TECHNIUM
SOCIAL SCIENCES JOURNAL

Vol. 25, 2021

A new decade for social changes

www.techniumscience.com

ISSN 2668-7798

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

Heterogeneous Analysis of the Nexus between Big Data Analytics and Value Co-Creation: Insight from Selected Service Businesses in Ghana

Samuel Kofi Otchere[1*], Hongyun Tian[1], Cephas Paa Kwasi Coffie[2], Frank Hammond[1]

[1]School of Management, Jiangsu University, 301 Xuefu Road, Zhenjiang, 212013, Jiangsu, China, [2]School of Management and Economics,University of Electronic Science and Technology of China, 611731, Chengdu, China

samme20142015@gmail.com*, 100003511@ujs.edu.cn, coffiecephagmail.com, forgeliani@gmail.com

Abstract. The study examines big data role analytics in interfirm value co-creation in selected service businesses in Ghana by focusing specifically on the heterogenous big data characteristics. This is in response to the ongoing debate on value co-creation and big data nexus. Using data from 61 purposively sampled service businesses in Accra-Ghana, the structural equation model provides that; big data analytics positively influences interfirm value co-creation in the selected businesses. Further, aside from big data volume, all the other big data characteristics (velocity, veracity, value, and variety) also individually influence value co-creation. Therefore, this challenges businesses of all sizes to invest in the application of big data for strategic decisions like value co-creation. Again, although businesses should be willing to collaborate with others, big data teams should be fully equipped for optimal analytics.

Keywords. Big data Analytics, Value co-creation, Big data Team, Service businesses, Ghana

Introduction

Debates on the usefulness of big data to the progress of businesses continue to reach new heights progressively (Lozada et al., 2019; Kolajo et al., 2019). This is because the modern world of business is founded on the availability of timely and accurate data (Furtado et al, 2017). Consequently, businesses today strive to better understand their processes, customers, and the environment through data analytics (Javashankar et al., 2019; Acharya et al., 2018). Although the initial cost of big data analytics may be relatively higher for smaller businesses, the ultimate long-run outcomes surpass this cost (Furtado et al, 2017;Xie et al., 2016). Previous and recent literaturehave reechoed the significance of big data analytics in business performance, innovation, and the sustainability of businesses of all sizes (Troisi et al., 2018; Zaki et al., 2017). While this is true, most businesses in developing countries like Ghana are yet to fully exploit this to their advantage (Marfo& Boateng, 2015). This is hypothetically down to the unavailability of skilled labor, inadequate financial resources, and managerial inefficiencies (Adjei et al., 2018; Marfo& Boateng, 2015). Therefore, this study attempts to present evidence ofa linkage between big data analytics and value co-creation in Ghanaian businesses. This is

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

necessary because of the need to create awareness through empirical justification to drive the interest of industry practitioners, policymakers, researchers, and other stakeholders.

Value co-creation signifies the interplay between customers, businesses, and other stakeholders within the creation of value for the benefit of all the parties involved (Nusenu et al., 2021; Tian et al., 2021). This exchange can be between firms to customers, firm to suppliers, or firm to firms (Opata et al., 2021; Aquilani et al., 2020; Otchere et al., 2019). Since this involves the sharing of timely and accurate information between the parties, big data analytics becomes a significant piece of the jigsaw puzzle (Troisi et al., 2018; Zaki et al., 2017). Nevertheless, big data analytics per existing literature extrapolates that the quality of the big data team available in a firm positively influences the outcome of the analytics and the quality of the decision process. This outlines one of the major issues inhibiting the use of big data in Ghana (Adjei et al., 2018). The availability of skilled labor in the area of big data analytics and the willingness of firms to commit resources to this agenda continues to limit big data application in the makingof decisions. Therefore, the current study seeks to provide evidence on the associationbetween value co-creation and big data in firms using big data analytics in their decision-making processes.

Given the role of businesses in the economy of Ghana and the need to achieve optimum productivity, several cost-cutting innovative avenues are explored constantly by these businesses. However, resource availability, lack of expertise, and managerial inefficiencies inhibit the application of modern techniques like big data analytics (Adjei et al., 2018; Marfo& Boateng, 2015). Although several studies examine the significance of big data in businesses (Ge et al., 2018;Caputo et al., 2017;Uden et al., 2018), studies in Ghana on this issue are scanty. Therefore, to close this gap, the current study explores the relationship between big data analytics and value co-creation. Specifically, the study examines the effect of the heterogenousbig data characteristics in value co-creation. To generate insights, the study seeks answers to the following research questions; what is the relationship between big data analytics and value co-creation? and, do the various big data characteristics affect value co-creation differently? Big data comprises of the five characteristics (Velocity, Value, Volume, Veracity, and Variety) and big data team. On the other hand, value co-creation focuses on interfirm value co-creation.

Using a sample of 61 purposively selected respondents in a structural equation model, the study determines a positive relationship between big data analytics and value co-creation. Further, aside from big data volume, all the other characteristics positively influence value co-creation in the selected firms. Therefore, this study provides a significant roadmap for businesses in Ghana to consider the useof big data in decision-making. It also challenges researchers to explore other avenues where big data could be useful in the country. The outcome of this study follows existing literature to suggest the significance of big data to business progress. According to Ge et al (2018) big suggest that big data could be usedin the creation of new services in the internet of things. Favaretto et al. (2020) and Kolajo et al. (2019) per a systematic study provesthat big data research is still initsearly stagesand requires more studies. However, Troisi et al (2018) challengebusinesses to invest in big data analytics to stimulate innovation and value co-creation. Again, Caputo et al. (2017) suggest that big data analytics can boost brand awareness amongst customers. Following, several studies establish a positive relationshipbetween big data analytics and value co-creation (Javashankar et al., 2019; Acharya et al., 2018; Lozada et al., 2019; Uden et al., 2018). Table 1 summarizes the existing literature on the subject. Therefore, this study adds to existing literature significantly from an African perspective.

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

The remainder of the paper is structuredas follows; the description of the research methods employed in the conduct of the study, the presentation of the study results, the discussion of the study results, conclusion, limitations, and recommendation for future studies.

Table 1. Summary of literature

Author	Focus	Method(s)	Outcome
Ge et al. (2018)	Big data and the Internet of things	Systematic literature review	Big data research and its associated application opportunities in eight IoT domains.
Favaretto et al. (2020)	Interpretation of Big data among researchers	Interviews and thematic coding	**There is noclear** definition of **big** data.
Kolajo et al. (2019)	Analysis of Big data streams	Systematic literature review	Big data is wideopen for further future research.
Troisi et al. (2018)	Big data management and co-creation	Case study	**Businesses** should invest in engagement platforms such as a digital forum, social media brand pages, or a **special** digital and interactive environment **designed** for the occasion to facilitate the collection, storage, and analysis of **customer-generated** big data.
Caputo et al. (2017)	Big data in value co-creation	Qualitative study	**A branded** content strategy can **fosterpositive** audience **attitudesabout** the brand
Javashankar et al. (2019)	Co-creation, Big data, and B2B	Semi-structured interviews and Constant comparative method	**It provides** evidence of **co-creation** through direct and indirect interaction, autonomous **co-creation,** and **the epistemic,** monetary and **ecologicalbenefits** in digital agriculture.
Acharya et al. (2018)	Big Data, knowledge co-creation, and decision making	Empirical research	**Knowledge-based** interactions between customers and sales **staff enhanceco-creation.**
Lozada et al. (2019)	Big data analytics and co-innovation	Structural equation modeling	Big data **enables** better and more **flexibleco-creation** of **products** and **services,as well as the creationof** more **reliable** networks **of cooperation withstakeholders,both internal** and external to the **company.**
Uden et al. (2018)	Big data and intellectual capital management	Systematic literature review	Big Data t**ransformation forICManagementaims** t**o create** value based on a set of critical **parameters** useful **fordefining** goals, **keyplayers** and stakeholders, processes and motivations.

Source: Authors Construct

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

Development of Research Hypothesis

Based on the research problem, the research objectives, and the research questions envisioned, the following hypothesis isdeveloped to provide answers as depicted in figure 1;

H1: Big data analytics positively influences value co-creation in the selected businesses

Big data here per our study refers to the different characteristics as well as the quality and sophistication of the big data team available. Per literature, the different big data characteristics positively influence innovation and value co-creation (Favaretto et al., 2020; Kolajo et al., 2019).Further, the quality of the big data team performing the analytics affect the quality of big data backed decisions (Lozada et al., 2019). Therefore, we propose that the big data characteristics and the big data team positively influences value co-creation in the selected service businesses.

H1a: Big data velocity positively influences value co-creation in the selected businesses

Big data velocity focuses on the time data flow into the organization from the different sources of big data. Per literature, timely inflow of data significantly affects the nature of analytics as well as the potency of the decision making process (Uden et al.,2018). Therefore, we suggest that big data velocity positively influences value co-creation in the selected service businesses.

H1b: Big data veracity positively influences value co-creation in the selected businesses

The truthfulness and the verifiable fact from big data affects the nature of analytics output and the consequent decision. Therefore, literature has established a positive association between big data analytics and the effect on decision making (Troisi et al., 2018). Consequently, we propose that big data veracity positively influence value co-creation in the selected service businesses in Ghana.

H1c: Big data volume positively influences value co-creation in the selected businesses

The quantity of data available to the big data analytics team to work with could significantly affect the nature of insights provided from the analytics process. Literature extrapolate that the volume of big data affects the nature of decision making in the organization (Javashankar et al., 2019). Therefore, we suggest that big data volume positively influence value co-creation in the selected businesses.

H1d: Big data variety positively influences value co-creation in the selected businesses

The variety of big data including structured and unstructured data offer big data teams different perspective. These data provide different avenues for the team to generate fresh insight. Literature surmises that big data variety influences the analytics outcome (Caputo et al., 2017). Therefore we suggest that big data variety positively influence value co-creation in the selected service businesses.

H1e: Big data value positively influences value co-creation in the selected businesses

The value of big data could become the defining moment in big data analytics. This is because data of no value to an organization should not be considered in the analytics process. Literature posits that big data value affects the quality of big data insights generated (Favaretto et al., 2020). Therefore, we suggest that big data value positively influences value co-creation in the selected service businesses.

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

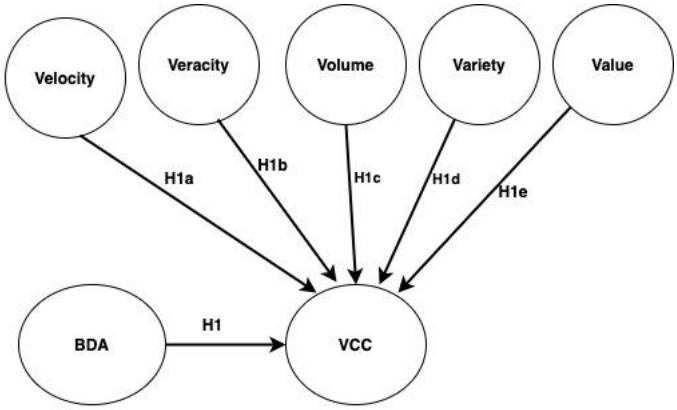

Figure 1. Conceptual Framework

Research Methods

The study employs an explanatory research approach to provide answers to the associationbetween big data analytic and value co-creation amongst firms in Ghana. The main data employed in the study is quantitative in nature. To streamline the study, we focus on only service provision businesses in Ghana. Although other classes of business in the country need big data analytics, the service businesses face fierce competition, and thus the need to constantly innovateprovides the basis for big data application in their strategic decision-making processes. The study focused on service businesses in the capital city of Ghana with about 400 such registered businesses. Given the Covid-19 protocols, the unwillingness of some businesses to participate in the survey, and the budget of the study, the purposive non-probability sampling technique was employed to include specific businesses that are willing to participate in the study. In all, a total of 61 businesses were sampled. To collect data, the chief executive officers (CEOs) of the businesses were the main study respondents. This is because they have. More knowledge about the strategic decisions of the company than others. A survey questionnaire was designed based on existing studies (Prester & Jurić, 2019; Ghasemaghaei & Calic, 2019; Niebel et al., 2019, Mikalef & Krogstie 2020; Schreieck & Wiesche, 2017) was used to collect the responses of the respondents. First, a set of businesses were engaged in a pilot study to determine the suitability of the research instrument. Next, the instrument was reworded to prevent errors and biasness. Finally, the survey instrument was individually administered from June-August, 2021. The 61 fully collated survey responses were coded and analyzed using the SmartPLS software.

Measurement of constructs

The study employs two main constructs namely big data analytics (BDA) and value co-creation (VCC). Table 2 summarizes the study construct, elements, and sources. Accordingly, the BDA construct has two key elements; big data characteristics (velocity, value, volume, veracity, and variety) (Prester &Jurić; 2019; Ghasemaghaei& Calic, 2019) and big data team (Niebel et al., 2019; Mikalef & Krogstie, 2020). Each element has 5 questions and 4 questions respectively. On the other hand, the VCC construct has two elements; approaches (Lusch & Nambisan, 2015), and measures (Schreieck & Wiesche, 2017; Ranjan & Read, 2016). The approaches and measure elements have 4 and 5 questions respectively.

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

Table 2. Measurement constructs

Constructs	Elements	Measures	References
BDA	Characteristics	5 questions	Prester &Jurić (2019), Ghasemaghaei& Calic (2019)
	BDA Team	4 questions	Niebel et al. (2019), Mikalef & Krogstie (2020)
VCC	Approaches	4 questions	Lusch and Nambisan (2015); Schreieck and Wiesche (2017); Ranjan and Read (2016)
	Measure	5 questions	

Source: Authors Construct

Model specification

A structural equation model (SEM) is usedto examine the relationship between big data analytics and value co-creation in the selected businesses. Precisely, the structural equation model allows the estimation of complex relationships between one or more independent variables and one or more dependent variables. Per the model,big data analytics is the response variable (Y) or the endogenous variable while interfirm value co-creation is the exogenous variable (X). The model can therefore be presented theoretically in a matrix form as:

$$\begin{bmatrix} y_1 \\ \cdots \\ y_p \end{bmatrix} = \begin{pmatrix} 0 & \cdots & \beta_{1p} \\ \vdots & \ddots & \vdots \\ \beta_{p1} & \cdots & 0 \end{pmatrix} \begin{bmatrix} y_1 \\ \cdots \\ y_p \end{bmatrix} + \begin{pmatrix} \delta_{11} & \cdots & \delta_{1q} \\ \vdots & \ddots & \vdots \\ \delta_{p1} & \cdots & \delta_{pq} \end{pmatrix} \begin{bmatrix} x_1 \\ \cdots \\ x_q \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \cdots \\ \varepsilon_p \end{bmatrix} \tag{1}$$

Summarily the matrix equation in Eq. (1) can be reformulated as:

$$Y = \boldsymbol{B}Y + \boldsymbol{\Gamma}X + \varepsilon \tag{2}$$

Where p represents the number of regression equations to be estimated simultaneously, p by $p\mathbf{B}$ square matrix contains the parameter coefficients of the regressors of Y variables on the other Y variables with the 0 diagonal values implying that a variable cannot cause itself. Also, the p by $q\boldsymbol{\Gamma}$matrix contains coefficients of the Y's on X's whereas ε is a p by 1 vector consisting of residual terms.

As perthe theoretical model specification, a deduction can be inferredthat a series of regression equations are to be estimated to assess the causal effects amid the variables employed in the study which can be found in the structural model as depicted by Figure 1.

Statistical analysis

This section provides an analysis of the survey responses generated from the purposively sampled 61 respondents from the businesses in Accra-Ghana. First, descriptive statistics are generated, then the reliability and validity of the study constructs are established. Finally, the model is estimated. Table 3 provides a summary of the descriptive statistics on the study respondents engaged in the study. Per the gender dispersion of the respondents, male respondents were more than females with 45 and 19 respondents respectively. On the age of the respondents, the majority of the respondents were above 30 years of age. Concerning the educational qualification of the respondents, most of the respondents had at least secondary

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

education with the majority boasting of tertiary education. Finally, most of the firms have employees, not above 50. This shows that these businesses are relatively small in size.

Table 3. Descriptive Statistics

Variables		Frequency	Percentage
Gender	Male	42	68.85%
	Female	19	31.14%
Age	18-25years	9	14.75%
	26-30 years	20	32.78%
	31years or above	32	52.45%
Education	Basic	3	0.05%
	Secondary	18	29.50%
	Tertiary	40	65.57%
Employees	10-50	46	75.40%
	Over 50	15	24.59%

Source: Authors Construct

Reliability and validity tests

The study employs series of tests to examine the reliability and the validity of the study constructs. Accordingly, the Herman Single Factor, B-S test, KMO and Bartlett's test, the Cronbach alpha, factor loadings, and the Eigen-value are employed. Per the Herman Single factor test using the principal axis factoring (PAF), the value of 31.30% indicates that a single factor is an issue in the study because the value is less than 50%. The Cronbach's alpha proves that the research instrument is internally consistent with values above 0.80. The KMO and Bartlett's test proves that the sampling is adequate. Again, the validity of the research instrument is measured using the average variance extracted (AVE). The outcome shows cross-loadings of above 0.8 respectively to support this assertion. Since the AVE values are expected to be 0.50 or above to suggest that the research instrument meets the requirements for reliability and validity.

Table 4. Construct Reliability and Validity

Factors	Eigen-value	Cum % variance explained	Cronbach α	KMO test	B-S test	Herman Single Factor
BDA	3.70	80.21	0.87	0.80	3112.81[a]	31.30%
VCC	3.46	81.30	0.89	0.87	3012.55[a]	

***Note:**[a] represents a 1% level of significance.

Further, this study tests the validity of the research instrument by usingthe cross-loading factor and average variance extracted (AVE). This is depicted in Table 5which shows the results of the cross-loading factor and the AVE. Via hypothesis, the cross-loading factor should have values greater than 0.7. As a result, items that do not load within this scale were eliminated. BDA (BDA1-BDA5), and VCC (VC1-VC4). Remaining items loaded with values greater than 0.7. This offers evidencethat the items adequately support the numerousconstructs contained inthe study.

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

Table 5. Cross-loading Factor and Average Variance Extracted

	BDA	VCC
BD1	.731	.303
BD2	.850	.070
BD3	.903	-.022
BD4	.895	-.200
BD5	.786	-.309
BD6	.842	-.053
BD7	.764	-.421
CC1	.325	.813
CC2	.054	.777
CC3	.023	.802
CC4	.041	.704
CC5	-053	.895
Average Variance extracted	0.87	0.82

The resultsof the AVE as shown in table 6 is expected to be greater than 0.5. consequently, the constructs usedin our researchshow 0.87 and 0.82 to indicatethat the research instrument confirmboth reliability and validity requirements to warrant moreinvestigation.

Empirical Results

Using SmartPLS we estimated the relationship between big data and value co-creation. Table 5 presents a summary of the result. The interpretations are based on the path coefficient and the p-value produced by the SmartPLS software. As per hypothesis H1, a significant value indicates that big data positive relationship with value co-creation. A unit increase in big data results in a 0.532 increase in value co-creation. Accordingly, the timely arrival of data also has a positive effect on co-creation and this is shown by the positive yet significant result as stipulated by hypothesis H1a. Next, we look at how big data veracity relates to co-creation. A positive and significant increase of 0.091 provides evidence of how accuracy or truthfulness impacts firm value co-creation. However, the analysis provides inconclusive results concerning the associationbetween big data volume and value co-creation. Hypothesis H1d, confirms that a unit increase in big data variety results in a 0.042 increase in value co-creation. Finally, a positive and significant result (0.231) is obtained in the interaction between big data value and value co-creation.

Table 5. SmartPLS Model Output

Hypothesis	Path Coefficients	p.Value	Decision
H1	0.532	0.00[a]	Supported
H1a	0.232	0.03[a]	Supported
H1b	0.091	0.01[a]	Supported
H1c	0.432	0.64	Not-supported
H1d	0.042	0.00[a]	Supported
H1e	0.231	0.04[a]	supported

Source: SmartPLS output

Technium Social Sciences Journal
Vol. 25, 533-543, November, 2021
ISSN: 2668-7798
www.techniumscience.com

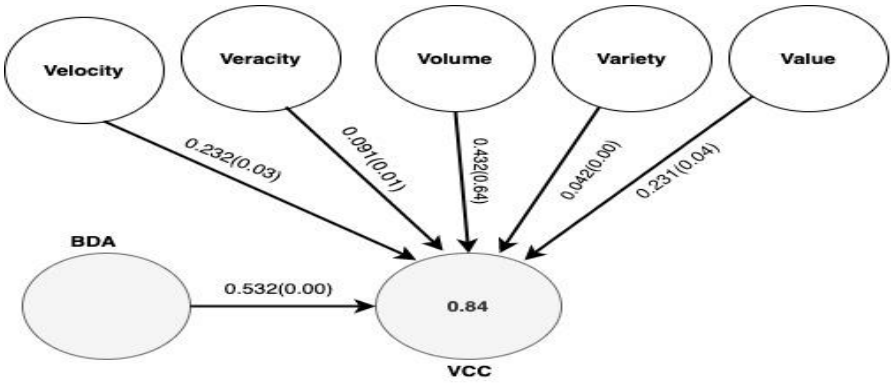

Figure 2. Model Output

Discussion

The study examines the relationship between big data analytics and interfirm value co-creation in selected service businesses in Ghana. Further, it examines the role of specific big data characteristics in value co-creation. The aforementioned results offer a snapshot into the benefits and value addition that big data offers to a firm's value co-creation capabilities. Evidence indicates that proper big data analytics play a major role in a business's ability to harness value co-creation (Troisi et al., 2018; Zaki et al., 2017). Therefore, businesses should consider the overall long-run contribution of big data analytics to performance instead of the initial investment which could deter relatively smaller firms. Again, it has been noted that the timely consumption of big data is crucial for a business, as this will assist in good decision making based on the most recent of data (Furtado et al, 2017; Xie et al., 2016). Managers are therefore encouraged to source up-to-date big data within their businesses.The accuracy of big data also plays a vital role in value co-creation within businesses. Faulty data has been known to be both costly and in some extreme cases resulted in an existential crisis for the businesses. It is therefore suggested that businesses that rely heavily on data verify the truthfulness of data they process it they are to gain any value co-creation benefits. Our results also indicate the need to have a variety of big data for value co-creation. Varied data offers more room for exploration hence enriching the value co-creation process, it provides an opportunity to brainstorm new ideas and make more detailed decisions. Subsequently, business decision-makers should embrace big data analytics and utilize the necessary tools to interpret and manipulate the data in their objective to co-create value.

Conclusion

The study examines a crucial phenomenon significant to the survival and creativity of businesses in Ghana. Per the results obtained and discussed, the following conclusions can be drawn;Big data analytics in the selected service businesses in Ghana drives value co-creation. This could be explained by the fact that decision-making is hinged on the availability of accurate and timely data. Further, this could also be because of the expertise of the data analytics teams in the various businesses. This signifies the age of big data analytics in the business decision-making process. Therefore, businesses of all sizes in Ghana should consider investment in big data analytics to properly understand their customers, market, and processes to develop winning strategies. All the big data characteristics promote value co-creation in businesses except big data volume. Specifically. Velocity significantly influences value co-creation in the selected businesses because timely data is all it takes to make any good decision. Value significantly

influences value co-creation in the selected businesses because data which has no value would be beneficial in value co-creation. However, The volume of big data has no significant relationship with value co-creation in the selected businesses. While this is expected to be positive, this could indicate the lack of expertise from the big data team. Therefore, businesses aiming to benefit from big data analytics should invest in big data teams to achieve optimum output. However, Big data variety significantly influences value co-creation in the selected businesses because the different sources of data and nature of data provide different insights for business decision making. Finally, veracity significantly influences value co-creation in the selected businesses because the accuracy or truthfulness of the data tospecific business needs could be useful in making the optimal choice.

Limitations and Implications for future studies

This study has few limitations which could be explored in future studies. However, the outcome of the study is not significantly affected by these limitations. First, the data focuses on the service businesses, and other studies could look into other types of businesses. Secondly, the business employs primary data using survey questionnaires and thus future studies could explore this phenomenon using secondary data. Finally, future studies can employ other econometric methods to generate insight into the subject.

References

[1] Acharya, A., Singh, S. K., Pereira, V., & Singh, P. (2018). Big data, knowledge co-creation and decision making in fashion industry. *International Journal of Information Management*, *42*, 90-101.

[2] Adjei, E., Gyamfi, N. K., &Otoo-Arthur, D. (2018). Towards a Big Data Architectural Framework for Healthcare in Ghana. *Communications*, *7*, 1-6.

[3] Aquilani, B., Piccarozzi, M., Abbate, T., &Codini, A. (2020). The role of open innovation and value co-creation in the challenging transition from industry 4.0 to society 5.0: Toward a theoretical framework. *Sustainability*, *12*(21), 8943.

[4] Caputo, F., Evangelista, F., Perko, I., & Russo, G. (2017, September). The role of big data in value co-creation for the knowledge economy. In *10th Annual Conference of the EuroMed Academy of Business*.

[5] Favaretto, M., De Clercq, E., Schneble, C. O., &Elger, B. S. (2020). What is your definition of Big Data? Researchers' understanding of the phenomenon of the decade. *PloS one*, *15*(2), e0228987.

[6] Furtado, L., Dutra, M., & Macedo, D. (2017). Value creation in big data scenarios: A literature survey. *Journal of Industrial Integration and Management*, *2*(01), 1750002.

[7] Ge, M., Bangui, H., &Buhnova, B. (2018). Big data for internet of things: a survey. *Future generation computer systems*, *87*, 601-614.

[8] Jayashankar, P., Johnston, W. J., Nilakanta, S., &Burres, R. (2019). Co-creation of value-in-use through big data technology-a B2B agricultural perspective. *Journal of Business & Industrial Marketing*.

[9] Kolajo, T., Daramola, O., & Adebiyi, A. (2019). Big data stream analysis: a systematic literature review. *Journal of Big Data*, *6*(1), 1-30.

[10] Lozada, N., Arias-Pérez, J., & Perdomo-Charry, G. (2019). Big data analytics capability and co-innovation: An empirical study. *Heliyon*, *5*(10), e02541.

[11] Marfo, J. S., & Boateng, R. (2015). Developing big data capabilities in developing countries: Evidence from a cross industry study in Ghana.

[12] Nusenu, A. A., Xiao, W., Say, J., &Opata, C. N. (2021). Value co-creation intention among consumers at the bottom of the pyramid: A study of rural and community banks in Ghana. *Journal of Psychology in Africa*, *31*(2), 159-166.

[13] Opata, C. N., Xiao, W., Nusenu, A. A., Tetteh, S., & Asante Boadi, E. (2021). The impact of value co-creation on satisfaction and loyalty: The moderating effect of price fairness (empirical study of automobile customers in Ghana). *Total Quality Management & Business Excellence*, *32*(11-12), 1167-1181.

[14] Otchere, S. K., Hong-Yun, T., &Kumaning, W. O. A. R. G. (2019). The Effect of Value Co-creation on Innovation Performance: The Mediating Role of Customer Perceived Value. *European Journal of Business and Management*, *11*(27), 47-55.

[15] Tian, H., Otchere, S. K., Coffie, C. P., Mensah, I. A., & Baku, R. K. (2021). Supply Chain Integration, Interfirm Value Co-Creation and Firm Performance Nexus in Ghanaian SMEs: Mediating Roles of Stakeholder Pressure and Innovation Capability. *Sustainability*, *13*(4), 2351.

[16] Troisi, O., D'Arco, M., Loia, F., &Maione, G. (2018). Big data management: The case of Mulino Bianco's engagement platform for value co-creation. *International Journal of Engineering Business Management*, *10*, 1847979018767776.

[17] Troisi, O., D'Arco, M., Loia, F., &Maione, G. (2018). Big data management: The case of Mulino Bianco's engagement platform for value co-creation. *International Journal of Engineering Business Management*, *10*, 1847979018767776.

[18] Uden, L., & Del Vecchio, P. (2018). Transforming the stakeholders' Big Data for intellectual capital management. *Meditari Accountancy Research*.

[19] Xie, K., Wu, Y., Xiao, J., & Hu, Q. (2016). Value co-creation between firms and customers: The role of big data-based cooperative assets. *Information & Management*, *53*(8), 1034-1048.

[20] Zaki, M., Theodoulidis, B., Shapira, P., Neely, A., &Surekli, E. (2017). The role of big data to facilitate redistributed manufacturing using a co-creation lens: patterns from consumer goods. *Procedia CIRP*, *63*, 680-685.