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The Interplay between Big Data and Sustainable Performance Management with Multiple-Case Studies

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Abstract: This study proposed the data-driven sustainable performance management model (DD-SPMM) under a big data lens, underpinned by resource-based view (RBV), institutional theory, dynamic capability view (DCV), and contingency theory, to achieve the intent of stakeholder and paradox theories. It utilizes a confirmative research design where 171 responses were collected via questionnaires from the Telecommunication, Automation, and Banking sectors in Egypt. Only 162 responses were deemed valid. The results showed that big data has a statistically major positive impact on the SPM. Analyzing coefficient values proven that all model hypotheses were generally accepted in three sectors. More importantly, the DD-SPMM has been practically proved to have a strong level of reliability using Cronbach's alpha values and has no auto-correlation problem based on Durbin -Watson values, which increases the generalization for the model. This study contributes to the literature by having an innovative, tested SPM model under a big data lens, considering the interrelationship between model phases.

Keywords
Big data, BDAC, SPM, corporate sustainability, DD-SPMM, and phases of SPM under a big data lens

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1. INTRODUCTION

Nowadays, best-practice companies employ big data resources (Tseng et al., 2019) to establish multiple ecosystems and data flows (Mazzei et al., 2017). Big data will fundamentally change how businesses compete and function. There is expanding understanding of the value of big data across industries and sectors (Gandomi et al., 2015), however many executives are still unsure how to effectively use this influx of data within their firms. Besides, in the work of (Wilkin et al., 2020), prioritizing big data still needs to be empirically explored. Following (Clarke, 2016), lowering the risk of analyzing irrelevant or incorrect big data provides BDA more effective inputs based on data quality, source reliability, and perceived value. As indicated by (Calic and Ghasemaghaei, 2020), one of the primary causes of the ambiguity surrounding big data's use is that the notion has many facets and that not all big data elements are equally appropriate for a given context. It would be beneficial for corporate social performance to address the issues of using big data to identify and uphold a company's moral responsibilities. However, big data identifies and acts on correlations between social and financial results. Reviewing Nisar et al., (2021); Nisar et al., (2022); Chatterjee et al., (2022); Horng et al., (2022); and Dehbi et al., (2022) , there is a limited understanding of how big data affects SPM. Thus, there is a need for further study, particularly in the areas of how organizations find new data-driven business opportunities, design new data products, develop novel big data-based business models, and influence the transition to new models. The lack of empirical studies in the literature on how firms manage different stakeholder interests to derive value from big data is another way that it stands out. To respond to such issues, this study works on developing DD-SPMM. The research model works on embedding big data into four phases of data-driven SPM and reflecting its effects on such phases, with the consideration of interrelationships. What makes DD-SPMM remarkable is the enhancement and establishment of the transition from a simple, regular assessment of sustainable performance to an ongoing, real-time assessment to confirm its relevance in the present. The fundamental research question is: How can big data affect SPM in companies and what is the practical use companies can make of such interplay?

2. THEORETICAL BACKGROUND

DD-SPMM is a comprehensive SPM model that captures the complexities of sustainability. The phases of the model foster businesses' ability to manage sustainability in a systematic and organized manner. According to Irfan and Wang (2019), RBV posits that companies can capture business value by utilizing resources in an integrated and efficient manner. Drawing on RBV, blending big data into SPM can be a source of sustainable competitive advantage.

The design of DD-SPMM depends upon the consideration of a set of principles as follows: the consideration of the privacy and security of data, the integrity between different data sources and different big data analytics (BDA), the transmission of real-time data and real-time synchronization, the dynamic collaboration among relevant participants and stakeholders, and the continuous and interactive feedback. Following (Green et al., 2018), rather than relying on summarized and static reports, consumers will increasingly turn to atomized, adaptable, and transparent data to construct their unique indicators of individual performance, real-time assessment, and reporting requirements.

DD-SPMM is distinguished by adding the big data initiatives phase to the SPM model developed by (Accenture, 2009) which focuses on the cycle of measuring, managing, analyzing, and reporting sustainability performance to make the collection of data as it is possible as can. DD-SPMM focuses on the ecosystem of data flows instead of data stocks. By combining internal and external sources of big data, DD-SPMM follows institutional theories. Besides, following DCV through considering BDAC in the big data initiatives phase.

The big data initiatives phase includes the selection of a big data strategy based on contingency theory. As indicated by (Ebner et al., 2014), if a decision for big data is made, there is a challenge of deciding the most suitable strategy for implementing BDA. This strategy should be relevant to the current organizational needs. Moreover, as stated by (Mawed and Al-Hajj, 2017), for big data to become a competitive advantage for a company, it must consider the larger context in which the data were created, as most firms collect data without comprehending the means or advantages.

In the strategic planning phase of DD-SPMM, following RBV, utilizing big data to plan the sustainability strategy, update existing sustainability performance measures, discover new sustainability performance measures, and plan the optimal processes, and BDA to manage the sustainable performance. Whether, in the implementation phase of DD-SPMM, utilizing contingency theory to prioritize big data. Based on (Wilkin et al., 2020), to cost-effectively exploit valuable information, prioritizing big data based on its quality is necessary to feed into BDA. Prioritizing big data should be done after data collection but before BDA.

3. HYPOTHESES DEVELOPMENT

Instead of mindlessly engaging in big data projects, it is necessary to first understand what is required to begin big data activities for certain projects (Sumbal et al., 2019). Recognizing opportunities and challenges of big data implementation is a contributing factor for big data initiatives. BDA has been used by companies to gain insights into their organization's success. Depending upon DCV, the combination of internally produced data with data obtained from external sources will make a big data asset precious. Companies engage in capability creation and realization by creating and reconfiguring internal and external resources to attain sustained superior performance in dynamic environments. as stated by (Calic and Ghasemaghaei, 2020), big data can be utilized for combining data with external partners and suppliers which can lead to synergistic value creation and organizational innovation. In the same line as (Singh and El-Kassar, 2019), developing sustainable capabilities including a corporate commitment is the key to developing sustainable practices and big data initiatives and therefore achieving sustainable performance.

Although providers sell big data management and analytics, the right use of big data, analytics awareness, data security and privacy awareness, human talent, skills, and experience with advanced big data management and analytics tools can be domain-specific, scarce, and unique to a context (Mawed et al., 2017; Xu et al., 2019). An integrated big data system should collaborate closely with upstream and downstream value stream partners to achieve common objectives by reorganizing data in new ways to make informed decisions (Chen et al., 2015a; Cosenz et al., 2020). The key to developing big data is selecting appropriate analytic tools based on the features of big data to obtain the information needed (Song et al., 2018). According to (Tabesh et al., 2019), the implementation of big data strategies is complicated due to the technological and cultural challenges related to big data. Managers should work in overcoming these challenges for successful big data initiatives. More importantly, managers should provide commitment and support, support effective communication and coordination, gain basic managerial analytics acumen, and foster a data-driven culture which is a crucial indication of the importance of big data to businesses. Strong data-driven cultures can produce forecasts that are crucial in deciding a company's future direction. Big data initiatives that lack consistent clear business objectives and strategies are failed. The incorporation of BDA in a firm's long-term business strategy, as well as the processes in place to promote business alignment with this strategy, are critical to BDA's success

(Constantiou and Kallinikos, 2015) indicated that the data generated by the procedures and operations associated with big data ensures that the appropriate data sources are always up to date. Big data tends to make current events more relevant to strategic decisions. Big data's

characteristics (unstructured, agnostic, heterogeneous, trans-semiotic) clash with the structured data sources used by conventional, prescriptive strategy models. The strategy in a big data environment, in opposite to standard strategy, follows an inductive and bottom-up approach instead of a deductive and top-down approach, a short-term horizon instead of a long-term horizon, and nowcasting instead of forecasting. In most cases, the settings of big data generation are outside the control of organizations, and they are not susceptible to the widely accepted norms of the expert rule on which data and expert knowledge have traditionally been based.

Big data provides the basis for merging data from various sources and applications. As such, big data facilitates the creation of new intangible assets and supports an organization's competitive strategy and business intelligence by altering the methods and processes by which information is made available to decision-makers in businesses and enabling the creation of innovative services (Constantiou and Kallinikos, 2015). According to (Nielsen, 2018), in a big data environment, management accountants should concentrate on holistic types of data, new analytics techniques and methods, daily measurements, and pattern and correlation detection. Besides, they must emphasize new abilities and ways of integrated thinking for performance and decisions (in real-time) to recognize new options and the use of various datasets for risk forecasting. They must create new KPIs and identify and introduce new holistic digitally driven business models. Management accountants must not only have descriptive reports to address questions about previous events, but they must also make forecasts, considering the effects of risks and uncertainty in decisions. Accordingly, this study predicts that:

H1. *Adapting big data initiatives under a big data lens positively affects SPM.*

The business landscape has altered because of big data, requiring organizations to innovate and rethink their present business strategies (Ylijoki and Porras, 2019). Big data is transforming how businesses interact, create value, innovate, motivate their employees, and address environmental issues (Hazen et al., 2016). Under a big data lens, data is collected without a pre-defined purpose (Günther et al., 2017). The relationship between data and strategy has evolved from ("strategy to data)"to ("data to strategy)". Big data allows for the collection of data that can be evaluated and adjusted to the specific needs of a company's strategies, assisting in the development of proactive initiatives (Gnizy, 2019).

Big data will fundamentally alter how businesses compete and function. Organizational success is dependent on the interaction of data, technology, people, and procedure. Organizations should continuously integrate data into their day-to-day operations, routines, and business strategy (EY, 2014; Mazzei et al., 2017). More importantly, through data monetization and strategic digital transformation, big data can help increase business model innovation, such as the consideration of scope, speed, and sources of digital business strategy (Sheng et al., 2017). Following RBV as pointed out by ((Mikalef et al., 2018), it's critical to recognize the various sorts of resources in the context of big data, because the degree to which they're infused into various business processes can be a source of competitive differentiation. The combination of big data and performance measurement tools could provide enterprises with more value than they would have if used alone. Big data can broaden the boundaries of performance measurement systems by enabling analytics to analyze massive amounts of structured and unstructured data (Mello and Martins, 2019).

In a big-data environment, strategy is becoming holistic and dynamic data-driven and continually updated with new data using big data analytics. Boundaries and externalities should be considered (Mazzei et al., 2017). According to (Constantiou and Kallinikos, 2015), the environment of business intelligence and strategy, as well as how businesses perceive, assess, and act upon their internal and external contexts, is linked to big data. Besides, big

data repositories or platforms have the ability for ongoing data generation and renewal or upgrading of data. Consequently, big data allows firms to radically change their business strategy and alter to different industry contexts. For instance, Nike moves from only producing shoes to also providing data services using their digital platform as a new value proposition to customers (Günther et al., 2017). (Tiwari et al., 2018) supported supply chain sustainability initiatives through utilizing BDA that improve financial, social, and environmental performance indicators. For example, analyzing GPS data and real-time traffic and weather data for dynamic delivery planning, has an impact on both the cost of gasoline and carbon emissions. Additionally, BDA provides supply chain managers with the capability to plan supply chain activities and adopt proactively to supply chain risks and external future events.

The benefits of a company's big data program can be boosted by using analytics, particularly in choosing KPIs for the company's success (Fanning, 2016). Big data can help management control systems by identifying behaviors that are linked to specific target outcomes, leading to the formulation of associated performance measurements (Warren et al., 2015). Following (Arnaboldi et al., 2017; Sheng et al., 2017), big data discover and establish new correlations and interactions. For example, to predict offline orders and reduce inventory costs, clickstream as web data is used. To measure how well social media responds to client and user requirements, social media data is utilized. To measure customer satisfaction effectively and efficiently, online reviews are utilized. To measure real-time brand performance, social tagging, and locational and geographical parameters were used. To measure the level and speed of information flow across social networks, new indicators on network dynamics developed. However, there is a challenge in ensuring the reliability of these new indicators through governing big data information. Companies would not be able to reap the advantages of big data simply by collecting more and better data. The ability of leaders to set attainable targets and identify what can be considered a success is critical for effective big data use (Daskalova and Ivanova, 2019).

More importantly, as illustrated before, the ability of organizations to effectively realize true sustainability performance is heavily reliant on collaboration and transparency among organization networks/partners to develop a set of sustainability requirements and achieve sustainable goals. BDA can efficiently improve a company's ability to implement sustainable practices as well as its overall success. In this regard, (Staniškis and Arbačiauskas, 2009), stated that companies must develop their own sets of core sustainability performance indicators that consider comparability, measurability, meaningfulness, clarity, efficiency, integrity, and continuity. Companies develop big data solutions to reduce operating costs by optimizing and automating marketing processes to gain a low-cost advantage. For example, Walmart Company utilizes Polaris' search engine to increase online sales through its website. Polaris' search engine ranks search results according to the number of likes the product has on social media and the number of favorable reviews it has, which all are new indicators of customer satisfaction.

According to (Grover et al., 2018), analyzing streaming data, including real-time performance data and just-in-time stock levels, can have a big effect on how well an enterprise runs. BDA can assist in determining a business process's strengths and weakness. By analyzing and monitoring corporate sites and online consumer product reviews, a company can determine purchasing patterns, frequently reported products or services issues, desired attributes of specific products or services, and promotional strategies, which provide recommendations for product/service innovation. Therefore, this paper predicts that:

H2. *Strategic planning under a big data lens affects SPM.*

BDA can make data more transparent throughout a company, allowing it to be used more frequently (Grover et al., 2018). (Wamba et al., 2017) highlighted that BDA is a game changer due to its tremendous operational and strategic potential that enables businesses to have a proactively and forward-thinking and examine and manage strategy using data. Amazon and Netflix are based upon purchase recommendations as source of purchase strategy In the same line, (Raut et al., 2019a; Raut et al., 2019b,) pointed out that BDA has the potential to alter the industrial business by more effectively implementing sustainable practices. All three components of sustainability (economic, environmental, and social) are positively influenced by BDA (Raut et al., 2019a,b). For instance, social media is used to exchange personal information, keep others informed about social activities and events, and attain new knowledge (Tseng et al., 2019).

(Mawed et al., 2017) conducted a case study in the facility management industry. They found that by correctly defining KPIs and gathering related data, big data enhances better planning and forecasting. BDA help decision-makers to understand risks and deal with them and evaluate how others deal with them. Thus, they concluded that big data improve performance management. (Ren et al., 2019) proposed a framework that highlights that BDA is used to predict, analyse, interpret, evaluate, and optimize sustainability performance at all phases of the product lifecycle in a timely mode, through implementing the strategy of servitization during the whole lifecycle, and hence prompt sustainable smart manufacturing.

Employees can benefit from the availability of big data by having more flexibility to behave based on data insights instead of managerial approval (Calic and Ghasemaghaei, 2020). In addition, big data aids advertising and marketing by allowing for more targeted products and services, leading to greater economic results and sustainable products and services (Blazquez and Domenech, 2018). As indicated by (Philip Chen and Zhang, 2014), e-Bay utilized sentiment analysis to alter large complicated data sets into visualized pictures to understand consumer trends and behaviors. More above, (Hassani and Gahnouchi, 2017) concluded that BDA , based on continuous flows of real-time data, assist companies in improving, changing, and updating process, and therefore improve business process management. Additionally, (Fernando et al., 2018) indicated that linking BDA, like trending hashtags and customer service performance, supports the concept of customer-service-oriented firms, which could improve service supply chain performance. For example, as stated by (Bhimani and Willcocks, 2014), purchases from Amazon and e-Bay, and searches on Google depend on prior hashtags for improving customer service performance. Accordingly, this paper proposes that:

H3. *Implementing SPM under a big data lens affects SPM.*

In big data-driven research, data are collected before any specific model is constructed ((Nielsen, 2018). Big data follows the inductive approach, in which a broad question is posed, and data is filtered, acquired, modeled, and finally analyzed (Arnaboldi et al., 2017).In the same line (Rikhardsson and Yigitbasioglu, 2018), big data focuses on patterns and relationships in data, where causes come second. Data quality is not at the core of internal controls and management reporting. This could fundamentally alter the management accountant's role in companies. According to (Gepp et al., 2018), information gathered in real-time through big data tools is displayed using tailored dashboards and state-of-the-art visualizations in a way that is more user-friendly than standard financial reports. Furthermore, the tools must show changes over time rather than just a snapshot, causing market participants to become less focused on the short term.

As highlighted by (El-Kassar and Singh, 2019), achieving sustainable performance can be done by following sustainable dynamic capabilities with big data utilization and configuring and continually reconfiguring resources to make big data initiatives reproducible and

sustainable rather than a one-time occurrence. Big data provides a broader view of the information flow, which accurately reflects future changes in business operations in real-time (Sheng et al., 2017), allowing managers to investigate and comprehend the sources of performance variability (Mawed et al., 2017). For instance, Schleich company monitors its ability to achieve targeted sales in a real-time manner by utilizing a power business intelligence (BI) platform to measure mean absolute error value (bias and error) for sales.

With BDA, business processes should be adaptable to deal with emerging different stakeholder interests and hence realize value (Günther et al., 2017). Due to the presence of dynamic contexts, BDA models are rarely pre-set. For evaluation and improvement, BDA models usually necessitate iterative solutions (Chen et al., 2015b). (Fernando et al., 2018) reached that BDA impacts service supply chain performance in terms of responsiveness positively.

Big data, through its new sources of data and analytics, provides new ways of constant real-time monitoring and feedback, such new responsibility and rewards structures in firms. (Bhimani and Willcocks, 2014). Big data can be used in continuous cycle monitoring to detect changes in customer sentiment and network relationships such as recommended friends on LinkedIn and Facebook, explore fraud in real-time, continuously search and interfere in health care practices, and better predict online transactions based on a data collection of product characteristics (Mello and Martins, 2019). Manufacturing sensor data allows for real-time monitoring of equipment and early detection of problems (Tiwari et al., 2018). Big data can disclose new critical measurements that should include in management control systems. Big data may aid in the discovery of new motivational metrics. As a result, improved monitoring and performance evaluation may result in greater production (Warren et al., 2015).

(Warren et al., 2015) pointed out that big data, through its ability to discover new behaviors correlated with respective goal outcomes, supports the discovery of new performance measures incorporated in management control systems. For instance, email tone could be proxy for employee morale. The number of emails sent by employees could be an indicator of productivity. The body language of the video captured for customers could be an indicator of customer satisfaction. More above, big data, through its new sources of data, support beyond budgeting practices. Thus, management accountants should have the capabilities and skills to deal with such issues. Big data's greatest advantage is in the improvements to the corporate reporting environment, particularly in terms of dynamic, real-time updates that allowed for improved accuracy (Al-Htaybat and Alberti-Alhtaybat, 2017; Marsden and Wilkinson,2018). Through this new modified corporate reporting, large volumes of highly changing data analyzed through BDA to provide real-time and tailor-made information to meet stakeholders' expectations. Hence, this paper proposes that:

H4. *Performance reviewing and acting under a big data lens affects SPM.*

H5. *Performance reviewing and acting under a big data lens affects adapting big data initiatives for SPM.*

H6. *Performance reviewing and acting under a big data lens affects strategic planning for SPM.*

4. RESEARCH DESIGN

4.1.Research model

The above-discussed hypotheses summarize in the conceptual model depicted in the following figure. This model emphasizes the continuous sharing and feedback of data among all SPM phases due to the existence of big data and its analytics. It can be that data flow has two sides due to the real-time eco-system effect of big data among SPM phases.

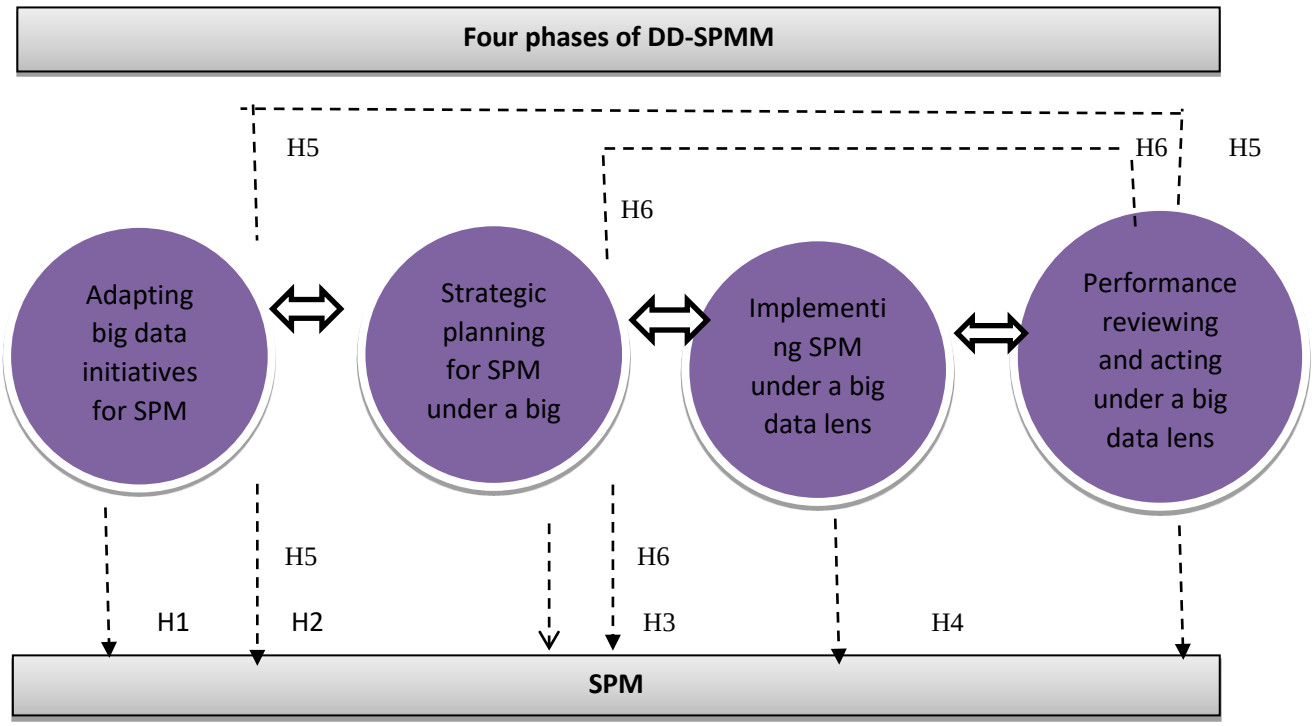

Figure 1. The conceptual model

4.2.Research sample and data collection

Egypt is progressing toward being a data hub. With the Covid-19 pandemic implications, more and more businesses are relying on data. The target population was chosen to conduct the investigation. It is made up of all big data specialists, who worked for companies that had adopted big data techniques and SPM. The data of the current study was gathered in two main stages as follows. Secondary data were gathered from a range of sources, including the Internet, magazines, corporate responsibility reports, and companies' sustainability reports before the questionnaire was conducted. In the first step, the researcher was able to identify the targeted industry sectors and companies and gather extensive background information on the case, as Table 1 shown, including the SPM and big data technologies utilized, the actions done, and the accomplishments made. Different sectors were targeted, as they may place different priorities on processing and utilizing big data which may have different impacts on SPM. Potentially biased responses are a possibility. Therefore, the respondents at the time of the questionnaire were given the assurance that their identity would not be divulged, which helped to eliminate this flaw of biased responses. LinkedIn was also used to contact potential respondents and request their participation. Out of 250 questionnaires given out together with a cover letter outlining the research and ensuring the confidentiality of the replies, 162 responses are received, and 171 ones are valid.

Table 1. Description of multiple-case studies

Industry sector	Case Description
Telecommunication sector	**Vodafone Egypt Company** Vodafone Egypt is a big telecommunication company that contributes significantly to creating an environment that is sustainable, inclusive, and connected. The recent adoption of Vodafone's digital telecommunication strategy paves the path for significant changes in the way they conduct business. Decisions must be made using in-depth analysis. To effectively manage this big data in a sustainable performance, they are working on the right combination of big data tools and big data specialists. **Orange Egypt Company** One of Egypt's top providers of mobile networks is Orange Egypt. Efforts at Orange are centered on sustainable development. In the areas of digital transformation and big data management, Orange Egypt strengthens its strategies. Orange was anxious to use the most up-to-date security technology and data protection in collaboration with globally specialized organizations in this regard. Orange Egypt recently announced the establishment of its integrated digital platform, which supports and directs creative, innovative, and promising ideas and turns them into actual projects. **Telecom Egypt company** The mission of Telecom Egypt is to provide Egyptian society with sustainable solutions depending upon Telecom Egypt's core technologies and practices. For more than 160 years, Telecom Egypt has a strategy to transform Egypt into a worldwide digital hub. The company not only utilizes big data, but it also makes a quick shift to the cloud and IT as a Service.
Automation sector	**Siemens Egypt Company** Siemens Egypt company was established to improve Egyptian's lives and society through using intelligent infrastructure, sustainable energy, trustworthy transportation, and sophisticated manufacturing. With their considerable automation and digitalization skills, Siemens solutions contribute to Egypt's sustainability strategy. To move from ego system to eco system, Siemens depends on both their inside big data platforms, such as Mind Sphere, that are specific to their operations, and outside big data platforms, such as Gestamp, that are provided by outside providers to find insightful, timely, and proactive analyses and forecasts.
Banking sector	**CIB Egypt Bank** CIB Egypt is a pioneer in the Egyptian banking sector and has deeply prioritized ESG practices. CIB Egypt follows a data-driven approach to sustainability. In 2015, CIB started making the transition to "big data," making it one of the pioneers of the concept. The four pillars of the CIB strategy are data enrichment, customer analytics and insights, data governance, and cultural development. The development and acceleration of decision-making processes will result from the accessibility and democratization of data, increasing CIB's responsiveness and agility.

4.3. Variables and measures

The model of this study includes five main constructs. Forty-eight questions were employed and covered all constructs included in the model. A 5-point Likert scale was used to measure each construct. Confirming the big data initiatives (BDI) construct, the pre-plan phase of DD-SPMM was measured with five items including twenty-five questions.

The first item for confirming big data initiatives, drawn from (Horng et al., 2022), is based on determining the appropriate big data sources (BDSO) with the consideration of internal and external sources. The second item is related to confirming the relevant big data strategy

(BDST) which was measured by nine sub-items derived and modified from (Horng et al., 2022). These sub-items inquired about the big data strategy that makes use of new data sources, the big data strategy that aids in streamlining information from various sources, the big data strategy that promotes the use of sophisticated analytics to accomplish corporate results, the big data strategy that aids in complying with industry regulatory standards, the big data strategy that aids in preventing privacy violations and cyberattacks, selects the big data strategy that reduces operational risks including inadequate access controls and data loss, the big data strategy that lowers data costs and enhances IT infrastructure, the big data strategy that aids in the development of digital and analytical capabilities, and the big data strategy that contributes to higher-quality data.

Besides, adopted by (Al-Khatib, 2022), confirming data-driven culture (DDC) is regarded as the third item for confirming big data initiatives. This item measured the thought of the company's management thinking that having, comprehending, and using data is crucial for the company's daily operations. The attempts of the company to be open to all contemporary concepts that go against data-driven concepts, the ability of the company to primarily use data-driven concepts to sustainably manage performance, the ability of company to promote using information and data to guide decisions, and even when that information conflicts with the management's opinions, the degree to which management of company views data as one of the company's most valuable assets, and the ongoing training of company's members' staff to base decisions on data were also measured.

Nine items were adopted by (Akter et al., 2019); (Al-Khatib, 2022); (Belhadi et al., 2020); (Horng et al., 2022); (Kamble et al., 2020); and (Wilkin et al., 2020) to measure BDAC that itself is considered a measure for confirming of big data initiatives. These items inquired about the ability of the business company to develop an IT infrastructure that incorporates big data technology for information integration, make investments in BDA software, develop robust big data management with the consideration of blockchain concept, make investments in procedures to guarantee the real-time data accessibility and high-quality data availability with the consideration of data authenticity, make investments in BDA that provides (versatile) flexible application of the acquired data, have data visualization capabilities, have the capability of contextual feedback, employ staff members who have proficiency with using data and working with IT systems and software, and offer a learning environment that encourages staff members to share their BDA knowledge with others.

Strategic planning under big data lens (STPBD) for SPM, the planning phase of DD-SPMM, is the second construct which was measured by the four items adopted from a previous study by (Dubey et al., 2018). The items measured the utilization of big data for developing the company's sustainable program, the proactive adaption of big data for formulating a distinct vision and a solid grasp of the strategic plan, as well as the scope of the industry and the business, the utilization of big data for setting of sustainable performance objectives, and the utilization of big data for determining of best sustainable performance practices.

Implementing of SPM under big data lens (SPM-BD), the do-phase of DD-SPMM, is the third construct which was measured by three items drawn from (Adrian et al., 2018) and (Beier et al., 2022). Four questions regarding selecting relevant (BDA) item which inquired about the selection and the utilization of BDA that promotes participation and transparency among staff members, the selection and the utilization of BDA that helps in implementing sustainable performance objectives and addressing sustainability issues, the selection and the utilization of BDA that helps in real-time processing and real-time performance measurements, and the selection and the utilization of BDA that helps in discovering areas of

performance improvement while minimizing risks as possible in a real-time. One question related to prioritizing big data (PBD) item that inquired if the use of relevant BDA enables the prioritization of big data. Besides, regarding the consideration of the strategy alignment (STA) item, there is a question statement about the execution of BDA's objectives with the consideration of the alignment with those of the business and IT strategies.

Performance reviewing and acting under a big data lens (PRA), the check and act phase of DD-SPMM, is the fourth construct which was measured by four items derived from the previous study by (Beier et al., 2022) and (Dubey et al., 2018). Evaluating performance under big data lens (EP) item inquired about the degree to which the usage of big data tools enables the business company to conduct a more comprehensive analysis of the business environment, the degree to which the business company regularly evaluates its strategies in response to data-driven insights, the degree to which the retail audits help the business company to regularly evaluate its performance with best practices of the business industry. Additionally, communicating performance under a big data lens (CP) item inquired about the degree to which big data tools help the business company to conduct more interactive comprehensive data visualization and configure more accurate, up-to-date, and less time-consuming tailored *ad⁄hoc* and versatile standard reports, whether internal or external reports. More above, Feedback under big data lens (FD) item inquired about the degree to which the use of big data tools helps the business company to discover new hidden business opportunities including new markets, new data sources, and new innovative products and services and eliminates new threats, update existing sustainability performance measures through removing obsolete ones and discovering new ones, and modify the sustainable performance targets and sustainable performance objectives.

Using four items drawn from (Dubey et al., 2018; Zhou et al., 2016), achieving the SPM construct is assessed. The participants were prompted to evaluate their company's performance in comparison to that of its rivals. These items measured the ability of the business company to provide a variety of big data driven sustainable products and services that meet stakeholder needs at competitive prices and have competitive profitability, which makes the company satisfied with its overall performance.

Based on the a forementioned discussion, the four independent variables of the proposed model are BDI (including BDSO, BDST, DDC, and BDAC), STPBD, SPM-BD (including BDA, PBD, and STA), and PRA (including EP, CP, FD, and R&P), the dependent variable is SPM, and BDI and STPBD are used as mediating variables to reflect the interrelationship between PRA and SPM.

5. DATA ANALYSIS & DISCUSSION OF RESULTS

A preliminary reliability and auto-correlation analysis were carried out before the hypotheses being tested. For ensuring internal consistency and hence reliability, Cronbach's alpha has been calculated as shown in Table 2, where all estimated values for the three sectors were found to have a strong level of reliability (Cronbach's > 0.7).

Table (2). Reliability results

	Telecommunication Sector	**Automation Sector**	**Banking Sector**
Composite Cronbach's Alpha	.984	.980	.993

To ensure the model at hand is trustworthy and suitable for predicting the population parameters, the current study utilizes Durbin-Watson (DW). As shown in Table 3, DW test statistic results in the range of 1.5 to 2.5 are generally considered to be normal. As the following table shows the sample has no apparent autocorrelation in three Sectors.

Table (3). Durbin-Watson Statistics

Case study Sector	Durbin-Watson
Telecommunication Sector	2.306
Automation Sector	2.294
Banking Sector	1.657

The analysis of multiple case studies reveals that all six hypotheses of the model have been accepted using SPSS 26 software, as illustrated in Tables 4,5, and 6**,** respectively. To test direct hypotheses (H1, H2, H3 and H4), linear regression has been utilized. Whereas, following (Baron and Kenny, 1986), mediating hypotheses (H5 and H6) have been tested using linear and multiple regression. The results demonstrate that BDI, STPBD, SPM-BD, and PRA have a substantial impact on SPM, based on the relevant unstandardized B and *P* -values. Following (Baron and Kenny, 1986), the results also indicate that PRA impacts BDI and STPBD and that have a major impact on SPM (H5 and H6) respectively. Where, at *P** < .001 (statistically very strong significance), *P*** < or equal .01(statistically strong significance), *P**** < or equal .05 (statistically significance), and *P***** >.05 (statistically insignificance).

Table 4. Hypotheses result in the Telecommunication sector

Hypothesis	Unstandanarized B	*P* -values	Hypothesis Status
H1	. 878	*P** < .001	It is statistically proven BDI positively affects SPM
			Hypothesis Accepted
H2	.764	*P** < .001	It is statistically proven STPBD positively affects SPM
			Hypothesis Accepted
H3	.806	*P** < .001	It is statistically proven SPM-BD positively affects SPM
			Hypothesis Accepted
H4	.789	*P** < .001	It is statistically proven PRA positively affects SPM
			Hypothesis Accepted
H5	.803	*P** < .001	It is statistically proven PRA positively affects BDI
	.789	*P** < .001	It is statistically proven PRA positively affects SPM
	For PRA=.444	*P*** = .01	It is proven BDI positively affects SPM in the existence of PRA, BDI is statistically significant, and hence BDI has a full mediation between PRA and SPM
	For BDI= .430	*P**** < .05	
			Hypothesis Accepted
H6	.882	*P** < .001	It is statistically proving PRA positively affects STPBD
	.789	*P** < .001	It is statistically proving PRA positively affects SPM
	For PRA= .567	*P* *<.001	It is proving STPBD positively affects SPM in the existence of PRA, STPBD is statistically insignificant, and hence STPBD has a partial mediation between PRA and SPM
	For STPBD= .252	*P*****>.05	
			Hypothesis Accepted.

Table 6. Hypotheses result in the Automation sector

Hypothesis	Unstandardized B	*p*-values	Hypothesis Status
H1	.920	*P** < .001	It is statistically proven BDI positively affects SPM
			Hypothesis Accepted
H2	.833	*P** < .001	It is statistically proven STPBD positively affects SPM
			Hypothesis Accepted
H3	.881	*P** < .001	It is statistically proven SPM-BD positively affects SPM
			Hypothesis Accepted
H4	.935	*P** < .001	It is statistically proven PRA positively affects SPM
			Hypothesis Accepted
H5	.774	*P** < .001	It is statistically proven PRA positively affects BDI
	.935	*P** < .001	It is statistically proven PRA positively affects SPM
	For PRA=.634	*P** < .001	It is proven BDI positively affects SPM in the existence of PRA, BDI is statistically and very strong significant, and hence BDI has a full mediation between PRA and SPM
	For BDI= .389	*P** < .001	
			Hypothesis Accepted
H6	.744	*P** < .001	It is statistically proven PRA positively affects STPBD
	.935	*P** < .001	It is statistically proven PRA positively affects SPM
	For PRA=.634	*P** < .001	It is proving STPBD positively affects SPM in the existence of PRA, STPBD is statistically insignificant, and hence BDI has a partial mediation between PRA and SPM
	For STPBD= .389	*P*****>.05	
			Hypothesis Accepted

Table 7. Hypotheses result in the Banking sector

Hypothesis	Unstandardized B	*p*-values	Hypothesis Status
H1	.940	*P** < .001	It is statistically proven BDI positively affects SPM
			Hypothesis Accepted
H2	.806	*P** < .001	It is statistically proven STPBD positively affects SPM
			Hypothesis Accepted
H3	.886	*P** < .001	It is statistically proven SPM-BD positively affects SPM
			Hypothesis Accepted
H4	.914	*P** < .001	It is statistically proven PRA positively affects SPM
			Hypothesis Accepted
H5	.865	*P** < .001	It is statistically proven PRA positively affects BDI
	.914	*P** < .001	It is statistically proven PRA positively affects SPM
	For PRA=.783	*P** < .001	It is proving BDI positively affects SPM in the existence of PRA, BDI is statistically insignificant, and hence BDI

	For BDI= .08	*P*****>.05	has a partial mediation between PRA and SPM **Hypothesis Accepted**
H6	.986 .935 For PRA=.906 For STPBD= .08	*P** < .001 *P** < .001 *P** < .001 *P*****>.05	It is statistically proven PRA positively affects STPBD It is statistically proven PRA positively affects SPM. It is proving STPBD positively affects SPM in the existence of PRA, BDI is statistically insignificant, and hence STPBD has a partial mediation between PRA and SPM **Hypothesis Accepted**

The multiple case studies, with the use of linear regression, accepted and offered evidence for the major direct positive impact of BDI, STPBD, SPM-BD, and PRA on SPM. H1 is consistent with (Behl et al., 2022; Ramadan et al., 2020) regarding the positive impact of BDAC on a firm's SCA. H1 is also consistent with (Al-Khatib, 2022) whose research looked into the link between BDAC and competitive advantage. H1 is supported by (Nisar et al., 2021) regarding the positive impact of a big data management on environmental performance and decision quality. H2 is consistent with (Nisar et al., 2022) regarding the utilization of DCV to build BDAC for setting sustainable performance objectives. H1, H2, and H3 are consistent with (Chatterjee et al., 2022) regarding the utilization of RBV and DCV for proactively constructing and implementing big data-driven innovation to improve firm performance. H3 and H4 are consistent with (Balakrishnan et al., 2010) as they focused on the positive impact of the continuous prioritization of big data sources on financial performance, and (Wilkin et al., 2020) as they concentrated on the importance of prioritized big data for better performance and decision-making. Additionally, with the use of linear and multiple regression, the results indicated that PRA impacts BDI and STPBD which have a major positive impact on SPM. What is distinguished the current study is the comprehensive focus on big data and SPM items and their overall interplay to achieve the intent of Paradox and Stakeholder theories.

6. CONCLUSIONS AND RECOMMENDATION FOR FURTHER RESEARCH

The researchers try to not only develop an innovative SPM model based on big data but also identify how big data drives the transition to the new line of business that may influence a company's strategy. DD-SPMM develops a structured framework to understand the role of big data initiatives for SPM and the role of big data towards strategic planning for SPM, implementation of SPM, and performance reviewing and acting of SPM. This model promotes the dynamic movement to new lines of business and new dimensions of sustainability in which there is an availability of prioritized data. This proposed model underpins RBV, institutional theory, DCV, and contingency theory to achieve the intent of stakeholder and paradox theories.

This study follows the confirmative approach. Using SPSS 26, DD-SPMM has been empirically evaluated through multiple case studies in three sectors to validate it in the real world. Using a reasonable sampling method, 171 questionnaires were gathered from the telecommunications sector, the automation sector, and the banking sector. 162 of those were valid. There are no significant differences in the findings of DD-SPMM

hypotheses in the three sectors; all hypotheses are accepted. Additionally, the DD-SPMM has been practically demonstrated to have no autocorrelation based on Durbin Watson values and a strong level of reliability based on Cronbach's alpha values, which results in a higher generalization for the DD-SPMM.

Despite the rising amount of big data research (McAfee and Brynjolfsson, 2012), many executives are still unsure how to effectively use this influx of data within their firms. The proposed data-driven model supports the exploration and development of multi-level, systematically integrated (including their inputs, processes, outputs, and feedback), and multi-stakeholder-oriented sustainability issues. Most companies gather data without understanding the means or rewards, thus to gain a competitive edge and enhance operational performance from the usage of big data, the firm needs to analyze the larger context in which the data were created (Mawed et al., 2017). This study is a response to numerous demands for research that look to determine how big data drives the transition to new lines of business that could affect a firm's strategy as well as to develop innovative SPM models based on big data.

The study extends prior literature by developing a conceptual DD-SPMM that explores the role of big data initiatives towards SPM and the role of big data towards strategic planning of sustainable performance, implementation of sustainable performance, and reviewing and acting of sustainable performance. Agreeing with (Haines et al., 2012), the effectiveness of performance management is not just a result of the design processes or best practices, but rather of the development and implementation of programs in various organizational contexts. The present study empirically investigates DD-SPMM through multiple-case studies.it can be concluded that, promoting big data value realization is distinguished by a limited number of empirical studies and research.

More specifically, to management accounting research has been multi-disciplinary (Hopper et al., 2015). The current model, is supported by RBV, institutional theory, DCV, and contingency theory to meet the intent of stakeholder and paradox theories.

Researchers and practitioners can use the study's findings to apply this model to other industries or other companies in the future. The current study focuses on the relationship between big data and SPM. It will be more interesting if moderating variables, like blockchain will be considered in future research. Besides, it will be worth, if control variables like firm size and firm reputation are taken into consideration in further studies. Moreover, the current study implicitly considers the effect of the COVID-19 epidemic when developing the theoretical model and testing it. It will be worth if the COVID-19 is explicitly investigated. The current study inherently considers SPM as a dependent variable that implicitly includes satisfied sustainable economic performance, sustainable social performance, and sustainable environmental performance. However, there is a need for future studies to explicitly evaluate the effect of the link of big data and SPM on each dimension of SPM separately required, and future studies to evaluate the differences of the proposed model in the same company across countries.

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