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Leading Role of Big Data Analytic Capability in Innovation Performance: Role of Organizational Readiness and Digital Orientation

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Abstract: The advancement of technology offers various opportunities for business organizations to achieve sustainable growth. Through emerging technologies, business organizations are able to collect and analyze essential information vital for the acceleration of innovation. Therefore, this study investigated how big data contribute to the innovation activities of manufacturing entrepreneurs in terms of big data analytic capability (BDAC). The aim of this study was to relate BDAC to organizational readiness and innovation performance (IP). Moreover, we examined the mediating role of organizational readiness between BDAC and IP. We also examined the strengthening role of digital orientation. To collect the study data, we approached 494 frontline managers of the manufacturing sector of Saudi Arabia. The collected data were analyzed using statistical techniques such as descriptive, correlation, and hierarchical regression techniques. We found that BDAC plays a vital role in developing organizational readiness and IP. The findings also proved that organizational readiness has a significant effect on IP. The results revealed that organizational readiness mediates between BDAC and IP.

Keywords: big data analytic capability; organizational readiness; innovation performance; digital orientation



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1. Introduction

The emerging technologies in the field of business organization have strategic importance for both researchers and management [1]. These advanced technologies have stimulated and increased the competitiveness of the business world in recent decades. Nowadays, managing big data has become a challenge and gained strategic importance for all kinds of business organizations [2]. The adoption of new technologies brings advantages in terms of managing big data and contributes to the innovation process of mastering big data. The strategic importance of big data has attracted the attention of all kinds of business organizations. In fact, using big data enables business organizations to make realistic decisions which are supported by evidence instead of intuition [3]. In the current decade, the notion of BDAC has become the focus of managers and scholars. BDAC refers to a firm's capacity to manage, process, and analyze big data [4]. However, there has been limited discussion regarding the outcomes of BDAC and approaching and utilizing the advantages of big data. Therefore, the aim of this study was to highlight the capabilities that enable organizations to collect, process, manage, and disseminate valuable information

among the players of the organization. BDAC represents a foundational and critical role for mastering big data and is referred to as the capability of an organization to effectively utilize these resources to solve problems of quality, decrease costs, set the most suitable prices, identify and retain customers, and gain competitive advantages over other firms in big data environments [5].

This study investigates how BDAC predicts organizational readiness and the IP mechanism of organizations [6]. Thus, based on the sociomaterialism perspective, the current study describes the predicament conceptualization dimensions of BDAC (administration (management), technology (technical), and HR resources) and highlights the importance of these dimensions to organizational readiness to achieve high efficiency in operations and maximum profit and competitive advantages over others in the industry [2]. In line with the assumptions of sociomaterialism and the information technology perspective, the current study aimed to investigate how BDAC is associated with organizational IP and the link between BDAC and organizational readiness.

Most organizations effectively utilize BDAC to achieve innovation performance [7]. BDAC broadly reflects a way to renovate business processes through which organizations do business [8]. Through BDAC, organizations are able to collect a variety of information necessary for innovation activities [9]. Existing studies have identified the potential of BDAC to change administration practice as well as theory [4], to bring about the next revolution in management [10] and innovation [11], and to reduce expenses and create value [12] and competitive advantages [13]. We examined the role of BDAC in the improvement of innovation performance.

It is self-evident that BDAC is critical for an organization to perform innovative work [14]. Some researchers claim that investment in BDAC are a myth; by utilizing this capability, an organization can upgrade its IP [15]. BDAC enhances an organization's capacity to utilize organizational data and resources for strategic decisions [16]. Researchers claim that the methods of internal business are vital with BDAC and a firm's IP [17,18]. Organizational readiness is one of the important factors that indicate the responses of an organization when changes occur [5]. The management dimension of BDAC gives directions to the organization to prepare all its resources using data analytics and hence is considered business knowledge [19]. This information and knowledge play a comprehensive role in a firm's culture as well as the processes to make competitive decisions [20]. Similarly, the technological capability dimension of BDAC shows the technological knowledge of an organization; we can consider this the actual capabilities of a firm to satisfy the requirements of clients, promote new products and services, and prepare for big changes [21]. Finally, BDA talent abilities include utilizing human resources effectively and the ability to absorb changes and take action according to real-time knowledge of market changes [19].

We also argue that the connection between BDAC and IP is composite rather than straightforward. Because it involves the preparation of an organization to undergo changes using BDAC, organizational readiness is an important factor for a firm's IP. Organizational readiness is concerned with the abilities of organizations that enable them to quickly implement and adopt changes to counter market movements [22]. All three dimensions of BDAC—management, talent, and technological capabilities—promote organizational operations, strategies, decision making, and the effective unitizing of the talent in the workforce, which are important indicators of the organizational readiness to absorb a change. Therefore, we also investigated the mediating role of organizational readiness in the BDAC and IP link.

Furthermore, digital orientation refers to business strategic orientation concerned with processes, practices, and activities that stimulate an organization's innovation-related decision making [23]. Digital orientation facilitates an organization regarding innovativeness, risk taking, and proactiveness for the generation and proper execution of innovative activities [24]. IP has strategic importance for an organization, which is facilitated by digital orientation [25,26]. In line with these arguments, the current study also considered the

moderating effect of digital orientation on the connection between organizational readiness and IP.

This study considered the direct impact of BDAC on organizational readiness and IP. Furthermore, the mediation of organizational readiness between BDAC and IP was also examined. Finally, the moderating effect of digital orientation was tested on the connection between organizational readiness and IP. The next section highlights the association between the study constructs. In the third section of the manuscript, we discuss the methods applied for testing the study hypotheses. The fourth section presents the results based on various statistical techniques. The last section contains the discussion of the obtained results and the conclusion.

2. Materials and Methods

2.1. BDAC and IP

BDAC is the capability of an organization to effectively utilize resources to solve problems of quality, decrease costs, set the most suitable price, identifies and retains customers, and gain competitive advantages over other firms in big data environments [5]. Big data offers a great opportunity in statistics that includes media data, real-time evidence, a huge capacity of data, new knowledge-driven data, and community broadcasting data [27]. IP is concerned with the extent to which an organization uses creative ideas to change its procedures, products, and processes that increase the value of products and services [28]. BDA helps business organizations to recognize the potential opportunities for improvement in their business procedures, processes, and products [8]. The big data mechanism is leading business organizations to focus their attention on the administration of both external and internal data in order to seize potential opportunities suitable for improving business performance [29]. Manyika et al. [14] suggested the importance of big data for productivity, innovation, and competition. BDAC makes it possible to collect, use, and analyze quickly generated, large-sized, and diverse data to support business decision making and develop infrastructures and business practices [2]. Researchers (e.g., [30,31]) have argued that BDAC has a significant role in an organization aiming to pursue transformational value creation opportunities and increase IP.

H1. *BDAC is positively associated with IP.*

2.2. BDAC and Organizational Readiness

Organizational readiness is the capability of a firm to use, implement, and gain competitive advantages by implementing the latest technology and business processes [32]. The readiness of an organization is the changes in the key driving strength to modify the old-style processes in the corporate atmosphere [33]. Usually, firms use big data management and investigation systems, mostly a database management system, to analyze and store and then design decision making [34]. The organizing of big data is the key that specifies the organizational readiness; the firm's properties play a very dynamic role in using big data analytics and management capabilities to forecast the readiness factor of the company [35]. The scope, nature, and scale of big data analytics management capability to manage data flow within an organization as well as outside it is a controlling factor that indicates the readiness of the firm [36]. Organizations use different tactics to handle big data analytics informational issues in warehouses and database centers, which indicate organizational readiness [37,38]. Researchers have found that new technology heavily depends upon technology compatibility and found advantages in using big data analytics [39,40]. Organizational leaders need to consider and implement a modern solution to big data analytics, determine how appropriate the solution is with current systems, and check the benefits of the change [41].

Therefore, organizations with BDAC are more likely to implement the latest technologies to collect valuable information [42], analyze, and make decisions using big data. This ability to draw exclusive and imperative conclusions links big data and organizational

readiness [43]. The availability of financial, technological, and human resources is a major factor affecting the readiness of firms assessing big data [44].

H2. *BDAC is positively associated with organizational readiness.*

2.3. Mediating Role of Organizational Readiness

Organizational readiness is the degree to which firms can manage, support, or react to changes occurring in the business environment [40]. A sense of readiness to business changes has a positive effect on innovative activities [45]. Organizational members with appropriate analytical skills are sufficiently intelligent to manage their tasks at high levels and can quickly apply their ability to new tasks due to proper training through the firm's advance readiness techniques [46].

Consequently, in order to maximize big data analytics, an organization needs to advance employees' high-level skills that permit them to use a new group of analytical tools to analyze and produce valuable insights from big data [21]. According to Manyika et al. [14], BDAC is considered a critical factor in using big data, managing the organization trusting in big data environments that boost the skills of workers, and increasing the proficiency of successfully executing big data analytics. Motwani et al. [47] argued that organizational readiness to adopt new changes develops organizational skills to share information, learn new knowledge, and make decisions using BDAC. According to Shahrabi and Pare [48], employees of organizations are enthusiastic to use new technology, and management has confirmed that their workers have a shared commitment and the skill to implement changes to expand the innovation of the organization.

Organizational readiness plays a mediating role in the BDAC and IP links. Organizational readiness facilitates the formulation and implementation of innovation strategies [49]. The cause behind this connection is the BDAC of an organization to leverage both internal and external information to enhance IP through organizational readiness [50,51]. Organizational readiness in response to BDAC positively influences IP [52,53]. Moreover, organizational readiness is vital for IP, and plays a major role in the BDAC and IP link. The mediating role of organizational readiness with the aid of BDAC facilitates the organizing of big data and information, which is the base of IP. This fact shows that BDAC significantly predicts IP via organizational readiness. IP increases through readiness to changes, and organizational readiness is derived from BDAC [52]. However, BDAC plays an important role in the development of organizational readiness which in turn enhances IP.

H3. *Organizational readiness is positively associated with IP.*

H4. *Organizational readiness positively mediates the BDAC and IP link.*

2.4. Moderating Role of Digital Orientation

Digital orientation is concerned with the adoption of practices, activities, and processes based on the latest technology through which organizations are able to make decision regarding market entry and innovation. Digital orientation is concerned with the organization's responsiveness to the newest ideas or a capacity to accept new ideas through product development [54]. Organizations with digital orientation contribute significantly to strategic and innovative business decisions as compared with those that lack digital orientation [55,56]. A higher strength of digital orientation will result in the innovative behavior of an organization [57]. Organizations with organizational readiness are more inclined to search for new ideas and formulate innovation activities which are significant for the outcomes of IP [58,59]. Therefore, we formulate the following hypothesis:

H5. *The connection between organizational readiness and IP is moderated by employee digital orientation.*

The hypothesis synthesis and the research theoretical framework is presented in Figure 1.

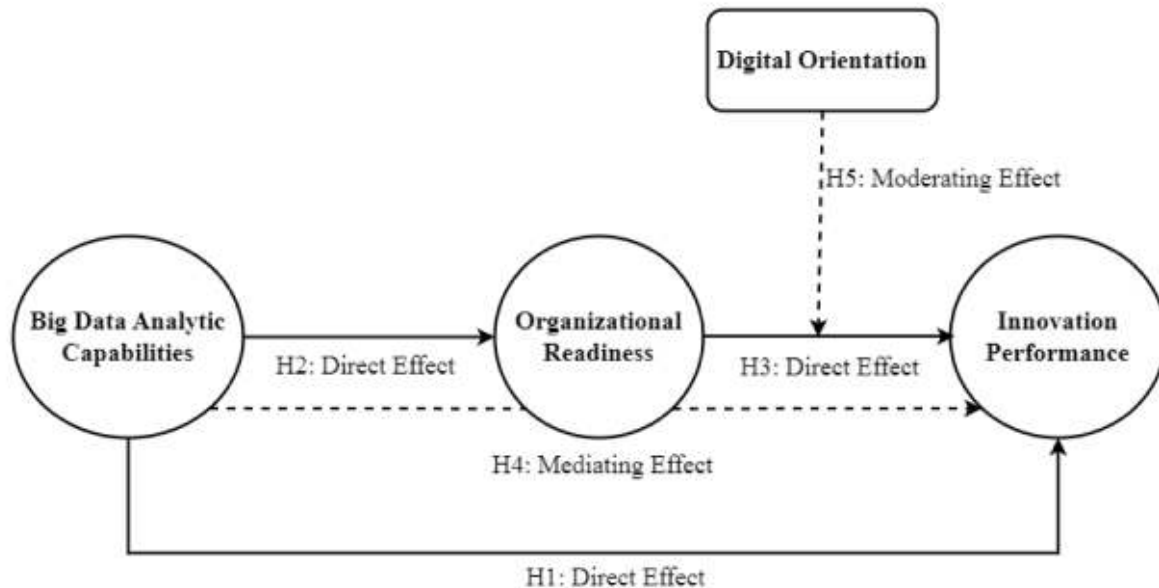


Figure 1. Theoretical framework.

2.5. Methodology

A cross-sectional design was applied in order to execute the research activities. Correlation statistics were used to confirm the association among study constructs. Correlation analysis highlighted the direction of the relationship among study constructs. For the purpose of analyzing collected data and testing the study hypotheses, we applied the Structural Equation Modeling (SEM) approach.

Sample and Procedure

The study population consisted of managers in the manufacturing sector whom we approached regarding the administration of the manufacturing sector. A list of 2342 frontline managers was received from the officials of the manufacturing sector of Saudi Arabia. Only 862 line managers were selected with the help of a systemic sampling technique. With the help of research assistants during the data collection process, 562 responses were received. Finally, 494 responses were considered for the final analyses and testing of the study's formulated hypotheses. Table 1 presents the characteristics of study respondents.

2.6. Study Measurements

BDAC was used as an independent variable and measured with 25 items in the study survey. This 25-item scale was adapted from the research of Mikalef et al. [56]. The items for the measurement of BDAC were adapted from the research of Kim et al. [57] and Karimi et al. [58]. The sample items included "in our firm, business analysts and line people meet frequently to discuss the issues relating to the business" and "our analytics personnel are very capable". Organizational readiness was measured with a six-item scale adapted from the work of Claiborne et al. [59]. The sample items included "We understand that specific changes may improve outcomes" and "When changes are necessary, management provides a clear plan for implementing". The items used for the measurement of organizational readiness produced a Cronbach's α value of 0.79. The responses regarding IP were obtained with the help of 11 items adapted from the work of Alegre and Chiva [60]. The sample items included "We introduce new solutions that offer good and cheap products/service".

These items generated an alpha value of 0.84. Finally, the moderator construct, i.e., digital orientation, was measured with the help of a four-item scale formulated by Khin and Ho [61].

Table 1. Respondents’ characteristics.

		N	%
Age (in years)	20–25	91	18.42
	26–30	129	26.11
	31–35	141	28.54
	35–40	96	19.43
	Above 40	37	7.48
Experience	5–10	97	19.64
	11–15	112	22.67
	16–20	163	32.99
	More than 20	122	24.70
Education	10 years	22	4.53
	12 years	67	13.56
	14 years	111	22.47
	16 years	143	28.95
	More than 16 years	151	30.57

Source: Authors’ synthesis.

3. Results

Table 2 contains the outcomes of the correlation. The findings revealed that BDAC has a significant positive direction towards organizational readiness, digital orientation, and IP (0.35 **; 0.23 *; and 0.29 **, respectively). Furthermore, organizational readiness has a positive direction towards digital orientation and IP (0.32 ** and 0.27 *, respectively). Finally, digital orientation, which moderates the organizational readiness and IP link, is also positively correlated with IP (0.19 *).

Table 2. Correlation.

	Mean	SD	1	2	3	4	5	6	7	8
Gender	0.9	0.81	1							
Respondent age	34	---	0.09	1						
Work experience	2.7	0.84	0.08	0.03	1					
Education level	2.8	0.91	0.06	0.05	0.04	1				
Big data analytic capability	3.8	0.93	0.09	0.12 *	0.08	0.07	1			
Organizational readiness	3.5	0.91	0.05	0.09	0.04	0.05	0.35 **	1		
Digital orientation	3.9	0.95	0.03	0.07	0.06	0.09	0.23 **	0.32 **	1	
Innovation performance	3.7	0.90	0.08	0.03	0.04	0.09	0.29 **	0.27 **	0.19 **	1

Note: SD (Standard Deviation); * $p < 0.005$ and ** $p < 0.001$. Source: Authors’ computation.

3.1. Constructs’ Reliability and Validity

Table 3 presents the outcomes of reliability and validity. We also analyzed the study’s variables using a confirmatory factor analysis (CFA). Model fitness was established, and our proposed model was compared with the best model. In contrast to the other three models we tried, our four-factor model suited the data well. The overall fitness of the model was shown by the following fit keys: $\chi^2 = 1032.58$, $df = 465$, $\chi^2/df = 2.221$, CFI = 0.93, GFI = 0.92, and RMSEA = 0.05.

Table 3. Reliability and Validity.

	Items	Alpha	FL	CR	AVE
Big Data Analytic Capability	10	0.81	0.72–0.92	0.83	0.69
Organizational Readiness	07	0.79	0.74–0.89	0.81	0.72
Innovation Performance	04	0.84	0.71–0.91	0.86	0.70
Digital Orientation	06	0.78	0.70–0.94	0.82	0.68

Source: Authors' computation.

3.2. Hypothesis Testing

Table 4 shows the outcomes for the direct impact of BDAC on IP and organizational readiness. The findings of the path analysis provide statistical proof of the impact of BDAC on IP at a significant level (0.26 *). On the basis of these findings, we accepted H1. Table 4 also contains the outcomes of the direct effect of BDAC on organizational readiness. The findings provide statistical proof of the impact of BDAC on organizational readiness at a significant level (0.41 *). On the basis of these findings, we accepted H2. Finally, Table 4 also contains the outcomes of the direct effect of organizational readiness on IP. The findings provide statistical proof of the impact of organizational readiness on IP at a significant level (0.33 *). On the basis of these findings, we accepted H3.

Table 4. Results of Path Analysis.

Specification	Estimate	LL	UP
Direct impact			
BDAC → IP	0.26 *	0.13	0.18
BDAC → Organizational Readiness	0.41 *	0.22	0.34
Organizational Readiness → IP	0.33 *	0.25	0.40

Note: * $p < 0.005$. Source: Authors' computation.

Table 5 shows the indirect effect of organizational readiness between BDAC and IP. To run the mediating test, we followed the techniques of Preacher and Hayes (2008) [54]. The mediating effect is valid and with a significant value. The results analytically proved that organizational readiness acts as a mediator (0.19 *). Thus, H4 was proved, and it was proved that the BDAC and IP link is mediated through organizational readiness.

Table 5. Results for the indirect effect of organizational readiness.

Specification	Estimate	LL	UP
<i>Standardized direct impact</i>			
Big Data Analytic Capability → IP	0.13	−0.05	0.27
Big Data Analytic Capability → Organizational Readiness	0.44 *	0.39	0.58
Organizational Readiness → IP	0.33 *	0.19	0.50
<i>Standardized indirect effects</i>			
Big Data Analytic Capability → Organizational Readiness → IP	0.19 *	0.07	0.27

Note: * $p < 0.005$. Source: Authors' computation.

To analyze the relationship between organizational readiness and IP, we utilized a hierarchical regression analysis to test the moderating influence of digital orientation. Table 6 shows the moderating effect of digital orientation on the causal relationship between organizational readiness and IP. The results show that digital orientation has an important and beneficial moderating impact on the association between organizational readiness and IP (0.26 **). This led to the acceptance of H5.

Table 6. Outcomes of hierarchical regressions.

	Step 1	Step 2	Step 3
Moderation of Digital Orientation			
Organizational Readiness		0.32 **	0.36 **
Digital Orientation		0.25 **	0.29 **
Organizational Readiness \times Digital Orientation			0.26 **
R ²	0.009	0.191	0.198
Adjusted R ²	0.003	0.159	0.175
Δ R ²	0.007	0.163	0.028
Δ F	4.172	79.63	17.13

Note: ** $p < 0.001$. Source: Authors' computation.

4. Discussion

The current study examines the outcome of BDAC on organizational readiness and IP. The findings proved the intervening effect of organizational readiness on the connection of BDAC and IP. The statistics revealed that BDAC positively predicted IP. These findings confirmed the results of previous researchers who documented the IP of organizations in the presence of the BDAC of organizations. IP is based on updated information about the market, product, and customers. Innovation activities in the form of products and processes require new information about the prevailing situation in the specific industry. BDAC enables business organizations to effectively utilize the existing resources and provide media data, real-time evidence, and new knowledge-driven data that are essential for increasing IP [31]. Shan et al. [29] and Ciampi et al. [2] suggested in their studies that the BDAC increases IP. Their results proved that BDAC provides innovative ideas for the organization.

The results of H2 proved that BDAC significantly predicts organizational readiness. Organizational BDAC is the key that specifies organizational readiness; a firm's properties play a very dynamic role in using big data analytics and management capabilities to forecast the readiness factor of the company. The capability regarding the data flow within an organization as well as outside it is a controlling factor, which indicates the readiness of a firm [35,36]. The findings of the current study support the findings documented by previous researchers who suggested that BDAC enables a business to make use of valuable information for the alignment of organizational resources for the betterment of the organization [42]. Organizations with BDAC are more likely to respond to the required changes. Goss and Veeramuthu [44] demonstrated that BDAC is an important predictor of organizational readiness. The findings related to H2 proved that BDAC significantly influences organizational readiness. The findings suggested that BDAC predicts organizational readiness; therefore, researchers in relevant fields must consider this relationship.

The results of H3 proved that organizational readiness significantly predicts IP. The findings of the current study support the findings documented by previous researchers who suggested that organizational readiness enables a business to make use of valuable information for the alignment of organizational resources for the betterment of the organization and IP [49]. The findings related to H3 proved that organizational readiness significantly influences IP. The findings suggested that organizational readiness predicts IP. H4 was formulated for testing the intervening role of organizational readiness in the BDAC and IP link. The statistical outcomes revealed that BDAC had a significant indirect association with IP. The mediating role of organizational readiness between BDAC and IP was also confirmed. The findings of the indirect effect of organizational readiness suggested that BDAC plays a critical role in the development of organizational readiness, which in turn enhances the level of IP. Finally, H5 proposed that digital orientation plays a role in enhancing the relationship between organizational readiness and IP. The findings show that the interaction term, such as organizational readiness \times digital orientation, has a significant effect on the organizational readiness and IP link.

4.1. Theoretical Implications

The statistical outcomes suggest the contribution of the current study to the existing body of knowledge. This research adds to the existing literature of innovation management in significant ways. This research endeavor significantly adds to the existing literature by formulating a research model that tested the BDAC as a determinant of organizational readiness and IP. Limited research was found in the literature that considered the technological factors for boosting the IP of organizations. Moreover, we investigated how BDAC develops organizational readiness and innovation activities. There is not even a single study which presents such a relation.

The importance of this survey consists in its review of BDAC in producing organizational readiness. Organizational readiness for change is critical to enhance the organizational stance regarding innovative behavior [34,62]. Limited studies highlighted the role of organizational readiness in the improvement of IP. Therefore, the current study fills this research gap by focusing on BDAC as a potential determinant of organizational readiness and IP as an outcome of organizational readiness.

4.2. Practical Implications

The study's findings have valuable practical and managerial implications. The findings suggested that the management of the manufacturing sector must concentrate on BDAC and that management can develop the innovation mechanism with the help of BDAC and in the presence of organizational readiness. Organizations with a higher level of organizational readiness are more likely to achieve IP.

The outcomes validated the foundational role of BDAC in organizational readiness and IP. IP is related to the extent to which an organization is involved in creative and innovative activities and is satisfying customers' demands with new products and services. Hence, IP is achieved with BDAC through which organizations are able to change their business processes and products and get ready for these changes that occur in the business environment. Similarly, this study also offers guidance on practical management regarding the benefits of BDAC for establishing organizational readiness. When organizations exercise big data management and concentrate on BDAC in response, they are more inclined towards innovation and more ready for these changes.

5. Conclusions

This study was conducted to examine the relationship between BDAC, organizational readiness, digital orientation, and IP. We proposed that BDAC develops organizational readiness which in turn enhances IP. The findings confirmed that BDAC positively determined organizational readiness, and organizational readiness significantly predicted IP. Moreover, the mediating role of organizational readiness also proved the relationship between BDAC and IP. Finally, the findings revealed that digital orientation significantly moderates the organizational readiness and IP link.

The study's findings have many practical implications, but it is not free from limitations, and these limitations indicate recommendations for future studies. The current study focuses only on manufacturing concerns despite gathering data from other sectors such as trading and services. Thus, for generalizing the findings, future studies can enlarge the scope by involving the trading and services sectors in their research. In this study, only a cross-sectional data analysis method was used; in order to eliminate this deficiency, many other statistical methods could be used in future research.

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