

## THE DETERMINANTS OF THE USAGE OF BIG DATA ANALYTICS (BDA) BY SMALL AND MEDIUM-SIZED ENTERPRISES (SME'S)

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### ABSTRACT

Small and medium-sized enterprises (SMEs) create a major contribution to the Pakistani economy, constituting 90% of all businesses and making over 50% of private jobs; this constitutes over 50% of the turnover of all firms in Pakistan. To the present finish, SMEs have an awfully vital economic weight at the national level; reason for selecting our subject. Moreover, SMEs struggle with not having an equivalent ability as massive enterprises to investigate new datasets with vital volume, speed, and selection. Per many studies, SMEs have steadily accepted new BDA scanning technology. The economic contribution of SMEs and therefore the attainable benefits for SMEs from the adoption of massive knowledge Analytics implies that it's vital to check the determinants of acceptance and adoption of massive knowledge Analytics by SMEs.

BDAs have more and more appeared as a frontier of opportunities in raising the performance of firms and more significantly SMEs. In this regard, the target of this study is to propose a theoretical model supported by the integration of Human-Organization-Technology (HOT), Technology-Organization-Environment (TOE) and the Technological Acceptance Model (TAM) to spot the key factors touching the acceptance and adoption of massive knowledge and its sequent impact on SMEs supported a reading of the prevailing literature. The results of existing studies indicate that technological, structural, environmental, and human parts are the most important variables that will facilitate SMEs' derive business price from the adoption of BDA and increase their performance.

### I. INTRODUCTION

The current world dominated by globalization, knowledge, rapid digitalization, very wide dissemination of information and competition via the latter has transformed the models traditional trading (Bouwman et al., 2018). Thanks to these technological advances, the use and implementation of new applications and information technologies (IT) have become huge assets for socio-economic change.

So far, Big Data Analytics (BDA) has received considerable attention from researchers and managers (Gupta et al., 2018). However, few studies have explored the important determinants of an organization's intention to adopt technology (Sun et al., 2016). The adoption of BDA depends on technical, organizational, environmental and human presented in the TOE model and the HOT model with the addition of the human dimension. Moreover, companies such as SMEs have not fully explored the promise of BDA (Mikalef et al., 2019). This study examines how SMEs benefit business values of adopting the BDA with the integration of the technology-organization-environment (TOE) model and the HOT (human-organization-technology) model.

In addition, to better understand the receptivity and acceptance of individuals to technologies information, Davis et al. (1989) proposed the technology acceptance model (TAM). The model is used to predict and explain user behavior and the use of computers (Agarwal and Prasad 1999; Davis 1989; Legris et al. 2003).

The BDA is still in its initial phase; and many companies have not yet decided to adopt it, according to several studies. Currently, a lot of research has been done to reveal the potential benefits and capabilities of BDA for SMEs. This study passed reviewed relevant research on SMEs nationally and internationally and selected the most common important factors that have a significant impact on the use of BDAs by SMEs through a quick reading of the existing literature. In this direction, the following question deserves:

**Through the existing literature, what do we know about the determinants of the usage of BDA by medium and small Enterprises (SMEs) nationwide and international?**

To answer this question, we will opt for an analysis of the existing literature review. While proceeding through the analysis of the key concepts of the research and presenting the various theories mobilized to address our

research question. The first part of this research presents the context, the problem of our research. And in a second part, we will analyze and interpret the literature review around our research question.

### **First Part: Contextualization and research problem**

We will first address the context of the research (1.1), and then we will justify the problematic of our research (1.2).

#### **1.1. The context**

Apparently, Big Data (BD) analytics is the most emerging trend in recent times. years. The BDA is presented as an innovative computing marvel or an approach based on different technologies (Park et al., 2015). It refers to a set of data very large and complex and to the advanced analytical techniques needed to store, manage and analyze this data Reference (Chen et al. 2012).

In addition, the potential and prospects of BDA are very important for SMEs. The use of BDA can facilitate alliances between SMEs by creating real-time solutions to challenges of each industry. This can be achieved by using transparency in decision making.

SMEs are specifically selected in this context for two main reasons: changes in SMEs can have a greater macroeconomic impact by because of their overall position in the economy, and they have the advantage and flexibility of adapt more quickly to changes.

It has also been reported in the literature that the use of Big Data technologies is influenced by determinants related to technological, organizational, environmental and human. However, few studies have explored the important determinants organizational intentions of SMEs to adopt this technology (Sun et al., 2016). By therefore, further research is needed to understand the level adoption of the BDA by SMEs and to identify the factors that influence its use by SMEs based on a review of existing literature.

To this end, this study examines the determinants of BDA use in SMEs by focusing on based on the model of the environment, technology and organization (TOE) and the model Human, Organizational and Technological (HOT) which adds the human dimension, for investigate the determinants of BDA use by SMEs to identify performance high organizational. The strength of the TOE model lies in its flexibility to explain the level of technology adoption among firms (Grant and Yeo, 2018; Tsou and Hsu, 2015).

Thus, extensive research on the impact of TOE factors on the adoption of various technologies are available in the literature, especially in large industries (Chandra and Kumar, 2018; Hsu and Lin, 2015). However, the results cannot be directly applied and generalized to the adoption of BDA by SMEs, because the impact of factors TOE and HOT depends on the type of technology, the size of the company and the country where research (Alharbi, Atkins and Stanier, 2016; Wang Jinmao, 2019).

Also, to better understand the organizational acceptance of AI systems, and more specifically the BDA, Davis et al. (1989) proposed the technological acceptance model (TAM), which is a powerful, robust and commonly used model to predict and explain the user behavior and the use of IT (Agarwal and Prasad 1999; Davis 1989; Legris et al. 2003). It is determined by perceived ease of use, perceived usefulness, attitude towards use, behavioral intent to use, and system usage. The perceived usefulness and perceived ease of use are the most important determinants of intent to use of the system (Wu and Wang 2005).

Indeed, it is important to examine the facts driving the adoption of BDAs in undertaken for the organization based on a quick reading of existing literature.

#### **1.2. The problem**

Based on the review and synthesis of the literature review, the benefits and challenges of Big Data Analytics are well identified, with many existing frameworks and tools. However, few studies focus on the implementation of BDA within SMEs. Therefore, extensive research into the impacts of TOE and HOT factors adding dimension human in addition to the adoption of various technologies and in particular Big Data are available in the literature (Chandra and Kumar, 2018).

Nevertheless, studies on the determinants of the use of Big Data in small and medium-sized businesses remain unclear, hence the purpose of this study. Thus, this study is based on the model TOE and the HOT model to explore and investigate the drivers of BDA adoption by SMEs nationally and internationally based on a quick reading of the literature existing. The strength of these models lies in their flexibility in explaining the level of

adoption of technology by companies (Grant & Yeo, 2018; Tsou & Hsu, 2015). Furthermore, this study aims to explore the effect of BDA on SMEs.

Moreover, there are many frameworks that explain the adoption of technology. The Technology Acceptance Model (TAM) was originally defined by Davis et al. (1989) to study the reasons for the adoption and use of computer systems. Hence the need to focus our research to understand the degree of acceptance of the technology of Big Data before its use by SMEs according to the framework of the existing literature. To this end, based on the TOE and HOT model, this research aims to propose a model with four dimensions based on the "technology", "environment", "organization" and "human ". Reviewing, previous related studies on SMEs at national level and international, this study selects the most frequently important factors, which have a significant influence on the use of BDA by SMEs.

## II. LITERATURE REVIEW

### Second part: Synthetic analysis of the literature review

In this second part, we define the key concepts of the research (2.1) and then we will present the research methodology (2.2) and we develop the analysis of the review of literature relevant to the research question (2.3).

#### 2.1. Definition of concepts

##### 2.1.1. Big Data Analytics

Big Data Analytics (BDA) refers to the process in which the organization can manage, process and analyze data to improve its performance, so that it becomes a subject emerging and hot for researchers and managers of the last decade (Fosso Wamba et al. 2016).

The rapid development of social networks advanced mobile technologies, websites E-commerce web, search engines and other types of news digital technologies (Surbakti, Wang, Indulska and Sadiq, 2020) led to the rise of comics and BDA. These BDAs offer businesses the ability to generate and capture data characterized by three V's (Volume, Variety and Velocity) (Russom, 2011). The volume makes reference to the large amount of data collected by companies to uncover hidden information and patterns in data and to gain knowledge reviews (Ghasemaghaei, 2020), while the variety represents the different formats of data that their management by the traditional analytical system is complicated. Those data include unstructured, semi-structured and structured data (Mohapatra and Mohanty, 2020), Velocity indicates the speed of real-time data generation and analysis (Kuo, Lin, and Lee, 2018).

##### 2.1.2. The technological, organizational and environmental model: The TOE model

The TOE model was originally introduced by Tornatzky et al. (1990) to understand the important factors impacting the adoption of new technologies in organizations. According to this framework, the adoption of any technological innovation must be predicted from three different perspectives: technology, environment and organization. The model TOE is one of the best-known theories that have been widely used in different studies of the adoption of innovation at the organizational level in different contexts (Baker, 2012). From the perspective of the TOE, the technological factors include the technologies on-site and offsite of a business and include both equipment and process. Point organizational view contains the characteristics, properties and attributes, while the environmental point of view includes the area of operation and the structure of a company (Tornatzky et al., 1990).

##### 2.1.3. The technology acceptance model: the TAM model

The TAM model (David, 1989) has been widely used to examine acceptance by users of various technologies in an organization, such as scheduling enterprise resources (Amoako-Gyampah and Salam, 2004), customer relationship management, cloud computing (Gangwar et al., 2015), Software as a Service (Wu, 2011) and data warehousing (Wixom and Todd, 2005). For a BDA system, the context has its unique characteristics and its use factors must also be taken into account. With the rapid diffusion of BDA techniques, the TAM was used to study the acceptance of the technology.

According to the TAM model, perceived ease of use, perceived usefulness, and intent behavior to use a system are essential to explain the intention behavior to use a computer system. On the one hand, the perceived ease of use refers to the extent to which an individual perceives a particular system effortlessly (Verkasalo, López-

Nicolás, Molina-Castillo, and Bouwman, 2010). On the other hand, the perceived usefulness refers to the degree to which an individual thinks the use of a particular system improve work performance (Huang, Quaddus, Rowe and Lai, 2011). Thereby, behavioral intention to use is a determinant of whether an individual is involved in a certain behavior (Ajzen and Fishbein 1980).

### III. METHODOLOGY

#### Research Methodology

To address our research question, we are conducting a study of the review of existing literature nationally and internationally, at two levels; in the first point, we proceed by analyzing the literature review of different disciplines, to determine the meaning of the three concepts, namely "the BDA", the "TOE model" and the "model TAM"; in the second point, we present the different theories mobilized to identify the determinants of the acceptability and use of new Big Tech Data Analytics by small and medium enterprises.

A literature search was undertaken to identify the determinants of acceptability and the use of Big Data Analytics by SMEs. Like the majority of the literature on the Big Data concerns large companies, the literature relating to SMEs was reviewed. A range of search terms was used, as it was expected that different words could be used to classify determinants, for example they could be classified as factors. The scope of the searches was limited to Big Data or Big Data Analytics, for maintain relevance to the topic. The two main search engines used in the literature review were Scopus and Google Scholar.

#### 3.1. Acceptance of BDA technology by SMEs

The TAM framework has been cited by several authors as one of the most popular theories for explain the use of information systems, and has been extensively studied and validated with a substantial empirical support.

According to Swanson (1982), perceived ease of use and perceived usefulness are factors important for user engagement in system implementation. Several previous studies have expanded the TAM. The TAM (David, 1989) has been used by several previous computational studies investigating behavioral intention and the use of system. It is an adaptation of the reasoning action model theory developed by Fishbein and Ajzen (1997).

In several previous studies, the authors examined a research design extending the TAM which measured implementation using employment factors, BDA dimensions, compatibility, self-efficacy, complexity and anxiety. These studies demonstrate the direct impact of these five factors on perceived usefulness and perceived ease of use, as well as their indirect impact on the intention of SMEs to use BDA tools. There are other studies in the literature that have studied the influence of certain factors on the acceptance of tools data mining. In the study by Esteves and Curto (2013), the decomposition theory behavior planning and the TAM model were used to examine actual adoption BDA technology. For this purpose, the authors have included the dimensions of the BDA, the compatibility, self-efficacy, and facilitation in their model, and also assessed intention to adopt BDA by SMEs using the perception of risks and benefits. In the study by Huang et al. (2011), the intention to use data mining tools has was studied using TAM.

Current research has focused on the TAM, as it helps to understand the relationship between user perceptions of benefits and ease of use of their system(s).

#### 3.2 The determinants of BDA use by SMEs

Much research on technology adoption has been conducted in countless different contexts such as health, business, education and economy. However, "what determines the propensity of an organization to adopt a particular innovation" is a important issue in technology adoption research (Fichman Robert, 1999). Many studies have pointed out that the integration of TOE and HOT theories provides factors better suited to the context of technology adoption in SMEs.

The TOE model covers all internal and external factors that can influence adoption technology by a company. It provides a stronger empirical and theoretical basis and a support for research at the organizational level (Alshamaila et al., 2013). Moreover, the TOE model has been recognized as the most commonly adopted theory of technology used by researchers (Oliveira and Martins, 2011; Hsu et al., 2014). Therefore, the TOE model is the theory most applicable to the context of SMEs, as it offers them insights rich and dynamic (Awa et al., 2015).

Thus, although small and medium-sized enterprises (SMEs) are essential for the economy of a country, they lag far behind in the use of BDA (Coleman et al., 2016). The lack of understanding and limited resources for Big



Data in SMEs is the main barriers to BDA adoption (Coleman et al., 2016; O'Connor and Kelly, 2017; Sen, Ozturk and Vayvay, 2016). Indeed, Maroufkhani, Wagner, Wan Ismail, Baroto and Nourani (2019) have systematically reviewed BDA studies and found that motor studies of BDA adoption by SMEs are rare.

At the same time, the consequences of the adoption of BDA technology by SMEs have been widely explored by researchers like Ainin et al. (2016), Garrison et al. (2015) and Voola et al (2012). Whereas, Diniz et al. (2018) examined the adoption of BDA in Brazilian banks by conducting interviews; and that this study revealed the important role of managers in preparing requirements for adoption and implementation Big Data success stories. Yadegaridehkordi, Hourmand et al. (2018) explored the influence of the adoption of BDAs in manufacturing companies. This study indicated that the technological resources, perceived benefits, quality, integration and complexity of BD are the main drivers of BDA adoption. Thus, the size of the organization, data environment and engagement were identified as predictors of adoption of the BDA in this study. Verma (2017) investigated corporate intent Indian manufacturers to adopt the BDA. All of this research has found that the quality and the benefits of BDA can positively influence its adoption.

By applying the TOE framework and the Analytic Hierarchy Process (AHP) approach, Park et al. (2015) identified and ranked the factors influencing the adoption of BDA by Korean companies.

The results of this study ranked technology as the most important context and perceived benefits as the most important influencing factor.

To understand the factors influencing the adoption of Big Data, Verma et al. (2017) have proposed a TOE model and they conducted interviews with Indian business leaders. They realize that strategic value is the main reason for deciding to adopt Big Data in their organization. Sun et al. (2016) applied the Diffusion Of Innovation integration (DOI), institutional theory and TOE to understand organizational adoption of the BDA. They reviewed related articles and came up with a series of factors of influence and conclusions.

Review of related studies shows that most of the studies on BDA adoption have been conducted in developed countries, such as the United Kingdom (Brock and Khan, 2017), South Korea South (Kang and Kim, 2015; Park et al., 2015) and Spain (Esteves and Curto, 2013). In effect, more research is needed in developing countries. There is no mature theoretical framework to comprehensively consider technical factors, organizational, environmental and human factors that can have a significant impact on the adoption of the BDA by SMEs, especially at the national level.

The HOT theory essentially presents information about the health of the computer system by integrating the "DeLone and McLean IS success model" and the "adjustment model of information technology (IT) organization" (Yusof et al., 2008). The model integrates "people", "organization" and "technology" and aims to improve successful adoption innovation in organizations. HOT is flexible enough to be applied to different contexts, stakeholder perspectives and cycle assessment methodologies life of the system (Ahmadi et al., 2015). This model has been successfully used in different contexts and its use in the adoption literature continues to grow (Lian et al., 2014).

Although the perception of HOT and TOE have similarities, the HOT model covers the perspective human and is not included in the TOE model. At the same time, the TOE framework is more powerful for examining the adoption of technology within a company, as it takes into includes an environmental perspective (Oliveira and Martins, 2011). Therefore, the integration TOE and HOT models develops a comprehensive framework that takes into account all perspectives and is therefore increasingly used for better decision-making in organizations. Meanwhile, the process of adopting an innovation being very complex, a single theory is not enough to explain all aspects of this process (Sun et al., 2016). Indeed, the integration of HOT and TOE is a solid basis for the development of findings in this study.

### **3.2.1 The technological context**

The technological determinants are generally based on the IT infrastructure, the security and privacy, relative advantage, compatibility, complexity, uncertainty and insecurity, testability and observability as well as other technological determinants. As a first step, to take advantage of the benefits of the BDA, to be able to collect, store, manage and analyze data more efficiently, information technology in an organization is important. Without a good IT infrastructure, organizations cannot reap the benefits of Big Data (Demirkan and Delen, 2013).

An important aspect of the BDA trend is the widespread diffusion of systems information, such as enterprise resource planning (ERP), supply chain management procurement (SCM) and customer relationship management (CRM). The use of systems such as ERP combined with BD growth should lead to better take organizational decision by SMEs, thus improving organizational performance (McAfee, 2012). Existing literature suggests that the use of BDA can bring multiple benefits to SMEs. However, obtaining these advantages is not so easy, in reason for the way of data processing.

An important aspect of the BDA trend is the widespread diffusion of systems information such as enterprise resource planning (ERP), supply chain management procurement (SCM) and customer relationship management (CRM). The use of systems such as ERP in combination with BD growth should lead to better grip organizational decision-making of SMEs and therefore to an increase in performance organizational (McAfee, 2012). The existing literature supports that the use of the system BDA offers several advantages to SMEs. However, it is not so easy to get these benefits, which is due to the way the system is used by the organization.

In a second step, effective and efficient DB processing and data analysis post-processing are important (Demirkan and Delen, 2013). Analysis is the generation of knowledge and intelligence needed to support decision-making and goals strategies of SMEs.

### **3.2.2 The organizational context**

Senior management support refers to the extent to which managers have the technical ability to understand and adopt new technological systems (e.g. example, the BDA) (Sanders, 2008). SME decision makers are more likely to be part of the management team, and their support is essential to the adoption of innovation. In fact they are the primary link between individual and organizational adoption of technology, because adoption trends correlate with the level of innovation of executives superiors or leaders. Previous research has shown that the adherence of senior leadership is a key determinant of the successful adoption of innovation (Alshamaila et al., 2013; Chen et al., 2015).

Organizational readiness is the ability and willingness of managers to adopt new technologies (Gangwar, 2018). It represents a company's ability to manage and invest in the adoption of new technologies, including capabilities and expertise computer techniques. In the field of business analysis and BDA, there are consensuses among scholars that organizational readiness is a prerequisite for the implementation of the BDA (Gangwar, 2018).

### **3.2.3 The environmental context**

Environmental factors are external boundary factors to which organizations may face (Xu, Ou and Fan, 2017). In terms of the environment, the companies are often more sensitive to dynamic external ecosystems. Thus, in the TOE model, competitive pressures, external support and regulations governmental represent external factors that generally influence the adoption of the BDA. Based on the definition developed by Chen et al. (2015, p. 18), pressure competitive refers to the "influences of the external environment that motivate organizations to use the BDA". It is the pressure that customers, suppliers and competitors exert on the company.

Some researchers believe that the increasing use of BDA by competitors may motivate SME decision makers to successfully and professionally acquire business information and analysis to maintain a company's competitive position company in the market (Chen et al., 2015; Lauten et al. Bach, Johnston and Adenilan-Ogondipe, 2017).

External support refers to extensive support provided by vendors or third parties to encourage companies to innovate and adopt innovations (Biney, 2019; Gangwar, 2018). It is one of the main drivers of innovation success and can have a positive impact on innovation adoption. Accepting external vendor support is an attribute important to the adoption of BDA, because companies can develop their capabilities innovation by learning from vendors and available open source platforms (Gangwar, 2018).

Additionally, government regulations can be prohibitive, but sometimes these regulations encourage companies to adopt specific types of new technologies (Tornatzky, Fleischer, & Chakrabarti, 1990). Rules and policies government in terms of incentives, technical standards and legislation can increase the adoption of BDA by SMEs (Lai et al., 2018). For example, Hsu, Ray and Li-Hsieh (2014) and Lai et al. (2018) found that firms facing high levels of regulation and government pressure are more likely to adopt this technology. As shown in Table 1 below, each dimension includes its BDA adoption criteria.

**3.2.4 The human context**

The effectiveness of change is "the degree to which members of the organization are psychologically and practically prepared to implement organizational change" (Weiner et al., 2008). The introduction of Big Data has brought new opportunities to organizations, but an organization's human readiness for change is a key factor to get the most out of it (Sun et al., 2016). Obviously, the intentions of managers to innovate significantly trigger beliefs and intentions positive in technology adoption decisions (Petter et al., 2013). In the same time, a favorable organizational climate can motivate employees to try new ideas without fear of being punished for failure (Brock and Khan, 2017). Thus, in the organizations with a high climate of change effectiveness, leaders and employees of the organization can better manage the changes associated with the adoption of the BDA by the SME.

Additionally, the interpretation of IT expertise is that the organization has sufficient staff and IT knowledge and skills to adopt the BDA (Powell and Dent-Micallef, 1997). In general, it is accepted that the availability of a experienced and knowledgeable staff is a key determinant of any innovation adoption. In fact, the lack of sufficiently qualified in-house IT specialists can lead to serious problems and additional costs, as companies have to hire external IT specialists (Maduku et al., 2016). The experience of the IT staff is very valued in BDA adoption studies, including "technology readiness" and "information system competence" (Kang and Kim, 2015; Sun et al., 2016).

**Source:** prepared by us based on the literature review

**TABLE 1:** Criteria and factors affecting the adoption of Big Data Analytics

Factors	Criteria	References
<b>Technological</b>	Complexity, Compatibility, Perceived Benefits Resources, technology, security and confidentiality, testability Observability, Quality and Integration of BDA	(Soon et al., 2016) ; (Park et al., 2015); (Verma et al., 2017); (Sun et al., 2016); (Brock and Khan, 2017); (Shin, 2016) ; (Kang and Kim, 2015) ; (Kwon et al., 2014);
<b>Organizational</b>	Culture organizational, Positive experience with projects IT, management support, Decision-making culture, Effectiveness of change, strategic direction, Organization structure, Size of the company, Resource capacity, human resources, Perceived costs	(Brock et Khan, 2017) (Kwon et al., 2014) (Park et al., 2015) ; (Verma et al., 2017) ; (Sun et al., 2016) ; (Brock et Khan, 2017)
<b>Environmental</b>	Competitive pressure from partners Government support and policy The fashion of SI, Turbulences du market, Institutional trust	(Park et al., 2015); (Verma et al., 2017); (Sun et al., 2016); (Kang and Kim, 2015)
<b>Human</b>	The effectiveness of change The interpretation of the expertise Of computer science	(Weiner et al., 2008) (Sun et al., 2016) (Kang et Kim, 2015) (Powell et Dent-Micallef, 1997)

#### IV. CONCLUSION

As the latest technological innovation, BDA is attracting more and more attention from managers from different industries. While the BDA certainly offers wonderful benefits for organizations, its adoption is still in its early stages and many companies are still not using actively this new technology for their innovations. A limited number of studies have conducted to identify the important factors that influence the adoption of Big Data Analytics by SMEs. Accordingly, based on the TOE and HOT frameworks, this research has explored the key drivers of Big Data Analytics adoption from the perspective of technology, organization, environment and people through a quick reading of existing literature. The results reveal that the TOE and HOT contexts have effect significant positives on the adoption of the BDA by SMEs.

As the BDA is still in the early stages of research in terms of development theoretical, methodological multiplicity and empirical examination, this research provides timely theoretical and methodological contributions that can be used by decision makers in the most effective way. Indeed, future researchers may consider different determinants or technological, organizational, environmental and humans, because the TOE and HOT models are flexible. To do this, researchers can include and exclude elements compatible with the context of their studies while taking into account the determinants of use explored in the literature review and, consequently, this can give more or less different results.

These results help us to open avenues of research on other subjects relating to the use of the BDA by SMEs in industry 4.0, and therefore to link knowledge management to Big Data Analytics Capabilities (BDAC).

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