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Interrelated Factors Influencing the Adoption of Big Data Applications: Empirical Study in Jordan

Rand Al-Dmour [1]***, Eatedal Ahmed Amin*** [2]***, Nour Saad*** [3] ***and Hala Zaidan*** [4]

ABSTRACT

This study aims to identify the main interrelated factors influencing the adoption of big data applications by commercial banks operating in Jordan. A study model was developed to guide the study based on a literature review and a technology adoption model. A survey approach was employed to collect the required data from 235 target respondents who were in top- and high-level management in commercial banks operating in Jordan.

The study results indicated that nine factors could be extracted from three major constructs: 1) Three factors were derived from organizational construct (top management support and readiness, business strategy orientation and organizational resources); (2) three factors were extracted from the technological construct (compatibility, complexity and security and privacy) and (3) three factors were extracted from environmental construct (business market structure, competition structure and governmental regulations). Findings indicate that organizational factors, technological factors and environmental factors significantly influence the adoption of big data analytics applications in commercial banks operating in Jordan and the "organizational resources" factor was the most important factor.

Keywords: Big data adoption, Organizational factors, Technological factors, Environmental factors, Commercial banks.

1 Department of Management Information Systems, School of Business, The University of Jordan, Amman, Jordan. rand.aldmour@ju.edu.jo

2 Department of Marketing, School of Business, The University of Jordan, Amman, Jordan. Eatedalameen@yahoo.com

3 Department of Marketing, School of Business, The University of Jordan, Amman, Jordan. n.jjsaad@outlook.com

4 Department of Accounting, the University of Jordan, Amman, Jordan. H.Zaidan@ju.edu.jo

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العوامل المتداخلة المؤثرة في تبني تطبيقات البيانات الضخمة: دراسة تطبيقية في الأردن

رند الضمور[1]، اعتدال أحمد أمين[2]، نور سعد[3]، وحلا زيدان[4]

ملخص

تهدف هذه الدراسة إلى التعرف إلى العوامل الرئيسية المتداخلة التي تؤثر في تبني تطبيقات البيانات الضخمة من قبل البنوك التجارية العاملة في الأردن. وبناءً على مراجعة الأدبيات ونموذج اعتماد التكنولوجيا، تم تطوير نموذج دراسة للاسترشاد به في تحقيق أهداف الدراسة. وقد تم استخدام منهج المسح لجمع البيانات المطلوبة من 235 مستجيبًا مستهدفًا كانوا يشغلون مواقع قيادية في الإدارة العليا في البنوك التجارية العاملة في الأردن.

وقد أشارت نتائج الدراسة إلى أنه يمكن استخلاص تسعة عوامل من ثلاثة تراكيب رئيسية: 1) ثلاثة عوامل من الهيكل التنظيمي (دعم الإدارة العليا والجاهزية، وتوجيه استراتيجية العمل، والموارد التنظيمية) و(2) ثلاثة عوامل من البناء التكنولوجي (التوافق، والتعقيد، والأمن والخصوصية) و(3) ثلاثة عوامل من البناء البيئي (هيكل سوق الأعمال، وهيكل المنافسة، واللوائح الحكومية). وقد أظهرت النتائج أن العوامل التنظيمية والعوامل التكنولوجية والعوامل البيئية تؤثر بشكل كبير وإيجابي في تبني تطبيقات تحليلات البيانات الضخمة في البنوك التجارية العاملة في الأردن، كما وجد أن عامل "الموارد التنظيمية" هو العامل الأول الأكثر أهمية.

الكلمات الدالة: تبني تطبيقات البيانات الضخمة، العوامل التنظيمية، العوامل التكنولوجية، العوامل البيئية، البنوك التجارية.

1 قسم نظم المعلومات الإدارية، كلية الأعمال، الجامعة الأردنية، عمان، الأردن.
2 قسم التسويق، كلية الأعمال، الجامعة الأردنية، عمان، الأردن.
3 قسم التسويق، كلية الأعمال، الجامعة الأردنية، عمان، الأردن.
4 قسم المحاسبة، كلية الأعمال، الجامعة الأردنية، عمان، الأردن.

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INTRODUCTION

Today, the banking business is characterized by increasing competitiveness, globalization and ever-faster innovation. As a result of technological innovations and intelligence data, big data plays a great and important role in the banking service sector more than ever before. Banks have a vast and big quantity of data. Because BD is extensively used in the banking and exchange sector, it preserves all the data related to this sector. Big data also gives many advantages to the bank sector; it helps in card fraud detection and provides an early warning for securities fraud. The securities exchange and commission are using big data to reveal financial market endeavours and actions using network analytic and natural-language processors. This helps catch illegal buying and selling activity in the financial markets (Goyal et al., 2017). According to Goyal et al. (2017), besides the great opportunities of the benefits from big data, come various risks of managing the data accurately and this data is very important for financial service, as it consists of clients' companies account information. The significance of big data in business and marketing activities and the future business survival are related to the capability and competence to understand and exploit big data for competitive purposes (Sun et al., 2018).

Because decision-making is increasingly data-driven, banks must efficiently obtain valuable information from a rapidly changing data environment. There is also competition in the banking industry over increasing customer reach with online-based tools. Banks offer personalized product offerings through online banking, mobile banking and ATMs. Efforts to reduce risk in banking transactions and increase access to reach a broader customer base require access to an enormous amount of data and the ability to process this data to draw meaningful conclusions that can be used for decision-making (Zhong et al., 2016; Breed and Verster, 2019; Rana, 2019). This is where big data analytics prepares to play an important role in boosting the growth of the banking industry and mitigating the amount of risk. Banks mainly use big data analytics for marketing analytics, risk management, fraud detection and prevention and strategy formulation (Wamba et al., 2017).

With most big data issues being based on cases in developed countries, cultural challenges, although complicated, show some consistency. However, there is a lack of studies that examined the status and the extent of use of big data in the banking sector in developing countries-such as Jordan-empirically. These geographical locations show strikingly different cultural considerations. The reality of the situation of IT in Jordan offers a unique context. There are changes taking place in the IT landscape of Jordan. While Jordan is a regional hub of IT expertise and an important market for corporations, there are many hurdles to be met. This study has come to find out where Jordan stands in terms of IT adoption, especially in big data applications and the main factors influencing the adoption of big data application by commercial banks operating in Jordan.

Two research objectives drove this study. Firstly, what are the critical factors for the successful adoption of big data that can be identified within the framework? Secondly, which implementation challenges do commercial banks face when adopting big data applications? Although the research questions are framed for Jordan's business context, it is believed that most of the findings will be generalizable to other emerging and developed country contexts.

Big Data Applications in Banking Industry

The banking industry is one of the most data-dependent sectors in the world. Banks currently have

massive amounts of customer data on hand, including through KYC compliance checks (customer know-how), customer activity at ATMs (ATMs), point-of-sale purchases and Internet banking files. So, it is not surprising that banking is one of the business domains that make the highest investment in big data and BA technologies. Today, data and data analytics are increasingly working as a basis not only for understanding more about customers, but also for improving internal processes, such as operations and compliance and greatly enhancing scalability. Marketing is one area in which banks benefit from advances in big data. Marketers can use big data to better understand customer preferences and respond to products and services that will be sold to them. Banks can even use customer data to monitor their behaviour in real time. For example, a bank can send an offer to a customer based on the use of a specific smartphone app or credit card data from an item having been purchased. Alternatively, if a prospective customer visits the bank's website to browse a specific service - for example, a loan service -, the big data marketing technology known as forwarding will allow the bank loan to be displayed on other websites visited.

Big data also helps banks make a more accurate assessment of borrowers' creditworthiness and potential lenders, providing more insight into their customers. Pérez-Martín et al. (2018) found that big data technologies can be successfully applied to large financial datasets to "separate risk groups". By adopting these technologies, the study concluded that there will be “less risk to financial companies when predicting which customers will be successful in their payments,” and as such, “more people can obtain credit loans. Literature suggests that big data has revolutionized overall marketing and marketing analytics. It introduces new concepts and new ways to do things to gain competitive advantage. Big data enables service innovation that generates strategic value for banks (Wedel and Kannan, 2016; Abbasi et al., 2016; Watson, 2019). The literature review shows an increasing number of studies on big data applications to create relational marketing benefits. Big data provides banks and their customers with several benefits: It gives banks a full view of their business, from customer behaviour patterns to internal process efficiency and even broader market trends. Bank marketing management can use the vast amount of available data (for example, online bank data web) to gain valuable insights from its clients. Banks that take advantage of big data from online data and web gain competitive advantages, because they know customers better. Studies showed that BDA's use of business intelligence and maintaining customer privacy creates important relationship marketing assets (Sun et al., 2018; Ducange et al., 2018; Palmatier and Martin, 2019; Cabrera-Sanchez & Villarejo-Ramos, 2019; Al-Dmour et al., 2020).

Big data analytics is now being implemented across the banking industry, helping provide better services to clients, both internally and externally and helping improve active and passive security systems (Srivastava and Gopalkrishnan, 2015). Järvinen & Karjaluoto (2015) defined marketing analytics as a measurement and management practice and market performance analysis to maximize the effectiveness and return on investment (ROI) of marketing activities. The report stressed that marketing analyses would assist banks in decision-making, which increases profitability. Pramanick (2013) indicated that banks are always in danger of losing clients and need strategies that depend on determining the appropriate customer right procedure. Thus, banks must invest in customer analytics that effectively segments their customers. This will help in determining the marketing mix, the right customer approach and marketing strategy. Morabito (2015)

added that automating marketing with big data will help banks serve individual customer needs while keeping marketing costs low, allowing for a personalized experience in a good return on investment.

Research Conceptual Framework and Hypotheses Development

The lack of research and conceptual frameworks to explain the adoption of big data applications has been lamented widely. Many of the traditional technology success, adoption and diffusion models, like the various Technology Adoption Models, such as TAM and UTAUT (Davis 1989; Venkatesh et al., 2003) and the IS success model (DeLone and McLean, 1992), take individuals as their unit of analysis and, although they often incorporate some technical aspects, they do not consider the organizational perspective. We, therefore, opted to use the Technology-Organization-Environment (TOE) framework (Tornatzky and Fleischer, 1990) as the organizing framework for this study and populate it with "first-order" factors lifted from the academic big data literature (Fig.1). Three organizational constructs were used in this research (Top management support, business strategy orientation and organizational resources). Three technological constructs were used in this research (compatibility, complexity, security & privacy considerations) and finally three environmental constructs were used in this research (business market structure, competition structure and government regulation). These factors are most frequently identified in previous studies in IT adoption as either incentive (also referred to in the literature as drivers, determinants, motivators) or barriers (inhibitors) to adoption and use. Researchers have clustered these factors in different ways. The relationships of these factors/variables with big data adoption are shown in Figure (1).

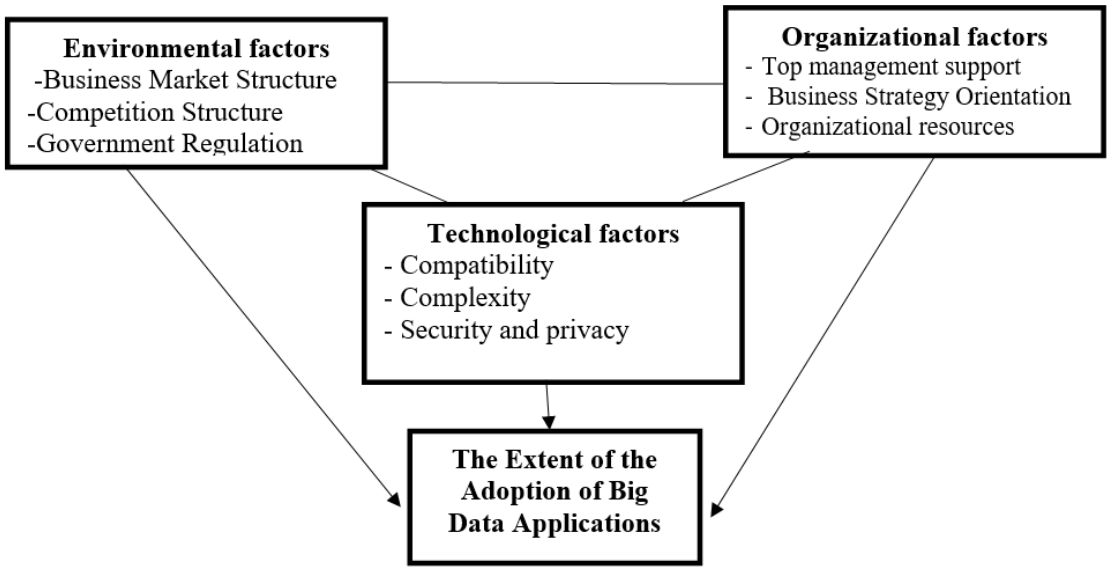

Figure (1)
Study model

Several studies have examined the adoption of IT for several reasons. In this study, the review is mainly limited to the adoption of big data applications. Motamarri et al. (2017) found that the business drivers to adopt big data analytics and maturity level differ from one firm to another. While some industries have started to utilize big data to execute their strategies actively (e.g. oil and gas industry), others, like the architecture, engineering and construction (AEC) industry, have not (Ahmed et al., 2017). Merhi and Bregu (2020) investigated the impact of techno-centric, government-centric and user-centric factors on the efficient and effective adoption of big data analytics in the public sector. They argued that techno-centric factors (maturity, authentication, non-repudiation, confidentiality, privacy, data integrity and technological advancement) are the most important category, followed by the government-centric and user-centric categories which have the same weight. They concluded that all tested factors have a positive impact on the dependent factor. Salleh and Janczewski (2016) gathered data from 25 respondents using an online questionnaire and applied a descriptive analysis. Their preliminary study indicated that top management support, information security, perceived compatibility, culture and organizational learning culture have significant positive effects on big data adoption. On the other hand, security and privacy regulatory concern are the only factors that do not affect big data adoption.

Park et al. (2015) adopted the (TOE) conceptual framework to identify and prioritize the factors determining the level of big data adoption and usage in Korean firms. Results showed that the effect of technological factors (perceived benefits from big data, data quality and integration, security and privacy, simplicity of system usage and compatibility) on big data adoption is the strongest compared with organizational and environmental contexts. Big data's perceived benefits are the most crucial factor among technological determinants, followed by data quality and integration, security and privacy, compatibility and system usage simplicity. The organizational aspect (management support for big data, technological capability and financial investment competence) is the second important determinant. Technological capability and financial investment competence are ranked highly in the organizational context, followed by management support for big data with the least importance. Environmental context (competitor adoption and usage, partner adoption and usage and government support and policy) is the weakest among all three contexts. Government support and policy had the highest weight, followed by the competitor adoption and usage, partner adoption and usage, respectively.

Almoqren and Altayar (2016) explored the driving factors determining the implementation of big data mining tools. Based on their findings, usage of data mining tools to accelerate big data is influenced by the following determinants: service quality, system quality, information quality and perceived benefits. Sumbal et al. (2019) performed semi-structured interviews with senior managers and experts at the oil and gas sector. The study covered eight countries with different cultures. They found that the most critical factors that demotivate big data adoption are: lack of data scientists and experts, the risk of cyber-attacks, reluctance from top management toward such technology, low data quality and incompatible IT infrastructure. Ahmed et al. (2017) concluded that the structural fragmentation with some small-sized companies and industry characteristics significantly impacted big data adoption. Large organizations with top management commitment are vital drivers to adopt big data systems. They also highlighted the positive impact of government regulations on such technology. Based on the framework and literature

review, the following main hypothesis was developed:

Ho1. Big data applications' adoption will be positively influenced by the three interrelated constructs: organizational, technological and environmental.

The following are the sub-hypotheses derived from the main hypothesis:

(1) ***Organizational Factors***: The first cluster of variables is called organizational factors that relate directly to the availability and use of internal resources. One of the most important factors that the frequently mentioned by previous studies is Top Management Support. It is defined as the extent to which an organization's top management gives support and commitment to information system security requirements and techniques (Salleh and Janczewski, 2016). Borgman et al. (2013) proposed that top management support sustains the adoption of new technologies effectively and efficiently. Big data should be linked to top management and their core values. Establishing new working methods in companies is difficult and it takes time to be an acceptable part of organizational culture (Cameron and Quinn, 2005). Organizations are responsible for raising the level of awareness among employees about big data measures and their importance. Hence, the turn of the organization is highly important (Park et al., 2004). Besides, other important factors that might influence big data application adoption are the organization's financial resources and capability. Data cost is one of the most common risks in using big data. The processes of data collection, storing, transformation, analysis, mining and security all require huge financial capabilities and costs, which impedes the process of big data adoption. Thus, this financial burden will negatively affect organizations' intention to adopt big data systems (Goyal et al., 2017). Therefore, the following influencing factors related to the organizational context are hypothesized:

H0a. Big data applications' adoption will be positively influenced by top management support, business strategy orientation and organizational resources.

(2) ***Technological Factors*****:** The technological factors relate to the technology and information systems and the pool of technologies available to the organization. The research literature identifies many technology-related factors that potentially affect the adoption of big data applications, such as compatibility, complexity, real-time decision-making abilities and security and privacy considerations. Rogers (2003) defined compatibility as "the degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of receivers". In this research, compatibility represents the level to which the company's current security technology and control techniques are appropriate for big data systems' security necessities. Borgman et al. (2013) found a significant positive impact of compatibility on adopting new technologies. If the organization's technology and structure are not consistent, this will not affect success as a sustained company (Wickramasinghe and Alawattage, 2007). Complexity is assessed based on obstacles and difficulties in providing security models and techniques for big data systems (Salleh and Janczewski, 2016). Davis (1993) argued that ease of use is one of the most influential factors in determining the user's acceptance of new information technology. Ease of use is "the degree to which an individual believes that using a particular system would be free of physical and

mental efforts" (Davis, 1993).

Decision-makers believe that big data increases its importance by providing valuable knowledge and information to make the most effective decisions (Elgendy and Elragal, 2014). Nowadays, decision-makers consider big data as one of the most significant assets. Huge amounts of highly detailed data from diversified origins represent a big opportunity to benefit companies. This is probable only when the data is genuinely analyzed to explore valuable insights, authorizing decision-makers to capitalize upon the discovered opportunities from the wealth of historical and real-time data generated through several mechanisms (Cyber, 2012). Furthermore, companies are involved in analyzing internal and external data. Because of large volumes and various types of unstructured and semi-structured data, it is essential to set more informed decisions depending on meaningful deductions from the data (Economist Intelligence Unit, 2012). Once the data has been collected, the challenge is how to secure and protect this data. The traditional data protection methods are not suitable for the ever-growing amount of big data, creating heightened security and privacy risks. Because of its huge amount and variety, big data encryption is hard (Chen et al., 2014). Indeed, some service providers depend on a third party to maintain and analyze huge datasets; this dependency may raise the probability of risks (Giri and Lone, 2014). Motamarri et al. (2017) proposed that the awareness of privacy and ethical considerations associated with big data analysis is required for both firms and customers. Therefore, the following influencing factors related to the technical context are hypothesized:

Hob. Big data applications' adoption will be positively influenced by compatibility, complexity, security and privacy.

(3) ***Environmental Factors*****:** The third categories of variables relate to the external environment in which an organization operates and include market conditions, regulatory influence, industry pressure and vendor influence. For example, intense competition is a reliable driver to adopt an innovation (Mansfield, 1968). It is suggested that organizations in rapidly growing sectors innovate more than in the other sectors regarding the industry life cycle. On the other hand, in declining sectors, innovation mechanisms and techniques are vague (Tornatzky and Fleischer, 1990). Government regulation is one of the major barriers in big-data management. The success of big data adoption depends on the governments' ability to set clear regulations and procedures that will direct various firms and users (Joseph and Johnson, 2013). These regulations should be collaborative to maximize the value of data and minimize potential troubles that may emerge from the implementation of such regulations (Merhi and Bregu, 2020). Moreover, they concluded that initiating new criteria is so sophisticated and requires special attention. A massive number of resources is an essential requirement in gathering and managing big data. As governments deal with big data, they should pay careful attention to government support and budget allocation (Merhi and Bregu, 2020). Leading companies and developed countries exploit huge amounts of structured and unstructured data to create value for their business operations. E-readiness, easily accessible IT solutions and partners and professional experts' availability are all essential drivers to adopt big data effectively (Dezi et al., 2018). Therefore, the following influencing factors related to the external environment context are hypothesized:

Hoc. Big data applications' adoption will be

positively influenced by business market structure, competition structure and government regulations.

Research Methodology

This research's target population consisted of all the commercial banks operating in Jordan up to 2019. Nineteen commercial banks are operating in Jordan and all of them have agreed to participate in this study. The target respondents were identified as commercial banks' senior and middle managers (IT, financial and marketers), because participants needed to have adequate knowledge to answer questions about the factors influencing big-data adoption. The rationale for choosing these managers lies in that they have the necessary knowledge to provide answers and are in the best position to complete the questionnaire. The researchers distributed a total of 300 surveys using both online and paper-based questionnaires. The number of usable returned questionnaires was 235, with a response rate of about 80%.

To guide the questionnaire design, several available questionnaires were reviewed. For construct validation, the questionnaire content was modified to the practice of Jordan business culture context based on a pilot study and feedback from five professional academic staff members in this filed. The questionnaire's content (measures) was mainly selected and adopted from relevant previous validated scales. The independent variables: "organizational, technological and environmental" were measured using a 5-point Likert scale by Goyal et al. (2017); Salleh and Janczewski (2016); Borgman et al. (2013) and Sun et al. (2018). The dependent variable (the extent of the adoption of big-data analytics applications) was measured using a 4-point scale ranging from (1) not adopted to (4) fully adopted, developed by Sun et al. (2018); Ducange et al. (2018); Palmatier and Martin (2019). Table (1) summarizes these constructs and their related items' measures.

Table (1)

Variables and measurement items

Independent Variables	
(1) Organizational Factors	
1. Top Management Support and Readiness	
O1	Our bank executives are highly interested and enthusiastic to allocate sufficient resources in the adoption of big data analytics applications
O2	Our bank top managers have stronger competence and higher IT knowledge
O3	Our bank executives have positive attitudes toward the technology innovation
O4	Top managers' decision-making at the corporate bank-level (e.g. a culture of evidence-based decision-making, decision-making norms)
2. Business Strategy Orientation	
O6	The bank's IS strategy prioritizes big data usage (e.g. information strategy, information governance policy)

O7	Our bank strategy is oriented to business analytics and using big data for strategic decisions (e.g. the business strategy of prioritizing big-data adoption)
O8	Our bank members have sufficient experience and skills to handle the changes engendered by information technology easily
O9	Our bank has a well-organized structure that is well-suited to the adoption of big data, (e.g. cross-organizational collaboration structure, IT departments and staff configurations)
3. Organizational Resources	
O10	The bank has adequate financial resources to the task of adopting big-data applications
011	We have sufficient human resources necessary to use big data analytics applications
O12	The bank knows how big data can be used to support marketing operations
O 13	The bank's technology resources are adequate for the task of adopting big data. (e.g. hardware, software, storage infrastructure)
O 14	Our bank has sufficient internal IT expertise & technological infrastructure to adopt big data (e.g. IT knowledge and skills within the organization)
2. Technological Factors	
1. Compatibility	
T 1	The characteristics of big data are perceived as being beneficial after observing how other organizations use it (e.g. a witness from the potential adopter observing big data adoption by another firm)
T 2	Changes in customers' product preferences, demands and needs in a big data environment (e.g. business environment fluctuation, changes in customers' product preferences)
T 3	Big data characteristics are perceived as being better than those of the idea it supersedes (e.g., its unique role for innovation, competition, productivity, customer value creation and good business problems solution)
T 4	Big data characteristics are perceived as being consistent with the existing IT architecture in an organization (e.g. scalability, integration into the existing information systems)
2. Complexity	
T 5	Big data characteristics are adopted without total commitment (e.g. it can be quickly tried out with minimal investment)
T 6	Big data characteristics are perceived as being difficult to understand and use (e.g. the difficulty of learning-related knowledge for employees who will use big data applications).
T 7	The timing of the adoption of big data is advantageous for the organization (e.g. the organization potentially benefits from the introduction of big data if implemented at this time)
3. Security and Privacy	
T8	Data collection from individuals causes individuals' security, privacy concerns. (e.g. legal implications of collecting customers' private information)
T 9	Concerns regarding potential unexpected consequences related to big data adoption (e.g. data security-related risk, uncertain profitability for big data adoption)

T 10	The bank believes that it will be safe to adopt big data (e.g. reliability, reliable platform, system trust safeguard, "strong relationship of trust", inter-organizational trust)
3. Environmental Factors	
1. Business Market Structure	
E 1	The quality of the local workforce encourages our company to use IT applications in marketing activities
E 2	The availability of qualified human resources locally encourages our bank to use big data
E3	Changes in customers' services preferences, demands and needs in a big data environment (e.g. business environment fluctuation, changes in customers' product preferences)
E 4	Adopting big data to follow partners and maintain the bank's internal balance with them (e.g., the readiness of suppliers in external collaborations)
2. Competition Structure	
E 5	The extent of the pressure from a bank's competitors can be combatted by adopting big data (e.g. competitive market, external threats from competitors)
E 3	Banks think that big data technology influences competition in their industry
E 9	Our bank is under pressure from competitors to adopt big data technology
3. Government Regulation	
E 10	Governmental agencies encourage banks to adopt big data by providing related support (e.g. legal environment, industry regulation, data protection regulations)
E 11	The laws and regulations that exist nowadays are sufficient to protect the use of big data technology
Dependent Variable: Big Data Applications	
A1	Customer segmentation and profiling
A2	Customer relation management
A3	Transaction channel identification
A4	Effective customer feedback analysis
A5	Risk assessment, compliance & reporting
A6	Managing customer data
A7	Fraud management & prevention
A8	Improved cybersecurity and risk management
A9	Personalized customer experience
A10	Customer spending patterns
A11	Lifetime value prediction
A12	Business process optimization and automation
A13	Product cross-selling
A14	Better employee performance and management

Respondents' Profiles

In this study, 55% of the respondents were males and 35% were in the age group between 40 and 49 years and in terms of their education, about 78% of the respondents have a bachelor's degree, while 42% of them have an experience of fewer than ten years and

about 51 % of them were acting as divisional/branch level managers in Jordanian commercial banks. Table (2) summarizes the demographic characteristics of the respondents.

Table (2)
The respondents' profile

Characteristics	Category	Frequency	Percentage (%)
Age	24- 29 years	64	27
	30-39 years	49	21
	40-49 years	82	35
	50 years and above	40	17
Sex	Male	129	55
	Female	116	45
Education	Secondary and /or diploma	17	07
	Bachelor's degree	183	78
	Graduate degree (MA or PhD)	35	15
Experience	Less than 10 years	87	37
	11-15 years	99	42
	16 years and above	49	21
Position	Divisional /branch manager	120	51
	Head of department/executive	63	27
	Chief officer/lower level	52	22

Distribution, Item Reliability Analysis and Construct Validity

To examine the test items' distribution and variables, Kolmogorov-Smirnov and Lilliefors and Shapiro-Wilk tests for normality were conducted on each of the test items and variables. The results show significant p-values ($p<0.05$), which means that the null hypothesis Ho about the normality of data distribution is rejected for almost all test items and variables. The values of skewness and kurtosis were found normally distributed because most of the values were inside the acceptable ranges for normality (i.e., -1.0 to +1.0) for skewness and less than 10 for kurtosis (Hair et al., 2017). The resulting Cronbach's alpha values range from 0.82 to .087, which means that each construct's items are highly correlated. To analyze the structure of the relationships between the variables and to test for a possibility of data reduction, factor analysis was conducted on the set of 32 items. Factor rotation varimax normalized was used. The maximum number of factors was set to the number of variables (16), while the minimum eigenvalue was set to 1; fourteen factors, which explain 74.98% of the data variance, were identified during the analysis. According to the Kaiser criterion, all the factors were retained, as their eigenvalues were greater than 1. Nunnally (as cited in Ngai et al., 2004) suggested that an item is considered to load on a factor when the factor loading is 0.4 or greater. Using this criterion, factor loadings were

analyzed and the instrument variables were adjusted to match newly discovered factors. KMO and Bartlett's tests were also conducted to judge the validity of the data and sample size for the exploratory and confirmatory factor analysis (0.83), which exceeds the minimum value of 0.6, indicating that the sample size is sufficient to conduct the global analysis. The Bartlett test results indicated a statistical significance level of less than ($\alpha \leq 0.05$), the significance level of Bartlett's test of sphericity was (Sig. = 0.00), indicating the existence of links between domains in the scale, data factorability and that we could benefit from factor analysis. Table (3) presents the number of factors underlying each construct with eigenvalue and cumulative variances.

Table (3)
The results of factor analysis

Major Construct	Factors	Number of Items	Rotation Sums of Squared Loadings	
			Eigenvalue	Cumulative %
Organizational	Top Management Support	4	5.621	51.063
	Business Strategy Orientation	4	1.528	58.799
	Organizational Resources	5	1.083	66.099
Technological	Compatibility	4	4.278	42.775
	Complexity	3	1.178	54.552
	Security and Privacy	3	1.025	64.804
Environmental	Business Market Structure	4	4.320	39.276
	Competition Structure	3	1.529	53.178
	Governmental Regulations	2	1.075	62.947

For multicollinearity diagnostics, the results in Table (4) indicate that all values of (VIF) are less than 10 and all values of tolerance are more than (0.1), which indicates that there is no problem with multicollinearity among the study independent variables. So, the study construction is valid and we can test the hypothesis based on these outcomes. Indeed, all values were within the acceptable ranges for both values. Consequently, the assumption of multicollinearity was not challenged.

Table (4)
The results of multicollinearity diagnostics

Dependent Variable	Independent Variables	Tolerance	VIF
Big-data Applications	Organizational Factors	0.991	1.010
	Technological Factors	0.967	1.034
	Environmental Factors	0.974	1.027

Hypotheses Testing

Correlation coefficients only describe the strength of some relationships between variables and do not imply causality. Furthermore, correlation measures the linear relation only. Multiple regression analysis was conducted to test the independent variables' simultaneous effects on the dependent variable and to use the most parsimonious model possible. Multiple regression analysis was used to test the study hypotheses (Ho1, Hoa, Hob and Hoc). The summary results of the main hypothesis (Ho1) in Table (5) show that the R-value (0.732) indicates that there is a positive relationship between the three interrelated constructs (organizational, technological and environmental) and the adoption of big data applications in commercial banks operating in Jordan.

Table (5)

Multiple regression summary for the main hypothesis

Constructs*	Model summary			ANOVA		Coefficients(a)		Beta
	R	R Square	Adjusted R Square	F-value	Sig.	T	Sig. (P-value)	
	0.732	0. 535	0.529	84. 100	0.000			
Constant*						2.747	0.007	0.501
Organizational						7.411	0.000	0.422
Technological						4.032	0.001	0.259
Environmental						2.213	0.028	0.139

The summary results of the sub- hypothesis (Hoa) in Table (6) show that the R-value (0.78) indicates that there is a significant relationship between organizational factors (Top Management Support and Readiness, Business Strategy Orientation and Organizational Resources) and the extent of the adoption of big data applications by commercial banks operating in Jordan at the significance level ($\alpha \leq 0.05$). The value of R square (0.608) indicates that 60.8% of the variance in adopting big data applications was explained throughout these three factors of the organizational construct. The results indicate that the most important variable that explains the big data applications variance was "Organizational Resources".

Table (6)

Summary of regression results for the first sub-hypothesis (Hoa)

Constructs*	Model summary			ANOVA		Coefficients (a)		Beta
	R	R Square	Adjusted R Square	F-value	Sig.	T	Sig. (P-value)	
	0.780	0.608	0. 600	17. 516	0.000			
Constant*						5.073	0.000	0.214
OR						4.873	0.000	0.381
TM						4.104	0.005	0.176
BS						3.815	0.008	0.184

**TM (Top Management Support and Readiness); BS (Business Strategy Orientation) and OR (Organizational Recourses).*

The summary results for the 2nd sub-hypothesis (Hob) in Table (7) show that the multiple correlation coefficient (R) value is (0.741), indicating that there is a significant relationship between technological factors (Compatibility, Complexity and Security and Privacy) and the extent of the adoption of big data applications by commercial banks operating in Jordan at the significance level (α≤0. 05. The value of the coefficient of determination (R square) is (0.549). This expresses that about (55.0%) of the variance in the adoption of big data applications is explained by these three technological factors. The small value, 0.008 (R square (0.549)-Adjusted R square (0.541) = 0.008), indicates that the results of the research sample might deviate from the results of the research population by (0.008); so, the sample of the study is representative. Table (7) shows that the F-value is (15.431), which is significant (Sig. F=0.000) at (α≤0.05); so there is a statistically significant influence of the technological factors on the adoption of big-data applications. Furthermore, the results indicate that the most important factor that explains the variance in big-data applications' practices was “Security and Privacy” with an influence value of about (34%).

Table (7)
Summary of multiple regression results for the 2nd sub-hypothesis (Hob)

Constructs	Model summary			ANOVA		Coefficients(a)		Beta
	R	R Square	Adjusted R Square	F-value	Sig.	T	Sig. (P-value)	
	0.741	0.0549	0.0541	15.431	0.000			
Constant*						4.142	0.007	0.134
CX						3.536	0.013	0.191
SP						5.324	0.000	0.342
CY						2.124	0.009	0.321

* *CY (*Compatibility); CX (Complexity) and SP (Security and Privacy).

The summary results for the third sub- hypothesis (Hoc) in Table (8) show that the multiple correlation coefficient (R) value is (0.645), indicating that there is a significant relationship between environmental factors (Business Market Structure, Competition Structure and Governmental Regulations) and the adoption of big-data applications by commercial banks operating in Jordan at the significance level (α≤0. 05). The value of the coefficient of determination (R square) is (0.416). This expresses that about (42%) of the variance in the adoption of big data applications is explained by these three environmental factors. Furthermore, the results indicate that the most important factor that explains the variance in adopting big data applications was the "Competition Structure” factor with an influence value of about (21%).

Table (8)

Summary of multiple regression results for the 3rd sub-hypothesis (Hoc)

Constructs	Model summary			ANOVA		Coefficients(a)		Beta
	R	R Square	Adjusted R Square	F-value	Sig.	T	Sig. (P-value)	
	0.645	0.416	0.408	13.53	0.000			
Constant*						3.172	0,006	0.124
BM						3.636	0.008	0.151
CS						5.425	0.000	0.212
GR						2.114	0.013	0.121

* BM (Business Market Structure), CS (Competition Structure) and GR (Governmental Regulations).

Results' Discussion

To achieve the study objectives and conduct the research using a systematic approach, an integrated model was developed based on a literature review and the (TOE) conceptual framework (Tornatzky and Fleischer, 1990). One of this study's main objectives is to identify the main patterns of factors that underline the three primary constructs of the study's conceptual framework. The results of the factor analysis (FA) indicate that nine factors can be extracted from the three primary constructs: (1) Three factors are derived from the organizational construct (Top Management Support and Readiness, Business Strategy Orientation and Organizational Resources); (2) three factors are extracted from the technological construct (Compatibility, Complexity and Security and Privacy) and (3) three factors are extracted from environmental construct (Business Market Structure, Competition Structure and Governmental Regulations). These nine factors were subjected to further analysis using multiple regression analysis and ANOVA. The results are consistent with previous studies that have used this framework in the context of IT adoption; for example, Al-Dmour et al. (2013).

Findings indicate that the three interrelated constructs (organizational, technological and environmental) are positively influencing the adoption of big data analytics applications in commercial banks operating in Jordan. Among the organizational factors, analysis reveals that the "Organizational Resources" factor is the most important factor influencing the adoption of big data analytics applications. Inadequate financial resources are considered a major obstacle in big data adoption and usage (Goyal et al., 2017; Lian et al., 2014). Accordingly, commercial banks should increase the budgets allocated toward big data adoption to utilize such technology. Additionally, banks should employ and acquire the most cost-effective big data systems and models because of their limited resources as working banks in developing countries. The result also showed that the "Top Management Support and Readiness" factor ranked the second most important factor. This finding is consistent with Sumbal et al. (2019), Chen et al. (2014) and Park et al. (2004), who found that top management support has a significant positive relationship with big-data adoption. Top management might be aware of big data's utilities. Nevertheless, big-data adoption is not their priority. Usually, employees have resistance toward new technologies, as they require unique skills and competences and

may hurt their current positions (Sumbal et al., 2019). As a result, commercial banks are highly recommended to organize ongoing seminars, workshops and training sessions to highlight the advantage of big data adoption and let employees gain knowledge about its systems, methods, techniques and mechanisms. Also, the "Business Strategy Orientation" factor has ranked the third most important factor associated with adopting big-data applications.

The results indicated that the “Security and Privacy” factor was ranked as the most important factor among the technological considerations. These results are supported by several studies from different industries (Park et al., 2015; Merhi and Bregu, 2020). These findings are inconsistent with (Chen et al., 2014; Giri and Lone, 2014; Lian et al., 2014; Sumbal et al., 2019). In the banking sector, big data is highly important and this data keeps growing over time. It contains much sensitive information and detailed analysis about clients, competition, financial market trends, partners and many other variables. Hence, it needs protection. For this purpose, it is beneficial for decision-makers to prioritize this dimension and allocate more financial and non-financial resources to increase the level of awareness for such factor among employees. In some cases, it is practical to depend on external parties, experts and consultants. Complexity is the second important technological factor. The simplicity of system usage will motivate firms to implement and utilize big data (Lian et al., 2014; Gangwar et al., 2015; Yang et al., 2015). Davis (1993) argued that ease of use is one of the most influential factors in determining the user's acceptance of new information technology. In this regard, decision-makers and specialists should choose big data systems that are easy to implement and manage training and workshops to teach employees how to deal with related new technologies smoothly. Compatibility came in the third rank. This result matches other studies which found a positive relationship between compatibility and big data adoption (Borgman et al., 2013; Yang et al., 2015). Based on that, banks should adopt the modern technologies and remodel/reorder their technological structures to manage big data appropriately, which results in leveraging the business power and value (Bhuvana et al., 2016). Compared with technological and organizational factors, the environmental factors had the lowest significant relationship with big data adoption. The results indicated that the “Competition Structure" factor is the most important environmental factor positively associated with big data adoption. This finding agrees with several previous studies highlighting the importance of competitive pressures in big data adoption (Dezi et al., 2018; Sumbal et al., 2019). Sumbal et al. (2019) concluded that most companies are influenced by their competitors' pressures. The results also indicated that “Business Market Structure” and “Government Regulation” factors positively influence big data adoption. These results are inconsistent with previous studies, such as Park et al. (2015) and Sumbal et al. (2019).

Conclusions and Limitations

Based on the research findings, the study concludes that the nine factors derived from three primary constructs: (organizational, technological and environmental) are significant predictors of the adoption of big data applications among commercial banks operating in Jordan. Therefore, policy makers of commercial banks in Jordan should understand, manage and consider these factors effectively to grasp big data's benefits. However, several limitations should be considered when evaluating and generalizing the study's conclusions. The study was conducted in one country, Jordan. Although Jordan is a valid indicator of prevalent factors in the wider MENA region and developing countries, this

research's lack of external validity means that any generalizations of the research findings should be taken with caution. Future research should be extended to other national and cultural settings and compared with this study's results.

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