Relationship between big data analytics and organisational performance of the Technical University of Kenya and Strathmore University in Kenya

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Abstract

Purpose – Big data analytics is a set of procedures and technologies that entails new forms of integration to uncover large unknown values from large data sets that are various, complex and of an immense scale. The use of big data analytics is generally considered to improve organisational performance. However, this depends on capabilities of different organisations to provide the resources required for big data analytics. This study aims to investigate the influence of big data analytics on organisational performance of Technical University of Kenya (TUK) and Strathmore University (SU).

Design/methodology/approach – This study was conducted as a mixed method research to enable a deep understanding of the concept. Primary data was collected through structured questionnaires and interviews with clientele and information communication technology staff from the TUK and SU, both in Nairobi, Kenya. Secondary data was collected through interviews and questionnaires. Data was analysed and presented using descriptive statistics.

Findings – The findings revealed that most of the variables of organisational performance such as innovativeness, creativeness, effectiveness, productiveness and efficiency are affected positively by conducting big data analytics in both institutions. The results demonstrate that the TUK showed a negative relationship between big data analytics and competiveness and profitability while SU showed a positive relationship between the two variables. In terms of regression analysis, the findings revealed that SU showed a good relationship between independent and dependant variables while the TUK had a weak influence.

Originality/value – This study is original in terms of its subject matter, scope and application.

Keywords Big data, Kenya, Big data analytics, Organisation performance, Strathmore University, Technical University of Kenya

Paper type Research paper

Introduction

Villars *et al.* (2011) define big data analytics as the technique which enables careful capture and extraction of value from large sets of data. Daniel (2019) adds that big data is generated by people, applications and machines. According to Boyd and Crawford (2012), analysing big data is challenging and requires high performance exemplified by fast processing and retrieval speeds. Currently, most organisations are thriving by using the data they generate during their day-to-day operations. Hence, data is viewed as being as valuable as gold; and like gold, it needs to be refined to realise its value. Data refining can be done by subjecting the data to analytics thereby enabling organisations to extract usable information from the enormous, diverse and complex data sets they generate. Through analytics, organisations

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are able to identify the different types of data they produce. In addition, analytics enables organisations to generate insights from the data thereby improving their decision-making. Chen *et al.* (2012) affirm that big data analytics enable organisations to understand the types of data they produce and the extent to which they are used to leverage performance.

Lavelle *et al.* (2013) assert that the highest performing organisations use big data analytics approaches to enhance their performance. Bryant *et al.* (2008) emphasise that big data can only be meaningful if it is analysed and catalogued well so as to enhance its real-time access by the users. When big data is synthesised to reveal the patterns and trends, organisations can expect higher efficiency and effectiveness. The more organisations recognise the fact that they are data-driven, the better they perform by achieving their objectives and targets as well as financial sustainability. Strausser (2015) and Shorfuzzaman *et al.* (2019) argue that universities are becoming fascinated by using big data analytics to support students' work and also to make better decisions and improve their operations. For instance, universities are able to know more about their students through data mining and analytics based on students' digital footprints. This is achieved by the use of technology to map activities the students and staff undertake online by collecting and analysing the data. This helps in learning the entire range of activities and hence works towards achieving the best from all. Strausser (2015) further argues that universities need to move from the application of big data analytics to improve academics and administrative performance by merely collecting data that reports past accomplishment to more detailed analytics that connects the dots for future endeavour. For instance, this can be achieved by the use of descriptive analytics to show what happened and why it happened. It may also involve predictive analytics that suggest what will happen and offer insights into how it can be made to happen (Dubey *et al.*, 2019).

Literature review

Big data and its analytics is one of the processes used by organisations to improve their performance (Shao and Lin, 2016). According to Frizzo-Barker *et al.* (2016), big data analytics offers insights to organisations on how to benefit from big data they generate, collect or consume. Chang *et al.* (2014) are of the view that big data leads to more effective and efficient decision-making. McAfee *et al.* (2012) argue that when organisations adopt the data-driven approach, they perform better financially and also meet their objectives. It can be deduced from the foregoing that authors concur that big data analytics supports organisations to improve their performance through effective decision-making, efficient operations and prudent financial management.

As their capacity to generate data has increased, through information and communication technology, organisations seem to be focusing on generating or acquiring data more than managing the data. This is unlikely to generate real value as having more data does not necessarily mean access to good and usable data. As argued by Boyd and Crawford (2012), numbers do not express themselves. Cantabella *et al.* (2019) suggest that organisations need to analyse the behaviour of clients generating data so as to make meaning out of it. In addition, big data analytics is of incomplete value if the verdict maker is not able to comprehend the analytics (Labrinidis and Jagadish, 2012). Lavelle *et al.* (2013) contend that conducting data analytics is challenging and faces implementation hitches such as organisational resistance to change.

The other issue of concern to the authors was exploring the understanding of the concept of organisational performance. It is generally understood as the measure of how organisations are able to gain insights in relation to the value they add to themselves, their customers and society at large (Mikalef *et al.*, 2019). According to Antony and

Bhattacharyya (2010), performance can be assessed using concepts such as innovativeness, competitiveness, creativeness, effectiveness, productiveness, efficiency and profitability. Innovativeness is the development of new and original ideas that are viable to the organisation; competitiveness is the aptitude of the institution to offer services and products that are of good quality and standards; creativeness is the potential of the organisations to conceive and execute new ideas; effectiveness is the degree of achieving the specified objectives; productiveness is the ratio of input to output; efficiency is the measure of how smooth the operations run and how systems work in the organisation; and profitability is an assessment of how the organisation gets returns on its investments. The authors used these elements of organisational performance in this study. The details of each of the elements are discussed hereunder.

Kuratko *et al.* (2014) observed that continuous innovations are instrumental to the success of an organisation. This is based on their ability to win against a competing organisation by providing goods that are exclusive and of great value to clients. Manyika *et al.* (2011) assert that for an organisation to be considered as innovative and sustainable, it needs to adopt big data analytics. Through their research, they gave the example of McKinseny Company, which conducted big data analytics where the researchers found that production of data in organisations has increased. They argued that the increase bequeathed competitive advantage to the organisations that are able to analyse their data more innovatively (Manyika *et al.*, 2011). They also observed that the majority of the most successful and innovative organisations are data-driven. Such organisations include Google, Amazon and Facebook, among others.

According to Wong (2012), institutions need to adopt big data and its analytics to help them to generate useful insights for innovation and decision-making to remain viable in the increasingly competitive environment. Tan *et al.* (2015) as well as Huda *et al.* (2018) were of the view that to get meaning out of big data, organisations need to implement big data analytics. Through data, organisations are able to be innovative because it provides the basis for innovation (Wamba *et al.*, 2017). Additionally, Tan *et al.* (2015) observed that the potential of big data analytics to aid organisational innovativeness is not well known but most of the emerging organisations are using big data to be more innovative in terms of their products and services. This is done by investing more on big data analytics to optimise their organisations and forecast the future.

Big data analytics has become a significant concept in enhancing organisational competitiveness. Competitive organisations are taking the concept of big data seriously to leverage their value. According to Oh *et al.* (2012), the organisations that are able to harness the benefits of big data and analytics achieve better performance against their competitors. Big data analytics is the approach to manage, process and analyse big data-related characteristics to discover useful patterns that the organisation can use competitively (McGuire *et al.*, 2012). Through big data analytics, organisations are able to transform data into useful resources to their advantage. Guo (2014) projected that between 2005 and 2020, big data would grow from 130 to 40,000 Exabytes. If this volume of data is analysed and managed well, it would assist organisations to create new growth and become more competitive. However, this depends on whether these organisations have the big data analytics infrastructure such as information communication technologies and personnel with skills to manage and analyse the big data.

Cook (1998) argues that creativity is a component of competitive advantage for organisations. Although there is a thin line difference between data and creativity, data is linear while creativity is non-linear. McAfee *et al.* (2012) argue that creativity involves parallel processing of huge quantities of information without predefined rules while data

and analytics become the blueprint for the thinking process. Creativity can be difficult to measure or demonstrate to an organisation. However, with the advent of big data analytics, organisations are able to reveal hidden patterns and insights which stimulate creativity of their employees to make the organisation more competitive. Big data analytics and creativity seem to be on different sides of a scale. However, in the real world, both should be combined to optimise organisational benefits. Big data analytics can be used to drive up creativity by providing quantitative intelligence to develop creative products and services (Adestra, 2013).

Organisations produce big data that they analyse to reveal patterns and trends that they need to embrace for improvement. These include issues such as cost reduction and enhanced productivity. Big data analytics and productivity of an organisation are related based on the fact that data has an influence on the key performance metrics in organisations. Big data analytics has become vital for organisations to innovate, compete and generate economic value. Analytics improve production quality through the analysis of unstructured data to make meaning which, in turn, brings about customer satisfaction and retention. Progressive organisations are adopting real-time analysis of big data to boost their performance and profitability. The implementation of big data analytics in organisations requires investment in data usage (Espinosa and Armour, 2016). Bichsel (2012) argues that big data analytics can benefit academic institutions by supporting resource allocation, student endeavour and financial management.

The authors observed the following from the literature review:

- Organisations which focus only on generating data are likely to find themselves with loads of data which they do not need and may never use. Therefore, progressive organisations should shift their focus from amassing data to effective analytics of what they generate, collect or consume.
- Many studies have demonstrated the link between organisational performance and big data analytics. However, they did not consider the possible or actual use of big data analytics to improve the performance of academic institutions.
- There is no evidence in literature of a study investigating the link between organisational performance and big data analytics in academic institutions in Kenya.

Background of the study

In academic institutions, big data comes from various academic, managerial and operational processes. On 25th July 2015 [1], International Business Machines (IBM) invested six billion Kenya shillings (approximately US$60m) in a skills venture platform in academic institutions (universities and polytechnics) in East Africa. The fund was used to develop cloud systems for over 50 institutions of higher learning in Kenya to support the development and management of study material. The programme was undertaken in partnership with Kenya Education Network (Ochieng', 2015). The skills imparted were on cyber-security, mobile education and business analytics. The training began on September 2015 [2] with technology and engineering students to prepare them for the job market and to deal with the situation where some students do not get jobs because of non-recognition of their degrees by the Engineers Board of Kenya arising from non-registration of the engineering courses offered by their universities. In December 2016, Dell Egan, Marino and Curly held a meeting with Information Technology faculty from Kenyatta University, Riara University, Moi University, Multimedia University, Jomo Kenyatta University of

Agriculture and Technology, Kenya College of Accountancy University, Strathmore University (SU), United States International University – Africa and Africa Nazarene University. The faculty were trained on data science and big data analytics with the aim of empowering them to deal with the large amount of content their universities were generating and to improve the quality of service offered by the universities to their clientele (Sang, 2017). The objective of the 5-day training was to train the 17 faculty members on tools of big data analytics to enable them to generate insight from the data their universities generate. [3] They were trained on Hadoop and MapReduce tools for big data analytics.

These initiatives demonstrate that universities in Kenya are not new to the concept of big data analytics. Nonetheless, it is also evident from the foregoing that universities in Kenya are commencing to experiment with big data analytics, including its tools and procedures. This is the context in which this study was conducted as a means of linking big data analytics to organisational performance of the universities. Two universities, that is, SU (private) and the Technical University of Kenya (TUK) (public) were used to provide the contexts. These two institutions were used to facilitate an understanding of the differences and/or similarities between the relationship between big data analytics on organisational performance from the perspectives of private and public universities in Kenya.

Rationale of the study

Academic institutions produce big data in terms of student and staff records, research output and innovations (Marín-Marín *et al.*, 2019). The big data include administrative, logistical, financial and procurement records. The records are produced fast as well as in vast volumes and diverse formats. Identifying, processing and applying this data by the academic institutions in decision-making and general operations of the organisations is challenging (Jiang *et al.*, 2019). Manyika *et al.* (2011) assert that the concepts of big data and analytics have developed into hotspots that fascinate most academic institutions as well as the private and government sectors worldwide. Mayer-Schonberger and Cukier (2013) affirm that big data is the new petroleum that will power the future knowledge economy. The same academic institutions are operating in increasingly complex and competitive environments and need to respond appropriately. According to Clarke *et al.* (2013), academic institutions should realise the need to make decisions based on the synthesis of the vast data that they generate to help them understand the rapidly changing contexts of the academic sector. The potential value of big data in supporting organisations in meeting their goals is a timely topic for investigation. In Kenya, the link between big data analytics and organisational performance of academic institutions is unclear. In fact, the authors are unaware of any other study that has investigated this linkage. Thus, academic institutions stand the risk of continuing to wallow in big data without generating meaningful value from it. This study sought to bridge the gap by analysing the relationship between big data analytics and organisational performance of academic institutions in Kenya. The specific objectives of the study were to examine the relationship between big data analytics and organisational performance of the TUK and SU; and analyse strategies which can be used to enhance a positive relationship between big data analytics and organisational performance of the two universities.

Methodology

This study was designed as a mixed methods research. According to Creswell and Plano-Clark (2015), mixed methods research approach design enables the understanding of a problem of study by using both qualitative and quantitative data collection and analysis techniques. This study adopted a convergent parallel mixed methods design. The data

collected and analysed was both qualitative and quantitative. The authors merged the results from both sets of data for comparison and validation. This enhanced the interpretation of similar and dissimilar concepts. The population of the study was 22,050. This comprised 15,000 students and 20 information communication technology (ICT) staff from TUK as well as 7,000 students and 30 ICT staff from SU. The total sample size for the study was 694 respondents. Information-oriented purposive sampling was used to select information-rich subjects for the study from the 22,000 students. Thus, class representatives in all academic programmes in both universities were selected for the study. From TUK, all 560 class representatives were selected from TUK, while from SU, all the 84 representatives were selected. All the 50 ICT staff from both universities were selected to participate in the study. Structured questionnaires were used to collect data from the class representatives while interviews were used to collect data from the ICT staff. Secondary data on the understanding of the concept of big data analytics was collected through documentary analysis. Data was analysed using SPSS and presented using descriptive and inferential statistics. Qualitative data was analysed thematically using ATLAS.ti.

Findings of the study

A total of 576 (83 %) participants responded to the study and provided usable data. The response rate (83 %) was considered more than adequate as Mugenda and Mugenda (2012) recommend that a response rate of at least 50% is adequate for analysis; 60% is generally good; while a response rate of above 70% is excellent. Kothari (2014) concurs with this position and adds that a response rate of above 70% is deemed to be very good.

Relationship between big data analytics and organisational performance at the Technical University of Kenya

Table 1 shows the correlation of big data analytics and organisational performance at TUK. The variables for big data analytics (insights and algorithms/models) were computed and combined using the SPSS version 21. This was then subjected to Pearson correlation analysis to show the relationship between big data analytics and organisational performance.

Data in Table 1 indicates that innovativeness, competitiveness, creativeness, effectiveness, productiveness, efficiency and profitability had correlation coefficients of $r = 0.573$*, $r = -0.221$, $r = 0.369$, $r = 0.531$*, $r = 0.591$*, $r = 0.591$* and $r = -0.424$, respectively. The significance levels for the same variables were 0.026, 0.429, 0.176, 0.042, 0.020, 0.020 and 0.115, respectively. Further interpretation of the findings is provided in Table 2.

Relationship between big data analytics and organisational performance at Strathmore University

Table 3 shows the correlation of big data analytics and organisational performance at SU. As in the case of TUK, the variables for big data analytics (insights and algorithms/models) were computed and combined using the SPSS version 21. The results indicate that innovativeness, competitiveness, creativeness, effectiveness, productiveness, efficiency and profitability had correlation coefficients of $r = 0.654^{**}$, $r = 0.673$**, $r = 0.780^{**}$, 0.765^{**}, $r = 0.707^{**}$, $r = 0.766^{**}$ and $r = 0.351$, respectively. The significance levels were 0.00 for the first six variables and 0.009 for profitability. Table 4 shows the interpretation of these findings.

A regression analysis was conducted to further establish the influence of the independent variable (big data analytics) on the dependent variables. Again, the

Table 1. Relationship between big data analytics and organisational performance at TUK

Correlations for TUK	Innovativeness	Competitiveness	Creativeness	Effectiveness	Productiveness	Efficiency	Profitability	Big data analytics
Innovativeness								
Pearson correlation	1							
Sig. (2-tailed)								
N	15							
Competitiveness								
Pearson correlation	0.121	1						
Sig. (2-tailed)	0.669							
N	15	15						
Creativeness								
Pearson correlation	0.459	0.295	1					
Sig. (2-tailed)	0.085	0.285						
N	15	15	15					
Effectiveness								
Pearson correlation	0.671**	0.337	0.877**	1				
Sig. (2-tailed)	0.006	0.220	0.000					
N	15	15	15	15				
Productiveness								
Pearson correlation	0.822**	0.159	0.732**	0.899**	1			
Sig. (2-tailed)	0.000	0.573	0.002	0.000				
N	15	15	15	15	15			
Efficiency								
Pearson correlation	0.822**	0.159	0.732**	0.899**	1.000**	1		
Sig. (2-tailed)	0.000	0.573	0.002	0.000	0.000			
N	15	15	15	15	15	15		
Profitability								
Pearson correlation	0.048	0.065	0.118	0.228	0.254	0.254	1	
Sig. (2-tailed)	0.864	0.817	0.675	0.413	0.361	0.361		
N	15	15	15	15	15	15	15	
Big data analytics								
Pearson correlation	0.573*	−0.221	0.369	0.531*	0.591*	0.591*	−0.424	1
Sig. (2-tailed)	0.026	0.429	0.176	0.042	0.020	0.020	0.115	
N	15	15	15	15	15	15	15	15

Notes: **Correlation is significant at the 0.01 level (2-tailed); *correlation is significant at the 0.05 level (2-tailed)

Table 2. Interpretation of the correlation of big data analytics and organisational performance of TUK

Variable	Correlation results	Interpretation
Relationship between innovativeness and big data analytics	R = 0.573*, sig = 0.026	Strong positive, significant relationship
Relationship between competitiveness and big data analytics	R = −0.221, sig = 0.429	Strong negative but insignificant relationship
Relationship between creativeness and big data analytics	R = 0.369, sig = 0.176	Moderate positive, insignificant relationship
Relationship between effectiveness and big data analytics	R = 0.531*, sig = 0.042	Strong positive, significant relationship
Relationship between productiveness and big data analytics	R = 0.591*, sig = 0.020	Strong positive, strongly significant relationship
Relationship between efficiency and big data analytics	R = 0.591*, sig = 0.020	Strong positive, strongly significant relationship
Relationship between profitability and big data analytics	R = −0.424, sig = 0.115	Strong negative, and insignificant relationship

authors used SPSS version 21 to code, enter and compute multiple regression so as to establish the causal effects between the variables. R^2 is a statistical term used to express how good one term is at predicting another. If R^2 is 1.0 then given the value of one term, one can perfectly predict the value of another term. If R^2 is 0.0, then knowing one term does not help to know the other term at all. More generally, a higher value of R^2 means that one can better predict one term from another. The rule of thumb is that R^2 of more than 50% is considered as significant. The regression analysis for TUK (Table 5) after combining the two independent variables (i.e. insights and algorithms), the R^2 was 0.289 representing 28.9%. This implies that the independent variables had minimal influence on the dependent variables at TUK.

Table 5 above indicates that big data analytics at TUK has an insignificant influence on the organisational performance with a percentage of 28.9%. This indicates that there are other factors that influence TUK's performance that are not necessarily related to big data analytics. These factors account for the 71.1% of the performance.

Table 6 shows that the regression analysis for SU after combining the two independent variables was R^2 = 0.625, representing (62.5%). This implies that these factors are important and influence the combined dependent variables of organisational performance at SU.

Table 7 indicates that big data analytics greatly influence the organisational performance of SU. The analysis indicates that the independent variable highly influences the dependent variable although there are other factors (37.5%) that also influence the performance.

Qualitative findings on the influence of big data analytics on organisational performance

The following are some of the verbatim excerpts from the interviews conducted on the benefits of big data analytics for organisational performance. The institutions of the respondents are indicated in brackets against their responses.

> Big data analytics enable us to identify customer needs and serve them efficiently. [SU]

> With big data analytics, we are able to do data mining and serve our clients faster. We are able to know who have not paid their fees on time and give them reminders. [TUK]

Table 3. Relationship between big data analytics and organisational performance at SU

Correlations for SU	Innovativeness	Competitiveness	Creativeness	Effectiveness	Productiveness	Efficiency	Profitability	Big data analytics
Innovativeness								
Pearson correlation	1							
Sig. (2-tailed)								
N	24							
Competitiveness								
Pearson correlation	0.816**	1						
Sig. (2-tailed)	0.000							
N	24	24						
Creativeness								
Pearson correlation	0.905**	0.894**	1					
Sig. (2-tailed)	0.000	0.000						
N	24	24	24					
Effectiveness								
Pearson correlation	0.736**	0.687**	0.924**	1				
Sig. (2-tailed)	0.000	0.000	0.000					
N	24	24	24	24				
Productiveness								
Pearson correlation	0.666**	0.816**	0.920**	0.942**	1			
Sig. (2-tailed)	0.000	0.000	0.000	0.000				
N	24	24	24	24	24			
Efficiency								
Pearson correlation	0.929**	0.685**	0.921**	0.895**	0.760**	1		
Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000			
N	24	24	24	24	24	24		
Profitability								
Pearson correlation	−0.112	0.069	0.288	0.589**	0.608**	0.193	1	
Sig. (2-tailed)	0.601	0.747	0.172	0.002	0.002	0.367		
N	24	24	24	24	24	24	24	
Big data analytics								
Pearson correlation	0.654**	0.673**	0.780**	0.765**	0.766**	0.707**	0.351	1
Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.009	
N	24	24	24	24	24	24	24	24

Note: **Correlation is significant at the 0.01 level (2-tailed)

Table 4. Interpretation of the correlation of big data analytics and organisational performance of SU

Variable	Correlation results	Interpretation
Relationship between innovativeness and big data analytics	R = 0.654**, sig = 0.000	Strong positive, strongly significant relationship
Relationship between competitiveness and big data analytics	R = 0.673** , sig = 0.000	Strong positive, strongly significant relationship
Relationship between creativeness and big data analytics	R = 0.780**, sig = 0.000	Strong positive, strongly significant relationship
Relationship between effectiveness and big data analytics	R = 0.765**, sig = 0.000	Strong positive, strongly significant relationship
Relationship between productiveness and big data analytics	R = 0.707**, sig = 0.000	Strong positive, strongly significant relationship
Relationship between efficiency and big data analytics	R = 0.766**, sig = 0.000	Strong positive, strongly significant relationship
Relationship between profitability and big data analytics	R = 0.351, sig = 0.009	Moderate positive, and strongly significant relationship

Note: The ** are as from the correlation analysis in SPSS to indicate the how strong the correlations are significant

Table 5. Regression analysis of TUK

Model	R	R^2	Adjusted R^2	Std error of the estimate	Sig.
1	0.538[a]	0.289	0.235	0.54745	0.039

Note: [a]Predictors: (constant), big data analytics (insights and models/algorithms)

Table 6. Regression analysis of SU

Model	R	R^2	Adjusted R^2	Std error of the estimate	Sig.
1	0.791[a]	0.625	0.608	0.60882	0.000

Note: [a]Predictors: (constant), big data analytics (insights and models/algorithms)

> Organisations are willing to invest money on big data analytics because through it they are able to smoothly operate and predict their output/outcome in future. [SU]

> Data is scattered in different places and connecting them for gaining insight makes an organisation to have a competitive advantage. This means that productivity is increased. [TUK]

> Different data streams could be combined more efficiently through big data analytics. When data collection is reliable, it can be connected with other sources to increase the efficiency of an organisation's operations. [SU]

Figure 1 is generated from ATLAS.ti. It shows the major themes which emerge from the verbatim responses of the participants of the study.

Figure 1 indicates that from the interviews with key informants, big data analytics enhances competitive advantage and effectiveness of academic institutions in Kenya. It also enables the organisations to offer timely services and improves their productivity. The

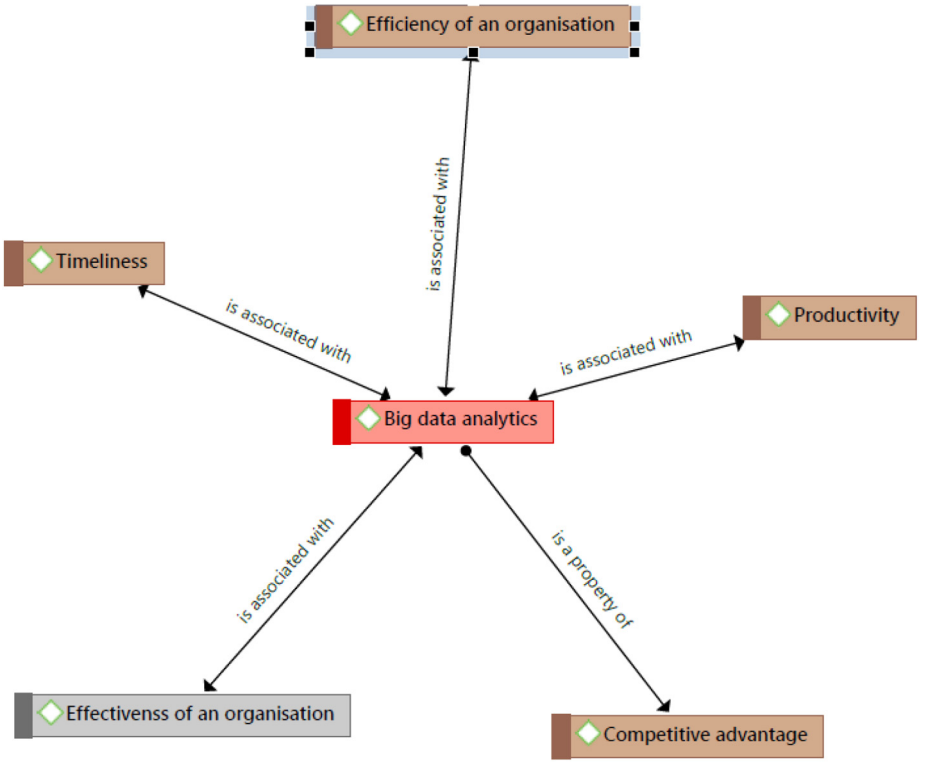

Figure 1.
Relationship between big data analytics and organisational performance

figure also indicates that big data analytics also enables organisations to operate efficiently and cost-effectively.

Strategies of enhancing the positive influence of big data analytics on organisational performance at Technical University of Kenya and Strathmore University

Figure 2 presents the views of the respondents from TUK on how to enhance the positive effect of big data analytics on organisational performance.

The image with the big circle to the right, in Figure 2, indicates that the respondents were of the opinion that availing big data analytics equipment and policy would enhance the management of big data analytics. In addition, they suggested that there is a need for training on big data analytics, especially on current tools of analytics. Arising from the results shown in

Figure 2.
Strategies of enhancing the positive influence of big data analytics on organisational performance at TUK

Figure 2, some 106 (46 %) of the key informants were of the view that big data analytics can be used for research and detection of errors in transcripts and certificates. They also indicated there is need for creating awareness about big data in the organisation. The informants also identified the need for adequate budgetary allocations for equipment purchase and staff development to enhance big data analytics, which in the end leads to better organisational performance.

On the contrary, respondents from SU proposed different strategies that can positively enhance the influence of big data analytics on the university's performance. The suggestions from the key informants are as shown in Figure 3.

It is evident from Figure 3 that most of the respondents were of the view that for big data analytics to influence their organisational performance effectively there is a need for more analytics tools than the usual Java and R programming. They also suggested the need for more courses or training programmes on the same to enhance their skills in big data analytics. The respondents also proposed that greater awareness be created among students and staff on the concept. Increased research support, both financially and time off for research activities, was also proposed as a strategy for enhancing big data analytics at SU. Additionally, they expressed the need to leverage on big data by making it accessible in data banks.

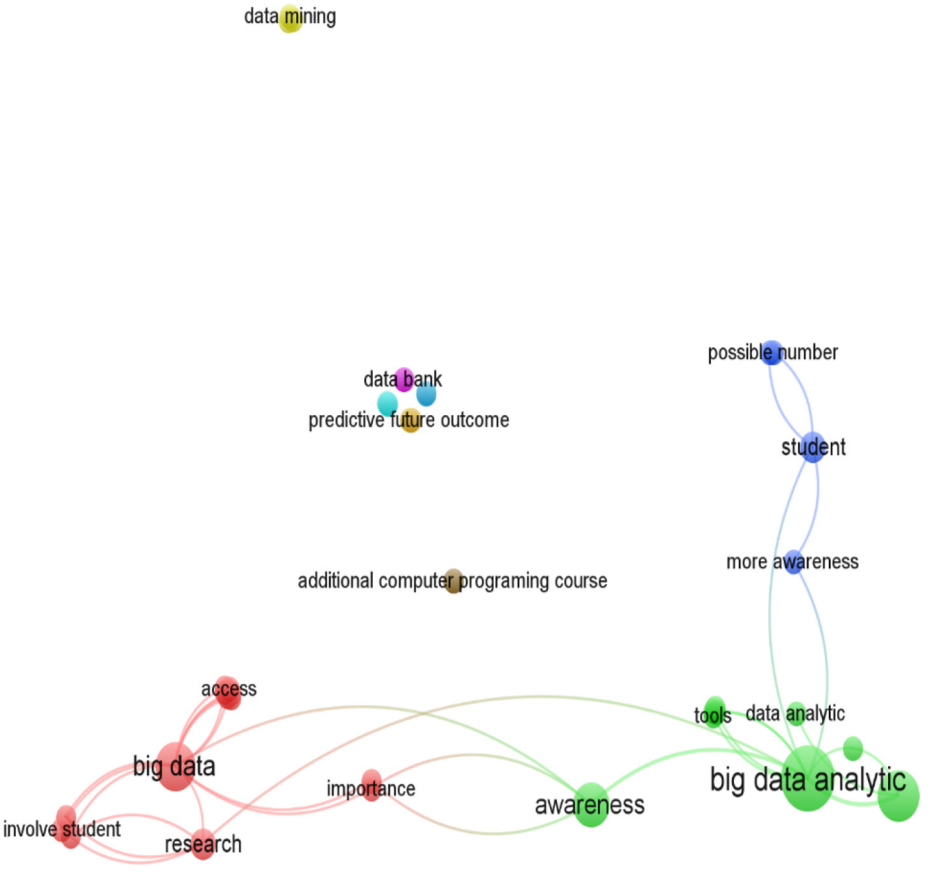

Figure 3.
Strategies of enhancing the positive influence of big data analytics on organisational performance at SU

Discussion

The findings of the study which have been presented in the preceding sections are interpreted and discussed in this section.

Relationship between big data analytics and organisational performance for Technical University of Kenya and Strathmore University

Several factors can contribute to organisational performance in relation to big data analytics. The factors and their influences are discussed hereunder:

Innovativeness. There was a positive and significant relationship between innovativeness and big data analytics for both institutions with correlations of 0.573 for TUK and 0.654 for SU. This shows that both public and private academic institutions in Kenya are able to develop and execute new ideas through big data analytics. The results are in agreement with Wong (2012), who asserted that institutions need to adopt big data analytics to be sustainable and generate useful insights for innovation and decision-making. This implies that for organisations to thrive, they need to be data-driven and apply big data analytics as a way of creating original ideas. The findings demonstrate that both public and private academic institutions in Kenya have the ability to continuously innovate if they leverage on big data analytics. This is evident from the positive relationship between big data analytics and innovativeness that this study has demonstrated.

Competitiveness. The study established that there were differences in the relationship between competitiveness and big data analytics in TUK and SU. TUK, on the one hand, had a strong negative and no relationship between competitiveness and big data analytics ($r = -0.221$, sig = 0.429). SU, on the other hand, had a strong positive and strongly significant relationship ($r = 0.673$, sig = 0.000). The differences can be attributed to the fact that public academic institutions in Kenya, such as TUK, acquire their clientele through government placement while private institutions, such as SU, undertake rigorous marketing to attract students and overcome competition. This implies that for TUK, like any other public university in Kenya, big data analytics does not necessarily influence its competitiveness. Another attribution for the negative correlation could be a lack of advanced technologies to conduct effective big data analytics at TUK. Chen *et al.* (2012) observed that for organisations to extract value out of large data sets and enhance organisational competitiveness, they need advanced information technologies.

Creativeness. The study established that there was a positive but insignificant relationship between creativeness and big data analytics for TUK ($r = 0.369$, sig = 0.176) while SU had a strong positive and significant relationship ($r = 0.780^{**}$, sig = 0.000). This implies that both public and private institutions can enhance their creativity potential by using big data analytics as they are able to develop new and original ideas. This finding concurs with the views of McAfee *et al.* (2012) that organisations that analyse their big data are creative. The positive relationship between big data analytics and creativeness indicates that conducting big data analytics influences the creativity capacity of the two institutions positively.

Effectiveness. Both institutions had positive correlation and significant relationship between effectiveness and big data analytics (TUK: $r = 0.531$, sig = 0.042; and SU: $r = 0.765^{**}$, sig = 0.000). This is because if big data is analysed using appropriate techniques and tools, it can give rise to numerous ideas and hence organisations can get effective results. Institutional big data can be analysed to enhance services and their delivery. These results are in agreement with those of Agnihotri and Sharma (2015), who opined that implementing big data analytics in organisations enable effective and better flow of services. These results are also in tandem with a survey conducted by Forbes Insights (2013)

with senior marketers about the effectiveness of big data analytics. The survey suggested that big data boosts marketing effectiveness. Thus, big data analytics enables both public and private institutions to analyse the vast amounts of data they generate and helps them to function more effectively.

Productiveness. The results show that both TUK and SU exhibited a strong positive and strongly significant relationship between productiveness and big data analytics (TUK: r = 0.591, sig 0.020; and SU: r = 0.707, sig 0.000). It is evident that public and private academic institutions are able to become productive by analysing and understanding the patterns in their big data. The findings indicate that with big data analytics, the two institutions are able to generate new information and identify designs that would enable them to improve their processes, increase supply chain efficiency and identify the factors that affect production. Some of the factors include human resource, equipment and machines, fiscal resources and physical infrastructure, among others.

Efficiency. Both TUK and SU had a strong positive and strongly significant relationship between efficiency with big data analytics (TUK: r = 0.591, sig 0.020; S: r = 0.766, sig 0.000). This finding confirms that when the institutions conduct big data analytics, their efficiency increases. This can be attributed to the fact that both institutions confirmed to work towards making the life of their clientele easier. Through big data analytics, the institutions are able to complete their tasks promptly and engage better with their customers.

Profitability. The study established that there is a difference in the relationship between profitability and big data analytics for the two institutions. Whereas TUK had a strong negative correlation and no significant relationship (r = −0.424, sig 0.115), SU had moderate positive correlation and a significant relation (r = 0.351, sig 0.009). Previous studies show that successful organisations use big data to help them to predict their future paths and to align themselves with their goals. McKinsey and Company (2016) argues that whether the organisations aim to increase profitability or decrease social inequality, big data analytics plays a crucial role for every organisation. Although there seems to be high correlation between big data analytics and profitability in SU, this was not the case for TUK, as the institution had a negative relationship of the two variables. This difference may be attributed to the fact that public academic institutions in Kenya, such as TUK, receive government capitation. Therefore, they are not directly interested in making profits. Conversely, SU, being a private institution, has to look for funds to remain in business hence it links its big data analytics to profitability.

Strategies to enhance the positive influence of big data analytics on organisational performance

The major findings were that the influence of big data analytics on organisational performance can be enhanced by providing tools and equipment for big data analytics; offering training on big data analytics; nurturing a data-driven culture; creating awareness on big data analytics; improving accessibility of big data; providing reliable ICT services; allocating a budget for big data analytics; employing big data analytics experts; developing a policy/strategy for big data analytics; conducting more research on big data analytics; and having an all-inclusive approach to the adoption of big data analytics.

The above results are in agreement with McKinsey and Company (2016), which argued that for companies to leverage on big data analytics, they must be ready to learn the concept as well as use the best tools and techniques to undertake it. The company also proposed that organisations should develop strategic plans on how to deal with big data analytics. Academic institutions need to have a strategy regarding big data collection, storage and usage. Miller (2014) stated that the differentiation in business requires a strategy that

considers data as a core business asset. The strategic focus should be clear and analytics should be connected to organisational business (Dhar, 2013; Provost and Fawcett, 2013; Waller and Fawcett, 2013). The strategy helps in focussing the work of data analysts on relevant matters relating to big data analytics.

The results from the empirical study negated two findings of IBM (2017), which project the view that for organisations to thrive in big data analytics, they only need three strategies: build a culture of analytics as well as enhance privacy and security. Contrary to the view by IBM, this study only found that organisations capitalising on big data and analytics platforms can enable the usage of all types of data sets. The findings did not have the views on privacy and security. This result was in agreement with International Business Machines (2014) that indicated that organisations need to invest in big data analytics.

In offering more courses on big data analytics, the findings are in agreement that there has been a digital revolution associated with the development of new technologies such as universal computing devices, flexible classrooms and mass open online courses. These help in providing more room for learning and providing an understanding of big data analytics where organisations are able to learn from online courses. This assists academic institutions to meet their evolving student needs and at the same time, reduce operational costs. From an organisational learning viewpoint, institutional effectiveness depends on big data analysis. According to Bichsel (2012), through the use of current technologies, organisations are able to gain insights from big data. These technologies also have influenced the academic fraternity by providing generation of valuable information by students, computer applications and systems (Hrabowski and Suess, 2010).

Big data analytics is a technique for advanced changes in academic which enable the institutions to provide data-based evidence and decisions (Siemens, Dawson and Lynch, 2013). There is a huge amount of big data from student's data, for example, enrolment, disciplinary records and academic records, and the academic institutions can leverage on them to gain insights and make the life of the students better. Big data analytics in academic institutions can be transformative and can change the current procedures of management, lecturing and learning (Baer and Campbell, 2011). This, therefore, contributes to policy and practice outcomes which may help address contemporary challenges facing higher education.

Conclusion

Most of the variables used to measure the relationship between big data analytics and organisational performance demonstrated a positive correlation. The variables that had a positive correlation in the two institutions were innovativeness, creativeness, effectiveness, productiveness and efficiency. While TUK had a negative correlation on competitiveness and profitability, SU had a positive correlation with the same. This can be attributed to the understanding that public institutions, such as TUK, get direct support from the government. Therefore, to them, big data analytics is not directly linked to competitiveness or financial profitability. Private institutions, on the other hand, remain sustainable through rigorous marketing and branding.

Recommendations

Based on the findings of the study, the authors make the following recommendations.

Develop big data analytics strategy

Both TUK and SU should have a clearly defined strategy on the use of big data analytics. The strategy will act as a guideline on what to do at each specific time and what the

deliverable would be. The strategy would thus help the institutions to realise the potential competitive advantages that big data analytics offers. This will also enable the institutions to get infrastructural and management support to adopt big data analytics for enhancing organisational performance.

Develop big data analytics policy
The TUK should develop a policy to link big data analytics to the competitiveness and profitability of the institution. Such a policy would be the anchor of actions adopted by or proposed by the organisation in matters pertaining to big data management.

Embrace more tools of big data analytics
Both TUK and SU need to embrace more big data analytics tools. They should particularly explore open source tools such as Hadoop and cloud-based analytics systems which bring significant cost advantages on the analysis and storage of large amounts of data.

Adopt diverse techniques of big data analytics
The two academic institutions should adopt diverse big data analytics techniques. For example, they can adopt techniques such as learning analytics and mobile analytics to enable them to get insight from their big data. Similarly, they can adopt advanced analytics techniques such as text analytics, machine learning, data mining, statistics and natural language processing. The techniques can be used to analyse previously untapped data sources independently or together with their existing enterprise data to gain new insights resulting in better and faster decisions.

Adopt collaborations to expand big data analytics in their institutions
There should be a collaboration between TUK, SU and other institutions to help them develop smarter solutions or access to already available big data analytics tools. They may get these tools from their providers if the two institutions do not have them. This may enable them to have access to the tools easily and in a cost-effective manner.

Invest on big data analytics and training on big data analytics
Both academic institutions should invest in enhancing their ICT tools, skills and capabilities. Investing on big data analytics significantly increases value addition on services or operating profits. Also investing on training personnel on big data analytics builds skills for the analytics. Skilled employees across the spectrum of data analytics roles are in short supply. So, aggressive actions to address this problem are critical.

Implications of the study. The findings of this study can influence the development of big data analytics policies by TUK and SU as well as other academic institutions in similar contexts. The findings can influence the development of big data analytics policy in regards to having a positive influence on competitiveness and profitability for TUK. On the other hand, SU can use the findings of the study to help in the development of policies on collaboration, big data analytics resource sharing and big data analytics training. Other academic institutions can use the findings to influence the development of policy on big data analytics as a means of enhancing organisational performance. The institutions of higher learning can use the results to enable them to develop policies on big data thereby underscoring the role of big data analytics in organisational decision-making. The findings of this study may be used to anchor the adoption of big data analytics as a means of enhancing organisational performance by TUK and SU. The findings may also be used by

the academic fraternity as well as ICT practitioners to influence the learning of the students. This can be done by conducting big data analytics through use of learning analytic to understand the student's digital footprints and use the data to guide them on their learning.

Recommendations for further study. Further studies identified as potentially beneficial in relation to this study include:

- Similar studies may be carried out on other private and public academic institutions to determine whether the outcomes of the current study can be generalised across the academic institutions in Kenya.
- Further research may be carried out to find out how the adoption of big data analytics in public academic institutions can positively influence competitiveness and profitability of the institutions.

Notes

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