Quantitative and Qualitative Studies in Business and Management (QQSBM)

Journal homepage: www.qqsbm.com

The impact of transparency and reliability on sustainable performance: The moderator effect of big data analytics capability

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ABSTRACT

Over the last few years, a considerable progress has been made, which has been accompanied by recent innovations and technological advances spurred by the advent of the fourth industrial revolution. Environmental sustainability is an essential component of sustainable business strategies and operations. The purpose of this research is to examine the impact of transparency and reliability on sustainable performance with the moderator effect of big data analytics capability. In the development of any integrated supply chain, increasing the confidence and trust among the partners and devising the reliability for them are the crucial factors to achieve sustainable success.

Keywords: transparency; reliability; sustainable performance; big data analytics capability

1. INTRODUCTION

Significant progress has been made in recent years, which has been accompanied by recent innovations and technological developments encouraged by the advent of the fourth industrial revolution (Hassoun et al., 2023). Since its inception in 2016 (Enzmann and Moesli, 2022; Kaczmarek, 2019), the concept of the "Fourth Industrial Revolution (4IR), also known as Industry 4.0," has encompassed the digitalization of industrial production, leading to fully intelligent, interconnected, and digitized production factories and organizational activities (David et al., 2022). While we recognize that the current shift in developed countries is toward the Fifth Industrial Revolution (5IR), the (4IR) is intriguing because Gumbo et al (2023) propose that global leaders recognize the benefits of purposefully developing 4IR digital capabilities within their firms.

The 4IR's scope has grown as a result of innovations and technologies dispersing more quickly and widely (Borba and Carvalho, 2022). Companies are looking to work with outside experts who possess greater degrees of expertise (Bacon et al., 2020). The fourth industrial revolution will stimulate speedier innovation, requiring businesses, governments, and other organizations to manage knowledge across borders (Krafft et al., 2020). Globally, many countries and regions are now turning to the industrial fourth revolution as their preferred development approach for generating ecosystem innovation (Huang et al., 2020). In order to achieve a common objective, ecosystem innovation alters the interactions between a variety of actors, such as producers, suppliers, service providers, users, regulators, and civil society organizations (Konietzko et al., 2020). The fundamental goal of the Fourth Industrial Revolution is to increase revenues and living standards (Dogaru, 2020). The 4IR reshapes innovation-related policies to achieve fair and steady

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DOI: https://doi.org/10.5281/zenodo.10479153

expansion (Li et al., 2021). As a result, innovation and sustainability are becoming increasingly vital for business success. More academics are pushing for more attempts to participate in innovation networks, which will guide firms toward enhancing sustainability (Payán-Sánchez et al., 2021). A company's sustainable performance is the alignment and combination of the three goals it wishes to achieve: financial, environmental, and social (Rizki et al. 2022). The 4IR and the environment are interconnected megatrends that can act as a two-edged sword (Muhammad et al., 2022). People's lives will be significantly changed by the 4IR, hence businesses should support environmental quality by creating environmentally friendly products (Elheddad et al., 2021). Environmental sustainability is a necessary component of sustainable business operations and plans (Housni et al., 2022). Governments are tightening environmental laws controlling enterprises, and consumers are becoming increasingly concerned about the nation of origin of products (Ghadge et al., 2021). Environmental legislation and sustainable development programs are driving enterprises to review, streamline, and upgrade their processes to boost environmental sustainability efficiency (Pinna et al., 2018). Strategies including decreasing energy use, investing in recycling, and participating in community events can help companies achieve sustainable profits (Liu and Stephens, 2019). Furthermore, because of the worrying situation of the environment, all corporate organizations have been compelled to expand their commitment to the adoption and implementation of sustainable and responsible business strategies (Sharma and Singla, 2021).

While most previous research has concentrated on identifying the environmental sustainability determinants using only greenhouse gas emissions as the environmental pollution indicator, researchers have found that the available findings are not sufficiently comprehensive because they do not consider the various environmental problems in a holistic way (Lei et al., 2023). Researchers state that a far more thorough investigation and careful selection of indicators are necessary in order to offer an accurate picture of a company when approaching environmental sustainability evaluation (Tóthová and Heglasová, 2022). Usubiaga-Liano and Ekins (2021) have concluded that countries still do not have adequate indicators to evaluate their performance from a strong sustainability perspective when it comes to environmental sustainability. Although environmental sustainability has been included in corporate strategy, this field of study is still relatively young. Investigating the relationship between environmental sustainability and the accuracy and transparency of information in the supply chain, as well as the potential moderating impacts of big data analytical capabilities, is thus one of the goals of this research.

According to Wang et al. (2020), technological innovation in the 4IR is anticipated to result in a long-term increase in production and efficiency, same to a supply-side miracle. Studies have demonstrated that implementing digital technology and Sustainable Supply Chain Practices (SSCPs) boosts environmental performance (Khan et al., 2023). It is crucial that manufacturing organizations progress towards sustainable supply chain and respond to the environment (Emamisaleh, and Rahmani, 2017). Currently, global industries transfer supply chain transformations to the top of industrial objectives and two grounds that justify this relevance are the increasing amount and potential of data and the innovations in the supply chain which is named now'' Supply Chain 4.0'' (Barata, 2021). Consequently, managers are trying to figure out how to work with other suppliers in their supply chain to properly fulfill their environmental responsibilities (Winter and Knemeyer, 2013).

Sustainable supply chain management (SSCM) practices, such as environmentally friendly sourcing and sustainable packaging, often yield positive outcomes when it comes to supply chain sustainability performance (Mastos and Gotzamani, 2022). By acquiring vital data that may be employed to enhance the competitive advantage from the supply chain procedure, a company's environmental performance may be pretty significant (Björklund et al., 2012). Industry 4.0 technologies have the potential to improve supply chain transparency, with a focus on system architectures and structures which facilitate transparency (Sunmola and Burgess, 2023). Notably, our paper's transparency refers to a company's sharing of information about its upstream operations and products to the general public, including investors and consumers (Zhou et al., 2022). Regretfully, it is not as easy as just forcing all suppliers to the plant or company to adhere to a specific set of environmental criteria (Awaysheh and Klassen, 2010). Hence, several campaigns have compelled lead corporations (such as Nike, Adidas, and H&M) to boost the openness of their supply chains (Egels-Zandén and Hansson, 2016). Effective information transparency rules and methods are becoming crucial to keep or regain supply chain partners' trust, while customers may now readily access official information from merchants and manufacturers (Montecchi et al., 2021). The supply chain is lengthy, involves connections across multiple regions, and contains numerous participants. As a result, there may be a lack of effective information exchange and problems with participant data trust (Zhang et al., 2020). Transparency, from the perspective of the supply chain, refers to the information that is readily available and available to the businesses that are part of a network of supply chains (Ada et al., 2021). Contemporary supply chains demand flow synchronization, such as information transparency and cooperation among supply chain participants are inevitable (Wadhwa et al., 2010). Difficulties in

implementing environmental sustainability performance are caused by supply chain limitations in information transparency that are not well reported in the literature.

The modern market requires complete responsiveness, high-quality products, and a highly reliable supply chain in a short amount of time and at the lowest feasible cost, according to Artsiomchyk and Zhivitskaya (2015). Because businesses and their supply chain partners are interconnected, a thorough understanding of supply network reliability is essential (Chen et al., 2017). Supply chain reliability is the probability that the chain will meet mission requirements to deliver the required supplies to the critical transfer points within the system (Thomas, 2002). Transparency and trustworthiness are prerequisites for information. True information is seen as reliable (Vedder and Wachbroit, 2003). When there is information asymmetry among its members, a supply chain's ability to share information reliably is crucial to its overall performance (Spiliotopoulou et al., 2016).

Achieving long-term success in the construction of any integrated supply chain requires building confidence as well as reliability among partners (Taghizadeh and Hafezi, 2012). To the best of our knowledge, the topics of supply chain transparency and information reliability are not well covered in the literature. According to Faheem et al. (2021), industries encounter difficulties in getting dependable data from many sources and delivering the collected big data in a shortened, predetermined period of time. Industry 4.0 includes big data as a technology (Grabowska and Saniuk, 2022; Castelo-Branco et al., 2022). The increasing demand for reliability and transparency of Big Data calculations is a major barrier to the adoption of Big Data technologies (Anisetti et al., 2023).

These novel data types could be used to give system and product reliability information with the right analysis techniques (Hong et al., 2018). Significant advancements in data storage, processing, and visualization techniques and technologies have been reported in response to the rapid growth of data volume, velocity, and variety (Mikalef et al., 2020). The conclusions of an analysis that is based on inaccurate, low-quality data are not at all helpful, even though there is a lot of collected data and the technology to use it is easily accessible (Kyeong and Nam, 2022). Big Data Analytic Capability (BDAC) is a capability of manufacturing firms that can improve their performance in terms of agility and innovation (Khan et al., 2022).

BDAC is required for analysis and informed decision-making (Shamim et al., 2020). The ability of a company to effectively and strategically arrange, assemble, and implement Big Data Analytic (BDA) resources to improve the performance of the entire business is known as BDAC (Ashaari et al., 2021). To build BDAC, companies need to pool their organizational, human, financial, and physical resources. As a result, firms need qualified BDAC individuals more and more to assist with big data processing and produce insightful market reports (Chen et al., 2022).

Researchers demonstrate how supply chain management could benefit from BDAC by providing potential benefits and a competitive advantage (Jha et al., 2020). While BDAC specialists have emphasized the need of creating an organizational model that explains how to strengthen BDAC, researchers contend that little is known about the components that lead to BDAC's enhancement (Morimura and Sakagawa, 2023). Researchers stressed the importance of certain non-technical resources in addition to the technology and data needed to create a BDAC (Gupta and George, 2016). Previous studies have shown the importance of big data analytics capabilities. However, no study has examined the role that BDAC plays as a mediator in the relationship between environmental sustainability performance and supply chain transparency and reliability.

The purpose of this study is to investigate how reliability and transparency affect sustainable performance, taking into account the moderating influence of big data analytics capabilities. This research will assist businesses in becoming environmentally sustainable, which will have a number of benefits for them, including enhanced competitiveness and brand image, lower costs and higher productivity, favorable business conditions, the ability to comply with regulations, attract investors and employees, tax benefits, waste reduction, increased innovation, and assurance of business continuity.

2- LITERATURE REVIEW

2-1 The fourth industrial revolution

An intentional approach to integrating cutting-edge Internet-based control systems that enable people and machines to connect anytime, anywhere with anyone and anything in the distinct complex system is described as the "fourth industrial revolution" (David et al., 2022). Software applications, which include capabilities like the Internet of Things, artificial intelligence, machine learning, cloud computing, and platforms, are where the key technical drivers of the 4IR have their origins (Enzmann and Moesli, 2022). It is anticipated that when smart technologies become more prevalent in the fourth industrial revolution, productivity growth would multiply (Gu et al., 2021). This revolutionary

transformation, which affects all industries, including primary, secondary, and tertiary ones, is centered on the five pillars of a stable society: food, security, health, wealth, and knowledge. According to Kimani et al. (2020), experts, the technology offers several possible benefits that will aid businesses in adjusting to the demands of the fourth industrial revolution. Subsequent studies made an effort to characterize Industry 4.0 by examining the possible uses of data and the capabilities of associated technologies (Castelo-Branco, 2022).

The Fourth Industrial Revolution promises a future in which virtual and physical production systems collaborate globally in a flexible manner. Because of the integration of pre-existing technologies and their interaction with one another in the digital, biological, and physical realms, the Fourth Industrial Revolution is very different from the previous revolutions (Li et al., 2021). It mainly concentrates on cutting-edge machinery for machine communication and applications to provide enhanced automation, self-monitoring, greater connection, and smart machines that can use the Internet of Things to evaluate and diagnose problems without the need for human interaction (Afolalu et al., 2021). Additionally, governments must set up appropriate procedures for regulating and maintaining digital infrastructure because evolving technologies have the potential to significantly damage people's privacy (Dogaru, 2020).

It signals profound changes in the production, use, interchange, and distribution of information in addition to changing the nature of labor and productive systems. In these processes, universities are vital (Baijnath et al., 2023). The widespread digitization and modern solutions used in smart factories have resulted in a shift in management paradigms and new open business models focused on the integration of intelligent, autonomous technologies, remote control, and improving quality of life (Grabowska and Saniuk, 2022).

Given that the 4IR has an impact on business models, it has the potential to change customer expectations, the standard of goods and services, organizational structures that maintain values, and, most importantly, the nature of collaborative and open innovation (Lee et al., 2018). As Information Technology (IT) pervades industries in the fourth industrial revolution, open innovation and open business models, which form the cornerstone of sharing economy companies, are two emerging business models that challenge existing company strategies (Yun et al., 2020). Due to its non-rivalry and non-excludability, these advancements cause new technological information to spread, which helps the entire economy through spillovers or excess returns (Venturini, 2022).

2-2 Innovation ecosystem

An economic community is supported by a business ecosystem, which is made up of interacting people and businesses (Paasi et al., 2023). The collective ecology that innovative companies create in accordance with particular norms and directions is referred to as the "innovation ecosystem" (Moore, 1993). Over the past few decades, the idea of innovation ecosystems has gained popularity in management and business studies, leading to talks on the need for a standard definition (Barile et al., 2022). An innovation ecosystem is "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize," according to Wolfert et al. (2023). An actor's or a population of actors' innovative performance depends on a dynamic collection of players, activities, and artifacts, as well as institutions and relationships, including complementary and substitute relationships (Li-Ying et al., 2022). According to academics, the establishment of innovation ecosystems is a process of embedding and integrating actors into a growing ecosystem structure (Dedehayir.et al., 2022). Other terminology for "innovation ecosystem" include "business ecosystem," "digital business ecosystem," "digital innovation ecosystems," "digital ecosystem," and "platform ecosystems" (Stahl, 2022). These uses could be connected to the significance of idea flexibility (De Vasconcelos Gomes, 2018).

The majority of academics hold the belief that the innovation ecosystem is made up of core enterprises, customers, suppliers, complementary innovators, and regulatory agencies; however, these players are entirely dependent on the system environment (Huang et al., 2020). Current triple helix theories explore the non-linear relationship between government, universities, and industry for knowledge creation and sharing, where the government provides stability, regulations, and rules of play, the industry acts as a source of production, universities provide new knowledge and technology, and competitors/substitutes and artifacts (such as products, technologies, etc.) are left out from many definitions of innovation ecosystems (Liu and Stephens, 2019; Granstrand and Holgersson, 2020).

A greater appreciation for the connections among numerous innovative actors is evident in the literature on innovation ecosystems (Oh et al., 2016). An innovation ecosystem seeks to change how participants collaborate and communicate with one another in order to contribute to a shared objective (Konietzko et al., 2020). Under the general heading of innovation ecosystems, several concepts have emerged, including co-working spaces, innovation hubs, and, more widely, collaborative spaces (Aumüller and Baka, 2023). A single organization's limitations and capacities are

exceeded by the resources and complementary assets that actors can access through an innovation ecosystem (Pushpananthan and Elmquist, 2022). The characteristics of the participants in each ecosystem might range from technology development to R&D and policy support, with each ecosystem encompassing the three components of the innovation triple helix (private sector, knowledge sector, and government sector) (Benitez et al., 2020). Firms, governments, universities, research organizations, NGOs, and customers may all be part of the innovation ecosystem (Cobben et al., 2023). An ecosystem supported by the government can aid private-sector innovation by covering financial gaps and addressing technological difficulties (Lepore et al., 2023). Knowledge collaboration with an expanding number of innovation ecosystem agents of various types (e.g., universities, suppliers, competitors, R&D laboratories, consultants, and so on) reveals that spillover effects knowledge generation (Audretsch et al., 2022). The issues that come from concurrent cooperation and competition among participants, as well as positioning within the ecosystem, are fundamental to innovation ecosystem strategies (De Vasconcelos Gomes et al., 2022).

The supply chain refers to the flow and transformation of information and products from the raw material stage to the consumer stage (Ojo et al., 2017). Firms participating in making a product and delivering it to the end user comprise a supply chain—raw material and component manufacturers, product assemblers, wholesalers, retailer merchants, and transportation corporations are all players (Mentzer et al., 2001). Shorter product life cycles, mass customization, the push for more sustainable processes and products, and the demand for quick and effective product delivery are all putting strain on process supply chains (Barbosa-Povoa and Pinto, 2020). Transactions, financial contracts, processes, knowledge, physical resources, and labor are all parts of the supply chain that help a product movement from supplier to consumer (Iranmanesh et al., 2023).

Supply chain innovation has always been connected with process innovation (Hahn, 2019). A shift in the supply chain's technology, network, or procedures that could take place within a business, a firm, or an industry is known as supply chain innovation (Solaimani and van der Veen, 2022). Despite realizing the benefits of supply chain innovation, companies still find it difficult to grow independently (Afraz et al., 2021). For supply networks to be creative, influential, intelligent, and consistent elements of an intelligent supply chain are essential (Qader et al., 2022).

One key area of study for Industry 4.0 is the supply chain. For instance, global initiatives across national boundaries allow "physical processes and information flows to be available when and where they are needed" (Barata, 2021). Research on Industry 4.0 technologies and their effects on supply chains has advanced rapidly in recent years. While this has produced many insightful findings, it has also fragmented the literature and made it more difficult to distinguish between what is known and what is unknown (Rad et al., 2022). Industry 4.0 facilitates the optimization of current procedures, material flows, minimizes damaged goods, and shortens waiting times across the supply chain (Sharma et al., 2021). Supply chain reconfigurability is becoming more and more important as factories of the future become modular and mobile, facilitating relocation and keeping manufacturing close to the consumer (Mantravadi et al., 2023). The seven implications of 4IR on supply chain management include digitalization, autonomy, transparency, mobility, modularization, network cooperation, and socialization (Ajayi and Laseinde, 2023).

2-3 Sustainable performance

The idea of sustainability is making sure that the economic, social, and environmental opportunities for future generations are not restricted by the activities of the present (Ghadge et al., 2021; Rosa et al., 2022).Sustainability includes, among other things, providing basic human needs, ensuring global food security, and comprehending the effects of economic activity on the environment (Carter and Rogers, 2008).These days, environmental, economic, and social sustainability serve as the three pillars of sustainability. All three are stated to be required for sustainability to succeed (Cope et al., 2022). Sustainability is a great business strategy, and it's crucial to transition processes in order to integrate and create a constructive, innovative corporate culture (Hassan et al., 2019). Within the context of earlier research employing optimization on sustainable supply chains, a number of different goals were applied, including the number of industrial exchanges, expenses, economic advantages, and environmental effects (Karaylan et al., 2021). Some authors have begun to address the implementation of cultural sustainability principles at the practice level from an organizational viewpoint, overcoming the usual and widespread concentration on other pillars (Errichiello and Micera, 2018). Industry 4.0 technologies are expected to create new value networks and distinctive business models, which will boost economic sustainability from the perspective of sustainability (Toktaş-Palut, 2022).

Businesses and governments must follow an innovation strategy that prioritizes environmental considerations in order to keep up with the advances brought about by the concept of 4.0 (Bildirici and Ersin, 2023). The majority of companies are under increasing pressure to improve their social and environmental operations from both internal and external sources, such as customers, politicians, and employees (Winter and Knemeyer, 2013). When assessing a

company's environmental performance, the following elements are taken into account: preventing pollution and pollution of products or raw materials; conserving natural resources; cutting back on fuel consumption; emitting greenhouse gases and using biodegradable products; and abiding by national environmental regulations (Khan et al., 2023). Environmental sustainability is important for two strong reasons: First of all, it lessens the possibility of climate change having detrimental environmental externalities. Second, it is a necessity for long-term development (Opoku et al., 2022).

Over the past few decades, supply chain management has placed an increasing emphasis on environmental sustainability (Sun et al., 2022; Kholaif et al., 2023). It is imperative that internal stakeholders and shareholders are made aware of the company's adoption of an environmentally responsible manufacturing approach. According to Rizki et al. (2022), shareholders have the ability to exercise control over a company in order to prevent environmental harm. Wealthy nations have already demonstrated an awareness of the need for sustainability strategies in order to develop a sustainable supply chain operating system (Sharma and Singla, 2021). In order to improve performance in meeting sustainability goals, researchers define sustainable supply chain collaboration as interactions between two or more parties (primarily, but not exclusively, firms) in the supply chain during processes of shared planning, sourcing, manufacturing, delivering, and returning goods and services (Kunkel et al., 2022). Rather than focusing on building robust, lean, or flexible supply chains as was first intended, it is now more important to establish sustainable ones given the connections between the economic, environmental, and social issues (Alamelu et al., 2023). The integration of environmental management concepts throughout the entire supply chain is crucial for achieving the full potential of sustainable supply chains, including the competitive advantage they confer. Finally, according to Niemann et al. (2016), it increases earnings and market share targets. Two sustainable supply chain strategies that improve supply chain sustainability performance include environmentally conscious purchasing and sustainable packaging (Mastos and Gotzamani, 2022).

Managers, policymakers, consulting firms, research institutions, NGOs, politicians, individuals, and any other stakeholders interested in understanding and developing supply chain organizations and sustainability practices in varied socioeconomic and cultural contexts (Fritz, 2022). The company must list all of the activities it manages and all of the processes it has implemented to promote supply chain sustainability by sourcing from social and environmental certified suppliers, including transportation initiatives such as using CNG vehicles to reduce pollution (Mann and Kaur, 2020). Academics have consistently emphasized the significance of senior management commitment, involvement, and extra support (Oelze, 2017).

The positive impact on economic, social, and environmental sustainability is one of the biggest benefits of effectively managing innovation activities (Payán-Sánchez et al., 2021). According to Costa and Moreira (2022), sustainable innovations have the potential to drive cleaner production by tackling social issues both in the short and long term, and by integrating environmental and economic objectives at both local and global levels. Because of the "perfect storm of innovation" that has been characterized as the convergence of various technologies and greater customer empowerment, 4IR has wider implications for supply chains (Hopkins, 2021).

2-4 Transparency

Information transparency refers to the degree of accessibility and visibility of information to specific market participants (Liu et al., 2022), as well as openness, communication (Kundeliene and Leitoniene, 2015), access to the free flow of timely and reliable economic, social, and political information (Williams., 2025), and the right to own some information (Al-Jabri and Roztocki, 2015). The transmission of information reduces uncertainty and smoothens supply chain processes (Ghode et al., 2020).

The extent to which all stakeholders in a supply chain have a shared understanding of, and access to, the product-related information that they require, without loss, noise, delay, or distortion (Sunny et al., 2020; Trienekens et al., 2017; Wognum et al., 2011). Transparency in the supply chain shares accurate data on operations, processes, and items, such as sourcing and origin, processing methods, and logistics (Sunmola and Burgess, 2023). According to Zhou, a transparent supply chain is vital for ensuring product quality or safety, as well as for building consumer loyalty and brand image (Zhou et al., 2022). Supply chain transparency is a dynamic competency required for incorporating sustainable principles in supply chain management (Montecchi et al., 2021). Because supply chains are embedded in larger societal structures and processes, they are influenced by a greater range of social structures and processes (Gardner et al., 2019). Suppliers are motivated to embrace socially responsible practices such as international labor practice norms, socially responsible purchasing, and similarities between environmental and social auditing when supply chains are transparent (Francisco and Swanson, 2018). Furthermore, a transparent information system avoids

all supply chain participants from being corrupted (Parkand Li, 2021). There is a clear link between an organization's level of transparency and its environmental sustainability performance. As a result, the following hypothesis is proposed.

H1: Transparency has a significant impact on environmental sustainability

2-5 Reliability

Reliable information is justifiable information that we would be justified in believing, information that we can trust (Schellekens and Prins, 2006), and it is characterized by believability, trust, trustworthiness, accuracy, fairness, and impartiality, among other things (Colepicolo, 2015). Shared information may be updated throughout the information transfer process, resulting in the manufacturer receiving inaccurate information (Huang et al., 2022). With its ability to provide reliable information, modern information technology has enabled deeper supply chain integration than was previously possible (Gunasekaran et al., 2004). For the supply chain to function efficiently, reliable information sharing is required (Spiliotopoulou et al., 2016). Reliable and complete information, not only regarding interruptions but also about the supply chain in general, promotes visibility and velocity, which increases supply chain resilience (Scholten and Schilder, 2015). The identity, location, and status of supply chain transiting entities, as well as the scheduled and actual dates and times for these events, are required for supply chain transparency and reliability (Paul et al., 2021).

To generate reliable data in the supply chain, transparent and reliable information can be gathered. New data types are now accessible for reliability research because of the growth of big data technology (Hong et al., 2018). Data reliability, which indicates the ability of the storage system to maintain data consistency, is one of the most crucial metrics of a data storage/management system (Yang et al., 2014). Reliability analysis of big data is essential since interpretation is the core of data analysis (Wu et al., 2014). Four processes were proposed by researchers to assess the reliability of big data: features selection, data preprocessing, reliability of the knowledge discovery process, discovery and acquisition, and data mining (Safhi et al., 2019). A company's procedure for acquiring reliable, high-quality data and using it for analysis is crucial to getting excellent data analysis (Kyeong, and Nam, 2022). Consequently, the following theory is put forth.

H2: Reliability has a significant impact on environmental sustainability

2-6 Big data analytic capability

Big data analytic capability, or BDAC, refers to a company's ability to efficiently use talent and technology to capture, store, and process data in order to provide insights (Mikalef et al., 2020). According to Shamim et al. (2020), the three important characteristics that influence big data analytic capability are BDA infrastructure flexibility, BDA management capability, and BDA human knowledge capabilities.

As big data analytics skills help businesses accurately identify their demands, corporate is expected to reevaluate its previous perspectives on supply chain management (Wang et al., 2020). Output reliability can be raised by using big data analytics and high-quality data in decision-making processes (Morimura and Sakagawa, 2023). Big data analysis-based decisions are unquestionably more effective, and they provide the basis of new business opportunities (Ejrami and Salehi, 2022). Managers can quickly create, deploy, and support a firm's resources thanks to BDA capabilities (Awan et al., 2021). Jha et al. (2020) state that enhanced operational efficiency, a more dependable and transparent supply chain, and a better understanding of customer behavior are among the advantages of BDAC. Companies that use BDAC are able to mobilize, execute, and integrate BDA resources more effectively, which increases market share and organizational effectiveness. Additionally, BDAC assists companies in fusing their business plan and BDA strategy (Ashaari et al., 2021). Academic research on the requirements and their impact on environmental sustainability in enterprises is currently lacking, even though BDA has a great deal of potential to support decision-making at the supply chain and organizational levels.

During the recent "big data" and "Industry 4.0" revolutions, organizations have been increasingly resorting to big data analytics to modernize everything from supply chain management to marketing and sales (AlNuaimi et al., 2021). Waqas et al. (2021) claim that BDAC improves long-term company performance. Little is known about how to use BDA effectively and efficiently to fulfill sustainability objectives, despite the fact that it is still a relatively new concept and that its application to sustainability is even more recent (Zhang et al., 2022). As a result, the following are hypothesized.

H3: Big data analytic capability moderates the impact of transparency on sustainable performance
H4: Big data analytic capability moderates the impact of reliability on sustainable performance

Figure (1) shows the conceptual framework of this research.

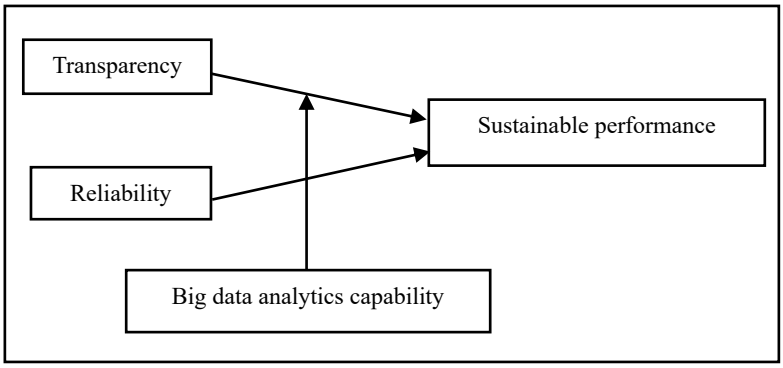

Figure (1): Conceptual framework

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