“Developing countries organizations’ readiness for Big Data analytics”

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Developing countries organizations' readiness for Big Data analytics

Abstract

Regardless of the nature, size, or business sector, organizations are now collecting burgeoning various volumes of data in different formats. As much as voluminous data are necessary for organizations to draw good insights needed for making informed decisions, traditional architectures and existing infrastructures are limited in delivering fast analytical processing needed for these Big Data. For success organizations need to apply technologies and methods that could empower them to cost effectively analyze these Big Data. However, many organizations in developing countries are constrained with limited access to technology, finances, infrastructure and skilled manpower. Yet, for productive use of these technologies and methods needed for Big Data analytics, both the organizations and their workforce need to be prepared. The major objective for this study was to investigate developing countries organizations' readiness for Big Data analytics. Data for the study were collected from a public sector in South Africa and analyzed quantitatively. Results indicated that scalability, ICT infrastructure, top management support, organization size, financial resources, culture, employees' e-skills, organization's customers' and vendors are significant factors for organizations' readiness for Big Data analytics. Likewise strategies, security and competitive pressure were found not to be significant. This study contributes to the scanty literature of Big Data analytics by providing empirical evidence of the factors that need attention when organizations are preparing for Big Data analytics.

Keywords: Big Data, Big Data analytics, organizational readiness for Big Data analytics, organizations in developing countries.
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Introduction

In today's competitive business environment, organizations are striving to move past the limits of spreadsheets and ineffective business intelligence reporting so as to achieve a wider and more personalized experience with data. Organizations today are constantly receiving and sending out data in different formats, at various speeds and using different media and technology. Thus, we have seen organization growing rapidly both internally and externally, hence, joining the data economy. This growth is foretelling an industrial revolution that is driven by highly accurate, real-time analysis, alerts actions, where data are processed instantly and transmitted leaving only the models and algorithms to be stored. Hence, an organization's potential to analyze these different forms of voluminous data is paramount and readiness for these analytics is now at centre stage.

Michael and Miller (2013) note that the dramatic growth of data within organizations continues to overpower the traditional analytic tools and requires software vendors to offer new data analytical solutions to handle the massive volumes of data, which are also known as Big Data. The Big Data concept may be looked at as the formation of datasets that continuously expand so much that it becomes challenging to manage using existing database management concepts and tools (Singh & Singh, 2012). Big Data is that amount of data just beyond technology's ability to process, manage and store efficiently (Kaisler, Armour, Espinosa & Money, 2013). Notwithstanding the data volumes, good analysis of Big Data could help an organization to gain insights and make better decisions, hence, achieving a competitive edge on the global market (Forbes Insights, 2015).

According to Forbes Insights (2015), the massive increase in scale of organizational data could be attributed to a number of reasons including cost pressures, consolidation of data centres as an effort to do away with distributed IT infrastructure, migrating and deployment in the cloud environment, as well as exponential growth in machine and user-generated data. From this perspective, it could be concluded that the amount of generated data is increasing as the data objects become bigger. Such an enormous amount of scale pressure on existing infrastructures, especially the storage platform is increasingly causing Big Data challenges (Forbes Insights, 2015). As a result, many organizations strive to find the best way to enhance the traditional data analytics to counteract the Big Data challenges, as well as remaining competitive in the business arena (Kaisler et al., 2013). This implies that many Big Data analytics efforts tend to abandon existing solutions in favor of something new, yet, the adoption of the new techniques has also to leverage the existing infrastructure.

Ferguson (2012) noted that, for many years, organizations have been building data warehouses to create insights for decision makers to act on improving business performance and to study their activities.

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He noted that these traditional analytical systems capture, clean, transform and integrate data from several operational systems before loading them into a data warehouse. However, he argues that even though these traditional environments continue to advance, many new more complex types of data have now emerged into what businesses ought to use in order to analyze and build on what they already know. Additionally, Michael & Miller (2013), Wielki (2013) observed that due to increasing use of technology in all business units, new data are being created and generated at high speed in organizations and end up outclassing the traditional analytics techniques and tools. This implies that to leverage on these Big Data, organizations need to improvize means that will lead to change of skills, leadership, structures, technologies and architectures, hence, calling for readiness to change.

Michael & Miller (2013), Wielki (2013) have also noted that despite all the buzz surrounding Big Data, organizations continue to generate data from variety of sources. Singh and Singh (2012) also noted that in organizations that leverage IT, data are now coming from various sources and in different formats making such organizations to be data rich, but knowledge poor. However, it is important to note that data by themselves have no value unless it has been processed and used for business purposes hence Big Data analytics becomes mandatory. Hence, Big Data analytics has become a top priority for many organizations as they expect to derive intuitions from the analyzed data to improve productivity, enhance the customer experience, reduce churn, cut costs, as well as seizing new business opportunities.

Good and well planned Big Data analytics presents various opportunities to organizations and these benefits are well documented. However, like any new technological innovations, heterogeneous challenges may impede organizations from realizing the full benefits of Big Data (Michael & Miller, 2013). Using and analyzing Big Data may involve many new techniques and technologies needed for working with unstructured data, streaming data, social data, machine data that may not be available in organizations. More still, selecting a better approach for Big Data that could arise from the increased number of users with different needs may also be a challenge (Singh & Singh, 2012). On the other hand, the growth of data from various sources may also cause its extraction to be challenging keeping in mind the ever stretched IT departments within organizations (Ferguson, 2012). Such challenges may easily be encountered by organizations in developed world, but could be a big dilemma to those in developing countries with limited technological expertise and infrastructure.

In many situations, the increase in the volumes of data being handled by an organization may imply a change in the technology needed to handle, access and process these voluminous data. More still, the methods of analysis may also change (Kaisler et al., 2013; Forbes Insights, 2015). These changes could be strenuous to the already IT constrained organizations, especially in developing countries that work with limited IT budgets. Hence, organizations need to prepare for these changes in terms of their financial strategies, structures, technologies and people and, thus, call for a need for Big Data analytics readiness.

As much as many organizations have been dealing with large volumes of data in their operations, the increasing use of IT in all aspects of business has added to velocity and variety of the data received (Michael & Miller, 2013; Wielki, 2013). Hence, Big Data is not a new term, but its analytics is a new concept. This implies that literature on Big Data analytics is still scanty and most of it is still in White papers. As a result, this study found no empirically validated work intended to assess the readiness of Big Data analytics, especially for those organizations in developing countries.

According to Pearson, Singh and Mackey (2014), most researches highlight technology as a major antecedent of Big Data, yet, technology is only a small part of the equation. They observed that organizations characteristics, processes, people's experience and skills also play a critical role that need to be investigated for Big Data analytics readiness. Furthermore, several studies on Big Data analytics concentrate on the benefits of using the available analytical tools without looking at other aspects that the organizations need to address (Michael & Miller 2013; Forbes Insights, 2015). Such has left a gap in knowing the bottlenecks, as well other antecedents that need attention for Big Data analytics readiness. This also remains a dilemma for those organizations in developing countries that have been always found to be at a slow pace with technology adoption and usage.

The dramatic growth and use of multi-technological innovations, the ubiquitousness of the internet and IT applications and the pervasiveness of smart mobile devices have increased real-time data collection and has exponentially led to Big Data in today's businesses environment (Juniper Networks, 2012). However, due to the various forms and structures of these collected data, the tools and architectures needed for its real-time analysis may vary and could be a challenge for many organizations, especially those operating with limited IT budgets.

Research (Singh & Singh, 2012; Juniper Networks, 2012; Forbes Insights, 2015) indicate that many organizations may not be ready for these drastic changes, hence, calling for a need for change analysis. Literature shows that in most instances when data volumes increase, organizations concern themselves with storage rather than the value in such data. Generally speaking, data storage costs have

largely dropped even for the most mundane data. Hence, organizations need to concentrate on such data analytics so as to draw better insight from it. However, this calls for organizations' readiness to change in all aspects including cultural, strategic and operational so as to analyze the generated Big Data, which is the goal for this study.

1. The Big Data concept and theoretical foundations

Research shows that there hasn't been a single universally recognized operational definition of Big Data. While some studies have defined it with reference to the three 'V's, i.e., volume, velocity and variety proposed in 2001 by the META Group, others have expanded it to incorporate related considerations such as variability and complexity (Singh & Singh, 2012; Michael & Miller, 2013; Forbes Insights, 2015). However, the Big Data concept is often used when the organization's existing traditional relational database and file systems processing capacities are exceeded in high transactional volumes, velocity responsiveness, and the quantity and or variety of collected data (Singh & Singh, 2012; Michael & Miller, 2013; Wielki, 2013). The growth of data in such circumstances is exponential and overwhelmingly big to fit the structures of relational database management systems (RDBMS) architectures making scalability a challenge. Hence, such data can only be meaningful to an organization if better processing techniques are adopted (Goss & Veeramuthu, 2013).

Kaisler et al. (2013) assert that Big Data analytics necessitates an organization to have the potential of collecting, managing, and analyzing massive volumes of data varieties, at a speed proportional to the rate at which data are received. They noted that such data need to be processed at the right time so as to give the end consumer information needed for informed decision making.

Goss and Veeramuthu (2013) observed that information dependent organizations draw data from a diverse range of sources such as web logs, social media, machine sensors, clickstreams, smart meters, customer relationship management (CRM) systems and micro blogging sites like Twitter. They suggested that the diversity and expansively big range of data sources not only call for scalability, but also for IT data specialists with good experience and skills to handle just-in-time scenarios. According to Singh and Singh (2012) and Forbes Insights (2015), the four major characteristics of Big Data, namely volume that refers to the amount of data collected managed and stored, velocity which refers to the speed at which data are received, variety relating to the different types of data received from multiple sources and value that relates to the insight obtained by an organization from Big Data not only demand for scalability, but also for better strategies and operational procedures.

1.1. Big Data readiness and maturity models. Benefiting from Big Data starts with the right strategies and methodologies that are aligned with business specific goals. This could require a provision of relevant strategies, ICT architecture and an appropriate operational framework for using the data. More still, organizations need to prepare its employees with expertise to handle such data and inculcate a culture of commitment to work with such Big Data. This could imply that organizational readiness assesses whether it is prepared for the change, and its people are ready to join and work within a new environment (Chanyagorn & Kungwannarongkun, 2011).

Organizational technological readiness is intended to explore its preparedness to embrace new innovations so as to keep informed of market demands in its environment. Hence, any change to be effective within an organization needs to have collective readiness at the individual and organizational levels (Weiner, 2009; Chanyagorn & Kungwannarongkun, 2011).

From this perspective, organizational readiness for change is a multi-level construct and it could be more observed at an individual, group, unit, department, or organizational level. These levels are essential for the theorization and assessment of the organization's preparedness. Rafferty, Jimmieson and Armenakis (2013) noted that organizational readiness for change is not a homologous multi-level construct and it could vary across the different levels of analysis and adoption of such new innovation. Furthermore, Moore (2014) observed that Big Data roadmaps and maturity models have been identified for as key guidelines needed for successful adoption of Big Data technologies.

According to Halper and Krishnan (2013), maturity models help to create structure around Big Data analytics projects, determining where to start, as well as supporting the monitoring and management of the speed and progress of Big Data analytics projects. Whilst providing capability assessment that focuses on specific Big Data areas to guide development of milestones and avoid pitfalls (Braun, 2015).

In a comprehensive study that evaluates and benchmarks eight existing data maturity models, Braun (2015) identifies the two most effective models as addressing the dimensions of organization, infrastructure, data management, analytics and governance as essential for maturity assessment. These dimensions are related to the factors that influence organization's Big Data analytics readiness.

1.2. Factors influencing organizations' readiness for Big Data analytics. Studies such as Singh & Singh (2012) Kaisler et al. (2013) Wielki (2013) Goss & Veeramuthu (2013) have indicated that numerous factors influence Big Data analytics readiness. However, like any other technological innovation, these factors may differ from one organization to another. These factors include, but not limited to.

1.2.1. Management support: has been identified as a critical success factor in the field of data business intelligence, warehousing and Big Data analytics (Chen, Chiang & Storey, 2012). Deriving the maximum value from analytics would need configuring and customizing the analytics implementation that meets the business goals and, thus, requires full support of management support.

1.2.2. Organizational size: organizations that have long handled massive volumes of data are beginning to motivate about the ability to handle a new type of data while organizational size is often positively correlated with the availability of resources (Chen et al., 2012).

1.2.3. Finances: for any data received within an organization, there must be a measurable cost effective way of analyzing them. Big Data analytics can reveal insights previously hidden by data that were too costly to process, such as sensor logs (Goss & Veeramuthu, 2013). Resource availability in terms of money and human resources is a major factor when assessing Big Data readiness in an organization.

1.2.4. Information and Communication Technology (ICT) infrastructure: the data grow in the industry, new techniques and approaches need to be adopted (Goss & Veeramuthu, 2013; Pearson et al., 2014). Infrastructure challenges include, though not limited to: complexity, speed, volume, analytics, and bandwidth, content, the capability to collect and process big data necessitates sufficient transmission and storage capacities, as well as computing power (Chen et al., 2012).

1.2.5. Scalability: traditionally organizations use data management and analysis systems, mainly based on relational database management system (RDBMS) to store and analyze data, produce reports and make decisions (Al-Najran & Dahanayake, 2015). However, these traditional RDBMS could be overwhelmed with Big Data due to many reasons. Kelly (2013) indicates that due to the various dissimilar data sources and the aggregated volume, it could be difficult to collect and integrate data with scalability from distributed locations.

Another reason is the failure to aggregate massive and heterogeneous datasets, while at the same time provide function and performance guarantee for retrieval, scalability, and privacy protection. Lastly, the mining of the massive datasets in real time to do visualization and prediction could be a challenge. Hence, to deal with the voluminous data, innovative solutions for data models, algorithms and architectures have to be designed providing the necessary scalability and flexibility for novel Big Data analytics applications (Al-Najran & Dahanayake, 2015).

1.2.6. Security: to release the Big Data analytics pressure, decision makers need to think and adopt the deployment of their services to the cloud environment (Chen et al., 2012). However, in order to do that, they have to consider the security of their data and the privacy of their customers. Hence, security is an essential antecedent for Big Data analytics.

1.2.7. Competition: organizations need to achieve a competitive edge, hence, they need to leverage Big Data by considering the distributed semi-unstructured and unstructured data types, which frequently start with mathematics, statistics and data aggregation efforts (Villars, Olofson & Eastwood, 2011). Proper Big Data analytics needs to be done in comparison with what the competitors in the market are doing.

1.2.8. Customers: the private and public sectors are starting to use Big Data in their everyday activities. Consumers are increasingly interacting with companies through various means that include, but not limited to social media, mobile, e-commerce sites, stores, and more that dramatically increase the complexity and variety of data types received and need to be analyzed within an organization. Hence, companies from retail to corporate need to use Big Data to better understand their customers' characteristics and choices (Singh & Singh, 2012; Kaisler et al., 2013).

1.2.9. Vendor: there are many vendors offering Big Data analytics solutions and tools (Singh & Singh, 2012). Against this backdrop, more and more Big Data analytics tools have come into the market with each claiming to be the best. In such situations, organizations needs to relay on vendors with reference and reputation to avoid fraud.

More still as Michael & Miller (2013) and Kaisler et al. (2013), a major challenge of Big Data analytics is that it requires a combination of advanced statistical, analytical and machine learning skills that may not be available in every organization, especially those in developing countries. With such a constraint, organizations need to leverage the expertise of the vendors for after-sale services and continuous in-service trainings.

1.2.10. Employee's e-skills: the digital transformation within the business environments has necessitated organizations to have IT departments (Goss & Veeramuthu, 2013). With the current technological developments, organizations need to attract, recruit and retain employees that are capable of having multi-channel engagement with customers, as well as capable of using the latest technologies to do Big Data analytics (Singh & Singh, 2012; Pearson et al., 2014).

1.2.11. Organizational culture: organization's culture relates to how it evaluates its performance, allocates its resources and motivates its employees to behave and perform their duties (Michael & Miller,

2013). Furthermore, Kalema, Motjolopane and Motsi (2016) argued that in the event of new innovations, organizations need to develop a culture that allows individuals of diverse specialties, expertise, skills and from different geographic locations to access the same information and to augment one another in all aspects of work.

Sarfaraz (2016) identified seven steps of building an organizational Big Data culture. These are; clarity of the goal that need to be attained, involvement of key people in Big Data decision making, promotion of a data-driven mind set, anticipation and being ready for objections, be in position to address emotions, educate the people involved in the Big Data projects and be ready to take action. It is, therefore, essential to build a Big Data-centric culture so as the organization to compete favorably.

1.2.12. Strategies: Big Data success starts with strategy (Michael & Miller, 2013; Sarfaraz, 2016). For Big Data to succeed, organizations should have clear strategies that address organizational and technical issues like Big Data architecture design, number of silos and integration points that are involved, as well as the tools needed for analytics. Good strategies also lead to accelerated innovations, high prediction power for customer demands, as well as helping to uncover unnecessary overhead costs.

Hence, an effective Big Data strategy should be holistic, business focused, flexible, structural and scalable (Kaisler et al., 2013). This implies that an effective Big Data strategy and methodology is essential for an organization to avoid various challenges, as well as keeping it competitive. With good strategies, an organization can design the right architecture to support the full enterprise and draw meaning from the collected data, using proven Big Data techniques and analytical practices, in specific operational contexts (Singh & Singh, 2012; Pearson et al., 2014).

1.2.13. Need change: organizational change management transitions an organization and its people from their current state to a new state and encompasses the integration and alignment of people, processes, culture and strategy (Sweeney & Whitaker, 1994). For readiness and success of any new innovation, people have to appreciate the need for change in terms of culture, accountability, resource availability, and capability of staff in terms of skills and experience.

1.3. Theoretical foundations. The objective of this study was to determine organizations' readiness for Big Data analytics based on Big Data maturity models and the factors that influence organizations readiness for change. The theoretical foundations for this study are rooted in the empirically tested maturity models, technological and organizational aspects, individual perspectives, as well as environmental characteristics relating to competition, vendors and customers. In addition, this study postulates that the capability for Big Data analytics requires organizations' change readiness, which is the new change management. From this perspective change readiness is the ability to continuously initiate and respond to change in ways that create advantage, minimize risk, and sustain performance and such calls for the need to change parameter (Sweeney & Whitaker, 1994).

Organizations need to attain the power to combine Big Data analytics, business process workflow and at the same time having employees with the right skills needed for a digital transformation. From this understanding, Big Data analytics readiness could be regarded as supra-individual state of affairs that need to be theorized about the organizational, technological and environmental determinants. Based on this theorization, this study used the Technology Organization Environment (TOE) model by Tornatzky and Fleischer (1990) with constructs of Change Management theory by Sweeney and Whitaker (1994) to underpin it as demonstrated in Fig. 1.

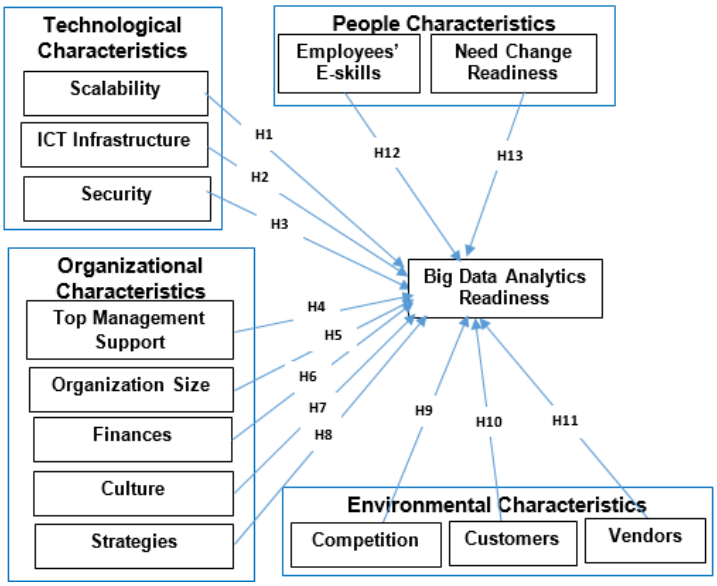

Fig. 1. Research model

1.4. Hypotheses development. Based on the identified factors in the literature and the research model (Fig. 1), thirteen hypotheses were developed.

H1: Data analysis tools and applications' scalability influence organizations readiness for Big Data analytics.

H2: The ICT infrastructure is essential for Big Data analytics readiness.

H3: Organizations information and systems' security are influential for Big Data analytics readiness.

H4: Top management support positively influences organization's readiness for Big Data analytics.

H5: The size of an organization impacts on its readiness for Big Data analytics.

H6: Availability of financial resources influences the organization's readiness for Big Data analytics.

H7: Organizational culture influences its readiness for Big Data analytics.

H8: Good strategies positively influence an organization's readiness for Big Data analytics.

H9: Competitive pressure influences an organization readiness for Big Data analytics.

H10: Customers' demands influence organization's Big Data analytics readiness.

H11: Applications and analytics tools vendors influence Big Data analytics readiness.

H12: Employees' e-skills are influential for organization's readiness for Big Data analytics.

H13: The realization of the need to change influences the organization's readiness for Big Data analytics.

2. Methodology

This study was conducted in South Africa and data were collected from the South African Revenue Services (SARS) head office. SARS is a governmental parastatal handling voluminous electronic data from the public on a daily basis. It has an IT department with six divisions. Participants of this department were randomly selected from these six divisions of; data warehouse development, data analytics, data management, business intelligence and data storage. By using simple random sampling, all employees in these divisions had a chance to participate in the study and, thus, helped to avoid biasness.

2.1. Questionnaire design and coding. Data were collected by using a questionnaire with close-ended questions. The questionnaire was designed based on a 5-point Likert scale whereby 1 and 5 represented strongly disagree and agree, respectively, 3 representing neutral, while 2 and 4 were respective intermediate values. Out of the 203 questionnaires that were distributed, 164 were returned giving a response rate of 80.8%. However, some 37 questionnaires were found to be having incomplete data and were discarded. The 127 usable ones were coded and transcribed into the Statistical Package for Social Sciences (SPSS) v21 for analysis.

During coding, each characteristic (construct) was abbreviated for easy analysis. Scalability was coded as SC and its four attributes as SC1 to SC4; ICT infrastructure as ICTI and its five attributes as ICTI1 to ICTI5, security as SEC and its attributes as SEC1 to SEC 3; top management support as TMS and its attributes as TMS1 to TMS4; organizational size as OS and its attributes as OS1 to OS3; financial resources as FR and the attributes as FR1 to FR3; culture as CU and its attributes as CU1 to CU3; strategies as ST and its attributes as ST1 to ST4. On the other hand, competitors as COM and its attributes as COM1 to COM 3; customer as CUS and attributes as CUS1 to CUS 3; vendors was coded as VEN and its attributes as VEN1 to VEN 3. The two people constructs employees' skills as EES and its attributes as EES1 to EES3; the need change construct was coded as NC and its attributes as NC1 to NC3. Lastly, the Big Data analytics readiness was coded as BDR.

2.2. Reliability of the study. Before data analysis, the questionnaire and each of the 13 constructs were tested for reliability. The questionnaire was found to be having a reliability of 0.881. The reliabilities for each of the 10 constructs were within the admissible range with (alpha) α-coefficient above the recommended threshold of .7 (Pallant, 2010). On the other hand, the constructs of strategies, culture and employees E-skills had reliabilities of .632, .58 and .673, respectively, all less than .7. However, as Mccrae, Kurtz, Yamagata, and Terracciano (2011) noted, reliability values above .5 could give a meaningful inter rater reliability and internal consistency. These constructs were included for further analysis, as it was thought that they could produce meaningful results.

3. Results

Detailed analysis of frequencies of the participants' demographics and situational variables, correlation and regression analysis were carried out. The descriptive statistics results of the demographics of the participants have been left out due to space. The next section reports on the correlation of the constructs and the regression analysis.

3.1. Correlation. To determine the interdependencies between constructs, correction analysis was carried out. Correlation demonstrates the strength and direction of a relationship between two or more constructs including the statistical significance of their association (Pallant, 2010). Results indicated that there is a strong significant relationship between top management support and the

need change readiness and financial resources with correlation coefficients of .687 and .654, respectively, at significant level of .01. Other constructs showed good correction values with the exception of strategies that was only significant with competition. The table demonstrating the correlation coefficients of the constructs was left out, however, the overall results gave an early indication that the suggested constructs are good antecedents of organization's readiness for Big Data analytics.

3.2. Regression analysis. Regression analysis is a mathematical approach of determining which independent construct has impact on the dependent one, which matter most or significantly and which can be ignored, as well as how the constructs interact with one another (Robila, 2006; Pallant, 2010). The regression analysis could also be used to predict the certainty of the constructs. For the significance, the critical ratio (t-value) should be equal or greater to ± 1.96 (Robila, 2006). Table 1 demonstrates the results obtained from the regression analysis.

Table 1. Regression analysis

Model	Un standardized coefficient		Stand. Coef.	t	Sig
	B	Std. Error	Beta		
(Constant)	4.104	.293	14.007		.000
Need Change (NC)	.715	.056	.684	12.768	.000
Employees E-skills (EES)	.254	.108	.167	2.330	.023
ICT Infrastructure (ICTI)	.331	.12.1	.068	2.739	.011
Culture (CU)	-.336	.130	-.257	-2.585	.012
Strategies (ST)	.155	.092	.137	1.690	096
Security (SEC)	-.098	.080	-.069	-1.225	.22.5
Scalability(SC)	1.053	.121	.906	8.703	.000
Top Mgt Support (TMS)	.568	.136	.448	4.176	.000
Organization Size (OS)	-.205	.092	-.111	-2.227	.034
Financial Resources (FR)	.103	.052	.066	1.987	.048
Competitors (COM)	.033	.12.8	.024	.258	.803
Vendors (VEN)	.242	.102	.168	.2.368	.042
Customers (CUS)	-.114	.057	-.076	-1.997	.048

a. Dependent Variable: EDR.

As demonstrated in Table 1, ten constructs were found to be significantly contributing to the organization's readiness for Big Data analytics. Of these significant constructs, scalability was found to contributing 90.6% of the overall prediction and with a high statistical significance of p = .000. This implies that scalability has a high estimated relationship and degree of confidence that the true relationship is close to the estimated relationship in Big Data analytics. This was followed by need change readiness and top management support with predictions of 68.6% and 44.8%, respectively, and both with p = .000. On the other hand, three constructs of strategies, security and competitors were found not to be significant with predictions of 13.7%, 6.9% and 2.4% at =.096, .225 and .803, respectively.

4. Discussions

In this study, 13 relationships were hypothesized to influence organization's readiness for Big Data analytics.

4.1. Findings. H1: Data analysis tools and applications' scalability influence organizations readiness for Big Data analytics. This hypothesis was supported. The implication of this is that organization should ensure that their RDMS, as well as the storage systems are flexible enough to allow scalability, as more data are incorporated into analytical tools. This finding is in line with what other researchers such as Goss & Veeramuthu (2013) and Al-Najran & Dahanayake (2015) observed that scalability plays a big role in Big Data analytics. Hence, to ensure readiness, the current storage, analytics tools and applications should be in position to scale up in order to be in position to handle massive data volumes originating from a wide variety of sources.

H2: The ICT infrastructure is essential for organization's Big Data analytics readiness. This hypothesis was supported. Big Data analytics applications often rely on a growing number of internal and external data sources containing structured and unstructured data (Goss & Veeramuthu, 2013). This implies that the organization's readiness for Big Data analytics has a high dependency on its current ICT infrastructure. Consequently, for the organization to be able to access and integrate data received from various sources and in different formats, it needs good ICT infrastructure. The current system used in the organization needs to have a good potential of handling such data and, if not, a new system needs to be procured. Results of this study are in agreement with what Kaisler et al. (2013) noted that new infrastructure may be needed when preparing for Big Data analytics in order to successfully leverage the various kinds of data structures and its analytics.

H3: Organizations' information and systems' security is influential for Big Data analytics readiness. This hypothesis was also supported. In many situations, as voluminous data are received from various sources and at a high speed, issues relating to security become a critical concern. This was also alluded to by Chen et al. (2012) and Forbes Insights (2015) who indicated that care should be taken to the increased flow of data into an organization from various sources, as cybersecurity attacks and fraud may be also on increase. However, the results of this study didn't support this argument. The implications of this could be that an organization is having good ICT infrastructure, security issues may be handled by the system without the knowledge of the end users. From this study, it could also imply that the participants were much concerned with analytical issues and left the security issues to vendors. This could explain why hypothesis (H11) was supported.

H4: Top management support positively influences organization's readiness for Big Data analytics. This hypothesis was supported. The results of this study imply for technological innovation to be successful, top management's support is a critical success factor. This support could be in terms of appropriate budgets, recruitment of skilled staff, training and helping in the alignment of IT strategies with those of the organization. In many IT projects, top management buy-in and support is essential (Chanyagorn & Kungwannarongkun, 2011).

The findings of this study are in agreement with what Sweeney & Whitaker (1994) and Rafferty et al. (2013) suggested that for effective change within an organization, there must be principal support. This could also imply that for staff to embrace new changes, they should be confident that their organizations including superiors and peers will provide tangible support for change in the form of resources and information. The belief that top management is ready to support staff is essential for the individual's development of a sense of self-efficacy and thus leading to the change of mind set.

H5: The size of an organization impacts on its readiness for Big Data analytics. This hypothesis was supported. The support of this hypothesis is an indication that since larger organization tends to have many branches and networks, they receive huge volumes of data from varied sources. This implies the need to analyze these Big Data in these organizations could be higher than in small ones. The findings of this study are in agreement with those of Pries and Dunnigan (2014) who also noted that organizations that generate or have been dealing with large data volumes from different sources for decades are more likely to be early movers. In respect to this study, data were collected from a governmental parastatal that like many other public sectors, deals with large volumes of data on a daily basis and such could be more ready to embrace Big Data analytics. Such could also explain why the hypothesis on the need change (H13) was also supported. This sentiment was also shared by Tornatzky and Fleischer (1990) who pointed out that the organizational size is a core antecedent for technology adoption.

H6: Availability of financial resources influences the organization's readiness for Big Data analytics. This hypothesis was supported. By the fact that Big Data analytics deals with increasing user needs that exceeds the traditional approach to analytics, organizations may require more resources and tools. Hence, procurement of new technological devices, applications and tools and to employee experienced data scientists necessitate the availability of financial resources. The findings of this study are in agreement with the Juniper Networks (2012) that indicated that the advent of Big Data analytics will require organizations to upgrade from the traditional online transaction processing (OLTP) data stores and structured query language (SQL) analysis tools to flat horizontally scalable database with unique query tools. The changing from the traditional to the advanced analytical tools that work in real time with actual data requires an organization to be in good sound financial position.

H7: Organizational culture influences its readiness for Big Data analytics. This hypothesis was supported. With increasing volumes of data handled within an organization, better analytics will help organizations to have increasing opportunities to deal with business challenges. However, an organization has to build a culture that allows its employees with diverse specialties, expertise, skills and from different geographic locations to analyze, share and access the same information and to augment one another in all aspects of work (Kalema et al., 2016). This makes organizational culture a core antecedent for Big Data analytics. The results of this study are in agreement with Sarfaraz (2016) who noted that when it comes to Big Data, culture can also swallow up huge capital outlays, high-powered infrastructure and the smartest teams of data scientists.

H8: Good strategies positively influence an organization's readiness for Big Data analytics. This hypothesis was not supported. The results of this study suggests that since Big Data have been around for much longer period of time, the emphasis would be more on the tools and other technological developments for analytics rather than the strategies. As much as this study's findings are not in agreement with what Chanyagorn & Kungwannarongkun (2011), Singh & Singh (2012) and Forbes Insights (2015) noted, strategic planning is paramount with Big Data analytics. However, it concurs with Pearson et al. (2014) who noted that since Big Data are already existing in organizations, what is needed are the intuitive tools that integrate data into day-to-day processes and translate modeling outputs into tangible business actions.

Michael and Miller (2013) add that organizations should be more worried about having experienced front end employees to deal with Big Data analytics so as to assist marketing managers to make real-time decisions. This also explains why hypothesis H12 was supported.

H9: Competitive pressure influences an organization's readiness for Big Data analytics. This hypothesis was not supported. Good Big Data analytics helps an organization to draw better insights needed for competitive advantage (Michael & Miller, 2013). The more efficient an organization is with its Big Data analytics, the more it is capable of business questions that could help them to achieve a competitive edge. The nature on SARs, where data were collected for this study, is that, being a government parastatal, it could matter less of the competitors, as it is more service than profit oriented. Hence, competitive pressure may not be more of a pressing issue than the customers that are being served and would request for better services. This could also explain why hypothesis H10 was supported.

H10: Customers' demands influence organization's Big Data analytics readiness. This hypothesis was supported. The result of this hypothesis is in agreement with Pries and Dunnigan (2014) who noted that organizations need to provide real-time answers to their customers. As more people become IT literate, they tend to do more of their work online including requesting of services. Such could increase requests handled and the amount of data received in various forms. Hence, due to these demands, organizations will be forced to have better analytics tools that could serve these queries in the shortest time possible. In an organization's environment queries, many flow in from customers in patterns range from 1-to-1, 1-to-many, many-to-1, and many-to-many. However, when the velocity or traffic of these queries increase and from various sources, organizations may become overwhelmed with the flow and end up being inefficient. Hence, to avoid this, they tend to acquire new ICT infrastructures and employ experienced personnel to handle the new analytical tools.

H11: Applications and analytics tools vendors influence Big Data analytics readiness. This hypothesis was supported. Studies by Singh & Singh (2012) Juniper Networks (2012) and Chen et al. (2012) have indicated that good governance is vital to the success of Big Data analytics in any business. However good governance encompasses consistent guidance, procedures and clear management decision-making. Organizations need to have consistent support from vendors of software applications and analytics tools.

H12: Employees' e-skills are influential for organization's readiness for Big Data analytics. This hypothesis was supported. Literature on Big Data analytics indicate that the core concern is the fact that organizations should have the ability to employ and attract employees with appropriate skills to handle Big Data and analyze them to realize business benefits associated with it (Singh & Singh, 2012; Pearson et al., 2014). The findings of this study are in agreement with those of Goss and Veeramuthu (2013) who noted that successful analytics of Big Data requires a combination of a rules-driven business process, analytics and people with the right skills. Such skills like deep analytical talents, Big Data and analytics savvy roles are capable of supporting technology roles.

H13: The realization of the need to change influences the organization's readiness for Big Data analytics. This hypothesis was supported. The results of this study imply that for organization to claim its readiness for Big Data analytics, its people should first appreciate that there is a need for a change and to do things in the right way. These results are in agreement with the findings of Sweeney and Whitaker (1994) and Al-Najran and Dahanayake (2015) who noted that people within the organization have to change their mind-sets and be ready for a change. By so doing, they should be in position to highlight the discrepancy between the current and the desired performance levels, fomenting dissatisfaction with the status quo, creating an appealing vision of future state of affairs, and fostering confidence that this future state can be achieved.

4.2. Limitations of the study. As alluded by Michael & Miller (2013) and Wielki (2013), the concept of Big Data analytics is relatively new and, therefore there is limited academic literature in this domain. As a result, this study depended mostly on White papers and internet materials from developers' and vendors websites. Since most of these websites are intended for commercial purposes, many of the White papers mainly report on the success stories and little or nothing is mentioned about the bottlenecks. This challenge might have limited this study to explore all the factors relevant for organizations readiness for Big Data analytics. This limitation could hinder the results of this study to be generalized to all Big Data analytics readiness projects.

More still, this study used only one parastatal SARs for data collection, hence, the selected sample may not be a good representative of all public sectors in SA. Besides, due to advanced technological developments in SA, it may not serve as a good representation of all developing countries. Such could limit the generalization of the results of this study to all developing countries.

Another shortfall is that this study collected data from participants, but their demographics and situational variables were not included in the final analysis. However, as Venkatesh, Morris & Davis (2003) and Kalema, Olugbara & Kekwaletswe (2011) indicated, with the exponential growth of technological

innovations and the changes in the business environment, users' perceptions towards technology may vary as time changes. This implies that factors that have been identified to influence organization's readiness for Big Data analytics may cease to be influential and new ones become salient. The leaving out of the analysis of the moderating effects of the users' demographics and situational variables is a limitation, as the variables would have helped in the prediction of these changes.

Recommendations

Readiness is a yardstick for a successful change, hence, organizational readiness is about getting an entire group and culture to accept and move forward with change (Sweeney & Whitaker, 1994). Hence this requires a rigorous identification of elements that play a role in this change. In other words, studies of readiness should involve several rigorous method of data collections and analysis in order to come up with a definite framework that could inform this change. Much this is so, this study only used a quantitative approach and only sampled one organization. Future studies should leverage the use of other approaches like the qualitative approach or a mixed methods to get more insights needed for organization readiness for Big Data analytics.

More so, due to the expected changes in the users' perceptions over technology, this study recommends that future research considers the analysis of interacting effects by analyzing the users' demographics and situational variables. Analyzing these moderating factors will help to predict users' behaviors with change in situations and time.

Conclusion

This study sought to investigate organizations readiness for Big Data analytics. Organizational readiness is a critical scenario, as it governs optimal implementation of technology (Venkatesh et al., 2003; Rafferty et al., 2013). Results of this study have indicated that the size and complexity of the organization plays a good role in its preparedness for Big Data analytics. At the same time, the employees' skill have equally been found relevant. Hence, readiness could be considered as getting people ready to adapt to the changes by ensuring they have the right information, skills, experience and toolsets.

Optimal implementation of a technological innovation is paramount for its success. Results of this study further indicated that for optimal implementation, stakeholders have to play their parts diligently and get involved in the changing process. These including top management, customers, vendors and employees. Employees have to be with relevant skills and experience and, if not, top management should support them by providing training.

Hence, readiness should embrace communication between the stake holders of an organization so that they work in a holistic manner. This is essential especially for organizations in developing countries that operate with limited resources. In such cases, vendors can offload tasks that are outside an organization's core competencies and help it to consolidate its existing capabilities of handling Big Data analytics.

More still, due to heterogeneous challenges, it is rare to find smooth, linear and longitudinal technology shifts in organizations of developing countries. Hence, readiness assessment for any technological innovation should examine all relevant factors ranging from individual to organization to global. The findings of this study indicated that organizations in developing countries need to pay attention to many factors and go through organizational, managerial, and cultural changes if they are to be ready and feverishly explore ways of benefitting from Big Data analytics. It is only by doing so that they will be able to gain capability of creating strong competitive advantages.

Big Data are often portrayed as a potential opportunity for organizations regardless of their nature. Many organizations, especially big firms in developed countries, are already benefitting from Big Data analytics. However, literature indicates that traditional technologies are struggling to match up the velocity, variety and volume at which Big Data are generated. Leveraging the findings of this study, organizations will be in position to know what to do, when to do it and how when they are faced with situations of Big Data analytics. Hence, this study contributes to the scanty academic literature of Big Data analytics, as its findings will be used by management to make informed decisions regarding Big Data analytics.

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