



The Link between Big Data and Innovation in the Big Data Era: The Roles of the Building Blocks of Innovation

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ABSTRACT

Innovation is the constructive force that guarantees organizational survival, growth, and competitiveness in a dynamic and constantly changing business environment. Innovation is important in solving problems and it gives an organization a competitive advantage. This article examined the pathways that lead to innovation in the era where big data sets are generated due to digitalization. An integrative literature review technique was employed to examine big data's roles in innovation. The article synthesized ideas from extant literature about big data, big data analytics, data analytics capabilities, and innovation. The findings indicate that data-driven innovation requires deliberate and targeted processes that take into cognizance some critical elements that can be regarded as building blocks. Thus, there are building blocks that are critical to data-driven innovation without which innovative processes and the outcomes of innovative processes will be unsuccessful. The building blocks of innovation are big data, big data analytics, big data analytics capabilities, insights, and decision-making. In addition, this article proposes the definitions of big data analytics and big data analytics capabilities. This article explains the linkage between big data and innovation, and presents theoretical contributions about innovation, and other valuable insights for improving practice.

Keywords: big data, big data analytics, big data analytics capabilities, building blocks, competitive advantage, decision-making, innovation, insight

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INTRODUCTION

In the era of digitalization, organizations are increasingly deploying technologies, e.g., artificial intelligence (AI), the Internet of Things (IoT), cyber-physical systems, robots, etc., that generate an enormous amount of data. The development of mobile technologies, payment systems, remote sensors, social media, cloud computing, and high-performance computing brought about an exponential growth in data, the phenomenon regarded as big data (Cheah & Wang, 2017). Big data is complex and includes unstructured and semistructured data, unlike traditional structured data. Big data includes texts, search indexes, emails, weblogs, social media forums, sensor data, videos, audio, GPS location information, more online data, log files, graphs, etc., (Tan, Zhan, Ji, Ye, & Chang, 2015).

Big data has many characteristics which include volume, variety, velocity, veracity, visualization, value, and variability. Big data usually has a high volume which implies data size which may have implications for storage. Big data variety refers to data heterogeneity, e.g., text, audio, video, etc., which poses challenges because of the lack of similarity in the generation process. Velocity concerning big data refers to data flow or the speed at which data becomes outdated. The veracity of big data entails data quality which includes accuracy, reliability, and source quality. Big data visualization involves presenting big data in a meaningful and comprehensible way. Value concerning big data denotes the contribution of data toward decision-making and performance. Variability indicates that big data is usually fast and exhibits continuous variation in data meaning and interpretation. According to McKinsey Global Institute, big data is a dataset that cannot be captured, stored, managed, and analyzed by typical database software tools (Manyika et al., 2011). These types of big datasets are beyond the storage and analytical capacity of regular database software tools and thus, paved the way for big data analytics in capturing, analyzing, and managing big data sets and in generating accurate

knowledge for decision-making. (Cadden, Weerawardena, Cao, Duan, & McIvor, 2023).

The Problem

The adoption of big data analytics can be a source of innovation in delivering new products and services (Mikalef, Boura, Lekakos, Krogstie, 2019b). Yet little is known about how firms can develop innovation through big data. Most firms lack the understanding of how to use their investment in big data to drive their innovation agenda. Even though innovation is an important element in creating competitive advantage (Ramadan, Shuqqo, Qtaishat, Asmar, & Salah, 2020; Lozada, Arias-Perez, & Perdomo-Charry, 2019). Still, literature portrays big data as a driving force for innovation. However, the means or path by which big data engenders innovation is not explicitly highlighted. Thus, this article examines how big data leads to innovation. Specifically, how big data (investment/adoption/application) translates into innovation or supports successful new product development. This article examines the link between big data and innovation. The pathway by which big data drives innovation or new product or process development

Importance of the Problem

There is growing interest in the literature on how data analytics can be employed in facilitating innovation (Wu, Hitt, & Lou, 2019). Data is one of the most important strategic assets. An investment in big data, big data technologies, and data-driven decisions are crucial in an environment with competitive pressure (Mikalef, Boura, Lekakos, & Krogstie, 2020). Concurrently, the application of big data analytics is growing among firms even though the benefits of adoption vary among firms (Wu et al., 2019). Essentially, the retrieval of data alone is not sufficient in engendering innovation. It is imperative to understand how to effectively use big data analytics for innovation.

It is pertinent to illuminate how and why some firms may acquire superior benefits from

using big data analytics for innovation in comparison to others (Wu et al., 2019).

Moreover, due to the enormous advancement in technology or global exponential growth in technology, firms generate a huge amount of data from their day-to-day operations which if deployed appropriately has potential benefits in developing technological capabilities, creating valuable insight about business processes, and increasing productivity (Saleem, Li, Ali, Mehreen, & Mansoor, 2020a). Specifically, some types of decisions and activities, especially innovation, are better supported by data and data analytics (Wu et al., 2019). Thus, it is important to help firms understand how the connection between big data and innovation is developed to enhance their innovation processes.

METHODOLOGY

This article investigated the concepts of big data and innovation by reviewing recently published and old literature regarding big data and innovation. The strategy employed includes searching databases to discover appropriate publications. The databases that were searched include Google Scholar, Wiley Online, Taylor and Francis Online, Springer Link, Science Direct, Sage Journals, Emerald Insight, Paperity, and CORE. The search was conducted between November 2023 and January 2025. The keywords used for searching include big data, big data analytics, big data analytics capabilities, big data analytics and innovation, big data and innovation, big data analytics capabilities and innovation, etc., The abstracts were scanned to ascertain their relevance and some publications were eliminated while some were retrieved from the databases. 374 publications were retrieved from the databases after the initial preliminary screening. A secondary screening was performed by reading through the texts to further establish the relevance of the retrieved publications. 313 retrieved publications were excluded from the review. The publications that were excluded comprised literature reviews, and articles that examined concepts such as big data and performance, big data and business value, big data and business intelligence, big data software, big data

technologies, big data and machine learning, cloud computing and big data, customer satisfaction with big data analytics, big data architectures, etc., 61 publications which fulfilled the inclusion criteria; focus on big data, big data analytics, big data analytics capabilities and innovation, literature that conducted hypothesis testing, and publications that generated findings using a population sample, data collection, and employed research methods such as survey, case study, interviews, longitudinal studies, etc., were included (See Appendix A).

The findings from the publications were analyzed and summarized, the emerging themes were categorized, and the summaries were grouped according to the themes. Additional literature which were included consisted of fifteen publications that provided the conceptual and theoretical foundation for the review which were sought separately and also through the references of already screened or reviewed literature. Eight web-based publications about big data and innovation and important concepts that were sought individually were included. The article employed the integrative literature review guidelines described by Torracco (2016) for synthesizing existing literature about big data and innovation to generate new knowledge about data-driven innovation. According to the recommendations of Toracco (2016; 2005), this article used guiding concepts from science and technology to synthesize ideas from literature in developing the conceptual model. For the synthesis process, the article integrated the concept of 'building blocks' with the ideas from the reviewed literature to generate new knowledge about big data and innovation. This article presents a new way of thinking about the concept of data-driven innovation and also proposes new definitions of big data analytics and big data analytics capabilities.

THE LINK BETWEEN BIG DATA AND INNOVATION

Big data analytics (BDA) helps organizations to change, embrace innovation and create values (Mikalef, Boura, Lekakos, & Krogstie, 2019a). Big data analytics play a huge role in

sensing, seizing, and transforming data to steer innovation and competitiveness in a complex business environment (Cadden et al., 2023). The utilization of big data analytics reduces costs and creates new platforms for innovation and disruption (Yu, Chavez, Jacobs, & Feng, 2018). In a highly competitive and changing business environment, the key to growth, survival, and adaptation to changes is innovation. Innovation refers to a new or novel idea, method, or device. Innovation is the introduction of new goods and services, and novel methods of production or non-technological dimensions such as management practices, marketing practices, etc., which allow firms to improve efficiency (Polder, van Leeuwen, Mohnen, & Wladimir, 2010). Innovation is a means of solving problems and innovation is necessary because it is not possible to solve new problems with old solutions (Boyles, 2022). Innovation can be categorized as radical or incremental. Radical innovation capabilities refer to the ability to make current products/services outdated through the introduction of a novel option. Incremental innovation capabilities are the ability to extend/reinforce expertise and product/service lines through improvements (Mikalef et al., 2019a).

An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process) (Organization for Economic Cooperation and Development [OECD], 2018, p.20).

A business innovation is a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm (Organization for Economic Cooperation and Development [OECD], 2018, p.20). Innovation could take the form of process or product innovation. A product innovation is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market (OECD, 2018,

p.21). Service innovation refers to new ways of creating customer value through service processes (Lehrer, Wieneke, vom Brocke, Jung, & Seidel, 2018). Damanpour and Gopalakrishnan, (2001) defined product innovation as new products or services introduced to meet an external user or market need and also defined process innovation as new elements introduced into an organization's production or service operations which may include but are not limited to equipment, task specifications, input materials, workflow mechanisms, and information flow mechanisms. A business process innovation is a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use by the firm (OECD, 2018, p.21). Process innovation capability refers to a firm's ability in comparison to its rivals to apply knowledge and resources to new process innovation activities that generate additional value for the firm. Process innovation is important because of its spillover effects. The value of process innovation is equal to the level of a firm's output (Mikalef & Krogstie, 2020). Process and product innovation are intricately connected, for instance, new product development or product quality improvements depend on changing existing processes or creating new processes (Mikalef & Krogstie, 2020). Innovation is sometimes a collaborative process, i.e., co-innovation. Co-innovation is the process of creating and developing new products, services, processes, and business models through the collaboration of an organization with external stakeholders such as clients, partners, suppliers, the general public, etc., (Lozada et al., 2019). Co-innovation involves internally and externally generated open innovation based on sharing intangible resources and is an inclusive process of value co-creation by different actors which enhances survival in times of instability (Ciasullo, Montera, & Douglas, 2022). Innovative processes include sustainability design and commercialization, which account for sustainable business growth and performance. Sustainability design involves transforming products/

services with technologies or materials into new sustainable offerings for the market (Zhang, Song, & He, 2020). Sustainable innovation takes into cognizance respect for the world's natural resources, regenerative capacity, and the development and well-being of humans and institutions in the process of developing new products, processes, services, and technologies (Baumann, Boons, & Bragd, 2002). Moreover, the green innovation process is one of the key factors in enhancing a firm's competitiveness (Zhu & Yang, 2021). Commercialization of innovation entails the launching and selling of newly innovated products/services into markets and building economies of scale by expanding production (Zhang et al., 2020).

The era of digitalization has heralded new approaches toward innovation. The availability of big data and computational power has enabled organizations to implement data-driven innovation (Babu, Rahman, Alam, & Dey, 2024). Davenport and Kudyba, (2016) described data-driven innovation (DDI) as the process of unlocking the hidden value of data in aiding innovations in various spheres, e.g., functional, operational, strategic, and business models. Similarly, Stone and Wang (2014) expounded data-driven innovation as the utilization of data in supporting the innovation process to create new or additional value. Data-driven innovation enables innovative application of data and data analytics and enhanced decision-making processes which lead to strategic benefits and organizational performance (Davenport & Kudyba, 2016).

Data-driven innovation refers to the innovation process that adopts data-based decision processes and employs techniques and technologies used for processing and analyzing big data. Data-driven innovation occurs in phases that include product conceptualization, data acquisition, big data refinement (conversion of unstructured/unrefined/ uncategorized data into usable insights and elimination of data volatility and redundancy), data storage and retrieval (with considerations for appropriate architecture, accessibility, etc.), distribution (ensuring the availability of relevant big data for decision

making), presentation (e.g., data visualization which involves harnessing the underlying key insights), and market/user feedback (Babu et al., 2024). Essentially, large amounts of data have enabled organizations to alleviate risks, make informed decisions, and facilitate data-driven innovation such as improving operational processes, conducting market analysis for a particular product, and introducing new products or upgrading existing products (Babu et al., 2024). Hence, literature has revealed that there is a connection between big data and innovation. Concurrently, this article sheds light on how this connection develops.

Thus, how is the connection between big data and innovation developed? Drawing from the ideas from science and technology, this article proposes that the connection between big data and innovation lies in the roles played by the package of functionalities or the building blocks of innovation. A building block is a package of functionality defined to meet the business needs across an organization (Opengroup.org, n.d). Similarly, there is a package of functionality for developing innovation in the big data era. Building blocks are core elements upon which a business may be built. Likewise, there are fundamental elements upon which innovation may be built. Building blocks are separate parts that make up a structure and they are the units of composition or construction. For example, cells are the fundamental building blocks of life science and atoms are the building blocks of matter.

In medicinal chemistry, building blocks, e.g., virtual molecular fragments or chemical reagents, are employed in the bottom-up modular assembly of molecular architectures, e.g., drugs construction or preparation, and they strictly determine what a final compound or a (supra)molecular construct will be (Farha, Malliakas, Kanatzidis, & Hupp, 2010; Tu & Tirrell, 2004; G. Schneider, Lee, Stahl, & P. Schneider, 2000). Concurrently, some fragments determine the outcomes of innovation. According to ideas from business and science, building blocks are essentials on which a larger entity is based or something crucial for making or developing another

thing while the absence of one or more building blocks makes a structure more vulnerable. Building blocks strengthen a structure. In congruence with the ideas from business, science, and technology, this article proposes that the building blocks of innovation are big data, big data analytics, big data analytics capabilities, insights, and decision-making. This article provides evidence from extant literature about big data in association with big data analytics, big data analytics capabilities, derived insights, and decision-making as the building blocks of innovation. An absence of any of these building blocks implies a poor innovative process which may not yield satisfactory outcomes. Figure one and Appendix B portray the building blocks of innovation. The package of functionalities of innovation and how they account for innovation in the era of digitalization are justified in the following sections.

The Building Blocks of Innovation

The Building Block: Big Data

Big data is defined as "high-volume, high-velocity, and high-variety (e.g., numbers, text, video, etc.,) information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight and decision making and process automation" (Gartner, n.d). The effective collection, management, and analysis of vast amounts of data produce invaluable insights necessary for fostering scientific and technological innovation that yield sustainable development and economic growth (Wei, 2023). Big data supports business diversification through the adoption, leveraging, and application of resources that result in innovative practices (Xie, Wang, & Miao, 2021). Big data applications make growing firms more effective in steering scientific and technological advancements in comparison to matured companies (Wei, 2023). The application of big data in supply chain operations enables new production development ideas and the optimization of the manufacturing processes in cost-effectively producing the new product (Tan et al., 2015).

Big data adoption or acceptance is a driver of green product innovation while big data assimilation and big data routinization have positive impacts on green process innovation in service sector organizations such as healthcare, tourism, finance, and education in Oman (Imran, Alraja, & Khashab, 2023). The association between big data usage and process or product innovation is moderated by information sharing (Saleem Li, Ali, Ayyoub, Wang, & Mehreen, 2020b).

The effects of big data investments on perceived big data performance are partially mediated by service innovation and service innovation mediates the relationship between data-driven market ambidexterity and perceived big data performance according to a survey of Swiss firms (De Luca, Herhausen, Troilo, & Rossi, 2021). The indirect effects of big data investments on perceived big data performance via service innovation are stronger when digitalization is higher (De Luca et al., 2021). Big data has a major beneficial connection with sales innovation for firms undertaking service innovation projects in the USA (Sazu, 2022).

Big data improves innovation outcomes by creating the possibility of scanning the environment and obtaining valuable information for improving the meaning and novelty of products and services (Lozada et al., 2019). Big data plays an important role in enhancing firms' innovative performance and consequently impacts firms' performance (Ghasemaghaei & Calic, 2020). Big data velocity and variety positively influence firms' innovation efficacy and efficiency (Ghasemaghaei & Calic, 2020). BD demonstrates a positive linear connection with firms' innovation sustainability (Sazu, 2022). The capability to strategically use knowledge from big data (television viewing data) in alignment with business strategy paves the way for innovation in a firm in the media and advertising industry (Prescott, 2016). Big data is important in making decisions about open innovation in a social TV context (Fortunato, Gorgoglione, Petruzzelli, & Panniello, 2017). Companies operating in the traditional industries in China achieve business model innovation by using

big data as crucial intellectual and economic resources (Cheah & Wang, 2017).

Big data management aids collaboration required for co-innovation (Lozada et al., 2019). Big data enables innovation management by making business innovation an inclusive process that incorporates stakeholders in the value co-creation initiatives (Lozada et al., 2019). Big data and co-innovation lead to organizational resilience in big SMEs which safeguard their survival during complex environmental threats (Ciasullo et al., 2022). Big data has a significant contributory role in SMEs' innovation performance because a higher big data quality facilitates innovation in SMEs (Verma, Singh, & Bhattacharyya, 2021). The use of big data is positively related to product and process innovation in SMEs (Saleem et al., 2020b). Big data usage fosters process or product innovation which consequently impacts supply chain performance and overall SME performance (Saleem et al., 2020b).

Big data-driven HR practices directly impact innovation competency in SMEs and also indirectly impact SMEs' innovation through human resource service quality or strategic human resource management, i.e., improves recruitment and selection, human behavior analysis, dashboards, engagement, learning and development, knowledge management, etc., (Verma et al., 2021).

Proposition 1: If big data is positively associated with innovation, then innovation will increase as a result of big data applications.

The Building Block: Big Data Analytics

Big data on its own is not sufficient in building innovation and competitive advantages, however, the capacity to generate valuable knowledge from big data in developing radical and incremental innovation leads to competitive advantage (Hallikainen, Savimäki, & Laukkanen, 2020). Explicitly, creating value from big data depends on the ability to glean knowledge and insights from big data, through big data analytics. Big data analytics (BDA) is defined "as a holistic approach to managing,

processing, and analyzing the 5 V data-related dimensions (i.e., volume, variety, velocity, veracity, and value) to create actionable ideas for delivering sustained value, measuring performance and establishing competitive advantage" (Wamba, Akter, Edwards, Chopin, & Gnanzou, 2014). Thus, based on the common themes found in literature, this article defines *big data analytics as a system of collecting, storing, processing, analyzing, and interpreting big data sets through advanced technological tools, e.g., software, in a way that reveals patterns and trends to gain insights; valuable information and knowledge, that facilitate decision-making and the creation of value for the business.*

Big data analytics technologies, tools, and infrastructure are key to big data analytics processes. Big data analytics technologies include application programming interface (API) (for accessing data from sensors, clickstreams, etc.), Hadoop framework (for analyzing large unstructured data), data lake (for storing data in its native format), web analytics, streaming analytics, mobile analytics, predictive analytics, visualization applications (for transforming data into visually comprehensive formats), social media analytics (for providing insights on customers' opinions, preferences, sentiments, etc.), and rule-based systems (Lehrer et al., 2018). Data analytic tools include Tableau for big data visualization, deduction graphs, Apache Mahout for machine learning algorithms in business, Storm for analyzing real-time computation systems, and InfoSphere for big data mining and integration (Tan et al., 2015). For example, big data analytic infrastructure is crucial in harvesting big data that could support supply chain innovation in terms of supply chain networks, supply chain processes, and supply chain technology (Tan et al., 2015). Appropriate data analytic infrastructure is necessary to use the information harvested from big data in modeling the supply chain operations and product development decisions and enhancing innovation capabilities (Tan et al., 2015). The material features of BDA technologies such as sourcing, storage, event recognition and prediction, behavior recognition and

prediction, rule-based actions, and visualization, enable service innovations in the form of automation of customer-sensitive service provision and new human-material customer-sensitive service practices for firms in from Austria, Germany, and Switzerland (Lehrer et al., 2018).

The analytic technique is crucial in big data analytics because it influences if and how a company will generate new insights from data for product development and operations improvement and employ a structured approach for decision-making (Tan et al., 2015). The technique used in harvesting useful information from big data determines the value of big data in strengthening product innovation capabilities (Tan et al., 2015). For instance, big data predictive and prescriptive analytics lead to product and process innovation which in turn influence SME performance in China (Saleem et al., 2020a).

Big data predictive and prescriptive analytics are positively related to product and process innovation in SMEs (Saleem et al., 2020a). Big data and predictive analytics influence competitive advantage via green innovation practices (El-Kassar & Singh, 2019). Big data and predictive analytics have a direct marginal influence on green product and process innovation, e.g., the redesign of production, operation processes, products, and services to fulfill environmental criteria such as reduction in consumption of energy, pollution emission, etc., (El-Kassar & Singh, 2019).

Big data analytics positively impact knowledge integration which fosters organizational innovation (Cadden et al., 2023). Big data analytics push firms to change their innovation processes towards combining both technology-driven and market-driven innovation (Capurro, Fiorentino, Garzella, & Giudici, 2022). Big data analytics can steer innovation processes and innovation achievements, and trigger new opportunities through the development of disrupting ideas that can model, convey, and influence market demands (Capurro et al., 2022). Marketing analytics use has a positive influence on knowledge integration, which engenders

organizational innovation (Cadden et al., 2023). Big data analytics impact sustainable supply chain performance economically, socially, and environmentally, through circular economy practices of reuse, reduce, and recycle (Cheng et al., 2022). BDA influences sustainable supply chain flexibility, i.e., the supply chain's ability to adapt in terms of speed, cost, quality, innovation, etc., in manufacturing firms (Cheng et al., 2022).

Big data analytics improves the capabilities to combine diverse sets of knowledge or prior technology (Wu et al., 2019). Big data analytics is more beneficial to innovation and is in high demand for innovations that are reliant on search and intensive information processing, innovations involving patent activity or diverse recombination of existing knowledge, and innovations related to process improvement while the combination of data analytics and process-oriented firm practices increases firms' productivity (Wu et al., 2019). Big data analysis fosters a higher propensity to innovate and increase innovation intensity in manufacturing and service industries (Niebel, Rasel, & Viete, 2019).

Proposition 2: If big data analytics is positively associated with innovation, then, innovation will increase as a result of big data analytics.

The Building Block: Big Data Analytics Capabilities

An organization's effectiveness in big data adoption and application depends on specific competencies, intelligence, and resources, which literature has delineated as big data analytics capabilities. Big data analytics capabilities (BDAC) is defined as the "ability of the firm to capture and analyze data toward the generation of insights, by effectively deploying its data, technology, and talent through firm-wide processes, roles, and structures" (Mikalef et al., 2019a). BDA Capabilities are dynamic capabilities that are valuable, difficult to imitate, and substitute, which create a competitive advantage (Ramadan et al., 2020). Gupta and George (2016) defined BDAC as a firm's capability

to assemble, integrate, and deploy its big data-based resources. Gupta and George's (2016) framework established that BDAC includes tangible and intangible resources and human skills. Tangible resources comprise internal data that are created through organizational processes, e.g., inventory updates, sales, transactions, or other internal processes, and external data that are either public or private data bought or traded, the technology required for the analytical processes, e.g., software such as Hadoop, and basic resources, e.g., financial and learning resources. Intangible resources are highly context-dependent, hard to mimic, and crucial to an organization's performance in a dynamic business environment, e.g., organizational learning and data-driven culture. Human resources include technical skills for understanding, operating, and modifying software systems, and other skills such as machine learning, data scrubbing, statistical analysis, and data extraction, and managerial skills that enable good communication and collaboration between the leadership team, managerial employees, and staff which support the full exploitation of business values from big data analytics.

This article builds on the conceptualization of big data analytics capabilities from literature and therefore proposes that big data analytics capabilities depend on *Big Data Capital*. Capital is the resource or anything used to generate profit, value, or advantage in a business or for its owner, e.g., machinery, intellectual properties like patents and trademarks, monetary or financial assets (Wesley, 2023). Capital is an input or stock of resources employed in the production process (Boulding, Kleinsorge, Pen, & Schmitt, 2024). There are different types of capital; intellectual capital, human capital, social capital, etc., Thus, this article defines big data capital as the *set of tangible capital, e.g., internal/external data, technology (software), financial resources, etc., and intangible capital, e.g., data-driven culture, the culture of experimentation, organizational learning, psychological safety, knowledge sharing, knowledge management, risk-taking, etc., and human capital, e.g., technical skills, managerial skills, innovative capabilities,*

knowledge, health, and intelligence, that are possessed by an organization or the individuals/groups within an organization. The cumulative total of these variables represents the holistic big data capital available to an organization in accomplishing its goals. For instance, the data analytics capabilities of a firm are represented by the proportion of employees who possess data analytic skills (Wu et al., 2019). Similarly, the big data capital of a firm is represented by the cumulative tangible capital, intangible capital, and the human capital of the organization.

Thus, this article defines *big data analytics capabilities as expertise and capacities drawn from big data capital that enable a firm to build, manage, utilize, and integrate big data sets in transforming the business.* Capital is used to make something better. Likewise, expertise derived from big data capital, which can be referred to as big data analytics capabilities enables a firm to successfully operate or perform big data analytics needed for improving business performance and creating value, innovation, and competitive advantage. How big data capital is managed or developed determines a firm's innovativeness. Innovation is a form of organizational performance and big data capital is crucial to a firm's capacity to innovate; to learn, absorb knowledge, and thereby innovate. For example, a high level of relational capital in an organization fosters a high level of big data innovation; and stimulates the capacity for acquiring and sharing knowledge, and using it for innovation (Bharati & Chaudhury, 2019). A high level of organization learning (inter-organizational approach of sensing changes in the environment, exploring alternatives, and adapting solutions) leads to technological competence that enables a high level of big data innovation (Bharati & Chaudhury, 2019). Strategic-level big data analytics capabilities (e.g., leadership, organizational culture, talent management, and technological resources) facilitate knowledge creation through big data and in turn enhance service innovation (Saqib, Yumei, Najam, & Mahmood, 2021). BDAC creates strategic flexibility which has positive effects on innovation performance by

enabling the ability to reallocate and reconfigure current resources in adapting to a volatile business environment (Zhang & Yuan, 2023). BDAC helps innovation teams in integrating and reconfiguring information resources and business processes in adapting to a fast-paced business environment (Hao, Zhang, & Song, 2019).

BDAC which includes tangible (financial), intangible, and human resources, has an indirect effect on radical innovation capabilities and incremental innovation capabilities (Mikalef et al., 2019a). Big data analytics capabilities, e.g., big data generation capabilities, data integration and management capabilities, advanced analytics, and data visualization capabilities, have a positive association with supply chain innovation during the COVID-19 pandemic (Bag, Gupta, Choi, & Kumar, 2021). Firms with a sophisticated IT platform (a high level of experience in change management, project management, and technology evaluation which facilitate technology assimilation) have a higher level of big data innovation (Bharati & Chaudhury, 2019). There is a positive relationship between big data technology implementation and the number of patents and the number of invention patents (Wei, 2023).

BDAC determines output, effects, and speed of innovations because a higher BDAC implies a higher innovation performance (Zhang & Yuan, 2023). Big data analytics capabilities positively influence organizational innovation, i.e., the adoption or implementation of new organization-wide processes, structures, and practices, which positively influence market performance (Khalil, Aziz, Long, & Zhang, 2023). BDAC positively impacts innovative performance in the form of product and process innovations in manufacturing firms (Khan & Tao, 2022). Big data analytics capability is positively related to product innovation performance (Hooi, Abu, & Rahi, 2018). According to a study of Chief Information Officers and IT managers in Greece, BDAC accounted for positive and significant impacts on incremental and radical innovation (Mikalef et al., 2020). Big data analytics capabilities positively impact business model innovation

(Ciacci & Penco, 2023). BDAC positively impacts innovation performance by enabling strategic innovation, which involves the transformation of business models, existing markets, and the nature of competition to create noteworthy value for customers and business growth (Zhang & Yuan, 2023). The stronger the BDAC, the stronger the positive effects of big data on the sustainability of innovation and organizational development in the USA (Hao, et al., 2019). BDAC has significant and positive effects on the proficiency of sustainability design of innovations and commercialization of innovations that entail technologies and sustainable products, services, and materials (Zhang et al., 2020). BDAC promotes the positive effects of big data on the sustainability of innovation and organizational development (Hao et al., 2019).

Tangible, intangible, and human resources BDACs are significantly related to co-innovation. Big data analytics capabilities directly and positively influence co-innovation, i.e., co-creation of products and services, creativity, and collaboration with internal and external stakeholders (Lozada et al., 2019). BDAC activates co-innovation which is realized through co-learning activities and shared data, tools, and technologies between an organization, customers, and other socio-economic actors (Ciasullo et al., 2022). Organizations with a high level of social media implementation (using social media for product design, product repair and development, and collaboration with stakeholders) have a high level of data-driven innovation (Bharati & Chaudhury, 2019).

BDA capabilities positively impact supply chain innovation and in turn supply chain performance (Bahrami, Shokouhyar, & Seifian, 2022). Big data analytics capabilities in MSMEs have significant impacts on supply chain innovation which ultimately increases financial performance (Bhatti, Ahmed, Ferraris, Wan Hussain, & Wamba, 2022a). Big data analytics capabilities have a significant effect on supply chain innovation; radical changes in product, process,

marketing, technology, and resources that result in value creation for stakeholders in manufacturing firms (Bhatti, Wan Hussain, Khan, Sultan, & Ferraris, 2022b). Big data analytics capabilities positively impact market innovation in the hospitality industry, i.e., improved the methods for product design, placement, promotion, and pricing (Khalil, et al., 2023).

BDAC which varies according to contextual factors, e.g., organizational size and industry produces different configurations of radical and incremental process innovation capabilities (Mikalef & Krogstie, 2020). Innovation leadership significantly moderates the relationship between big data analytics capabilities and healthcare supply chain innovation during the COVID-19 pandemic. Innovative thinking in leadership supports decision-making and builds employees' confidence in BDA applications (Bag et al., 2021). Big data analytics capabilities significantly impact MSMEs' supply chain innovation when mediated by digital platform capabilities or network capabilities (Bhatti et al., 2022a). The BDAC in organizations has indirect effects on radical and incremental innovation when fully mediated by dynamic capabilities (Mikalef et al., 2019a). Big data analytics capabilities positively impact supply chain innovation through supply chain agility which entails responding quickly to short-term market changes and supply chain adaptability which entails configuring source base and structure of the supply chain to achieve longer-term efficiency gains (Bhatti et al., 2022b). Big data analytics capabilities have a direct impact on business model innovation (the reconfiguration of the business value logic for a company and its stakeholders) and via entrepreneurial orientation (Ciampi, Demi, Magrini, Marzi, & Papa, 2021).

BDACs have positive and significant impacts on radical innovation, and a positive association with incremental innovation when moderated by information governance; information governance is the set of capabilities necessary for creating, capturing, evaluating, storing, utilising, controlling, accessing, archiving, and deleting

information over its life cycle (Mikalef et al., 2020). The effects of BDAC on innovation performance are moderated by environmental uncertainty due to the unpredictability of the external environment and the inability to predict the impact of environmental change (Zhang & Yuan, 2023). Big data analytics capability along with environmental hostility, i.e., interactions with threats from the environment, fierce competition, enable firms to innovate their business models (Ciacci & Penco, 2023). The impact of BDAC on an organization's radical innovation is heightened under a higher environmental dynamism, i.e., the unpredictability of environmental change, and higher environmental heterogeneity, i.e., diversity and complexity of environmental conditions (Mikalef et al., 2019a). High environmental dynamism significantly amplifies the effects of information governance and BDACs on incremental and radical innovation (Mikalef et al., 2020). Big data analytics capabilities impact supply chain innovation and are positively moderated by technological uncertainty; a crucial environmental factor that occurs due to a rapid pace of innovation in products, processes, and technologies (Bhatti et al., 2022b). BD Analytics capabilities moderate the impacts of BD on firms' growth and gross margin in firms executing service innovation projects, the higher the BDAC the higher the impacts of BD on gross margin and sales growth (Sazu, 2022).

Proposition 3: If big data analytics capabilities are positively associated with innovation, then innovation will increase as a result of big data analytics capabilities.

The Building Block: Insights

The American Psychological Association [APA] (2018) described insight as the clear and sometimes sudden discernment of a solution to a problem via approaches that are not obvious and may never become so. Insights are obtained through selective combination by putting together available information in developing a solution to a specified problem, or by selective comparison, which involves distinguishing

the exact information that is already stored in an individual's long-term memories that is relevant to a specified purpose, and by selective encoding which entails identifying relevant information versus irrelevant information. Therefore, this article suggests that insight includes information, knowledge, ideas, etc., For example, big data development engenders information, knowledge, and resources dissemination, steers inter-organizational competition, and stimulates business diversification (Xie et al., 2021). Big data analytics provides the potential for obtaining information from big data that can facilitate the development of innovation and understanding or redefinition of firm-customer relationships (Capurro et al., 2022). Essentially, information is a message that reduces uncertainty, and insight may lead to ideas. An idea is a conception in the mind that occurs as a result of mental understanding. An idea is a thought, conception, or notion (Audi, 1995). Likewise, big data management is associated with the processes of ideation (Lozada et al., 2019). Moreover, insight is discernment, perception, and seeing what is not evident to an average mind or oftentimes a sudden but deep, accurate, and clear understanding of a complex problem. Insight is a combination of discernment and understanding. For instance, data-driven insights are valuable insights generated from diverse data sources, which help in understanding past and present trends and predicting future trends, and subsequently positively influence decision-making quality (Awan et al., 2021).

A company's success depends on its ability to draw insights from both traditional and non-traditional data (Tan et al., 2015). The implementation of BDA helps organizations to understand their data, generate critical insights, and redefine strategies (Mikalef et al., 2019a), for example, the analysis of big data from social media (e.g., X.com) generated by viewers about TV shows provided valuable insights for innovating the design of the TV show's episodes or seasons (Fortunato et al., 2017). BDA promotes the use of marketing analytics that generate business and marketing insights which are valuable for mobilizing resources for taking advantage of

market opportunities (Cadden et al., 2023). BDA provides key insights in enabling firms to understand the changes occurring in the business world (Bahrami et al., 2022). BDAC supports sensing, learning, coordination, transformation, and integration processes which enhance radical and incremental innovation capabilities (Mikalef et al., 2019a).

Insights play a crucial role in innovation and the creation of values. The ability to gain useful insights from big data is a means of developing competitive advantage in a constantly evolving business environment (Bahrami et al., 2022). Big data analytics provide a clear-cut advantage over competitors in delivering critical insights that steer improvement in products/processes and in building radically new products/processes (Mikalef et al., 2020). BDA is worthwhile for gaining actionable insights, creating business value, and establishing competitive advantage. Big data analytics provide insights and reveal patterns useful in understanding the business and market. Big data analytics are insight-generating tools that enhance radical and incremental process innovation capabilities (Mikalef & Krogstie, 2020). Big data analytics facilitate insights that enable process and structural adjustments in organizations which result in product or service innovation (Khalil et al., 2023). Big data analytics help in developing the ability to obtain, process, and apply new knowledge for exploiting market opportunities, and integration of new knowledge into value-creating activities which result in innovation that fosters competitive advantage (Cadden et al., 2023). BDA makes it possible to access and integrate insights that are not attainable through less sophisticated processes. BDA generates insights that are useful for predicting customer demand and preferences which consequently lead to improvement of products and services (Khalil et al., 2023).

Proposition 4: If insights from big data analytics are positively associated with the development of innovation, then innovation will increase as a result of the generation of insights from big data analytics.

The Building Block: Decision-Making

Decision-making is a critical pathway by which big data and big data analytics can result in value creation. Decision-making functions as a building block in innovation. Decision-making is described as the cognitive process of choosing between two or more alternatives which may be clear-cut or complex and may involve analysis or experimental manipulation (APA, 2018). The use of data analytics by firms in making decisions is expanding due to the proliferation of data about consumers, suppliers, competitors, and partners (Wu et al., 2019). Data-driven decision-making has become an integral part of a firm's processes for building competitive advantage and driving growth (Wei, 2023). Big data analytics turns data into useful information that supports decision-making. BDA helps in uncovering patterns, trends, and correlations that support business and corporate decision-making.

Through BDA, firms develop the ability to make concrete and timely business decisions embedded in BDA-enabled insights. Big data helps in strengthening the decision-making process toward generating value for the business (Lozada et al., 2019). Big data is a valuable resource that provides information or knowledge that enables managers to develop data-driven decision-making processes (Verma et al., 2021). High-quality data generated through tangible digital data collection technology and intangible routine assets enhances decision-making (Prescott, 2016). Social big data contributes to decision-making that supports the management of tourists' satisfaction, for enhancing the sustainable growth of destinations, sustaining the value creation process, and innovating the offering for tourist experience (Del Vecchio, Mele, Ndou, & Secundo, 2018).

Big data technologies improve a firm's decision-making and managerial capabilities useful in integrating and exploiting resources toward improving innovation outcomes (Xie et al., 2021). BDAC makes it easy to participate in decision-making and problem-solving needed for developing organizational initiatives or co-creating innovation that

advances competitive advantage (Ciasullo et al., 2022). BDA increases a firm's tendency to become the frontier for innovation by enhancing decision-making capabilities (Zhu & Yang, 2021). BDAC enables factual and accurate information needed for decision-making which enhances a firm's knowledge absorption capacity for the creation of knowledge, transformation and integration of new knowledge into a firm's operations which consequently builds a firm's agility (Khan & Tao, 2022).

Big data analytics capabilities have positive associations with entrepreneurial orientation, which involves decision-making regarding innovation, risk-taking, and proactiveness, that enable the exploitation of opportunities in both existing and new markets (Al-Darras & Tanova, 2022). Big data technologies provide new data information practices and engender novel decision-making possibilities, which support firms' innovative performance, e.g., product innovation and market success of product innovations (Niebel et al., 2019).

Proposition 5: If decision-making through the use of big data analytics is positively connected to innovation, then innovation will increase as a result of decision-making based on big data analytics.

Problem-Solving in the Context of Data-Driven Innovation

Problem-solving is the process of identifying or defining a problem, determining the root cause or causes of the problem, identifying alternative solutions, deciding the best course of action to solve the problem or selecting a solution from the options available, and implementing the selected solution (Warren & Wood, 2023).

BDA enables businesses to identify and solve problems which leads to the discovery of opportunities (Bahrani, et al., 2022). Big data provides new knowledge that can be exploited to find solutions to many problems and to develop innovations. BDA capabilities increase the joint creation of knowledge or information which serves as input for the co-creation of innovative solutions to problems (Ciasullo et al., 2022). Big data capabilities

enhance innovative performance by increasing firms' agility which promotes creative problem-solving needed for addressing market challenges (Khan & Tao, 2022).

Proposition 6a: If data-driven decision-making is positively associated with problem-solving, then, problem-solving will increase as a result of data-driven decision-making.

Proposition 6a: If innovation is positively associated with problem-solving, then, problem-solving will increase as a result of innovation.

Building Competitive Advantage via Data-Driven Innovation

The building blocks of innovation play important roles in creating a competitive advantage.

Big data is a source of value creation, and a significant driver of innovation and competitive advantage (Tan et al., 2015), and at the same time, innovation is a competitive advantage. A competitive advantage is a factor, condition, or circumstance that gives a productive entity a superior or favorable business position in comparison to its competitors. These factors include cost-efficient production, unique products/services, superior quality of products/services, superior margins, and the generation of more sales. Danielsen and Framnes (2017) argued that a competitive advantage is the comparative ability of a firm to be innovative, attain cost-efficiency, gain market share, sustain profitability, and continue growing in comparison to competitors. Competitive advantage is a two-dimensional construct that includes marketing performance and financial performance which are measured in comparison to competition (Dubey et al., 2021). Besides, Ramadan et al. (2020) indicated that sustainable competitive advantage is a firm's superior social, economic, and environmental performance in comparison to competitors. Specifically, BDAC plays a vital role in an organization's competitive armory as they are tools, competencies, and specializations necessary for exploiting data that stimulate

business model innovation (Ciacci & Penco, 2023). Big data provides valuable insights useful in strategic decision-making which can lead to improved competitive advantage (Khalil et al., 2023).

Big data contributes to a firm's competitive advantage by improving products and service offerings to customers (Prescott, 2016). Big data capabilities have become pivotal in harnessing the power and value of big data in creating a competitive advantage for firms (Zhang, Shang, Cheng, & Hu, 2022). Big data technologies are essential in developing scientific and technological innovations that give rise to a firm's competitiveness (Wei, 2023). Big data enables the integration of external resources for international diversification, which profoundly increases innovative performance and the creation of competitive advantages.

Data quality and technological innovation are critical building blocks of competitive advantage (Dubey et al., 2019).

BDAC enhances innovation capabilities, i.e., a firm's ability to implement innovative ideas in designing and developing new products or improving existing products, while innovation capabilities increase a firm's sustainable competitive advantage (Ramadan et al., 2020). BDAC such as data resources, insights, the creativity of managers, collective intelligence, organizational learning, data-driven culture, technical skills, and complementary organizational resources, support varying levels of radical and incremental process innovation capabilities that provide a competitive edge (Mikalef & Krogstie, 2020). BDA capabilities reduce the degree of environmental complexity because it enables a firm to stay abreast of evolving market and customer preferences, predict and respond to competitors, and identify new business opportunities (Ciacci & Penco, 2023). Big data analytics capabilities through higher dynamic capabilities; the capacity to incorporate or sense, create or seize, and reconfigure or transform internal and external competencies in managing constantly changing environments, lead to a higher competitive performance (Danielsen &

Framnes, 2017). Big data analytics capabilities through organizational agility (the capacity to detect market changes such as opportunities and threats and respond swiftly and transform the business) positively impact organizational innovation and marketing innovation which creates competitive advantage (Khalil et al., 2023).

Combined ambidextrous innovation strategies (exploratory strategy which involves experimenting with new knowledge and field, and exploitative strategy which involves adapting innovation practices based on existing knowledge) partially mediate the association between big data analytic capabilities and sustainable competitive advantage (Zhang et al., 2022). Big data analytics enhance a firm's sustainable

capabilities that include green product innovation and green process innovation, i.e., saving energy, recycling, etc., which lead to competitive advantage and sustainable performance (Singh & EL-Kassar, 2019). Big data analytics enable open innovation for developing sustainable products which gives rise to competitive advantage (Ali et al., 2020).

Proposition 7a: If BD, BDA, and BDAC are positively associated with innovation, then innovation will increase as a result of BD, BDA, and BDAC.

Proposition 7b: If BD, BDA, and BDAC are positively associated with innovation, then the competitive advantage will increase as a result of an increase in innovation.

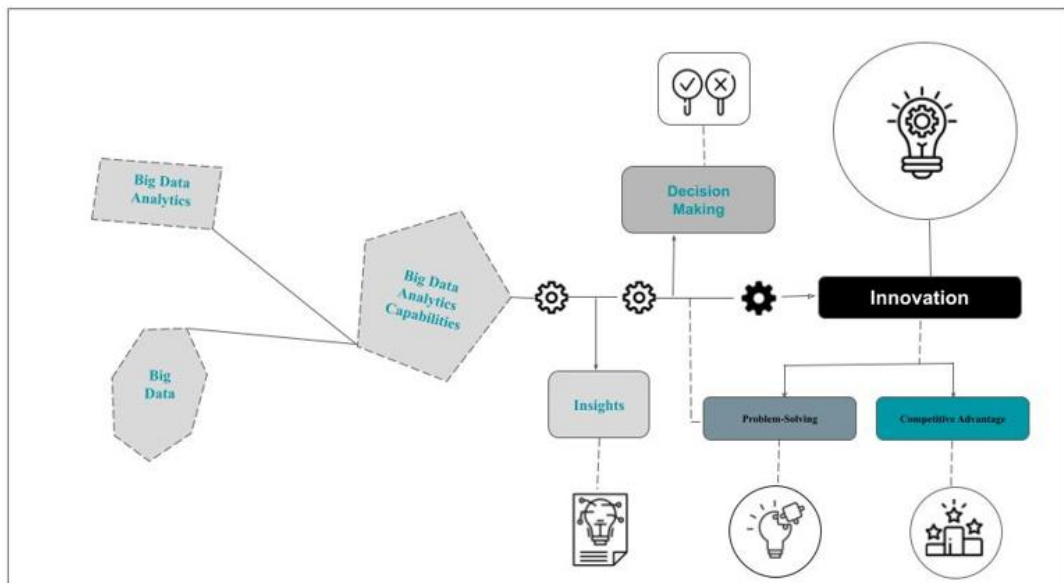


Figure 01: The Building Blocks of Innovation

DISCUSSION

Theoretical Implications

This article contributes to knowledge about big data and innovation by proposing the building blocks of innovation, which is a collective concept that describes big data, big data analytics, big data analytics capabilities, insights, and decision-making concerning innovation. This article presents a theoretical statement about innovation in the era of big data. *Innovation is a competitive advantage and an outcome of the holistic processes*

involving the building blocks of big data, big data analytics, big data analytics capabilities, insights, and decision-making. This article underpins innovation as a competitive advantage. This positions innovation as a value-creating process.

Cadden et al. (2023) indicated that innovation has a direct positive relationship with competitive advantage. Innovation includes new products, services, processes, technologies, management and marketing approaches that increase product

differentiation and decrease cost thus leading to competitive advantage. Essentially, based on the synthesis of extant literature, this article posits that *innovation is a constructional process of problem-solving that relies on a package of functionalities which include big data, big data analytics, big data analytics capabilities, insights, and decision-making, and which guarantees a competitive advantage*. This article provides insights into the pathway essential for building innovation and the interrelationships between innovation and the building blocks of innovation. Innovation is a problem-solving mechanism. The extent of innovativeness of an organization is subject to its capacity to solve problems, the use of big data, the analytics processes, and the collective expertise accruing from big data capital in an organization. Specifically, the development of innovation is contingent on critical building blocks which cannot be omitted or substituted. The omission of any of the building blocks in the development of innovation will impact the outcomes of the innovative process. Big data, big data analytics, big data analytics capabilities, insights, and decision-making are the core elements or fragments for building innovation, or which determine the outcomes of innovation. The quality of big data, big data analytics, big data analytics capabilities, insights, and decision-making determines the strengths or effectiveness of innovation. Big data capabilities are pivotal building blocks of the innovative process. The level of quality of big data capabilities determines innovation outcomes; it either strengthens innovation positively or negatively impacts innovation. Besides, the route to innovation is the generation of valuable insights from big data through big data analytics capabilities (whereby insights are denoted as information, knowledge, and ideas). Innovation is dependent on informed decision-making through the use of big data, the deployment of capabilities, and the systematic process of collecting, storing, analyzing, managing, and interpreting enormous data sets.

This article expands the understanding of big data analytics by synthesizing the definition of big data analytics based on common

themes from reviewed literature and existing conceptualizations. *Big data analytics is a system of collecting, storing, processing, analyzing, and interpreting big data sets through advanced technological tools, e.g., software, in a way that reveals patterns and trends to gain insights; valuable information, and knowledge, that facilitate decision-making and the creation of value for the business*. This article proposed the concept of *big data capital* which comprises intangible capital, tangible capital, and human capital. The combination of these capitals indicates the holistic big data capital available to an organization. The article established that effective big data analytics is dependent on the big data capital of an organization. The article suggests that big data capital is the *set of tangible capital, e.g., internal/external data, technology (software), financial resources, etc., and intangible capital, e.g., data-driven culture, the culture of experimentation, organizational learning, psychological safety, knowledge sharing, knowledge management, risk-taking, etc., and human capital, e.g., technical skills, managerial skills, innovative capabilities, knowledge, health, and intelligence, that are possessed by an organization or the individuals/groups within an organization*. Some of the units in the definition include organizational learning which means an inter-organizational approach to sensing changes in the environment, exploring alternatives, and adapting solutions (Bharati & Chaudhury, 2019). Psychological safety refers to an individual's perception of the consequences of taking interpersonal risks in the workplace (Edmondson & Lei, 2014). Innovative capabilities are the skills and knowledge required to effectively absorb, master, and improve existing technologies, and products and create new ones (Mikalef et al., 2020). Intelligence is described as the ability to solve hard problems (Minsky, 1985), or the ability to achieve goals in a wide range of environments (Legg & Hutter, 2007). Big data capital is important in enabling an organization to utilize big data analytics effectively in achieving its goals. Essentially, big data capital can be perceived as the cornerstone of big data analytics capabilities

in an organization. Moreover, this article defines *big data analytics capabilities as expertise and capacities drawn from big data capital that enable a firm to build, manage, utilize, and integrate big data sets in transforming the business.*

Implications for Practice

The study has significant implications for management and organizational stakeholders. Firms stand to derive great benefits from big data, as the article has portrayed that big data is essential in creating value for organizations. For example, analyzing and drawing insights (e.g., comprehensive information about consumer behavior in real-time) from various combinations of data such as individuals' activities, relationships, keyword searches, clickstreams, and locations, has become more valuable in influencing business decisions that enhance organizational performance (Wu et al., 2019).

The ideas from the building blocks of innovation are valuable in supporting organizational stakeholders in rethinking their approach to innovation. To enhance innovation performance in organizations, leaders should consider all the building blocks of innovation and employ a holistic approach to developing innovations. This article suggests that the package of functionalities, big data, big data analytics, big data analytics capabilities, insights, and decision-making are crucial for organizational leaders in building innovation that leads to competitive advantage in a fast-paced, competitive, dynamic, and complex business environment. Essentially, a competitive business environment could pose threats or opportunities to businesses (Khan & Tao, 2022). However, innovation could enable firms to stay abreast of competition and flourish in a highly competitive environment.

Building blocks of big data, big data analytics, big data analytics capabilities, insights, and decision-making are essential for building innovation in various dimensions, spheres, and contexts. Still, firms need to adapt their data analytic processes and build data analytics capabilities according to their unique needs or context. Specifically, for an

organization to achieve either radical or incremental innovation and product or process innovation, there is a need for a robust data analytic process and capabilities or expertise drawn from the big data capital that is unique to the organization. Mikalef and Krogstie, (2020) indicated that it is important for firms to adapt or shape BDAC to fit the environment of a firm's operation which may vary according to contexts and constraints.

The key to harnessing the benefits of big data entails developing a firm's BDAC or big data capital with strong expertise in big data analytic processes and knowledge regarding developing data-driven innovation that leads to competitive advantage. Mikalef et al., (2019a) stated that organizations that would build and maintain a competitive position must develop big data analytics capabilities that are proficient in analyzing real-time customer data, generating insights, and deploying solutions to problems.

Moreover, as the need for developing a firm's BDAC is increasing along with the labor market demand for data scientists, Dolezel and McLeod (2019) suggested that higher institutions should take a proactive approach to closing knowledge gaps about data analytics skills through planned dissemination of data analytic skills to learners. Academics should endeavor to deliver data analytics knowledge and skills to future data scientists by re-engineering the curriculum to focus on big data analytics and expanding data science course offerings.

Moreover, leadership plays a big role in successfully driving innovation through big data. Leaders have the power for operational and strategic decision-making about big data analytics. At the same time, the leadership style and approach impact the outcomes of big data investments for the organization. For instance, in organizations where leadership employs coercion and manipulation, the coercive and manipulative powers negatively impact the power (effects) of big data analytics which in turn negatively impacts relationship innovation, e.g., adverse impacts on trust, knowledge sharing, data, analytics, and satisfaction (Akhtar, Khan, Rao-

Nicholson, Zhang, 2019). However, in firms, where leadership employs expert and referent powers, the non-mediated powers produce a positive impact on the power of big data analytics which in turn positively impacts collaborative partnerships. The power of big data analytics positively mediates the relationship between traditional organizational powers and relationship innovation in collaborative partnerships (Akhtar et al., 2019).

Limitation of study and directions for future research

This study recognizes that there could be other variables responsible for innovation, e.g., experimentation, corporate culture, learning, psychological safety, etc., Still, this article emphasizes that these variables can serve as inputs that are fed into the data collection in the innovation process. In the context of innovation, big data is heterogeneous and covers a wide range of constructs which may include the aforementioned variables. Besides, in this article, these constructs (experimentation, corporate culture, learning, psychological safety, etc.) are accounted for under the intangible capital and are part of the big data capital. Essentially, the theoretical contributions made by this study can be expanded further under different disciplined inquiries. The proposed interrelationships (propositions) between innovation and the building blocks of innovation can be examined through future research endeavors.

CONCLUSION

In a rapidly evolving business environment, data-driven innovation creates a competitive advantage. Data-driven innovations are useful in addressing market challenges and the wicked problems of the world. Targeting unique or complex problems through big data, big data analytics, big data analytics capabilities, insights, and data-driven decision-making has been proven as a valuable approach in building innovation that is sustainable, commercializable, and leads to competitive advantage. Innovation that gives

rise to competitive advantage is built on data-driven decisions. Specifically, driving successful innovation requires investments in big data, however, big data that would foster innovation cannot remain in the raw data state but go through transformation via big data analytics which is entrenched in big data analytics capabilities, and must yield insights that enable successful decision-making. Developing, increasing, and improving innovation depends on the holistic processes involving the building blocks of innovation.

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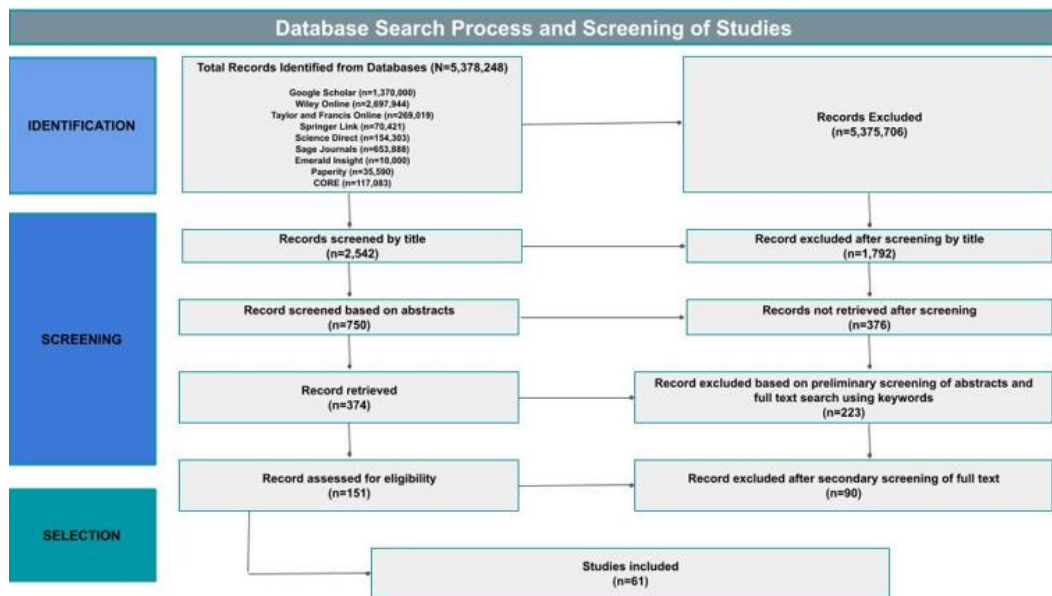
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APPENDICES

Appendix A

Publication Selection Process



Appendix B

The Building Blocks of Innovation

