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The UAE Employees' Perceptions towards Factors for Sustaining Big Data Implementation and Continuous Impact on Their Organization's Performance

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Abstract: The UAE has officially launched the Big Data initiative in the year 2022; however, the interest in and adoption of Big Data technologies and strategies had started much earlier in the private and public sectors. This research aims to explore the perceptions of the UAE employees on factors needed to implement sustainable Big Data and the continuous impact on their organizational performance. A total of 257 employees were randomly selected for an online survey, and data were collected using a Likert-style five-point scale that was tested for validity and reliability. The findings indicate that employees believe that Big Data Sustainable Implementation leads to Business Performance. Additionally, employees consider factors such as Big Data Architecture Quality, Human Cognitive Factors, and Organizational Readiness to significantly impact on Sustainable Implementation. Further, a moderating impact of Human Cognitive Factors was found on the relationship between Big Data Architecture Quality and Sustainable Implementation. The study provides managerial insights and recommendations for policymaking.

Keywords: big data sustainable implementation; critical success factors for big data implementation; success with big data

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1. Introduction

On 25 January 2022, the UAE government launched the "Big Data Sustainable Development" under the UN platform as part of the 2030 Agenda for Sustainable Development [1]. The UN 2030 Agenda for Sustainable Development focuses on goals under the UN Millennium Development Goals [2]. Big Data Sustainable Development is a part of the UAE's national agenda for harnessing the power of Big Data to provide better quality of life and development for its residents [3].

The UAE is, therefore, committed to sustainable development by harnessing the potential of emerging technologies such as Big Data. The role of the government as an active agent in promoting, creating, originating the Industrial 4.0 and Big Data environment and the issues that are related to the data sharing policies and human skills [4]. Smart government initiatives on the smart grid, such as smart transportation, smart health, smart governance, and public safety and security in Dubai, spur various applications leveraging big data analytics [5]. Even though the Big Data initiative is new, a plethora of research work has been conducted to investigate various aspects of Big Data implementation. Predominantly, research is emerging on the challenges, impact, and benefits of Big Data Implementations [6], but very little research has been conducted on the critical success factors for continued success of Big Data in organizations. For example, Big Data Analytics has attracted research interest in analyzing public satisfaction in relation to the service quality. In a similar fashion, a study revealed that perceived usefulness, perceived ease of use, and social influence were the factors that influenced the net benefit which is used to measure the success of implementing big data analytics in the information system [7].

Another study that involved two government agencies in Dubai [1] indicated that the quality of Big Data has a significant impact on the quality in decision making that is based on the information system [8]. Additionally, several other studies had been conducted to address various issues that lead to sustainability of Big Data implementation with respect to economic, environment, social performance [9], sales growth [10], supply chain management [9], and improving the effectiveness of accountants [11].

However, while there has been some research focusing on the investigation of critical factors in implementing Big Data initiatives, there is less evidence of research on the perceptions of employees from the organizations adopting Big Data. Bearing in mind the fact that the UAE government spends 17.32% of the 1.98 billion spent in the MEA [12] on Big Data applications and implementation, it is essential that the sustainability of Big Data Implementation can be studied and evaluated. From the perspective of IT experts, more attention should be devoted to how to manage Big Data solutions after the introduction [13]. The current study is, therefore, aimed to study the critical success factors that enable sustainability for Big Data implementation in the UAE, both in the public and private sector organizations. A recent study has already indicated that in one of the public sector organizations, RTA, the employees are positive towards the implementation of AI and Big Data initiatives [14], and the current study intends to add to the literature in terms of exploring perceptions of the employees regarding the factors that have been considered in implementing Big Data and the sustainable implementation of the programs. By doing this, the study aims to contribute to fill the gap in literature and give insights about employee perceptions about Big Data sustainable implementation and critical success factors. More specifically, the current study aims to answer the following research questions:

i. What are the critical success factors for Big Data sustainable implementation in the public and private sector organizations, as perceived by their employees?
ii. What is the perception of employees towards Big Data sustainable implementation in their organizations?
iii. What is the perception of the employees towards Big Data sustainable implementation's impact on business performance of their organizations?

The following sections present a review of the extant literature, followed by conceptual framework and the development of research hypotheses. This is followed by a section on research methodology, then findings and finally discussion and conclusion.

2. Literature Review

2.1. Critical Success Factors for Big Data Implementation

There has been an increase in the number of studies that evaluate the critical success factors for Big Data implementation; however, most of these studies have looked at factors impacting the initial implementation of Big Data projects. Currently, there is a dearth of evidence focusing on evaluating success factors for continuous usage or expanded usage of Big Data after the initial implementation stage has passed. This limitation is observed in global literature as well, though it is further highlighted in Big Data studies from the UAE. For example, only one conference paper [14] was found that focused on long-term implementation issues of Big Data in a public sector organization in the UAE. Moreover, this study focused only on understanding employees' perceptions on the benefits of Big Data, rather than on evaluating any critical success factors for long-term implementation of Big Data. As such, the current review of the literature on critical success factors is predominantly derived from studies that have evaluated critical success factors related to Big Data initial implementation, though it also contains the review of limited research studies that have dwelled on sustainable implementation of Big Data.

2.1.1. Quality of Big Data Architecture

Long-term sustainable usage and expanded usage of Big Data technology is impacted by its ability to continuously expand in scope and utility, as well as its scalability and interoperability [15]. As Big Data are collected from diverse sources, it becomes essential

that the organization implementing Big Data analytics consistently increases its capacity to collect, collate, store and share data. The quality of big data analytics infrastructure is an essential factor that can help organizations in retrieving, collating and analyzing data coming in from diverse points and in increasingly different formats [16]. This is an essential characteristic for the long-term and continuous success of Big Data projects [16].

Big Data analytics infrastructure is of high quality if it is interoperable, flexible, scalable and compatible to various types and formats of data [17]. Owing to the rapidly changing magnitude and velocity of data generated, the sustainability of Big Data analytics depends upon the system architecture to be scalable in terms of both capturing and modeling and analyzing the data [18]. Some of the challenges listed in the literature about the Big Data implementation include technology challenges, and the ability of the organization to invest in expanding its technological capabilities and to utilize them effectively. For example, large amounts of data that are generated with Big Data require additional storage space and novel database management systems architecture and capabilities, and a new environment that can support the adoption of new technologies [19,20]. In addition to storage space and database management systems, challenges also arise due to the fact that Big Data needs to deal with data and inputs in many different formats, and as such, require the flexibility to capture and analyze all bits of data [21,22].

Research has found that firms that have a flexible Big Data architecture that can be scalable and interoperable, are likely to have a positive impact on their overall performance. For example, according to Wamba et al. [17], organizations that can drive scalability through Big Data are likely to perform well in the long term. Organizational ambidexterity, a term that means that organizations that have the capability to focus on both current and future requirements [23], has been linked with organizational performance [24]. Ambidexterity is driven by Big Data architecture that allows for diverse sources of data to be pooled in, which is flexible and responsive to rapid changes in the business environment [24]. Additional factors listed in literature are data connectivity and data compatibility, which are linked with the ability of the system to pool data and integrate data from diverse platforms.

According to Hung et al. [23], both data connectivity and compatibility have been found to have a positive effect on the active use of Big Data analytics systems. In addition to the aspects of data integrity (which include data timeliness, data readability and data accuracy) adoption and sustainability of Big Data implementation is likely to be high if the users believe that the data that is available to them has been integrated from multiple platforms and can lead to comprehensive decision-making [4,25]. Some of the factors that impact data compatibility are directly related to the increasing variety and volume of data that is collected, as well as the accelerated velocity in which data are being generated and made available. Overall, it can be presumed that Big Data implementation is likely to be impacted by the technical capabilities of the organization in the form of having a flexible and scalable Big Data architecture that allows for not only reliable, credible, and usable data to be collected, but also ensures connectivity. For this, the organization needs to be well connected both internally and externally, so that data can be pooled and shared without technological bottlenecks and lack of connectivity related interruptions [26].

Factors such as interoperability, connectivity, and scalability can be expected to have a consistent impact on Big Data sustainable implementation over a period of time, as new formats of data emerge, and new avenues of data collection and sharing evolve. Taken together, the above research indicates that the quality of Big Data infrastructure continues to be a critical success factor for Big Data sustainable implementation over the long term, though different scholars have defined the quality of Big Data infrastructure differently. The current research would take an eclectic stance and include factors such as scalability, compatibility and connectivity to mean quality of Big Data infrastructure and study the impact on Big Data sustainable implementation.

2.1.2. Organizational Readiness

In addition to the technological factors, Big Data implementation faces challenges in terms of organizational factors. Foremost, while Big Data is increasingly being recognized for its benefits, there is still organizational resistance around the increased scale of data availability and analytics that goes along with Big Data technology. Most organizations continue to struggle with traditional data that is generated and adopting Big Data may appear overwhelming for them [27]. The construct of organizational readiness has been cited in literature as an antecedent factor for Big Data implementation [28]. According to Klievink et al. [28], organizational readiness is an essential aspect involved in sustainable Big Data implementation. Organizational readiness is measured through the uncertainties (or resolution of these uncertainties) in terms of organizations' capability to effectively utilize Big Data.

Organizational readiness is therefore dependent upon organizational alignment with the Big Data strategy, organizational capabilities to effectively use Big Data and organizational maturity level with e-governance. While these factors were studied by Klievink et al. [28] as critical success factors for initial implementation of Big Data, they have the potential to make an impact on the continued success of Big Data implementation [29].

For example, organizational readiness requires organizational strategic alignment with Big Data and IT strategy, which in turn reflects on potential of Big Data toward value creation [20,30,31]. Some of the specific challenges that organizations face in implementation of Big Data are related Big Data Implementation or expected value creation from adoption of Big Data and direct involvement of the top management [20,30]. Other scholars have also found that successful implementation is possible when organizations have a well-defined business goal that is met with Big Data, and when they have systems in place to measure the effectiveness of Big Data in meeting those goals and creating value [31]. In other words, when one of the criteria of organizational readiness, namely organizational alignment with Big Data strategy, is fulfilled. Over a period of time, Big Data strategy still needs to be aligned with the value creation goal of the organization, and as such, it continues to be a factor for long-term sustainable implementation of Big Data.

Organizational readiness also includes organizational capabilities that can be measured in terms of Big Data governance framework [32], ethical and security frameworks [27]. A major challenge arises around the governance of Big Data, to monitor the quality of data that is generated and analyzed, and which can have a substantial impact on the organizational performance [32]. Due to the large volume, velocity, and veracity issues related to data accuracy, organizations need to have a Big Data governance framework in place if they want Big Data implementation to be successful. It is also essential to understand that traditional governance concepts and laws may be redundant in case of Big Data governance and management, simply because Big Data is a transformational technology and warrants novel challenges to be dealt with at unprecedented pace and scales [32]. It is therefore important that Big Data governance frameworks need to be dynamic and have the potential to deal with ever-emerging new challenges related to data usage, storage, data sharing and data management. In addition to the legal and governance framework, Big Data successful implementation is also challenged by ethical issues around privacy, identity protection and security and managing risks associated with handling consumers data and third-party data [27]. These capabilities are required to be consistently present if Big Data implementation is to be made sustainable, and as such, can be considered a critical success factor for Big Data sustainable implementation.

Another organizational capability that seems to determine successful and sustainable implementation of Big Data is availability of trained managers that can use big data analytics effectively and make accurate decisions. In fact, according to Soon, Lee and Boursier [33], one of the biggest barriers to implementing Big Data is the lack of trained technologists that can work with the dynamic environment of big data. According to Adrian et al. [34] and Halaweh and Massry [35], Big Data implementation success depends upon the organization's ability to hire and retain data scientists and trained IT professionals with

specialization in Big Data technologies. Several researchers have found that organizations face a serious challenge to Big Data implementation sustainability in terms of not being able to acquire Big Data trained employees with the critical skills to manage and operate the new technology [33]. There appears to be a shortage of skilled workers who have the Big Data expertise [33] in the form of domain knowledge as well as industry knowledge [18]. Organizations need to continuously plan and manage a trained workforce that can handle its Big Data technologies, and as such, this capability too can be considered a critical success factor for sustainable implementation of Big Data.

Finally, according to [28], organizational readiness as reflected by the e-governance maturity level of an organization also impacts Big Data implementation. E-governance maturity level is indicative of several organizational factors including flexible organizational structure and communication channels that allow for the governmental organization to use emerging technologies in coordination with other public organizations to deliver customized and on-demand services to customers [31]. While not explicitly mentioned in literature as a critical success factor for Big Data implementation sustainability, it can be presumed that organizations that allow for flexibility of communications and decision-making are likely to be more successful and sustainable in managing their Big Data projects. According to Saltz and Shamshurin [31], using Big Data analytics requires having a dynamic environment and rapid decision making, which calls for teamwork and multiple channels of communications and decision making to allow making real-time changes to data analysis to ensure quality outcomes. Organizational maturity with e-governance, therefore, needs to be consistently improved if Big Data sustainable implementation is to be achieved.

In summary, it can be said that the above research suggests that Big Data sustainable implementation is linked with organizational readiness. Factors such as alignment of the organization's strategic goals with Big Data strategy, organization's e-governance maturity level, and organizational capabilities related to Big Data governance, and developing Big Data experts are some of the factors included within OR.

2.1.3. Personal Factors

Other research suggests that personality factors such as openness to novelty and rational thinking impacts Big Data implementation [23]. According to Teo et al. [36], openness to novelty is a critical factor that impacts the amount of attention that decision-makers give to new technologies and can lead to a lack of sustainable implementation. People who have a high level of openness to novelty are likely to be more aware of the benefits of using Big Data, and commit more time and energy in learning, adopting and using the new technology. In addition to the attribute of openness to novelty, research has also found that people who adopt an experiential style of cognitive thinking are likely to embrace and adapt to the needs of the new technology, as opposed to those with a rational style of thinking [23].

Hung et al. [23] have suggested an explanation to this counterintuitive finding. According to Hung et al. [23], rational thinkers are likely to use logic and analyze the benefits of Big Data in a systematic manner, but as they may not have the capabilities to conduct such an analysis in a comprehensive manner, they may end up rejecting the new technology. On the other hand, experiential thinkers are likely to be more motivated and influenced by the visionary benefits offered by Big Data technology, and hence, may be able to adopt and implement it in a more sustainable manner. While there is no study that has specifically linked comprehensive personality or cognitive factors with Big Data adoption and sustainable implementation, both TAM (Technology Adoption Model) and TOE (Technology, Organization, and Environment Framework) underscore the importance of psychological factors as crucial to technology implementation [18]. Moreover, there is a case to be made for people factor to have a continuous influence on Big Data usage or resistance to use, and as such, is considered a critical factor for long-term sustainability of Big Data implementation.

2.2. Sustainable Implementation of Big Data—Meaning and Measurement

Sustainable implementation of technology, especially emerging technologies such as Big Data analytics, is difficult to evaluate or ascertain as deployment of the technology is still in its nascent stages. Additionally, its success and failure outcomes are yet not adequately assessed by most organizations [37]. However, using the literature on successful change management and technology adoption models, it can be justifiably presumed that sustainable implementation of Big Data technologies can be assessed in the form of continued, and increasing use of the new technology within the organization [38,39]. Previous studies have used TAM model to evaluate the adoption of Big Data [33], and though TAM, TOE and UTAUT (Unified Theory of Acceptance and Use of Technology) models provide a useful guidance on adoption, but almost all of the studies and theories agree on the construct of enhanced usage or sustainable usage of Big Data technologies to mean sustainable implementation.

2.3. Sustainable Implementation of Big Data and Business Performance

Although some data suggests an association between Big Data implementation and performance outcomes [38], there is much less research available on how business performance outcomes can be made sustainable with adoption and usage of Big Data. For example, business performance improvement is an area of research that has received considerable attention, where researchers are reporting an enhancement of business performance from across the sectors and across the globe after Big Data implementation [37,38,40–42]. However, the role of business performance outcomes that are sustainable with long-term implementation of Big Data, have yet not been studied, though the reason could be the fairly nascent introduction of Big Data in business. Nevertheless, it can be presumed based on the trends observed in literature on Big Data and business performance, that sustainable Big Data implementation leads to sustainable business performance.

2.4. Sustainable Implementation of Big Data and 2030 Agenda for Sustainable Development

The UN 2030 Agenda for Sustainable Development relies substantially on digital transformation and Industry 4.0, and Big Data is an essential technology that enables this. In order to meet its aspirations of complete health and hygiene, zero food wastage, clean energy for all, and sustainable development of industries and diverse sectors, the UAE government is focusing on reliable sources of relevant data and Big Data is increasingly becoming part of the government-led organizations in the UAE [3].

3. Conceptual Framework and Hypotheses

The critical success factors for Big Data success have been identified at various past research, as discussed in the literature review above. However, a comprehensive model of assessing these factors over the longer term to gauge the sustainability of Big Data Implementation is not available, though guidance can still be drawn from the theoretical models of TAM, TOE, and UTAT. However, the theoretical models are overly dependent upon the perceptions of people about the usefulness, benefits, risks, ease of use or quality of new technology available to them and maybe there is a lack of objective evaluation of the situation from the technical and organizational perspectives. Additionally, another limitation of the above models is that they predominantly guide the assessment of initial adoption of new technology, rather than provide a framework to assess the sustainability of implementation of the technology. On the other hand, some scholars have found it more useful to take the organizational maturity models as the theoretical framework. For example, Klievink et al. [28] employ constructs such as organizational readiness, which, while focusing on organizational technological capabilities, organizational e-governance maturity levels, along with organizational IT strategy alignment with business goals. However, Klievink et al. [28] fall short of focusing on people related factors that have been found essential in Big Data implementation by other scholars [23,36].

As such, the current study develops a more eclectic theoretical framework for studying the independent factors that impact on long-term sustainability of Big Data implementation. Since, most studied critical success factors that relate to success of Big Data implementation are categorized around three broad areas—technological factors, organizational factors and people factors, the current research, too, conceptualizes a model with these three broad factors as the independent influencers of Big Data sustainable implementation.

More specifically, the technological factors are derived from the work of Wamba et al. [17], where factors such as Big Data Infrastructure quality is considered to be high if it is interoperable, scalable. Additionally, from the work of both Wamba et al. [17] and Hung et al. [23] where the quality of Big Data architecture is found to be linked with its being adaptable or compatible to various types of data [17,23]. Additionally, the work of Comuzzi and Patel [19] and Eybers and Hattingh [20] indicated additional factors linked to the overall construct of Big Data quality architecture and included technological factors such as storage systems and database management systems that were connected across the organizational stakeholders and suitable for handling the volume, velocity, variety and the changing dynamics of Big Data analytics systems.

We therefore suggest the following hypothesis based on the above research:

H1. *Big Data Infrastructure Quality positively and significantly impacts on the long-term sustainable implementation of big data applications.*

The current study evaluates the perceptions of the UAE employees toward Big Data infrastructure quality, by using the items on scalability [43], compatibility [25] and connectivity [26] of Big Data architecture employed by the organization (see Table 1).

Table 1. Measures used in the Survey.

Construct	Items	Author
Big Data Architecture Quality (BDAQ)		
Big Data Scalability	1. The Big Data analytics system is able to support very large datasets created now and in the future. 2. All the components in Big Data systems are capable of scaling to address the ever-growing size of complex datasets.	Hu et al. [43]
Big Data Infrastructure Compatibility	1. Big data analytics systems effectively integrate data from different areas of the company. 2. Big data analytics systems pull together information that comes from different places in the company. 3. Big data analytics systems effectively combine data from different areas of the company	Nelson et al. [25]
Big Data Infrastructure Connectivity	1. Compared to rivals within our industry, our organization has the foremost available big data analytics systems and connections. 2. All remote, branch, and mobile offices are connected to the central office. 3. Our organization utilizes open systems network mechanisms to boost connectivity. 4. There are very few identifiable communications bottlenecks within our organization	Kim et al. [26]

Table 1. *Cont.*

Construct	Items	Author
Organizational Readiness (OR)		
Organizational Alignment of Value Creation Goal with Big Data Strategy	1. The use of big data analytics systems is aligned with our company's business objectives. 2. The use of big data analytics systems fits our company's organizational culture. 3. Overall, it is easy to integrate big data analytics systems into our company's business process.	Chen et al. [30]
Organizational e-governance maturity	1. Activities and information are organized centrally and made available to all relevant organizations and stakeholders 2. Centrally built IT facilities support all information and applications and fully accessible to all involved stakeholders 3. Collection, combination and analysis of large, complex datasets with unconventional technologies to create new knowledge for the organization is done successfully	Klievink et al. [28]
Organizational Capabilities such as Big Data Governance Framework and Availability of trained Data Scientists	1. Capability to design and develop IT strategy, decision-making and responsibility structures, supporting the organization, including integration of new IT systems is done effectively 2. Capability to design and develop a compliance strategy including process design, monitoring and redesign of processes, especially regarding privacy protection, security and data ownership regulations 3. My organization has the capability to design and develop a data strategy including collection, acquisition, quality control and data partnerships 4. My organization has highly skilled Data Scientists with Domain and Industry Knowledge 5. My organization provides regular training and development for its Data Scientists	Klievink et al. [28] Soon, Lee and Boursier [33]; Gao et al. [18] and Adrian et al. [34]
Human Cognitive Factors (HCF)		
Openness to Novelty	1. I like to investigate different ways of using big data analytics. 2. I like to figure out different ways of using big data analytics 3. I am very curious about different ways of using big data analytics	Thatcher et al. [44]
Cognitive Thinking Style	1. I try to avoid situations that require thinking in-depth about something. 2. I prefer to do something that challenges my thinking abilities rather than something that requires little thought. 3. I do not like to have to do a lot of thinking. 4. I prefer complex to simple problems. Thinking long and hard about something gives me little satisfaction.	Epstein et al. [45]

Table 1. *Cont.*

Construct	Items	Author
Big Data Sustainable Implementation (SI)		
	1. Big Data analytics systems used daily and with almost all processes involved in the organization 2. I spend considerable time using big data analytics systems weekly	Urbach et al. [39]
Business Performance (BP)		
	1. My organization has achieved its revenue maximization goal 2. My organization has been successful in delivering customer happiness 3. My organization has been successful in developing happy employees	Akhtar et al. [37]; Popovič et al. [41]; Spiess et al. [42]; Akter et al. [40]; Sardi et al. [38]

Next, organizational readiness is a latent construct that includes factors such as organizational alignment, organizational maturity and organizational capabilities. The works of Klievink et al. [28] and Chen et al. [30] that present organizational readiness as a factor impacting Big Data implementation, through organizational value creation alignment with Big Data strategy, organizational e-governance maturity level, and organizational capabilities such as Big Data governance framework and Big Data expertise are used. Additionally, organizational capability is expanded through the works of Soon, Lee and Boursier [33], Gao, Koronios and Selle [18] and Adrian et al. [34], who have found linkages between organizational capability of having skilled data experts with the organization as a critical success factor for Big Data Implementation. Based on this literature, the following hypothesis is suggested:

H2. *Organizational readiness positively and significantly impacts on the long-term sustainable implementation of big data applications.*

The current study evaluates the perceptions of employees toward their company's readiness, which is measured by using items on organizational alignment with Big Data Strategy [30], e-governance maturity level [28], and organizational capabilities Klievink et al. [28], see Table 1.

Additionally, personal factors such as openness to novelty and an experiential style of thinking have also been found to have a positive impact on the long-term sustainable implementation of big data applications. As such, the following hypotheses are proposed:

H3. *Human Cognitive factors positively and significantly impact the long-term sustainable implementation of big data applications.*

The current study evaluates the perceptions of employees about their cognitive styles which is measured by using items on organizational alignment with Big Data Strategy [30], e-governance maturity level [28], and organizational capabilities [28], see Table 1.

Additionally, the research also hypothesized that the Humans' cognitive styles may be having a moderating impact on the effectiveness of other factors such as quality of infrastructure, organizational readiness, and long-term sustainable implementation of Big Data.

H4a. *Human Cognitive factors positively and significantly moderate the relationship between Quality of Big Data infrastructure and long-term sustainable implementation of big data applications.*

H4b. *Human Cognitive factors positively and significantly moderate the relationship between Organizational Readiness and long-term sustainable implementation of big data applications.*

It is also essential to note that Big Data implementation sustainability is a construct that is reflective of consistent and expanding usage of Big Data in organizations [39]. As such, the current study measures sustainable implementation of Big Data using the construct developed by Urbach et al. [39], on usage of Big Data technology, (see Table 1). This will be the dependent variable for the current study and will be used to measure the UAE employees' perceptions toward the sustainable implementation of Big Data. In addition, the employee's perceptions towards their company's Business performance will also be assessed in order to test the following hypothesis:

H5. *Sustainable implementation of Big Data positively and significantly impacts business performance.*

Business performance is assessed through employees' perceptions about their company's performance on revenue enhancement, customer satisfaction and employee satisfaction, which are the performance indicators used to evaluate performance [37,38,40–42], see Table 1.

The following Figure 1 shows the conceptual framework of the research:

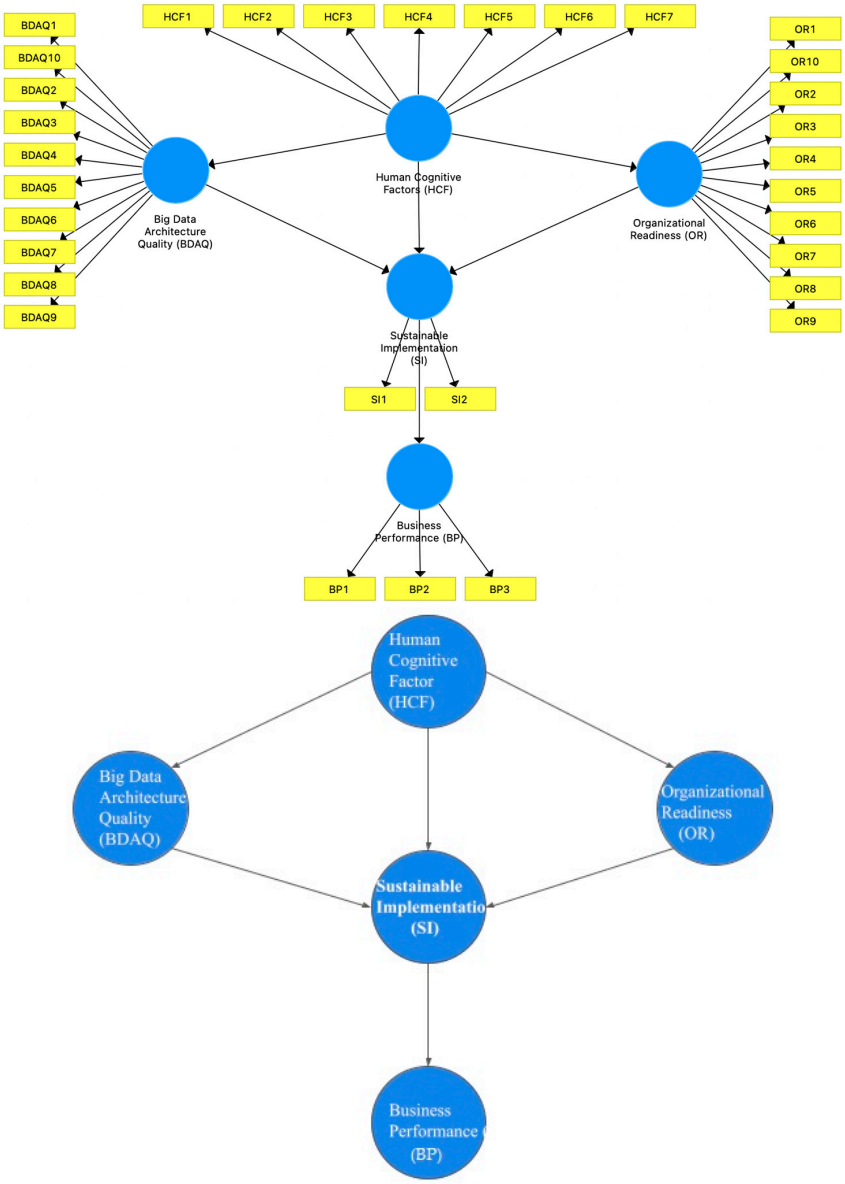

Figure 1. Conceptual Framework.

Latent Variable 1 =BDAQ—Big Data Architecture Quality (IV)
Latent Variable 2 = OR—Organizational Readiness (IV)
Latent Variable 5 = HCF—Human Cognitive Factors (IV/Moderator)
Latent Variable 3 = SI—Sustainable Implementation of Big Data (DV)
Latent Variable 4 = BP—Business Performance (DV)

4. Research Methodology

4.1. Research Paradigm and Approach

The aim of the research is to understand the perceptions of the employees in an objective manner about critical success factors in sustainable implementation of Big Data, using validated standardized measures. The research adopts a positivist paradigm. A positivist paradigm allows for objective, context-free, and non-value laden collection of data that can be statistically analyzed to test hypotheses [46]. The positivistic approach is, therefore, best suited with quantitative methods of data collection such as survey instruments [47]. The current study uses a survey derived from an eclectic mix of different standardized instruments used by scholars to measure specific variables, as discussed below.

4.2. Measures and Survey Questionnaire

4.2.1. Measures

The following Table 1 gives an overview of the questions included in the research and the works of other scholars that were used as guidance for the development of the items. As can be seen in Table 1, the different variables used in this study are measured using validated scales employed by previous researchers to study the individual constructs. This eclectic approach has been suggested as an acceptable approach to scale development for organizational studies [48]. Additionally, the reliability and validity of the final scale were tested using Cronbach's Alpha and Discriminant Validity measures as discussed further in Section 5 (Findings).

4.2.2. Survey Questionnaire

The survey consisted of 5-point Likert-style questions that gave the respondent a choice on a scale of 1 to 5. The first part of the questionnaire requested demographic data, and the second part asked questions that were used for testing the research hypothesis.

4.3. Data Analysis

The collected data were analyzed using SMART-PLS (SmartPLS GmbH, Oststeinbek, Germany), to develop construct validity and reliability and test the hypotheses. We adopted the standard alpha significance level of $p < 0.05$ for statistical significance.

4.4. Sampling and Data Collection

Data were collected from employees from both the private and the public sector organizations in the UAE. The sampling was judgmental, rather than random, as permissions would be needed from the organizations to allow employee participation in the research. The researchers contacted 15 organizations in the UAE, and received a positive response from 8, and the survey was distributed in these 8 organizations, leading to a collection of 250 responses to date. The data collection was done through questionnaires that could be either filled online or on hard copy.

5. Findings

5.1. Reliability and Validity

5.1.1. Cronbach's Alpha

Cronbach's Alpha is a measure of internal consistency, and it measures scale reliability. It is used to determine if the items used to measure a construct are closely related and if

they can consistently measure that construct [47]. Acceptable values of Cronbach's Alpha are between 0.70 and 0.95 as shown in Table 2.

Table 2. Cronbach's Alpha scores for independent and dependent variables.

Type	Factors	Cronbach's Alpha
IV	Big Data Architecture Quality of (QBDA)	0.905
IV	Organizational Readiness (OR)	0.871
IV and Moderator	Human Cognitive Factors (HCF)	0.905
DV	Sustainable Implementation of BD (SI)	0.778
DV	Business Performance (BP)	0.799

Note: The scores for the Cronbach Alpha calculations indicate that they were over 0.7 for all variables. These findings establish that the items used to measure individual factors were reliable and consistent in measuring that factor.

5.1.2. Discriminant Validity

Discriminant Validity is a test to show that the different variables used in the study are not related to each other and are measuring unique constructs [47]. A discriminant validity score of less than 0.7 is considered acceptable.

Table 3 shows that the discriminant validity is less than 0.7, thus it can be assumed that the variables used in the study were different from each other and measured distinct concepts.

Table 3. Discriminant Validity Scores for independent and dependent variables.

	BD Architecture Quality (BDAQ)	Organizational Readiness (OR)	Human Cognitive Factors (HCF)	Sustainable Implementation of BD (SI)	Business Performance (BP)
BD Architecture Quality (BDAQ)	-				
Organizational Readiness (OR)	0.302				
Human Cognitive Factors (HCF)	0.291	0.196			
Sustainable Implementation of BD (SI)	0.18	0.279	0.511		
Business Performance (BP)	0.253	0.224	0.247	0.336	

5.2. Hypothesis Testing

5.2.1. Independent Variables' Impact on Dependent Variables

Table 4 shows the results of the Path Coefficient Analysis for the first three Hypotheses:

Table 4. Path Coefficient Analysis.

	Original Sample (O)	Sample Mean (M)	Standard Deviation	T-Statistics	*p*-Value
BD Architecture Quality (BDAQ) on Sustainable Implementation	0.247	0.273	0.092	2.686	0.007
Organizational Readiness (OR) on Sustainable Implementation	0.376	0.211	0.036	1.945	0.036
Human Cognitive Factors (HCF) on Sustainable Implementation	0.13	0.198	0.013	2.233	0.016
Sustainable Implementation on Business Performance	0.57	0.211	0.029	1.897	0.008

The above findings highlight that for the relationship between QBDA and SI, the *t*-statistics is 2.686 which is greater than 1.96, and *p*-value is 0.007, which is less than $p = 0.005$. As such, the following H1 is accepted:

H1. *Big Data Infrastructure Quality positively and significantly impacts on the long-term sustainable implementation of big data applications.*

The above findings highlight that for the relationship between OR and SI, the *t*-statistics is 1.945 which is slightly less than 1.96, but noticing that the *p*-value is 0.036, which is less than $p = 0.005$, the following H2 is accepted:

H2. *Organizational readiness positively and significantly impacts on the long-term sustainable implementation of big data applications.*

Next, Table 4 highlights that for the relationship between ECF and SI, the t-statistics is 2.233 which is greater than 1.96, and *p*-value is 0.016, which is less than $p = 0.05$. As such, the following H3 is accepted:

H3. *Human Cognitive factors positively and significantly impact the long-term sustainable implementation of big data applications.*

The above findings highlight that for the relationship between Sustainable Implementation and Business Performance, the *t*-statistics is 1.897 which is less than 1.96, but *p*-value is 0.008, which is less than $p = 0.005$. As such, the following H5 is accepted:

H5. *Sustainable implementation of Big Data positively and significantly impacts Business Performance.*

5.2.2. Moderating Relationships

The moderator relationships are tested using the Product Indicator Method. Table 5 highlights the impact of Human Cognitive Factors on the relationship between Quality of Big Data Infrastructure and Long-Term Sustainable Implementation of big data applications.

Table 5. Moderating Impact of ECF on the Relationship b/w QBDA and SI.

	Original Sample (O)	Sample Mean (M)	Standard Deviation	T-Statistics	*p*-Value
Moderating Effect 1	0.14	0.177	0.009	1.998	0.09
BD Architecture Quality (BDAQ) and Sustainable Implementation	0.247	0.273	0.092	2.686	0.007
Human Cognitive Factors (HCF)—Sustainable Implementation	0.13	0.198	0.013	2.233	0.016

The moderating effect calculations show a positive impact as the *p*-value is less than $p = 0.05$ in Table 5. As such, the following H4a is accepted:

H4a. *Human Cognitive factors positively and significantly moderate the relationship between Quality of Big Data infrastructure and long-term sustainable implementation of big data applications.*

Next, the moderating impact of ECF on the relationship between Organizational Readiness and Sustainable Implementation was calculated (Table 6).

Table 6. Moderating Impact of ECF on the Relationship b/w OR and SI.

	Original Sample (O)	Sample Mean (M)	Standard Deviation	T-Statistics	*p*-Value
Moderating Effect 2	0.14	0.177	0.009	1.018	0.06
Organizational Readiness (OR)—Sustainable Implementation	0.376	0.211	0.036	1.925	0.036
Human Cognitive Factors (HCF)—Sustainable Implementation	0.13	0.198	0.013	2.233	0.016

The moderating effect calculations show an insignificant impact as the *p value* is only slightly less than $p = 0.05$ in Table 6, and the t-statistics is also less than 1.96. As such, the following hypothesis H4b cannot be accepted.

H4b. *Human Cognitive factors positively and significantly moderate the relationship between Organizational Readiness and long-term sustainable implementation of big data applications.*

5.2.3. Perceptions of Employees on Sustainable Implementation in Their Organizations

Figure 2 shows that a majority of UAE employees (58.8%) believed (strongly agreed or agreed) that their organization has successfully and sustainably implemented Big Data:

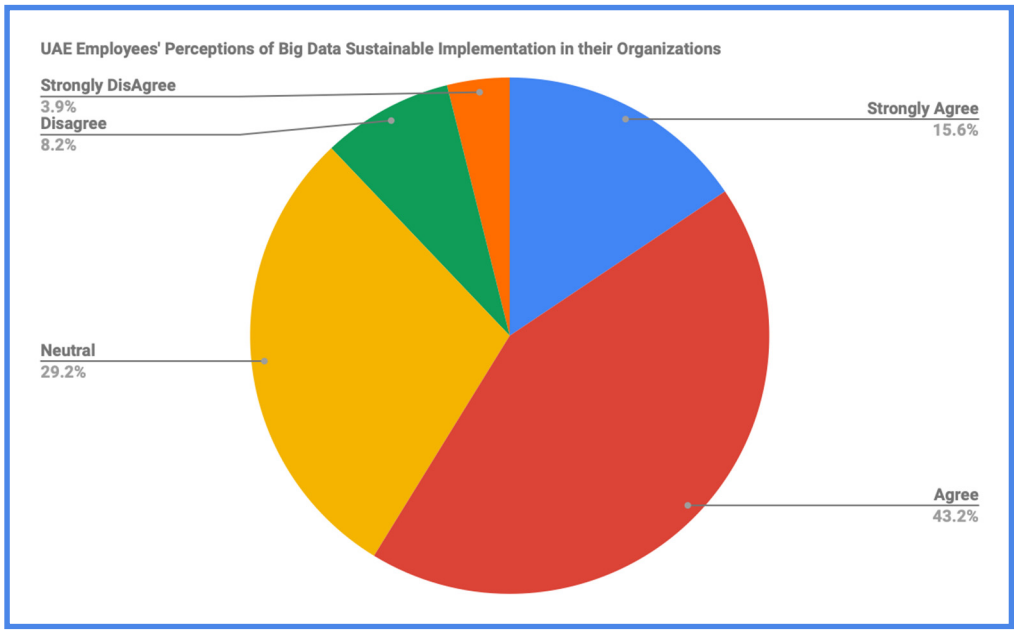

Figure 2. UAE Employees' Perceptions of Big Data Sustainable Implementation in their Organizations.

This finding indicates the perceptions of the employees around the success of Big Data Implementation in their organizations, and as such, also reveals that there may be scope for creating further awareness and involvement of employees (as nearly 41% either thought the implementation was not sustainable or refrained from commenting).

6. Discussion

UAE Employees' Perceptions of Factors Essential for Big Data Sustainable Implementation

The research findings largely conform with the existing literature on Big Data Implementation and expand it to include the perspectives of the UAE employees. As such it fills a gap in knowledge as most previous research has been undertaken in the context of Western organizations, and from the perspective of the IT managers or the organizational leaders.

The current study found that QBDA impacts directly and significantly on SI, aligning with previous literature [4,16,18,23,25]. However, it should be noted that the current study did not explore how well the organization was internally connected that allowed for sharing of the data from different parts, which is a prominent factor underscored by [26] in Big Data sustainable implementation. The current research has nevertheless established that the employees in the UAE organizations consider BD Architecture Quality (BDAQ) to be of essential importance to the sustainable implementation and consistent usage of the Big Data systems.

Next, the current study found that organizational readiness, too, has a direct and significant impact on Big Data implementation in the UAE organizations as per the employees' perceptions. OA has been linked with Big Data implementation in numerous studies, for example, by Klievink et al. [28], Chen et al. [30], Eybers et al [20], and Saltz and Shamshurin [31]. However, it needs to be noted that organizational readiness is a construct that is largely determined by the top managements' policies on IT and their strategic outlook, the employees' perceptions may only provide a cursory insight into the organizational readiness of their organization. Additionally, OA includes concepts such as data privacy and data storage regulations [32] and ethical and security frameworks [27], which may not be fully and transparently available to all respondents. However, since the study focused on evaluating their perceptions, their opinions can be considered valid and accurate to the best of their knowledge. Additionally, with the employee perception that

OA significantly impacts on SI of Big Data, it is likely that the top leadership would take cognizant of the fact and focus on aligning their strategies with IT and Big data strategy in future.

Next, the study also found a direct and significant impact of Human Cognitive Factors on Big Data Sustainable Implementation, as well as a moderating impact of HCF on the relationship between QBDA and Big Data Sustainable Implementation—these results highlight the significance of human factors. Personal factors have already been linked with sustainable implementation of Big Data as reported by Hung et al. [23], Teo et al. [36] and Gao, Koronios and Selle [18]. However, most of the previous research has been focused on assessing the impact of personal factors such as the employees' abilities, attitudes, intentions, resistance, and expectations, or their external supporting factors or barriers. There is only little research that is recently emerging that focuses on the employees' cognitive factors and their approach to the problem [44,45], and the current research fills this gap. These findings suggest that employees who adopt a more curious approach to things, who indulge in deep-thinking, and who cherish complex problems are likely to be more forthcoming when it comes to embracing Big Data in a sustainable manner.

The research also found that according to the UAE employees, Sustainable Implementation of Big Data directly and significantly contributed to the Business Performance. This is an important finding, as it indicates that the UAE employees are aware of the impact of sustainable implementation of Big Data, and as such, they are likely to be committed to making the Big Data implementation sustainable in their organizations. While the linkages between Big Data implementation and performance outcomes have already been explored [37,38,40–42], most of this research has reported the perceptions of IT experts or top leaders in organizations. By portraying the perceptions of the UAE employees, the current study fills a gap in literature and provides insights about harnessing the employees' commitment toward Big Data implementation. Finally, research also provided evidence that the majority of the UAE employees perceived that their organization has successfully implemented Big Data.

7. Conclusions

7.1. Summary of Research

The research successfully answered all the research questions. It reported QBDA, OR, and HCF as critical success factors for Big Data sustainable implementation in the UAE Public and Private sector organizations. Additionally, it underscored the key role played by HCF in moderating the relationship between QBDA and Sustainable Implementation of Big Data. The research also found that 58.8% of the respondents believed that Big Data was sustainably implemented in their organizations. Finally, the research also found that the UAE employees believed that Big Data sustainable implementation had a direct and positive impact on business performance of their organizations.

7.2. Theoretical and Practical Implications

7.2.1. Theoretical Implications

The research on Big Data implementation is rare in the UAE. This is due to both the nascent nature of Big Data projects and the fact that most Big Data initiatives are top driven, which implies that there is less focus on collecting ground level feedback and progress reports. The current study adds to the literature on Big Data implementation significantly, by using the perspectives of the UAE employees, who are the ground-level operatives in any Big Data implementation projects, and hence essential, credible and relevant stakeholders. Future research should explore the constructs of QBDA, OR, and HCF in more depth in the specific context of the UAE, and thus lead to theory building.

7.2.2. Practical Implications

The current research has practical strategic and managerial implications, as it indicates the importance of QBDA, OR, and HCF in Big Data sustainable implementation in the UAE.

Hence, it can both inform and encourage the top management in the UAE organizations to further focus on these crucial key factors. By presenting the perceptions of the employees, the research provides the top-leadership with usable insights that they can base their future actions upon.

7.3. Original Value

The paper is one of the first to focus on the employees' perceptions and as such it fills an important gap in the literature and presents the understanding of Big Data Sustainable Implementation from a unique paradigm of the employees. Since most large and transformative projects are undertaken in a top-down approach in governmental organizations, the perceptions of employees are not taken into account, which is an omission that may be potentially leading to problems in implementation as well as sustainability of Big Data projects. The current research provides original value and inspires a new research direction.

7.4. Research Limitations and Recommendations for Future

The current research did not compare and contrast the perceptions of employees from the private and the public sector organizations, and it is possible to gain more in-depth insights on the subject by doing such a comparison. As such, any future research is recommended to take this approach.

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