Positioning big data analytics capabilities towards financial service agility

Abeeku Sam Edu
Operations and Management Information Systems, University of Ghana Business School, Accra, Ghana

Received 20 August 2021
Revised 18 November 2021
13 December 2021
Accepted 18 December 2021

Abstract

Purpose – Enterprises are increasingly taking actionable steps to transform existing business models through digital technologies for service transformation such as big data analytics (BDA). BDA capabilities offer financial institutions to source financial data, analyse data, insight and store such data and information on collaborative platforms for a quick decision-making process. Accordingly, this study identifies how BDA capabilities can be deployed to provide significant improvement for financial services agility.

Design/methodology/approach – The study relied on survey data from 485 banking professionals' perspectives with BDA usage, IT capability development and financial service agility. The PLS-SEM technique was used to evaluate the underlying relationship and the applicability of the research framework proposed.

Findings – Based on the empirical test from this study, distinctive BDA usage grounded on the concept of IT capability viewpoint proof that financial service agility could be enhanced provided enterprises develop technical capabilities alongside other relevant resources.

Practical implications – The study further highlights the need for financial service managers to identify BDA technologies such as data mining, query and reporting, data visualisation, predictive modelling, streaming analytics, video analytics and voice analytics to focus on financial knowledge gathering and market observation. Financial managers can also deploy BDA tools to develop a strategic road map for data management, data transferability and knowledge discovery for customised financial products.

Originality/value – This study is a useful contribution to the burgeoning discussion with emerging technologies such as BDA implication to improving enterprises operations.

Keywords Big data capability, Financial service agility, IT capability view, PLS-SEM

Paper type Research paper

1. Introduction

Digital technology innovations have gradually changed the phase of doing business globally and subsequently influenced organisations performance. In their view, Cai *et al.* (2019) observed that the business ecosystems are evolving mainly because of advanced innovations in digital technologies. Therefore, many enterprises such as financial institutions have taken actionable steps to transform existing business models through digital technologies for service transformation. Consequently, financial institutions are steadily heading towards digital banking for a number of reasons (Chanias *et al.*, 2019; Pramanik *et al.*, 2019). However, the most imperative reason is informed by deploying innovative information technologies to improve financial service agility (FSA) driven by data and information (Werth *et al.*, 2020). There is, therefore, a demand for an orientation towards enterprise agility as a new paradigm within the financial service ecosystems. Diverse studies have stressed the antecedents or consequences of enterprise agility (Melián-Alzola *et al.*, 2020). Keenly, antecedents for most enterprise agility has been ascribed to digital technology innovations, which stimulates strategic decision-making, operational efficiency and stability (Harraf *et al.*, 2015; Tallon *et al.*, 2019). Although Financial institutions have been deploying unique information technology

Funding: This research was funded by the University of Ghana Business School (Award number: 03221821).

Aslib Journal of Information Management
Vol. 74 No. 4, 2022
pp. 569-588
Emerald Publishing Limited
2050-3806
DOI 10.1108/AJIM-08-2021-0240

(IT) strategies to shift from traditional banking into the era of digital banking, digital disruptions are on the ascendency (Manser *et al.*, 2021; Morkunas *et al.*, 2019).

This has presented an opportunity for financial institutions to deploy emerging digital technologies with their accompanying capabilities to build FSA to differentiate products or services valuable to customers and ultimately improve revenues. Seemingly, continuous advances and rapid availability of huge financial data calls for banks to deploy digital technologies and applications to improve data acquisition, data processing, data and information storage, knowledge creation and decision-making process in real-time (Labun, 2016; Mavlutova *et al.*, 2020).

In recent times, billions of intelligent devices connect to create intelligent systems to interact through data sharing on the cloud. Therefore, financial institutions have opined that knowledge derived from financial data through the use of technologies and financial resources is the new greatest asset for banks (Skyrius *et al.*, 2018). This has immensely offered emerging digital technologies such as big data analytics (BDA) capabilities to comprehensively analyse customers' financial data and other related financial data to enhance banking operations. BDA capabilities offer financial institutions to source financial data, analysis of data, insight and store such data and information on collaborative platforms for a quick decision-making process in real-time. Financial data acquisition, processing and storage, have become pivotal for financial institutions (Roumeliotis, 2019). While current studies on BDA deployment generally suggest an enhancement in enterprise operation, there is still missing discourse on its implications on financial service operations, hence, linkage to BDA capabilities is an important gap to explore. Based on this concept, the objective of this study is to reveal the connection between BDA capabilities implications on financial services agility.

As such, the role of BDA capability usage relies on the overall IT capability development by a firm to promote enterprise agility. Additionally, based on Tallon *et al.* (2019) recommendation for future study to investigate the impact of IT on enterprise agility, this study proposes BDA capability (IT) topology usage as a factor to improve FSA. Moreover, this insight is useful for shaping the discourse in IS literature towards BDA evolution for financial services. The usage of BDA tools has been ascribed to be a catalyst to promote firms' preparedness to collect and analyse large sizes of data for intelligence decisions. Thus, the study proposes a holistic view of BDA capabilities usage in the financial service context. Hence the study analysed the extent to which BDA capability uses can stimulate FSA through the mediating role of the IT capability framework.

The remaining section of the study presents the literature review and the theoretical framework. The next section presents the research methodology followed by data and, and the final section presents the discussions of findings, implications and conclusions.

2. Literature review

2.1 An overview of technology applications in financial services

A cursory review of technology applications and platforms deployed by financial institutions for retail banking and other services over the period ranges from stationed to virtual technology platforms. Again, organisations that develop technology and some start-ups whose activities do not guarantee obtaining financial services licences are gradually expanding to collaborate with banks in various aspects of financial trading. These trends contribute to driving financial institutions to refocus attention to financial technology (FinTech) for operations. FinTech is therefore defined as "technologically enabled innovations that could result in new business models, applications, process, or products with an associated effect on financial markets and institutions and the provision of financial services" (Gun, 2020). Therefore, financial technologies are driving the extent to which

financial institutions are meeting customers' expectations intending to improve payments, transfers, deposits and other business-related concerns (Boratyńska, 2019; Makeeva *et al.*, 2021). The evolution of digital technology started with the introduction of automated teller machines (ATMs), and gradually due to widespread use of the Internet, most banks started Internet banking. Increasingly, the improvement of analogue phones to smartphones also changes the face of banking activities. Currently, due to the cost of banking operations, customer data management, customised products, and services, improving remittances and payments, ATM to ATM interactivity, scalability of digital resources and improving customers services, many banks globally are focussing on integrating emerging technologies like the Internet of Things (IoTs), BDA applications, cloud computing and blockchain to enhance financial services. More importantly, financial institutions are largely faced with conceivable volumes of financial data, and customers' financial transactions require emerging technologies to facilitate insight and knowledge creation from these data.

Similarly, the financial industry is the most data-driven compared to other industries leading to a far-reaching limit with their legacy systems. Big data technologies have therefore advanced the analysis of a range of data that provide financial institutions with the capabilities and tools to obtain, classify, integrate and analyse structured and unstructured financial data from BoTs and cloud services. This, in turn, promotes retail banking the opportunity to aggregate available information about customers to provide better service comprehensively. In a nutshell, big data technologies have enabled financial institutions to fully project customer-centric outcomes, operational optimisation, financial management, creating new financial products and employee collaboration(Hajiheydari *et al.*, 2021). The usefulness of BDA for banking operations includes customer data scalability, wide network accessibility of data, regularising reporting, real-time customer focus, sentiment analysis, control anti-money laundering and customer segmentation (Ali *et al.*, 2020; Sun *et al.*, 2019; Latif *et al.*, 2018).

2.2 IT capability viewpoint

The contention for most firms is the level at which distinctive capabilities of organisations resources are developed to support business needs. From the understanding of resource-based view, championing unique resources within a firm alone will not yield the needed business value from IT and other resources available to an organisation (Barney *et al.*, 2001). It is, therefore, fundamental to further focus on how the capabilities of IT resources and different outlooks support firms' processes. Diverse IT capabilities have been cogitated to comprise "managerial IT skills, technical IT skills, IT infrastructure, IT-enabled processes, relationship IT infrastructure, IT business experience and IT based-assets" (Garrison *et al.*, 2015; Fink, 2011; Bhatt and Grover, 2005). Substantial findings from extant studies have advocated that deploying the applications of these capabilities alongside other aligning resources support an enterprise's performance (Mikalef and Pateli, 2017; Zhou *et al.*, 2015; Wang *et al.*, 2012).

Perception from the Capability framework suggests a definite advantage for an enterprise using the distinct capabilities of resources to improve efficiency. Therefore, the capability view is explained as the "ability of firms to build unique competencies that can leverage their resources" (Karimi *et al.*, 2007). The preceding argument is that, whereas enterprise resources can be uniquely used to create an advantage, identifying and harnessing the capabilities from a strategic position or at a functional level eventually drives business success (Makadok, 2001). More recently, continuous innovation in IT development and the ubiquitous nature of digital applications and platforms by Chae *et al.* (2018) and Ravichandran *et al.* (2014) suggest enterprises develop capabilities through IT assets and configure these capabilities with other resources to promote decision-making, operational excellence and quick customer feedback. Also, Garrison *et al.* (2015) suggested that capabilities are identified as "firms-specific and

non-transferable", and their unique deployment promotes business success. IT capabilities require an organisation to harness all IT infrastructure, digital platforms and human IT capabilities to steer performance. There is a need to holistically integrate all organisation's digital applications and platforms to support functional and operational activities. More importantly, for firms that rely on enormous data to steer operational activities, there is the view to identify and deploy IT resources with capabilities and other resources that are central to transforming service delivery. Holistically, within the context of data management, data transformation, data storage, and data transferability deploying emerging digital technologies such as BDA is essential to promote the hierarchy of "Data to Information to Knowledge and Wisdom" (Ardolino *et al.*, 2018). Based on extant studies from the opportunities BDA provides to various enterprises, this study proposes integrating BDA capabilities as pivotal to service transformation in financial services. Therefore, a framework is proposed to elucidate the capabilities of these IT resources to improve data management, data analytics, data transferability and knowledge sharing.

2.3 Linking BDA capabilities for financial services operations

Review from research findings and industry outlook has highlighted how intelligent devices and systems connectivity alongside cloud computing and data predictive and descriptive are anticipated to disrupt a firm's IT strategies and operational execution (Coreynen *et al.*, 2017; Bughin and Van Zeebroeck, 2017). Supporting this view, Porter and Heppelmann (2015) explore how smart device connectivity supports BDA to transform an industry for a competitive advantage. Specifically, the adoption of the IoTs, now being referred to as "Bank of Things", has helped commercial banks use ATM kiosks to directly interact with customers' mobile phones to easily withdraw money without using their debit cards or master cards. The fundamental value derived from IoTs connected devices is the transmission of customers' financial transactions that allow financial institutions to collect, exchange and create insight from such customers information. As cited by Monteagudo (2020), "Bank of Things (BoTs) is the material infrastructure that facilitates the billions of data transfers that take place every day". Subsequently, commercial and retail banks are leveraging on BoTs data to improve the use of ATMs services by increasing or decreasing the installation of ATMs at specific zones based on the volumes of transactions. Also, the interconnectivity of technologies has improved digital payments and transfers with seamless procedures. An additional essential feature of IoTs that banks use is leveraging sensor devices embedded on vehicles in transit to dispense cash to ATMs machines and, similarly, sensor devices embedded in auto loan vehicles. These added IoT actuators support banks to monitor or easily track all vehicles in transit to specific ATMs to prevent diversions or wrongful locations. The sensors on the auto loan vehicles also provide data on customers' vehicle availability. As such, this move is helping the banks to curtail theft and assist fast recovery auto loan cars.

To sum up, banks are leveraging on IoTs to envisage potential fraud with master cards or credit cards transactions. Depending on the location, master cards are used or swiped, and banks can verify the account holder's device or mobile and the location of the transaction.

Most banks have acknowledged that the level of data been generated has enormously increased due to different sources of collecting data with BoTs. As such, data have now become the most vital assets banks relied upon to effect changes for financial services operations. Largely, the focus for banks is the ability to create value, insight and leverage from data assets. Most banks have therefore construed big data into "a greater scope of information, new kinds of data and analysis, real-time information, data influx from new technologies, modern media, large volumes of data, the latest buss word and data from social media" (Forest *et al.*, 2014). Applications and platforms from new digital technologies have further classified data into volumes, variety, velocity, veracity and value. Personal data and

data from daily financial transactions from customers have been optimised using BDA capability tools to create new financial business models, collaborations amongst employees, detecting fraud, optimising financial operations and customer-focussed services (Hasan *et al.*, 2020). BDA tools such as data mining, query and reporting, data visualisation tools, streaming analytics, etcetera have been deployed by commercial and retail banks to analyse data to drive specific business models to benefit customers and operational improvements. Besides, banks also imitated that the move to invest in big data infrastructure improves data processing, data storage, data management and data analytics. Seemingly, through "weblog data" from banks connected channels and "geospatial data" from mobile phones applications alongside data from core banks operations are quickly retrieved for analysis using BDA intelligence tools. The scope of investigating money fraud-related transactions has largely been improved through a large sample of financial transaction data generated by banks. Clearly, big data and accompanying analytical tools have extended the scope of conceivable means to perform analysis from a large spectrum of available data.

BDA capabilities significantly explore the ability to transform an enormous amount of disparate data to maximise enterprise value with speed. BDA capabilities have been categorised into "aspirational, experienced and transformed" (Lavalle *et al.*, 2011). The aspirational and experienced level of capabilities emphasises exploiting big data technologies to accomplish cost reduction and optimising operations, whereas transformed capabilities aim to drive customer profitability and "market targeted investments in niche analytics" (Wang and Hajli, 2017). From the view of financial data-information lifecycle management, BDA capability could be viewed as the capacity to "generate, store, organise, process, analyse, evaluate the sizable amount of financial data in copious forms towards delivering meaningful insight to financial analysts in a timely fashion". This study further categorises BDA capabilities into analytical capabilities, traceability capabilities, predictive capabilities, prescriptive capabilities, decision-making capabilities and visualisation capabilities. Significantly, developing BDA capabilities impacts enterprise agility (Gupta *et al.*, 2020; Stylos *et al.*, 2021).

2.4 Financial service agility

Continuous advances in market trends have largely affected the way enterprises operate. In response, enterprises have developed management models to address these complexities and changes ref essentially. Therefore, a combination of extant studies focusses on enterprise agility to respond to uncertainties within the global market space (Mandal *et al.*, 2017; Tallon *et al.*, 2019). Enterprise agility must relate to paradigms that foster business adaptability, flexibility and speed in a timely fashion within an ecosystem (Sherehiy *et al.*, 2007). In this regard, financial institutions awareness is to adapt to the developments in the financial industry and respond to customer demand. Although generally financial institutions score low on adaptiveness, speed and stability, research has observed that enterprise agility significantly contributes to financial optimisation. Amongst other things, IT-enabled platforms facilitate strategic FSA for competitive advantage and sustainability. Therefore, FSA is recognised as a financial institution's ability to identify appropriate digital technologies to improve financial processes such as customisation, creating new financial products, employee collaboration, financial data management and knowledge from financial operation data ref. Ostensibly, BDA technologies have been agued to empower agility for "dynamic, volatile and time-sensitive services industries" such as the financial industry (Stylos *et al.*, 2021; The ASEAN Post, 2020).

2.5 Conceptual framework

From a holistic review and perspective of BDA capability intelligence and IT capability viewpoint, this study proposed a conceptual framework in Figure 1 to conceptualise IT

capability as the useful channel for creating managerial and technical competencies for enterprise agility. Thus, the IT capability view embraces the quality of BDA technology resources and the ability to use them to promote FSA. Furthermore, the framework hinges on previous studies position on promoting information systems capabilities to enhance digital technology usage for value creation. Therefore, deploying and incorporating BDA capabilities intelligence through the IT capability framework as an enabler will enhance FSA (Panda and Rath, 2016). Cepeda and Arias-Pérez (2019) further observed that IT capability aid as an enabler for promoting the linkage between investment in digital technology and overall service agility. Additionally, the success of BDA usage depends not only on the accompanying technological resources BDA possesses but also on the deployment of a competent management approach to leverage technology usage. In this regard, this study advocates that IT capability dimensions such as managerial and technical capabilities to integrate the BDA intelligence positively affect FSA. This perspective is further opined that a firm's ability to integrate and manage IT resources together, apart from their ownership, creates sustainable strategic and competitive value (Buhalis and Volchek, 2021; Gonzalez *et al.*, 2019; Tallon *et al.*, 2019). Beyond the challenges, firms encounter in the BDA deployment (Latif *et al.*, 2019), adequate development of BDA capabilities intelligence supports firms sustainability (Raguseo and Vitari, 2018; Ali *et al.*, 2020; Zhu and Yang, 2021). For example, Ali *et al.* (2020) argued that strategic BDA capabilities intelligence promotes financial services efficiency and sustainability. Also, Zhu and Yang (2021) posited that there is clarity with navigating BDA capability intelligence for transforming product to customer-centric significantly affects FSA for survival. In that regard, H1 is proposed to identify the role of IT capability strategy to direct effective use of BDA to support FSA. Hence, there is a positive relationship between BDA usage and IT capability strategy.

H1. BDA capabilities usage has a positive and direct influence on IT capability dimensions.

Additionally, based on a cursory review of literature, H2 is proposed to identify the relationship between BDA usage and FSA. For example, Vinodh *et al.* (2012) estimated that amongst other drivers to agility, deploying and incorporating IT applications and tools promotes enterprise agility. More specifically, incorporating emerging technologies such as BDA intelligence applications with other digital platforms have a positive impact on enterprise agility (Gupta *et al.*, 2019, 2020). Recent empirical evidence also advocates that BDA implementation successfully impacts banking and financial services operations (Hajiheydari *et al.*, 2021; Mohini, 2021; ZareRavasan, 2021). Based on this viewpoint, hypothesis 2 is proposed to explain the positive impact of BDA capabilities on banking and financial service operations.

H2. Using BDA capabilities enhances FSA.

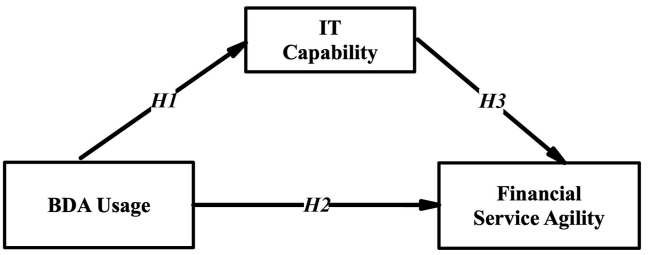

Figure 1.
Research framework

Lastly, hypothesis 3 as shown in Figure 1, advocates that strategic management of IT capability dimensions significantly supports BDA incorporation with other resources to enhanceFSA . Considerably, Gao *et al.* (2020) posited that managing technical IT capability effectively can differentially enhance firms' agility. However, in their review Mao *et al.* (2016) highlight that a comprehensive synergy amongst technical IT capability, managerial capability and operational capabilities must incorporate variabilities in emerging technologies to leverage on FSA. Significantly, firms that are minded with emerging digital technology with appropriate IT capability strategy succeed with market agility (Li *et al.*, 2021; Felipe *et al.*, 2020).

H3. IT capability has a mediating effect on the relationship between BDA usage andFSA .

3. Methodology

3.1 Research design and data collection

The study employed a mix of qualitative and quantitative research approaches. These approaches provided an in-depth insight into the literature review, design of the questionnaire, data collection and empirical analysis of data collected. Crewel (2014) observed that combining qualitative and quantitative approaches reveals a sufficient understanding of a research problem. The study, therefore, relied on a survey approach for data collection through questionnaire administering. The empirical study was based on three stages. Firstly, from an in-depth review of literature, the questionnaire was designed and structured into two parts purposely to respond to the objectives of the study. Secondly, data were collected through an online survey and face-to-face administering of the questionnaire. In order to ensure the validity and reliability of the constructs with their respective set of questions, a pilot test was initially conducted with 50 respondents. Their perspective and suggestions improved the final version of the questionnaire administered. Thirdly, the survey questionnaire was administered amongst IT workers, bank branch managers and operations staff from the financial institutions. Respondents were mainly from the IT department, operations department and bank managers because these categories of bank staff are involved in deploying and using digital technology innovations such as "Bank of Things", BDA applications, and cloud computing services. Data collected comprised attributes of respondents and their understanding of BDA technology and applications. Additionally, perceptual data was collected to access and evaluate the level of respondents' agreement to test the proposed model regarding the use of BDA technology capabilities and its significant impact on FSA.

A total of 555 questionnaires were collected and retrieved between 2020 and 2021. However, 485 questionnaires were deemed useful for the analysis representing 87% response rate.

3.2 Measurement of variables and indicators

This study used three variables as elucidated from the conceptual framework to propose the financial sector can leverage with emerging digital technology. The measurement scale of the constructs was developed and adopted after the literature review. A five-point Likert scale was used to rate the dimension ranging from 1 (strongly disagree) to 5 (strongly agree) with respect to three constructs (Dwivedi *et al.*, 2017; Hair *et al.*, 2015; Gupta *et al.*, 2020). The three constructs (BDA usage, IT capability and financial service agility) were made up of a set of specific dimensions from literature. Extensively based on empirical contributions from literature, BDA usage was centred on 11 measurement items covering financial data

aggregation, insight creation, decision support analysis, risk analysis, fraud detection, financial knowledge repository database and internal data and information traceability (Gupta *et al.*, 2020; Edu *et al.*, 2020; Hasan *et al.*, 2020; Hassani *et al.*, 2018; Srivastava and Gopalkrishnan, 2015). The BDA capability intelligence provides high-frequency financial analysis to ensure safety with financial activities and to protect customers' privacy with available data (Sun *et al.*, 2019). Hasan *et al.* (2020) and Rabhi *et al.* (2019) further suggested that the opportunities with big data capabilities deployment and developing useful IT capability strategy promote financial operation sustainability. Additionally, proponents of the IT capability viewpoint considers BDAs as intelligent applications that facilitate firms to create enterprise agility and sustainable competition (Barlette and Barlette, 2020; Côrte-Real *et al.*, 2017; Wang *et al.*, 2017, 2019). This study relied on the proposed dimensions as espoused in literature to measure the mediating role of IT capability for FSA. Mainly, the dimensions include the deployment of relevant digital technologies for financial services, developing operational capability, managerial capability and strategic use of digital technology resources (Gupta *et al.*, 2020; Gao *et al.*, 2020; Wang *et al.*, 2019; Hosseini *et al.*, 2017). Respectively, FSA measurement items reflect financial service delivery sustainability, financial service adaptability, scaling up customer service delivery, leveraging the integration of BDA technology, incorporating IT applications and tools and flexible operation systems (Vinodh *et al.*, 2012; Forest *et al.*, 2014; Srivastava and Gopalkrishnan, 2015; Hajli *et al.*, 2020). The FSA measurement indicators used, relate to a firm's propensity to be agile to adapt within the ecosystem they operate. This study, therefore, relied on the concept of enterprise agility, which explains firms' resilience to proactively respond swiftly within an ecosystem they operate (Pereira *et al.*, 2021; Clauss *et al.*, 2021). Therefore the indicators used are related attributes as espoused from extant studies to measure the use of BDA in the financial sector (Hajli *et al.*, 2020; Hajiheydari *et al.*, 2021).

Data collected were analysed using structural equation model (SEM) with the aid of the PLS 3 analytical tool. SEM is a technique that can model latent variables and statistically test the entire model for accounting for any measurement errors accompanying a "plethora" of research hypotheses (Henseler *et al.*, 2015). Essentially, because the study's objective is exploratory in nature, the partial least square method is appropriate to measure the causal relationship between the BDA usage and financial service agility grounded on the IT capability viewpoint.

4. Results

4.1 Sample profiling

The demography details the sample profiles of the respondents to ensure adequate representation of diverse views from their answers. Respondents were generally from different banking institutions comprising bank managers, IT and operation staff. From the analysis, respondents' professional positions comprise IT and operations, data analyst, systems analyst, application and security, data processing officer, research and operations, bank managers and customer service operations. The results show that 8% of the represents are IT and operational professionals, 4% are customer services operations staff, 10% are application and security professionals and 22% are data analysts. Additionally, bank branch managers, research and operations officers and system analysts represent 47% in total. In terms of the various digital applications technologies deployed for financial services concerning BDA, IoTs and cloud computing, the results indicate that BDA and cloud computing applications are largely shaping the level of financial service delivery.

4.2 Reliability and validity test

To ensure indicator reliability for constructs proposed in the research model, this study set factor loading values at the threshold 0.70 and above as recommended by Hulland (1999) and Hair *et al.* (2014). In addition, the study used the Cronbach coefficients, composite reliability (CR) and average variance extracted (AVE) to examine internal consistency, convergent validity and reliability. Hair *et al.* (2017) observed that the threshold for Cronbach values should be 0.70 or above, and all CR values as a confirmatory feature for all constructs indicators should be ≥ 0.70 (Bagozzi and Yi, 1988; Vinzi *et al.*, 2010). The acceptable value for AVE values for measuring convergent validity must be ≥ 0.50 as indicated by Hair *et al.* (2017). Accordingly, the results from Table 1 demonstrate that indicators for internal consistency, convergent validity and reliability were within the acceptable threshold for the framework proposed in Figure 1. Discriminant validity metrics were further used to assess the relationship between constructs substantially. Hence, the Heterotrait-Monotrait Ratio (HTMT) recommended by Hair *et al.* (2018) was used. Table 2 shows that the HTMT values were all below the threshold of 0.80.

The phenomenon of common method bias (CMB) was further considered using the collinearity diagnostic test as recommended by Kock (2015) (see Table 3). A collinearity test was therefore performed for all the constructs and indicators as shown in Tables 3 and 4. Overall, the results demonstrate that all variance inflation factor (VIF) values are less than 3.3, indicating that the model proposed has no issue with CMB (Kock, 2015). Significantly, the results show that CMB poses no problem with results shown.

Construct	Indicators	Factor loadings	Ca	CR	AVE
Big data analytic usage	BDA 1	0.723	0.929	0.939	0.584
	BDA 2	0.756			
	BDA 3	0.741			
	BDA 4	0.765			
	BDA 5	0.722			
	BDA 6	0.796			
	BDA 7	0.821			
	BDA 8	0.811			
	BDA 9	0.742			
	BDA 10	0.765			
	BDA 11	0.758			
IT capability	IT CAP 1	0.811	0.849	0.888	0.570
	IT CAP 2	0.812			
	IT CAP 3	0.817			
	IT CAP 4	0.820			
Financial service agility	FSA 1	0.755	0.832	0.888	0.664
	FSA 2	0.754			
	FSA 3	0.766			
	FSA 4	0.760			
	FSA 5	0.761			
	FSA 6	0.742			

Table 1. Validity and reliability test

	BDA usage	Financial service agility	IT capability
BDA usage			
Financial service agility	0.789		
IT capability	0.776	0.739	

Table 2. Heterotrait-Monotrait Ratio (HTMT)

Construct	Indicators	VIF
Big data analytic usage	BDA 1	1.805
	BDA 2	2.181
	BDA 3	2.136
	BDA 4	2.210
	BDA 5	1.916
	BDA 6	2.924
	BDA 7	2.052
	BDA 8	2.567
	BDA 9	2.754
	BDA 10	2.972
	BDA 11	2.193
IT capability	IT CAP 1	1.751
	IT CAP 2	1.756
	IT CAP 3	1.797
	IT CAP 4	1.821
Financial service agility	FSA 1	1.831
	FSA 2	1.757
	FSA 3	1.734
	FSA 4	1.957
	FSA 5	2.090
	FSA 6	1.688

Table 3.
Collinearity test – variance inflation factor (VIF)

	IT capability	Financial service agility
BDA usage	1.00	1.892
IT capability	–	1.892

Table 4.
Collinearity test – variance inflation factor (VIF)

Indices	Threshold	Estimated model
SRMS	<0.08	0.066
NFI	Closer to 1	0.828
Rms-theta	<0.12	0.128

Table 5.
Model fit

4.3 Model fit and hypothesis test

Consistency with PLS-SEM model estimation, the overall fit of the proposed model was tested using the recommended model fit indices. The standardised root mean square residual for covariance matrix (SRMR), normed fit index (NFI) and RMS-theta were considered (Hair *et al.*, 2017). The acceptable threshold for each model fit index and the results obtained from the analysis is presented in Table 5. The fit index values show that the proposed model for BDA usage moderated through IT capability to enhance FSA is substantially fit. The overall significance of the relationship between BDA usage and FSA is tested at a 0.05 significance level. The results shown in Table 6 indicate that BDA capabilities usage and effective IT capability dimensions are positively related. Hypothesis 1 also shows a significant impact between BDA capability and effective IT capability dimensions($\beta = 0.687,\ t = 24.283$). Similarly, BDA capabilities usage is positively associated and statistically significant with FSA($\beta = 0.532,\ t = 12.652$) as proposed in H2. Hypothesis 3 further indicates that the role of IT capability dimensions has a positive and significant impact on FSA($\beta = 0.264,\ t = 5.743$).

Path coefficient	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	*T* statistics (|O/STDEV|)	*p*-values	Decision
BDA usage → IT CAP	0.687	0.688	0.028	24.283	0.000**	H1 -supported
BDA usage → FSA	0.532	0.534	0.042	12.652	0.000**	H2 -supported
IT CAP → FSA	0.264	0.261	0.046	5.743	0.000**	H3 -supported

Note(s): Significance level @ 0.05**

Table 6.
Hypothesis testing

In addition, Figure 2 shows that BDA usage through IT capability alignment positively improves FSA. The overall value for R^2 indicates that 54.44% of improvement from FSA can be attributed to developing the capability of BDA usage enabled through IT capability strategies.

5. Discussions

This section highlights on key findings of the study by validating the proposed framework. The objective of the study was to elucidate the deployment and usage of BDA capabilities for promoting FSA. The study suggested that the impact of BDA usage significantly affect FSA. The empirical data analysis further indicates that the mediating role of IT capability strategy

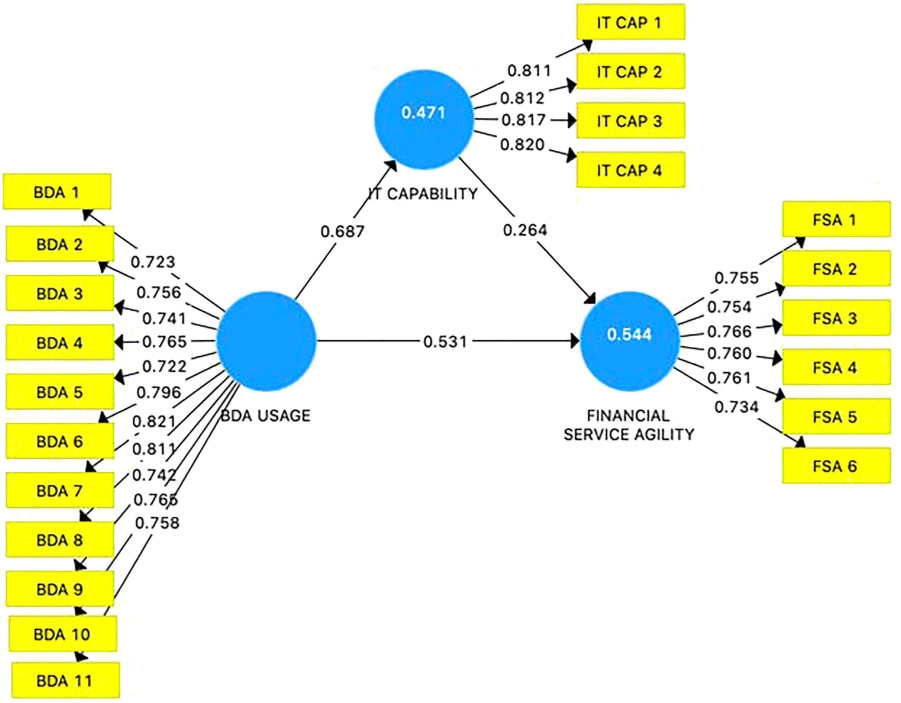

Figure 2.
Results of research framework

could lead to improving FSA. Consistent with existing studies, the use of technological capabilities alongside other resource capabilities improve enterprise agility (Melián-Alzola *et al.*, 2020; Bustinza *et al.*, 2019). As such, the need to identify specific digital technologies for enterprise data management, data transferability, data analysis, data scalability and knowledge creation cannot be overemphasised (Wang *et al.*, 2018). This brings to the perception of this study about BDA technologies as suggested by Sivarajah and Papadopoulos *et al.* (2017), to improve enterprise sustainability. Also, from their perspective, developing BDA capability and usage with other relevant resource capabilities stimulates competitive advantage and enterprise performance (Fiorini *et al.*, 2018; Edu *et al.*, 2020).

The result from this study demonstrates the relationship between BDA usage and FSA through the IT capability viewpoint. Therefore, from the IT capability view, key technical skills, IT infrastructure and managerial skills must seek to distinct BDA technologies to create sustainable financial services. A cursory review of BDA impact on enterprise performance shows that the results from this study are consistent with findings from other empirical studies (Stylos *et al.*, 2021; The ASEAN Post, 2020; Hassani *et al.*, 2018; Hajli *et al.*, 2020). Accordingly, this study posits the call for financial institutions to identify specific BDA capabilities that align with IT capability strategies and operations as suggested by Gupta *et al.* (2020) and Hajiheydari *et al.* (2021).

Holistically, technological capabilities encompass the idea of selecting digital technology resources and integrating enterprise strategies with emerging technology prospects (Buhalis and Volchek, 2021; Gonzalez *et al.*, 2019; Tallon *et al.*, 2019). Therefore, collocate these capabilities supports the strategic application of digital technology resources for daily financial service deliveries. Seemingly, deploying and using emerging BDA tools with existing digital resources scale up financial service stability (Hajli *et al.*, 2020). Therefore, emphasis on IT capability strategy is the differential factor for financial institutions in a volatile financial market (Hajiheydari *et al.*, 2021). On that basis, the first hypothesis (H1) for this study establishes a positive relationship between IT capability management and BDA capability usage (Melián-Alzola *et al.*, 2020). Therefore, hypothesis one (H1) is supported. Again, the role of IT capability for BDA deployment and significantly contributes to 0.554 (R^2) variations in financial service administration as demonstrated in Figure 2 and supported by hypothesis 3 (H3). Although deploying BDA tools alone may enhance FSA, this result shows that developing the overall capabilities with other digital technologies contributes to improving financial service performance (Tallon *et al.*, 2019; Zhu and Yang, 2021). Accordingly, Hajli *et al.* (2020) and Nejatian *et al.* (2019) observed that key FSA must consider technology awareness, leveraging the integration of BDA technology, incorporating IT applications and tools and leadership in IT usage.

Essentially, the need to promote BDA usage in the financial sector has been advocated despite significantly missing empirical findings (Ali *et al.*, 2020). This study empirically validates the scaling up of BDA usage in the financial sector from developing financial institution context in Ghana which is missing in the literature. Accordingly, Hassani *et al.* (2018) observed that financial institutions could deploy BDA capability tools such as data mining techniques to provide insightful information from the conceivable volume of financial data, customer financial transactions to reach enhanced strategic decisions. Forest *et al.* (2014, p. 11) also identified that managing BDA capabilities effectively provides financial institutions with the ability to "digest physical and institutional channel interactions, customer data, graph data, and geo-location data". Further studies that corroborate this study have suggested that BDA capability can be used to enhance enterprise agility, especially to predict customers' transactional patterns for tailored services (Stylos *et al.*, 2021). Song *et al.* (2021) also promoted the need for financial institutions to use digital platforms with BDA to potentially identify the risk of borrowers and the quality of customised services.

Generally, enterprise credibility in a volatile market such as the financial sector depends on the ability to harness functional resource capability such as BDA technologies to improve service agility. Findings from this study and preposition from the research framework distinctively support financial institutions to develop the capabilities with BDA technologies. Prepositions from existing literature in general highlight the role digital technologies and applications contributes to enterprise agility in diverse forms (Hughes and Chandy, 2021; Gao *et al.*, 2020). For example, Gao *et al.* (2020) observed that effective IT capability for digital resources and other applications promotes firms' agility such as intelligence insights with market analysis and strategic business modelling. Other studies also intimated that aligning BDA tools within the financial services can leverage banks to gain competitive advantage and more of customer focus as revealed in this study Song *et al.* (2021), Hassani *et al.* (2018), Hajiheydari *et al.* (2021).

6. Implication of study

6.1 Theoretical implication of the study

The theoretical implication of this study is provided in two folds. First, the study attempts to underscore a new perspective with BDA capability and enterprise agility. Through the IT capability viewpoint, the study projects a topology that emphasises digital technology capabilities to attain overall financial service delivery. Holistically, the study builds on developing distinctive BDA capabilities that will respond to enterprise agility, thereby providing flexibility for enterprises when faced with critical aspects of strategic decisions. Secondly, the study analysed the relationship between BDA usage and IT capability and the impact on FSA. The empirical results revealed that digital technology capability plays a key mediating role for BDA and FSA. Therefore, developing specific or unique capabilities from BDA technologies enhances financial institutions capability to respond to changes in the financial market. This study also elucidates that digital technology usage, IT capability view and enterprise agility are positively related. Hence the theoretical foundation for aligning digital technology and resource-based view and IT capability view in the literature is supported from the empirical data analysis. The proposed methodology and the framework in this study address how emerging digital technologies can effectively sustain firm sustainability. The complexity of identifying the interrelationship of technology and firm agility is supported in this study (Tallon *et al.*, 2019; Melián-Alzola *et al.*, 2020; Gao *et al.*, 2020; Hughes and Chandy, 2021).

6.2 Managerial implication of the study

Bolstering various study BDA capability implications for the financial sector (Song *et al.*, 2021; Galhau *et al.*, 2016; Gupta and George, 2016), this study demonstrates the impact of BDA usage on FSA. The findings help financial institutions focus on nurturing technical capabilities of digital technology deployment and strategic managerial capabilities to utilise emerging technologies like BDA applications. The study further highlights the need for financial service managers to identify BDA technologies such as data mining, query and reporting, data visualisation, predictive modelling, streaming analytics, video analytics and voice analytics to focus on financial knowledge gathering and market observation. Financial managers can also deploy BDA tools to develop a strategic road map for data management, data transferability and knowledge discovery for customised financial products. In achieving service agility in an emerging market, financial institutions must adopt BDA tools to develop robust and durable digital products to access changes in the financial market. In effect, financial institutions must ensure prioritisation to review existing IT strategies to identify appropriate BDA tools for specific operations (Latif *et al.*, 2018). Beyond the possible benefits

to derive, Chanias *et al.* (2019) and Sun *et al.* (2019) observed that financial institutions must examine the types of BDA capabilities usage, identify what BDA tools are needed, what they will facilitate and what they contribute. Besides, the ultimate use of digital technology tools and applications is not solely on the investment undertaken, but more on the technological capability to improve enterprise agility (Queiroz *et al.*, 2018; Ghasemaghaei, 2019; Mikalef *et al.*, 2020).

6.3 Conclusion

Despite contributions from existing studies with emerging technologies such as big data, this study mainly explores BDA technology usage and FSA. The study was built on the IT capability viewpoint (Garrison *et al.*, 2015; Li *et al.*, 2021; Felipe *et al.*, 2020) from IS research perspective to examine the implication of building strategic BDA capabilities to respond to enterprise agility. The study relied on survey data from 485 banking staff from the IT department, operations department and bank managers on their perspectives with distinctive BDA usage, IT capability development and FSA. Data collected were analysed using PLS-SEM to investigate the underlying hypothetical relationship and the applicability of the research framework proposed. Based on the empirical test from this study, distinctive BDA usage grounded on the concept of IT capability viewpoint suggest that FSA could be enhanced provided enterprises develop technical capabilities alongside other relevant resources (Mikalef *et al.*, 2020). This study is a useful contribution to the burgeoning discussion with emerging technologies such as BDA implication to enterprises operations (Sun *et al.*, 2019). The proposed methodology for this study addresses the dynamics of digital resources relationship with firms' sustainability. From the perspective of bank managers, operations staff and IT workers for this study, IT capability does moderate the impact of BDA usage on FSA (Melián-Alzola *et al.*, 2020). The emphasis for this study also reiterates that digital technologies applications and tools such as BDA enable firms to transform and survive with changing trends (Hughes and Chandy, 2021; Tallon *et al.*, 2019). The perspective from this study also contributes to deepening the understanding of the implication of the IT capability viewpoint. The emphasis for IT capability dimensions must therefore focus on the strategic use of resources, acquisition of relevant digital technology resources and relevant use of digital resources for BDA usage. Additionally, this study offers opportunities for the future to explore BDA and enterprise agility in different contexts based on the limitations of this work.

Finally, a fundamental limitation for this study is focussed on financial institutions in Ghana, and therefore the findings are within the context of a developing country. Therefore, that result represents perceptual views from banking professionals. Although perceptual data is allowed, a recommendation for future research must consider operational data to support empirical findings. Again, notwithstanding the findings from this study, there are still limited discussions for BDA application in the financial sector. Hence future research must investigate further to validate the implications of the relationship between BDA usage to improve financial services. Lastly, future research should consider how BDA capabilities can support financial intelligence analysis.

References

Ali, Q., Salman, A., Yaacob, H., Zaini, Z. and Abdullah, R. (2020), "Does big data analytics enhance sustainability and financial performance? The case of ASEAN banks", *Journal of Asian Finance, Economics and Business*, Vol. 7 No. 7, pp. 1-13.

Ardolino, M., Rapaccini, M., Saccani, N., Gaiardelli, P. and Ruggeri, C. (2018), "The role of digital technologies for the service transformation of industrial companies", *International Journal of Production Research*, Taylor & Francis, Vol. 56 No. 6, pp. 2116-2132.

Bagozzi, R.R. and Yi, Y. (1988), "On the evaluation of structural equation models", *Academy of Marketing Science*, Vol. 16 No. 1, pp. 74-94.

Barlette, Y and Barlette, P (2020), "Big data analytics in turbulent context: towards organizational change for enhanced agility", *Production Planning and Control*, Vol. 31 No. 1, pp. 1-18, doi: 10.1177/01655515211047425.

Barney, J., Wright, M. and Ketchen, D.J. (2001), "The resource-based view of the firm: ten years after 1991", *Journal of Management*, Vol. 27 No. 6, pp. 625-641, doi: 10.1016/S0149-2063(01)00114-3.

Bhatt, G.D. and Grover, V. (2005), "Types of information technology capabilities and their role in competitive advantage: an empirical study", *Journal of Management Information Systems*, Vol. 22 No. 2, pp. 353-277.

Boratyńska, K. (2019), "Impact of digital transformation on value creation in Fintech services: an innovative approach", *Journal of Promotion Management*, Routledge, Vol. 25 No. 5, pp. 631-639.

Bughin, J. and Van Zeebroeck, N. (2017), "The best response to digital disruption", *MIT Sloan Management Review*, Vol. 58 No. 4, pp. 80-86.

Buhalis, D. and Volchek, K. (2021), "Bridging marketing theory and big data analytics: the taxonomy of marketing attribution", *International Journal of Information Management*, Elsevier, Vol. 56, September 2020, doi: 10.1016/j.ijinfomgt.2020.102253.

Bustinza, O.F., Vendrell-Herrero, F., Perez-Arostegui, M. and Parry, G. (2019), "Technological capabilities, resilience capabilities and organizational effectiveness", *International Journal of Human Resource Management*, Routledge, Vol. 30 No. 8, pp. 1370-1392.

Cai, W., Richter, S. and McKenna, B. (2019), "Progress on technology use in tourism", *Journal of Hospitality and Tourism Technology*, Vol. 10 No. 4, pp. 651-672.

Cepeda, J. and Arias-Pérez, J. (2019), "Information technology capabilities and organizational agility: the mediating effects of open innovation capabilities", *Multinational Business Review*, Vol. 27 No. 2, pp. 198-216.

Chae, H., Koh, C.E. and Park, K.O. (2018), "Information and management information technology capability and firm performance: role of industry", *Information and Management*, Vol. 55, pp. 525-546.

Chanias, S., Myers, M.D. and Hess, T. (2019), "Digital transformation strategy making in pre-digital organizations: the case of a financial services provider", *Journal of Strategic Information Systems*, Elsevier, Vol. 28 No. 1, pp. 17-33.

Clauss, T., Abebe, M., Tangpong, C. and Hock, M. (2021), "Strategic agility, business model innovation, and firm performance: an empirical investigation", *IEEE Transactions on Engineering Management*, IEEE, Vol. 68 No. 3, pp. 767-784.

Coreynen, W., Matthyssens, P. and Van Bockhaven, W. (2017), "Boosting servitization through digitization: pathways and dynamic resource configurations for manufacturers", *Industrial Marketing Management*, Elsevier, Vol. 60, pp. 42-53.

Côrte-Real, N., Oliveira, T. and Ruivo, P. (2017), "Assessing business value of big data analytics in European firms", *Journal of Business Research*, Elsevier, Vol. 70, pp. 379-390.

Crewel, J (2014), *Research Design: Qaulitative, Quantitative and Mixed Methods Approaches*, 4th ed., Sage Publication, pp. 1-342.

Dwivedi, Y.K., Rana, N.P., Jeyaraj, A., Clement, M. and Williams, M.D. (2017), "Re-examining the unified theory of acceptance and use of technology (UTAUT): towards a revised theoretical model", *Information Systems Frontiers*, Vol. 21 No. 3, doi: 10.1007/s10796-017-9774-y.

Edu, S.A., Agoyi, M. and Agozie, D.Q. (2020), "Integrating digital innovation capabilities towards value creation: a conceptual view", *International Journal of Intelligent Technologies*, Vol. 16 No. 4, pp. 37-50.

Felipe, C.M., Leidner, D.E., Roldán, J.L. and Leal-Rodríguez, A.L. (2020), "Impact of IS capabilities on firm performance: the roles of organizational agility and industry technology intensity", *Decision Sciences*, Vol. 51 No. 3, pp. 575-619.

Fink, L. (2011), "How do IT capabilities create strategic value? Toward greater integration of insights from reductionistic and holistic approaches", *European Management Journal of Information System*, Vol. 20 No. 1, pp. 16-33.

Fiorini, D.C.P., Seles, R.P.B.M., Jabbour, C.C.J., Mariano, E.B. and Jabbour, L.D.S.A.B. (2018), "Management theory and big data literature: from a review to a research agenda", *International Journal of Information Management*, Elsevier, Vol. 43, July, pp. 112-129.

Forest, H., Foo, E., Rose, D. and Berenzon, D. (2014), *Big Data: How it Can Become a Differentiator*, Deutsche Bank, Deutche, pp. 1-28.

Galhau, F.V., Dermine, J., Schimel, N., Pauget, G., Gaumer, Q., Morteir, S. and Moutaib, A. (2016), "Financial stability in the digital era", *Financial Stability Review*, Vol. 20, pp. 1-176.

Gao, P., Zhang, J., Gong, Y. and Li, H. (2020), "Effects of technical IT capabilities on organizational agility: the moderating role of IT business spanning capability", *Industrial Management and Data Systems*, Vol. 120 No. 5, pp. 941-961.

Garrison, G., Wakefield, R.L. and Kim, S. (2015), "The effects of IT capabilities and delivery model on cloud computing success and firm performance for cloud supported processes and operations", *International Journal of Information Management*, Elsevier, Vol. 35 No. 4, pp. 377-393.

Ghasemaghaei, M. (2019), "Are firms ready to use big data analytics to create value? The role of structural and psychological readiness", *Enterprise Information Systems*, Taylor & Francis, Vol. 13 No. 5, pp. 650-674.

Gonzalez, R., Gasco, J. and Llopis, J. (2019), "ICTs in hotel management: a research review", *International Journal of Contemporary Hospitality Management*, Vol. 31 No. 9, pp. 3583-3609.

Gun, M. (2020), "The path to FinTech development research on Islamic finance in Turkey", in Naifar, N. (Ed.), *Impact of Financial Technology (FinTech) on Islamic Finance and Financial Stability*, IGI Global, Hershey, PA, USA, pp. 65-96.

Gupta, M. and George, J.F. (2016), "Toward the development of a big data analytics capability", *Information and Management*, Elsevier, Vol. 53 No. 8, pp. 1049-1064.

Gupta, S., Qian, X., Bhushan, B. and Luo, Z. (2019), "Role of cloud ERP and big data on firm performance: a dynamic capability view theory perspective", *Management Decision*, Vol. 57 No. 8, pp. 1857-1882.

Gupta, S., Drave, V.A., Dwivedi, Y.K., Baabdullah, A.M. and Ismagilova, E. (2020), "Achieving superior organizational performance via big data predictive analytics: a dynamic capability view", *Industrial Marketing Management*, Elsevier, Vol. 90, October 2019, pp. 581-592.

Hair, J.F.J., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2014), *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Sage Publications, pp. 211-213.

Hair, J.F., Hult, T.G., Ringle, C.M. and Sarstedt, M. (2015), *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Sage Publications, Vol. 38, pp. 220-221.

Hair, J., Hollingsworth, C.L., Randolph, A.B. and Chong, A.Y.L. (2017), "An updated and expanded assessment of PLS-SEM in information systems research", *Industrial Management and Data Systems*, Vol. 117 No. 3, pp. 442-458.

Hair, J.F., Sarstedt, M., Ringle, C.M. and Gudergan, S.P. (2018), *Advanced Issues in Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Sage Publications, Thousand Oaks, CA.

Hajiheydari, N., Delgosha, M.S., Wang, Y. and Olya, H. (2021), "Exploring the paths to big data analytics implementation success in banking and financial service: an integrated approach", *Industrial Management and Data Systems*, Vol. 121 No. 12, pp. 1-32.

Hajli, N., Tajvidi, M., Gbadamosi, A. and Nadeem, W. (2020), "Understanding market agility for new product success with big data analytics", *Industrial Marketing Management*, Elsevier, Vol. 86, July 2018, pp. 135-143.

Harraf, A., Wanasika, I., Tate, K. and Talbott, K. (2015), "Organizational agility", *Journal of Applied Business Research*, Vol. 31 No. 2, pp. 675-686.

Hasan, M.M., Popp, J. and Oláh, J. (2020), "Current landscape and influence of big data on finance", *Journal of Big Data*, Springer International Publishing, Vol. 7 No. 1, doi: 10.1186/s40537-020-00291-z.

Hassani, H., Huang, X. and Silva, E. (2018), "Digitalisation and big data mining in banking", *Big Data and Cognitive Computing*, Vol. 2 No. 18, pp. 1-13.

Henseler, J., Ringle, C.M. and Sarstedt, M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modelling", *Journal of the Academy of Marketing Science*, Vol. 43 No. 1, pp. 115-135.

Hosseini, S., Kees, A., Manderscheid, J., Röglinger, M. and Rosemann, M. (2017), "What does it take to implement open innovation? Towards an integrated capability framework", *Business Process Management Journal*, Vol. 23 No. 1, pp. 87-107.

Hughes, N. and Chandy, R. (2021), "Commentary: trajectories and twists: perspectives on marketing agility from emerging markets", *Journal of Marketing*, Vol. 85 No. 1, pp. 59-63.

Hulland, J. (1999), "Use of partial least squares (PLS) in strategic management research: a review of four recent studies", *Strategic Management Journal*, Vol. 20 No. 2, pp. 195-204.

Karimi, J., Somers, T.M. and Bhattacherjee, A. (2007), "The role of information systems resources in ERP capability building and business process outcomes", *Journal of Management Information Systems*, Vol. 24 No. 2, pp. 221-260.

Kock, N. (2015), "Common method bias in PLS-SEM: a full collinearity assessment approach", *International Journal of E-Collaboration*, Vol. 11 No. 4, pp. 1-10.

Labun, J. (2016), "The banking industry and digital innovation: in search of new business models and channels", *European Journal of Service Management*, Vol. 20, pp. 5-16.

Latif, Z., Tunio, M.Z., Pathan, Z.H., Jianqiu, Z., Ximei, L. and Sadozai, S.K. (2018), "A review of policies concerning development of big data industry in Pakistan: subtitle: development of big data in Pakistan", *2018 International Conference on Computing, Mathematics and Engineering Technologies: Invent, Innovate and Integrate for Socioeconomic Development, ICoMET 2018 - Proceedings*, IEEE, pp. 1-5.

Latif, Z., Lei, W., Latif, S., Zulfiqar, H.P., Ullah, R. and Zeng, J. (2019), "Big data challenges: prioritizing by decision-making process using analytic network process technique", *Multimedia Tools and Application*, Vol. 78, pp. 27127-27153.

Lavalle, S., Lesser, E., Shockley, R., Hopkins, M.S. and Kruschwitz, N. (2011), "Big data, analytics and the path from insights to value", *MIT Sloan Management Review*, Vol. 52 No. 2, pp. 21-31.

Li, H., Wu, Y., Cao, D. and Wang, Y. (2021), "Organizational mindfulness towards digital transformation as a prerequisite of information processing capability to achieve market agility", *Journal of Business Research*, Elsevier, Vol. 122, December 2019, pp. 700-712.

Makadok, R. (2001), "Toward a synthesis of the resource-based and dynamic- capability views of rent creation", *Strategic Management Journal*, Vol. 22 No. 5, pp. 387-401.

Makeeva, V.G., Nikitin, S.A. and Elkina, D.A. (2021), "Digital transformation of the financial services market in Russia", in Popkova, E.G., Ostrovskaya, V.N. and Bogoviz, A.V. (Eds), *Socio-Economic Systems: Paradigms for the Future. Studies in Systems, Decision and Control*, Springer, Vol. 314, doi: 10.1007/978-3-030-56433-9_73.

Mandal, S., Korasiga, V.R. and Das, P. (2017), "Dominance of agility in tourism value chains: evidence from India", *Tourism Review*, Vol. 72 No. 2, pp. 133-155.

Manser, P.E.H., Dahl, A.J. and Peltier, J. (2021), "Digital servitization value co-creation framework for AI services: a research agenda for digital transformation in financial service ecosystems", *Journal of Research in Interactive Marketing*, Vol. 15 No. 2, pp. 200-222.

Mao, H., Liu, S., Zhang, J. and Deng, Z. (2016), "Information technology resource, knowledge management capability, and competitive advantage: the moderating role of resource commitment", *International Journal of Information Management*, Elsevier, Vol. 36 No. 6, pp. 1062-1074.

Mavlutova, I., Volkova, T., Natrins, A., Spilbergs, A., Arefjevs, I. and Miahkykh, I. (2020), "Financial sector transformation in the era of digitalization", *Studies of Applied Economics*, Vol. 38 No. 1, doi: 10.25115/EEA.V38I4.4055.

Melián-Alzola, L., Fernández-Monroy, M. and Hidalgo-Peñate, M. (2020), "Information technology capability and organisational agility: a study in the Canary Islands hotel industry", *Tourism Management Perspectives*, Elsevier, Vol. 33, December 2018, 100606.

Mikalef, P. and Pateli, A. (2017), "Information technology-enabled dynamic capabilities and their indirect effect on competitive performance: findings from PLS-SEM and fsQCA", *Journal of Business Research*, Elsevier, Vol. 70, pp. 1-16.

Mikalef, P., Krogstie, J., Pappas, I.O. and Pavlou, P. (2020), "Exploring the relationship between big data analytics capability and competitive performance: the mediating roles of dynamic and operational capabilities", *Information and Management*, Elsevier, Vol. 57 No. 2, 103169.

Mohini, P.V. (2021), "Big data analytics in banking and financial services sector", *EPRA International Journal of Research and Development*, Vol. 6 No. 3, pp. 92-96.

Monteagudo, J. (2020), *The Bank of Things (BoT): Background, Definition and Key Drivers*, The Bank of Things (BoT), Greater Madrid, available at: https:cybersecurityobservatory.com/bank-of-things-bot-background-definition-key-drivers/ (accessed 18 September 2020).

Morkunas, V.J., Paschen, J. and Boon, E. (2019), "How blockchain technologies impact your business model", *Business Horizons*, Kelley School of Business, Indiana University, Vol. 62 No. 3, pp. 295-306.

Nejatian, M., Zarei, M.H., Rajabzadeh, A., Azar, A. and Khadivar, A. (2019), "Paving the path toward strategic agility: a methodological perspective and an empirical investigation", *Journal of Enterprise Information Management*, Vol. 32 No. 4, pp. 538-562.

Panda, S. and Rath, S.K. (2016), "Investigating the structural linkage between IT capability and organizational agility: a study on Indian financial enterprises", *Journal of Enterprise Information Management*, Vol. 29 No. 5, pp. 751-773.

Papadopoulos, T., Gunasekaran, A., Dubey, R., Altay, N., Childe, S.J. and Fosso-Wamba, S. (2017), "The role of Big Data in explaining disaster resilience in supply chains for sustainability", *Journal of Cleaner Production*, Elsevier, Vol. 142, pp. 1108-1118.

Pereira, V., Budhwar, P., Temouri, Y., Malik, A. and Tarba, S. (2021), "Investigating Investments in agility strategies in overcoming the global financial crisis - the case of Indian IT/BPO offshoring firms", *Journal of International Management*, Elsevier, Vol. 27 No. 1, 100738.

Porter, M.E. and Heppelmann, J.E. (2015), "How smart, connected products are transforming companies", *Harvard Business Review*, Vol. 93 No. 10, pp. 1-19.

Pramanik, H.S., Kirtania, M. and Pani, A.K. (2019), "Essence of digital transformation—manifestations at large financial institutions from North America", *Future Generation Computer Systems*, Elsevier, Vol. 95, pp. 323-343.

Queiroz, M., Tallon, P.P., Sharma, R. and Coltman, T. (2018), "The role of IT application orchestration capability in improving agility and performance", *Journal of Strategic Information Systems*, Elsevier, Vol. 27 No. 1, pp. 4-21.

Rabhi, L., Falih, N., Afraites, A. and Bouikhalene, B. (2019), "Big data approach and its applications in various fields: review", *Procedia Computer Science*, Elsevier, Vol. 155 No. 2018, pp. 599-605.

Raguseo, E. and Vitari, C. (2018), "Investments in big data analytics and firm performance: an empirical investigation of direct and mediating effects", *International Journal of Production Research*, Taylor & Francis, Vol. 56 No. 15, pp. 5206-5221.

Ravichandran, T., Lertwongsatien, C. and Lertwongsatien, C. (2014), "Effect of information systems resources and capabilities on firm performance: a resource- based perspective", *Journal of Management Information Systems*, Vol. 21 No. 4, pp. 237-276.

Roumeliotis, P. (2019), "Homo virtualis", *Virtual Learning Environments*, Vol. 2, pp. 1594-1612.

Sherehiy, B., Karwowski, W. and Layer, J.K. (2007), "A review of enterprise agility: concepts, frameworks, and attributes", *International Journal of Industrial Ergonomics*, Vol. 37 No. 5, pp. 445-460.

Skyrius, R., Giriūnienė, G., Katin, I., Kazimianec, M. and Žilinskas, R. (2018), "The potential of big data in banking", in Srinivasan, S. (Ed.), *Guide to Big Data Applications. Studies in Big Data*, Springer, Cham, pp. 451-486.

Song, H., Li, M. and Yu, K. (2021), "Big data analytics in digital platforms: how do financial service providers customise supply chain finance?", *International Journal of Operations and Production Management*, Vol. 41 No. 4, pp. 410-435.

Srivastava, U. and Gopalkrishnan, S. (2015), "Impact of big data analytics on banking sector: learning for Indian banks", *Procedia - Procedia Computer Science*, Elsevier, Vol. 50, pp. 643-652.

Stylos, N., Zwiegelaar, J. and Buhalis, D. (2021), "Big data empowered agility for dynamic, volatile, and time-sensitive service industries: the case of tourism sector", *International Journal of Contemporary Hospitality Management*, Vol. 33 No. 3, pp. 1015-1036.

Sun, Y., Shi, Y. and Zhang, Z. (2019), "Finance big data: management, analysis, and applications", *International Journal of Electronic Commerce*, Routledge, Vol. 23 No. 1, pp. 9-11.

Tallon, P.P., Queiroz, M., Coltman, T. and Sharma, R. (2019), "Information technology and the search for organizational agility: a systematic review with future research possibilities", *Journal of Strategic Information Systems*, Elsevier, Vol. 28 No. 2, pp. 218-237.

The A.P. (2020), "Big data is revolutionising microfinancing", The ASEAN POST.

Vinodh, S., Aravindraj, S., Pushkar, B. and Kishore, S. (2012), "Estimation of reliability and validity of agility constructs using structural equation modelling", *International Journal of Production Research*, Vol. 50 No. 23, pp. 6737-6745.

Vinzi, V.E., Chin, W.W., Henseler, J. and Wang, H. (2010), *Handbooks of Partial Least Squares: Concepts, Methods and Application*, Springer Berlin Heidelberg, pp. 1-813.

Wang, Y. and Hajli, N. (2017), "Exploring the path to big data analytics success in healthcare", *Journal of Business Research*, Vol. 70, pp. 287-299.

Wang, N., Liang, H., Zhong, W., Xue, Y. and Xiao, J. (2012), "Resource structuring or capability building? An empirical study of the business value of information technology", *Journal of Management Information Systems*, Vol. 29 No. 2, pp. 325-367.

Wang, Y., Byrd, T.A., Wang, Y. and Byrd, T.A. (2017), "Business analytics-enabled decision-making effectiveness through knowledge absorptive capacity in health care", *Journal of Knowledge Management*, Vol. 21 No. 3, pp. 517-539.

Wang, Y., Kung, L.A. and Byrd, T.A. (2018), "Big data analytics: understanding its capabilities and potential benefits for healthcare organizations", *Technological Forecasting and Social Change*, Elsevier, Vol. 126, pp. 3-13.

Wang, Y., Kung, L.A., Gupta, S. and Ozdemir, S. (2019), "Leveraging big data analytics to improve quality of care in healthcare organizations: a configurational perspective", *British Journal of Management*, Vol. 30 No. 2, pp. 362-388.

Werth, O., Schwarzbach, C., Rodríguez Cardona, D., Breitner, M.H. and Graf von der Schulenburg, J.M. (2020), "Influencing factors for the digital transformation in the financial services sector", *ZVerWiss*, Vol. 109 Nos 2-4, pp. 155-179.

ZareRavasan, A. (2021), "Boosting innovation performance through big data analytics: an empirical investigation on the role of firm agility", *Journal of Information Science*, Vol. 47 No. 5, pp. 1-16, doi: 10.1177/01655515211047425.

Zhou, K., Liu, T. and Zhou, L. (2015), "Industry 4.0: towards future industrial opportunities and challenges", *12th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD)*, IEEE, pp. 2147-2152.

Zhu, X. and Yang, Y. (2021), "Big data analytics for improving financial performance and sustainability", *Journal of Systems Science and Information*, Vol. 9 No. 2, pp. 175-191.

Further reading

Chen, Y., Wang, Y., Nevo, S., Benitez-amado, J. and Kou, G. (2015), "IT capabilities and product innovation performance: the roles of corporate entrepreneurship and competitive intensity", *Information and Management*, Elsevier, Vol. 52 No. 6, pp. 643-657.

Corresponding author
Abeeku Sam Edu can be contacted at: asedu@ug.edu.gh