 2016; Sun et al. 2018). These measures serve as determinants that help understand how the organisational factors influence the decision-making process and outcomes related to technology adoption. This study identifies top management support, IT expertise, and organisational resources as organisational factors influencing the adoption of BDA in Saudi companies.

Top management support

Top management support is the level of understanding and acceptance that managers have towards a new technology system. According to Ramdani, Chevers and Williams (2013), it refers to the positive attitude of CEOs towards adopting technology. Numerous studies, such as those conducted by Scupola (2009), Van Huy et al. (2012), and Sanders (2014), have highlighted the importance of top management support as a critical factor in the adoption of innovation in an organisation. Without the support of top management, successful implementation of technology adoption is unlikely. Regardless of the size of the organisation, top management can promote change by fostering collaboration and reinforcing values through a shared vision for the company (Ramdani et al. 2013). When top managers have a positive outlook regarding the potential benefits of technology adoption for the organisation, they are more likely to take action to support the adoption of a new system (Ramdani & Kawalek 2007).

According to Tien et al. (2020), a positive attitude from top managers instils confidence that sufficient resources will be

allocated to adopt the new technology. By providing support, top managers play a facilitator role in orchestrating the change process in terms of organisational norms, values, and cultures, enabling other members of the organisation to accept and adopt the new technology (Karahanna & Preston 2013). In conclusion, the role of top management is crucial in creating a supportive environment for adopting new technologies.

Information technology expertise

The term IT expertise refers to the knowledge and skills that IT professionals possess. A meta-analysis of previous studies that examined the relationship between organisational characteristics and adoption of IT innovations revealed that the presence of IT experience is a critical factor in facilitating adoption (Hameed & Counsell 2014). This finding is supported by empirical evidence showing the positive impact of IT expertise on the adoption of various innovations, including big data adoption (Nam, Kang & Kim 2015). The lack of sufficient IT experience has been identified as a barrier to IT adoption, especially for small businesses that often lack specialised IT knowledge and technical skills (Thong 1999). Premkumar (1996) points out that some companies may not be aware of new technologies or be reluctant to adopt them because of the risks involved or because of their inability to effectively integrate innovation to meet business-related challenges. It is also suggested that organisations may delay adoption until they have gained sufficient internal experience (Thong 1999). Conversely, companies with higher levels of IT expertise are more likely to adopt innovations because they have a better understanding of the potential benefits of adoption.

Organisational resources

Organisational resources play a crucial role in an organisation's adoption of big data technology. According to ISs literature, financial, technological, and human resources availability influence an organisation's decision to adopt new technology (Hameed & Counsell 2014). Financial resources refer to capital availability for investing in technology innovations, implementing subsequent changes, and covering expenses during usage (Oliveira & Martins 2010). In the context of big data, Korean firms were significantly impacted by financial resource availability (Nam et al. 2015). Technological resources involve the level of IT sophistication, IT usage and management, and IT infrastructure within the organisation (Hameed & Counsell 2014). Organisations are more likely to support new technology adoption when financial, technological, and human resources are available (Soon et al. 2016). However, resource availability alone may not be enough for organisations to adopt BDA. Although the relationship between resources and organisational adoption has been explored in IS adoption research, the data supporting this relationship has been inconclusive. Nevertheless, most ISs literature suggests a positive relationship between organisational resources and innovation adoption (Boonsiritomachai 2014; Nam et al. 2015).

Resistance to change

Resistance to change is a term used diagnostically or pejoratively to describe a person who is perceived as needing to adapt their views or behaviour in certain areas for one reason or another, frequently at the suggestion or requirement of an authority figure, senior manager, or advisor, but is unable or unwilling to do so. Resistance to change was identified by Zander (1950) as 'behaviour which is intended to protect an individual from the effects of real or imagined change'. In the view of Folger and Skarlicki (1999), resistance is defined as 'employee behaviour that seeks to challenge, disrupt, or invert'.

Resistance to change is a significant factor that plays a crucial role in any change process, particularly in strategic changes rather than evolutionary ones (Pardo Del Val & Martínez Fuentes 2003). Employees often resist change because of their limited tolerance levels, making it challenging to acquire the new skills and behaviours required by the introduced change. This resistance is also rooted in employees' fear of learning new skills and their apprehension or inability to adapt. The level of resistance experienced by employees is influenced by the treatment they receive during the change process and the relationship between employees and the organisation (Strebel 2009).

Lallmahomed, Lallmahomed and Lallmahomed (2017) demonstrated the critical role of RTC in the adoption of E-government and the detrimental effect of RTC on adopting E-government systems. Alomari, Sandhu and Woods (2014) also examined RTC in the context of IT adoption and concluded that it is a significant factor in the failure of IT system deployment. Numerous additional research in the realm of technology adoption has identified the RTC as a barrier to adoption (Mahmood et al. 2013; Nov & Ye 2009; Sharma, Gupta & Acharya 2020) and found that RTC acts as a moderator in the association between the variables Intention to Use (IU) and Actual Use (AU) of the SCM systems. Beal, Stavros and Cole (2013) conducted another study in which they employed RTC as a moderator and discovered that it was a significant moderator of the association between psychological capital and organisational citizenship behaviour.

In a recent study on Big Data Analytics (BDA), Shahbaz et al. (2020) investigated the moderating effect of Resistance To Chang (RTC) on the relationship between Information Use (IU) and Actionable Use (AU), and found evidence of negative moderation. The study also suggested that future research on RTC should encompass diverse cultures, demographics, and sample sizes to enhance its applicability in BDA research. In our study identifies the factors that moderate the relationship between organisational factors

and the adoption of BDA in Saudi companies, including behavioural and psychological resistance, high costs of change, and fear of loss of power.

Behavioural resistance

The term 'behavioural resistance' is commonly used to describe employees' attitudes towards organisational change. It is worth noting that people often resist changes not because of the changes themselves, but because of how those changes will affect them personally. Oftentimes, employees become comfortable in their roles, areas of expertise, and relationships with their coworkers and supervisors. Even when employees are unhappy in their current work environment, they may still find change to be stressful. These factors are essential to understanding employee behaviour in the workplace. According to Oreg (2003), people have different natural tendencies when it comes to adapting to or resisting change. These differences can be seen in how employees perceive and react to specific changes, whether they are voluntary or imposed. Moreover, Oreg (2003) suggests that employees who are naturally resistant to change may experience negative emotions, such as anxiety, anger, or fear, which can significantly influence their overall attitude towards the change. Therefore, management should be mindful of employees' emotions and their resistance to organisational change and consider how these factors impact employee commitment to the organisation's long-term objectives.

Psychological resistance

Resistance to change can be influenced by emotional factors, particularly when past experiences with change have been negative. Oreg (2003) identifies several psychological reasons for resistance, including a lack of appreciation, employee distrust, and concerns about job security.

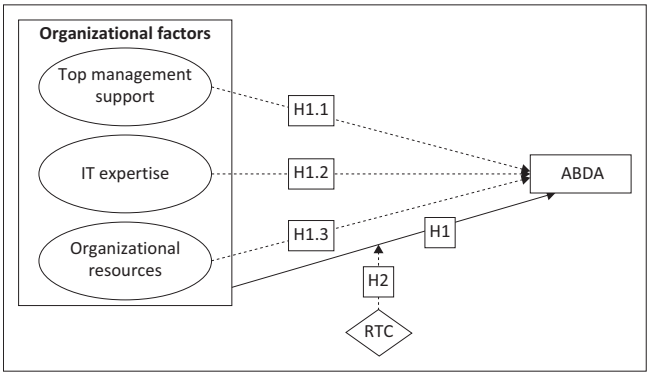
Employees may feel unappreciated if they believe management does not recognise their contributions, which can contribute to resistance. Job security is also a significant concern for employees, as they may feel uncertain about how the change will impact their roles and whether their jobs are at risk. This fear of job insecurity greatly influences employee decisions and RTC. Psychological reasons for RTC, as described by Misener and Mason (2006), can include a fear that technological changes will bring tedious and boring work or that they will need to exert effort to learn new skills to adapt to the changes. Employees may also feel apprehensive about understanding and applying new ideas and methods in the new environment created by the change. Negative perceptions of technological change can lead to negative psychological thinking among employees, which is detrimental to the organisation. To address this, organisations should strive to convince employees of the positive impacts of change through motivation and training tailored to their specific needs in the changing environment.

Costs of change are high

According to Kaila (2005), managers and supervisors initiate change in order to improve organisational performance in response to market trends, conditions, and industry competition. However, even when management recognises the necessity of change, they may be concerned about the associated expenses, especially those related to technology implementation. The change process incurs ongoing costs that need to be managed by the organisation. These costs can include fees for installing new technology, providing training and development to help employees adapt to the latest technology, and covering the costs of the installation itself. It is the responsibility of managers to consider these financial requirements before implementing the change process. Management often perceives change as bringing additional costs to the organisation. These costs include planning expenses for implementing changes, such as technology and machinery, and labour costs associated with managing the changes. Other costs such as advertising, research, development, and more costs may also be incurred. Even if employees and management accept the change, they may still worry about the financial implications of the change process. Management needs to consider both pre-implementation and post-implementation costs associated with change, as they may need to allocate resources to handle these expenses, particularly if the change process does not go smoothly.

Fear of loss of power

According to Carr (2002), managers may resist organisational change because they fear losing their power or position. To ensure successful change implementation, managers need to understand the requirements of the change process without being concerned about job or power loss. Doing so increases the likelihood of retaining managers in the organisation for longer. Hayajneh and Zaghloul (2012) identified five barriers to technology adoption, including the cost of implementing new technology, poor management and bureaucracy, a lack of skilled staff, absence of qualified IT staff, and a lack of awareness about the benefits of technology. Their study, conducted in four Arab countries, including Saudi Arabia,



Source: Hamed, A. & Bohari, A.M., 2022, 'Adoption of big data analytics in medium-large supply chain firms in Saudi Arabia', *Knowledge and Performance Management* 6(1), 62–74. https://doi.org/10.21511/kpm.06(1).2022.06

ABDA, Adoption of big dataAnalytics; RTC, resistant to change.

FIGURE 1: Conceptual model.

found that the cost of implementation and bureaucracy and/or poor management were the primary reasons for resistance to new technology change.

Conceptual model and hypothesis statements

A conceptual model has been developed for the literature review (Figure 1), which is divided into three parts: dependent, independent, and moderator variables. The independent variable is organisational factors (top management support, IT expertise, and organisational resources). The RTC is a moderating variable in the middle group. Adoption of BDA is the dependent variable in the right group. Based on the conceptual model, several hypotheses' statements have been developed.

H_1: Organisational factors have a positive effect on the ABDA in supply chain operations among companies in Saudi Arabia.

$H_{1.1}$: Top management support has a positive effect on the ABDA in supply chain operations among companies in Saudi Arabia.

$H_{1.2}$: IT expertise has a positive effect on the ABDA in supply chain operations among companies in Saudi Arabia.

$H_{1.3}$: Organisational resources have a positive effect on the ABDA in supply chain operations among companies in Saudi Arabia.

H_2: Resistance to change as a moderator has a negative effect on the relationship between organisational factors and the ABDA among companies in Saudi Arabia.

Research methods and design

This study used a quantitative method to achieve the research objectives mentioned in introduction. The research questionnaire, which was utilised to collect data, was adapted from existing literature. The questionnaire used a 5-point Likert scale allowing respondents to indicate their agreement or disagreement on a scale ranging from 'strongly disagree' to 'strongly agree'. In addition, the use of a 5-point Likert scale has been recommended by researchers as it reduces frustration levels and enhances the likelihood of obtaining meaningful responses from participants (Babakus & Mangold 1992; Sachdev & Verma 2004). The questionnaire contains four sections. The first section shows the demographic profile of this study, mainly reports on individual demographics, including five major variables, namely current position, company field, company size by annual revenue, company size by employees, and company experience in the field of business. The second section contains questions about organisational factors (top management support, IT expertise, organisational resource). The third section contains questions about RTC. This section includes four sub-variables: behavioural resistance, psychological resistance, costs of changes are high, and fear of loss of power; all sub-variables contain three items. Respondents were asked about the reasons for RTC in adopting BDA. The fourth section contains questions about the adoption of BDA. This section contains 12 questions, in which respondents were asked about the benefits of adopting BDA in enhancing supply chain operations.

Population of study

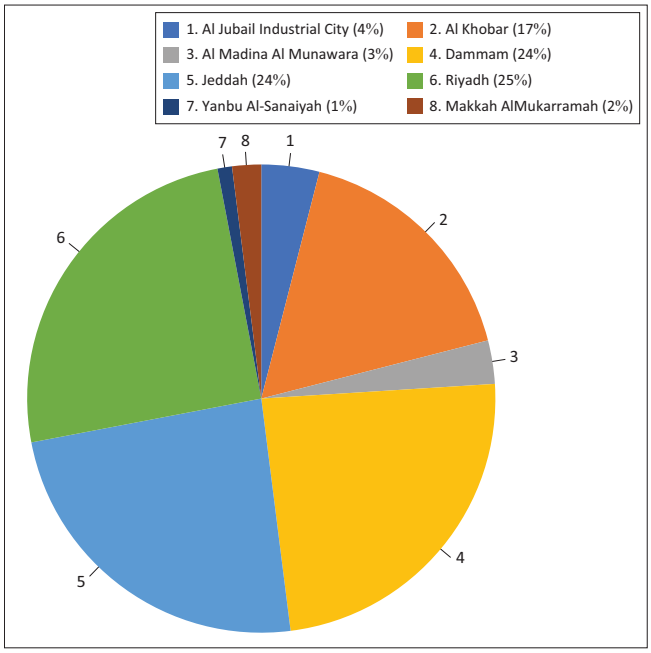
The study population includes managers in medium-large companies in Saudi Arabia. According to Monsha (2022), medium and large companies are defined in this study as companies operating in Saudi Arabia. Medium firms have full-time employees between 50 to 249, and their estimated revenues range from 40 to 200 million Saudi Riyals. Large firms have over 250 full-time employees, and their estimated revenues are more than 200 m Saudi Riyal. Table 1 demonstrates the classification of organisations in Saudi Arabia.

The target population of this study includes senior management, IT and MIS managers, human resource managers in medium and large companies in Saudi Arabia. The selection of this target population is based on the understanding that the decision to adopt BDA in medium and large companies requires the approval and involvement of senior management. Additionally, the second criterion for selection relates to the respondents' experience in supply chain activities and their knowledge of integrating BDA into these activities to leverage its capabilities.

TABLE 1: The Saudi classification of companies.

Type	Employee number	Annual revenue (SAR)
Micro	1–5	≤ 3 m
Small	6–49	> 3 m and < 40 m
Medium	50–249	≥ 40 m and < 200 m
Large	≥ 250	≥ 200 m

Source: Monsha'at, 2024, *Welcome | Monsha'at*, viewed 01 March 2024, from https://www.monshaat.gov.sa/en



Source: Demographic Data Analysis

FIGURE 2: Distribution of the study sample according to the cities of Saudi Arabia.

Sampling

This study covers 450 medium-large supply chain companies in Saudi Arabia, recognised by the Ministry of Commerce and Industry, operating in various fields across different locations such as Riyadh, Dammam, Makkah Al-Mukarramah, Al Madina Al Munawara, Jeddah, Al Jubail Industrial City, and Khobar. Specifically, this study will sample the departments of supply chain companies, such as procurement, import/export, inventory, purchasing, operations, logistics, and IT. Figure 2 illustrates the proportions of the study sample distribution by Saudi cities.

This study employed a purposive sampling method to select the research sample. Sekaran and Bougie (1993) stated that purposive sampling is confined to a specific type of people who can provide the desired information, either because they are the only ones who have it or conform to some criteria set by the researcher. According to Sekaran and Bougie (1993), judgement sampling involves selecting subjects in the best position to provide the required information. The selection criteria determined the use of judgement sampling, which included the respondents' awareness of BDA and their role as decision-makers in adopting BDA.

Data collection

Two questionnaires were sent to each company and 1 month was given to complete the questionnaire. To ensure their participation, companies receiving the questionnaire were informed of the importance of completing and returning the survey on behalf of the designated participants. This notification was sent to encourage the timely submission of the questionnaire by the specified sample group. The questionnaire was created using Google Forms and distributed electronically to the study sample via email. The participants were requested to share the questionnaire with relevant managers within their respective companies. As a result of the low response rate to the questionnaire after the end of the specified period, managers of some companies were contacted to encourage them to participate and respond to the questionnaire to increase the response rate. In the end, 900 questionnaires were sent to the study sample, and 402 companies responded to the questionnaire, with a response rate of 45%. According to Sekaran and Bougie (1993), a 30% response rate is considered acceptable and, in many cases, even exceptional. Table 2 summarises the response rates.

Data analysis procedures

The acquired data were analysed by using both Statistical Package of Social Science (SPSS) techniques software version 29.0 and Partial Least Squares Structural Equation Modelling (PLS-SEM) techniques via Smart-PLS software version 4.0. The SPSS was used to describe respondents' demographic profiles, report descriptive statistics, and≈complete the normality test. Smart-PLS was used primarily for testing Measurement Model and Structural Model.

Result

The demographic profile of this study mainly reports on individual demographics. Table 3 shows the frequencies and percentages of these variables.

Table 4 shows outer loading, Cronbach's Alpha, composite reliability (CR), and average variance extracted (AVE) for composite variables, adoption of BDA and organisational factors for all items with a factor loading value greater than 0.70.

TABLE 2: Summary of the response rates (N = 900).

Questionnaire distributed	*n*	%
Undelivered	498	-
Delivered	402	-
Number of responses	-	45

Source: Demographic Data Analysis

TABLE 3: Demographic statistics (N = 402).

Variable	Frequency (*n*)	%
Current position at your company		
CEO/President/VP/Managing director	54	13.4
CFO/Treasurer/Controller	10	2.5
CIO/IT director/Technology director	310	77.1
Non-executive position	28	7.0
Company field		
Telecommunications	7	1.7
Banking and insurance	19	4.7
Construction/agriculture/materials	57	14.2
Education and scientific research	8	2.0
Energy and utilities	14	3.5
Entertainment/media/tourism	5	1.2
Information technology	76	18.9
Manufacturing	48	11.9
Public sector and healthcare	17	4.2
Retail and wholesale	8	2.0
Services	17	4.2
Transport/logistics/post	126	31.3
Company size, by annual revenue (SAR)		
Less than 85 m	70	17.4
85–150 m	211	52.5
150–300 m	82	20.4
300–500 m	20	5.0
500–1000 m	11	2.7
More than 1000 m	8	2.0
Company size, by employees		
Less than 50	8	2.0
50–100	254	63.2
101–150	86	21.4
151–250	29	7.2
251–400	11	2.7
More than 400	14	3.5
Company experience (years)		
Less than 5	103	25.6
5–10	232	57.7
11–20	45	11.2
21–30	15	3.7
Longer than 30	7	1.7

Source: Demographic Data Analysis

TABLE 4: Results of outer loading.

Construction	Latent variables	Indicators	Outer loading
Adoption of BDA	Adoption of BDA	ABDA1	0.816
		ABDA2	0.819
		ABDA3	0.815
		ABDA4	0.790
		ABDA5	0.825
		ABDA6	0.818
		ABDA7	0.815
		ABDA8	0.818
		ABDA9	0.823
		ABDA10	0.789
		ABDA11	0.814
		ABDA12	0.816
Organisational factors	Top Management Support	OTMS1	0.864
		OTMS2	0.830
		OTMS3	0.791
	IT expertise	OITE1	0.869
		OITE2	0.785
		OITE3	0.744
	Organisational Resources	OOR1	0.827
		OOR2	0.775
		OOR3	0.848
Resistance to change	Behavioural resistance	RTCB1	0.756
		RTCB2	0.747
		RTCB3	0.761
	Costs of changes are high	RTCC1	0.898
		RTCC2	0.881
		RTCC3	0.668
	Fear of loss of power	RTCF1	0.878
		RTCF2	0.725
		RTCF3	0.749
	Psychological resistance	RTCP1	0.803
		RTCP2	0.763
		RTCP3	0.826

Source: Smart-PLS analysis

BDA, big data analytics; ABDA, adoption of big data analytics.

Cross loadings

The indicator loadings achieved in SEM should be more significant than 0.700 (Hair et al. 2019). From the study model, all loadings of the indicators (21) exhibited in Table 5 were higher than 0.700. The highest loading was 0.877, while the lowest loading was 0.703.

Convergent validity and reliability assessment

To ensure the model of the study meets the convergent validity criteria, the following thresholds should be achieved: Cronbach's Alpha > 0.70, Composite Reliability > 0.70, and Average Variance Extracted (AVE) > 0.50. Results show that Cronbach's alpha ranged between 0.703 and 0.914, all CR (rho_a) and (rho_c) was greater than 0.70, and AVE ranged between 0.582 and 0.788. Table 6 shows that the Cronbach's Alpha and CR values for all variables were over 0.70. Additionally, the AVE for all the variables has a value greater than 0.50.

Discriminant validity assessment

Table 7 shows that each construct's squared root of AVE in the diagonal is higher than the correlation coefficients (off-diagonal) for each construct in the related rows and columns. For instance, AVE for ABDA (0.658), then the square root of it (0.888) which is higher than the correlation coefficients with other constructs (0.770). Hence, discriminant validity was confirmed using Fornell-Larcker Criterion.

TABLE 5: Cross-loading analysis.

Items	IT	OR	TMS	ABDA	RB	RC	RF	RP
OITE1	0.864	-	-	-	-	-	-	-
OITE2	0.829	-	-	-	-	-	-	-
OITE3	0.792	-	-	-	-	-	-	-
OOR1	-	0.877	-	-	-	-	-	-
OOR2	-	0.785	-	-	-	-	-	-
OOR3	-	0.746	-	-	-	-	-	-
OTMS1	-	-	0.826	-	-	-	-	-
OTMS2	-	-	0.776	-	-	-	-	-
OTMS3	-	-	0.848	-	-	-	-	-
ABDA1	-	-	-	0.816	-	-	-	-
ABDA10	-	-	-	0.819	-	-	-	-
ABDA11	-	-	-	0.815	-	-	-	-
ABDA12	-	-	-	0.79	-	-	-	-
ABDA2	-	-	-	0.825	-	-	-	-
ABDA3	-	-	-	0.818	-	-	-	-
ABDA4	-	-	-	0.815	-	-	-	-
ABDA5	-	-	-	0.818	-	-	-	-
ABDA6	-	-	-	0.823	-	-	-	-
ABDA7	-	-	-	0.789	-	-	-	-
ABDA8	-	-	-	0.814	-	-	-	-
ABDA9	-	-	-	0.791	-	-	-	-
RTCB1	-	-	-	-	0.756	-	-	-
RTCB2	-	-	-	-	0.747	-	-	-
RTCB3	-	-	-	-	0.761	-	-	-
RTCC1	-	-	-	-	-	0.861	-	-
RTCC2	-	-	-	-	-	0.703	-	-
RTCC3	-	-	-	-	-	0.748	-	-
RTCF1	-	-	-	-	-	-	0.776	-
RTCF2	-	-	-	-	-	-	0.780	-
RTCF3	-	-	-	-	-	-	0.811	-
RTCP1	-	-	-	-	-	-	-	0.813
RTCP2	-	-	-	-	-	-	-	0.763
RTCP3	-	-	-	-	-	-	-	0.770

Source: Smart-PLS analysis

IT, IT expertise; OR, organisational resources; TMS, top management support; ABDA, adoption of big data analytics; RB , behavioural resistance; RC, costs of changes are high; RF, fear of loss of power; RP, psychological resistance.

TABLE 6: Internal consistency reliability test.

Constructs	Cronbach's alpha	CR (rho_a)	CR (rho_c)	AVE
IT expertise	0.772	0.775	0.868	0.687
Organisational resources	0.721	0.741	0.843	0.642
Top management support	0.751	0.757	0.857	0.667
ABDA	0.953	0.955	0.958	0.658
Behavioural resistance	0.626	0.627	0.799	0.570
Psychological resistance	0.714	0.717	0.840	0.636
Costs of changes are high	0.753	0.796	0.860	0.676
Fear of loss of power	0.689	0.705	0.829	0.619

Source: Smart-PLS analysis

CR, composite reliability; AVE, average variance extracted; ABDA, adoption of big data analytics.

TABLE 7: Discriminant validity using Fornell-Larcker Criterion.

Construct	ABDA	Organisational factors	Resistant to change
ABDA	0.888	-	-
Organisational factors	0.770	0.804	-
Resistant to change	0.603	0.580	0.731

Source: Smart-PLS analysis

ABDA, adoption of big data analytics.

Path coefficient (λ) of the research hypotheses

For answering the research hypotheses, SEM-PLS performed with constructs (organisational factors, top management support, IT expertise, and organisational resources) by direct relation with the ABDA. Table 8 exhibited that three out of five hypotheses were supported.

Measurement moderator variable (Resistance to Change)

Resistance to change is introduced as a moderator variable in this study. It is assumed that RTC influences as a moderator between organisational factors and adoption of BDA. Smart-PLS was performed with moderator (RTC), which consists of four (LOC) components with (12) items. One item (RTCC3) had loading (0.668) less than 0.70, thus it was deleted from the model; as a result, all the items and constructs were valid. Table 9 and Figure 3 show the result. However, RTC had no significant effect as a moderator on therelationship between organisational factors and ABDA ($\beta = -0.002$, $t = 1.496$ and p-value = 0.135 > 0.05). It is also evident that there is no interaction. Therefore, the results do not support hypothesis H2.

TABLE 8: Path coefficient of main and secondary research hypotheses.

Hypotheses	Path	β	STD	T S	P V	Decision
H_1	Organisational factors -> ABDA	0.195	0.128	1.524	0.127	Not supported
$H_{1.1}$	Top management support -> ABDA	0.152	0.103	2.990	0.022	Supported
$H_{1.2}$	IT expertise -> ABDA	0.119	0.110	1.987	0.047	Supported
$H_{1.3}$	Organisational resources -> ABDA	-0.042	0.101	0.418	0.676	Not supported

Source: Smart-PLS analysis

TABLE 9: Path coefficient of resistance to change moderating variable.

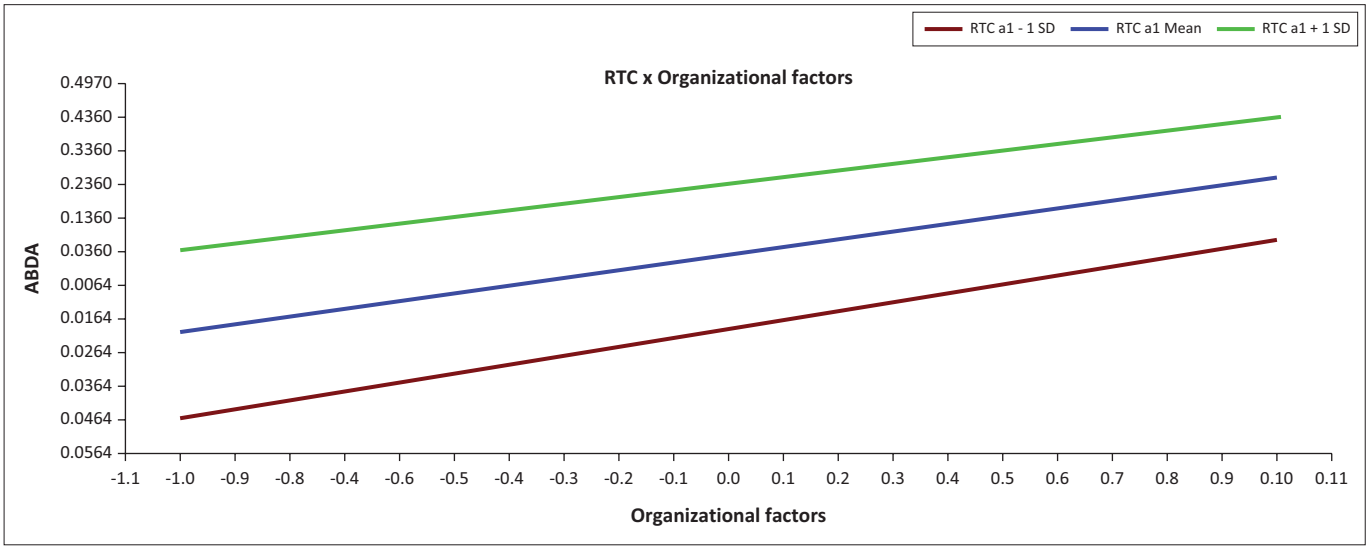
Hypotheses	Path	β	STD	T S	P V	Decision
H_2	Resistance to change (RTC) x Organisational factors -> ABDA	-0.002	0.022	1.496	0.135	Not supported

Source: Smart-PLS analysis

ABDA, adoption of big data analytics.

Discussion of results

The study examined several organisational factors concerning the ABDA in medium and large companies, including top management support, IT expertise, and organisational resources. The results of the study indicated that there was no significant correlation between organisational factors and the ABDA. This can mean that organisations face some challenges when adopting big data technology, such as organisational resources. Nevertheless, the study found that top management support positively influenced BDA adoption in supply chain operations. This finding aligns with existing research that emphasises the recurring and essential role of top management support in driving high organisational intention to adopt big data technology (Jang et al. 2019; Lai, Sun & Ren 2018; Petersen & Nguyen 2017; Sun et al. 2018; Verma & Chaurasia 2022). The support of top management plays a vital role in facilitating the adoption of innovative technology within organisations, particularly when they recognise the benefits that such technologies offer in improving the business environment. Managers must unify efforts, lead work teams, and overcome challenges to adopt innovative technologies successfully. Furthermore, the study indicated a positive impact of IT expertise on adopting big data technology. Experience in the field of IT is considered one of the most valuable assets for companies (Nam et al. 2015). While organisations may provide the necessary IT infrastructure to adopt BDA technology, they often face challenges in sourcing professionals with expertise in big data technology. The availability of skilled professionals is crucial in successfully implementing and leveraging big data technology. Regarding organisational resources, the results of the study did not support a significant relationship between organisational resources and the adoption of big data technology. This suggests that organisational readiness



Source: Smart-PLS analysis

RTC, resistant to change; ABDA, adoption of big data analytics.

FIGURE 3: Slope analysis for resistance to change moderation.

may not significantly influence the intention of Saudi companies to adopt BDA in supply chain operations. The introduction of Saudi Arabia's Vision 2030, which emphasises digital transformation in both the public and private sectors and intense market competition, may have compelled Saudi companies to view adoption of big data technology as a competitive necessity rather than a competitive advantage (Alaskar et al. 2021). As a result, these firms may have already taken necessary steps to improve their readiness and willingness to adopt this new technological innovation.

Despite previous research consistently indicating a negative impact of RTC on technology adoption, the findings of this study did not support such a relationship. This deviation can be attributed to the digital transformation project launched by Saudi Arabia, which is part of the country's Vision 2030 initiative. The government's digital transformation project aims to enhance the efficiency and effectiveness of government and private businesses, prompting organisations in Saudi Arabia to embrace digital transformation actively. Given the strong emphasis on digital transformation and the incentives provided by the government, organisations in Saudi Arabia have shown a keen interest in keeping up with technological advancements. This proactive approach to digital transformation may have mitigated the adverse effects of RTC, leading to the study's findings that did not support the expected relationship. It is imperative to consider the unique context of the Saudi Arabian market, where the government has actively promoted and facilitated digital transformation initiatives. This supportive environment has likely influenced organisations to overcome RTC and adopt new technologies more readily than in contexts where such initiatives are less pronounced.

Implications of the study

Based on this study's results, several implications can be drawn at the companies, customers, and country levels. The implications for supply chain companies based on the study's findings can be, BDA enhances consumer satisfaction. Also, enhancing supply chain risk management. Furthermore, developing competitive intelligence, and improving supply chain visibility. In addition, fostering innovation and new business models and optimising decision-making processes.

The implications for customers concerning BDA can be to provide personalised experiences, increase customer loyalty, track customer behaviour, improve customer retention, and utilise predictive analysis to anticipate and meet customer needs more effectively. By harnessing the power of data, companies can enhance the overall customer experience and deliver tailored products, services, and interactions that align with customer preferences and expectations.

The successful implementation of the national transport and logistics strategy in Saudi Arabia relies on businesses leveraging BDA technology to enhance their performance. By harnessing the power of big data, companies can improve operational efficiency, strengthen SCM, adopt a customer-centric approach, enable data-driven decision-making, and drive innovation in the transport and logistics sector. These outcomes contribute to the overall objectives of the national strategy, including economic growth, improved standard of living, fiscal sustainability, and increased contribution to the national gross domestic product (GDP).

Limitations and future research

The study focussed exclusively on medium-large supply chain companies in Saudi Arabia. To generalise the findings to the broader Saudi market, it is necessary to develop a framework that can also be tested in small-medium enterprises. Future research should aim to validate and extend the proposed framework for BDA adoption by incorporating other theories such as RBV (Resource-Based View), TTF (Task-Technology Fit), and TAM (Technology Acceptance Model). By integrating these theories, the framework's explanatory power can be strengthened, and previously unexplored aspects of BDA adoption and implementation can be better understood. Furthermore, the factors influencing BDA adoption may include data quality and integration, organisational culture, and decision-making culture. It is essential to consider these variables and their interrelationships when examining the adoption of BDA in organisations. The study also incorporated the moderator of RTC to highlight its influence on the relationships between organisational factors and BDA adoption. To gain a more comprehensive understanding of RTC in technology adoption, further studies should be conducted to identify potential factors contributing to RTC and explore strategies to overcome them.

Conclusion

The study focussed on medium-large companies in Saudi Arabia to investigate the factors influencing the adoption of BDA in their SCM. It also explored how existing organisational factors impact the adoption of big data, with RTC acting as a moderator. The study revealed a lack of significant correlation between organisational factors such as top management support, IT expertise, and organisational resources, and the ABDA. This suggests potential challenges for organisations in these areas. Surprisingly, the study found no significant effect of RTC on the adoption of big data technology, contradicting previous research indicating a negative influence of resistance on adopting modern technology. Identified factors of RTC included behavioural and psychological resistance, high cost of changes, and fear of loss of power. Despite the unexpected results regarding RTC, this information can still assist organisations in addressing challenges and allocating resources effectively for the ABDA in their SCM.

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Authors' contributions

A.H. contributed to the conceptualisation, methodology, formal analysis, investigation, writing of the original draft, visualisation, resources, writing - review and editing, supervision, and funding acquisition. S.D., A.F. and S.B. contributed to the writing of the original draft, resources, and writing, review and editing of the article.

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Data availability

The findings of this study can be supported by data available upon request from the author.

Disclaimer

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