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Big data analytics capabilities and supply chain sustainability: Evidence from the hospitality industry

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Big data analytics capabilities have piqued the curiosity of academics and practitioners in recent years. However, there has been little research conducted on the effects of these capabilities on supply chain sustainability, particularly in emerging economies. To address this gap, this article attempted to investigate the impact of big data analytics capabilities on the supply chain sustainability of Jordan's hospitality industry using quantitative data derived from 512 managers in senior and middle levels of hotels listed in Jordan Hotels Association (JHA). Structural Equation Modelling (SEM) was conducted for hypothesis evaluation. The research findings proved that the dimensions of big data analytics capabilities, which were infrastructure flexibility, management capabilities, and personnel capabilities, had a significant positive role in enhancing supply chain sustainability. Therefore, the research provided a series of recommendations for managers in these hotels, the most important of which was allocating significant investments in modern data-collecting technologies to record key changes across the supply chain, including manufacturing, transportation, and distribution.

1. Introduction

The capability of companies to satisfy their obligations associated with ensuring the future well-being of future generations is intimately tied to the modern economic system. Customers' changing desires, regulatory requirements, and environmental and societal concerns have imposed themselves as drivers of the companies' success and ability to operate in a dynamic market (AlBrakat et al., 2023). Therefore, Park and Li (2021) stated that supply chain sustainability has emerged as one of the management strategies driving organizations to embrace environmentally friendly supply chain practices. Supply chain sustainability is a holistic approach that assures the attainment of stakeholder goals and decreases companies' negative environmental imprint by encouraging the use of new technologies and renewable energy sources, as well as minimizing natural resource depletion (Edwin Cheng et al., 2022). Big data analytics has become critical for companies to achieve a competitive position and generate sustained economic growth as digital technologies have proliferated and the amount, diversity, and speed of data generation have increased (Al-Alwan et al., 2022; Dubey et al., 2020). Big data analysis is based on a systems approach (inputs, processes, and outputs) requiring sophisticated human and technical capabilities to deal with massive volumes of data and produces conclusions that enable rational decision-making about the company's future (Mikalef et al., 2020). Furthermore, the significance of big data analysis is centered on developing the company's strategic sights (Jeble et al., 2018; Singh & Del Giudice, 2019), tracking changes in customer habits (Alshawabkeh et al., 2022), and advocating innovation (Ciampi et al., 2021). The hospitality industry is distinguished by complicated supply chains involving several stakeholders, including farmers, producers, distributors, retailers, and consumers (Alzboun et al, 2016; Ibrahim and Alzboun, 2021) . These supply chains are prone to inefficiency, as well as severe environmental and social hazards if they are not monitored and adequate actions to address deviations are not taken. In this context, big data analytics skills are critical for tackling concerns associated with supply chain sustainability by offering clear insights into environmental, social, and regulatory compliance norms. Although several studies have examined the influence of big data on supply chain sustainability

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(Bag et al., 2020; Saberi et al., 2019), the scarcity of research in developing nations spurred this investigation. The present research provides a theoretical explanation of how big data capabilities contribute to supply chain sustainability in the hotel industry in Jordan. Furthermore, it gives various implications and justifications emanating from the empirical evidence.

2. Literature review and hypotheses

2.1 Big data analytics capabilities

The notion of big data analytics capability centres on the company's ability to harness the power of massive volumes of data, also known as big data, to extract useful insights and drive informed decision-making (Akter et al., 2016; Ciampi et al., 2021). It refers to a combination of technologies and processes that enable companies to gather, store, process, analyze, and display large amounts of data (Behl et al., 2022). Pathak et al. (2023) described big data analytics capabilities as the skills utilised to investigate a company's internal and external environment's huge amount and diversity of data employing sophisticated analytics techniques such as machine learning and predictive modelling. According to Shokouhyar et al. (2020), companies require integration among infrastructure flexibility, management capabilities, and personnel capabilities for big data analytics.

Infrastructure flexibility refers to a company's physical or technological asset's ability to adapt and respond to evolving priorities and expectations. It comprises the ability to readily adjust, expand, or reconfigure components of a company's infrastructure to fit changing business requirements and technology improvements.

Management capabilities are the collection of skills, techniques, and procedures that enable companies to organize and exploit big data resources for analytics purposes in an effective manner. To enable the effective implementation and exploitation of big data analytics efforts, the management capabilities include data governance, data quality management, data integration, data lifecycle management, and strategic planning.

Personnel capabilities reflect the aggregate knowledge and expertise that workers inside the company have collected in order to successfully deal with vast and complicated data sets to generate meaningful insights. Technical skills in data administration, data processing, statistical analysis, programming languages, and machine learning methods are among these capabilities. In addition, domain-specific information, such as an awareness of the business environment and industry dynamics, is included in personnel capabilities.

2.2 Supply chain sustainability

The idea of supply chain sustainability refers to the integration of social, environmental, and economic factors into a company's supply chain activities (Saberi et al., 2019). It entails considering the long-term implications of supply chain operations on individuals, the environment, and profitability, to adopt proactive steps to reduce negative impacts and increase good contributions of companies (Cao et al., 2023). Sachin and Rajesh (2022) declared that the sustainable supply chain strives to include ecological ideas and practices into overall operations such as safeguarding the company's resource demands, in addition to manufacturing, distribution, and logistical activities. The sustainable supply chain is concerned with decreasing a company's negative environmental imprint, encouraging social responsibility, and assuring ethically sourced investment in order to create economic value for stakeholders.

According to several studies, the three dimensions of supply chain sustainability are environmental sustainability, economic sustainability, and social sustainability (Govindan et al., 2020; Edwin Cheng et al., 2022). Environmental sustainability is described as "responsible management of natural resources and ecosystems in order to fulfil the demands of the present generation without compromising future generations' ability to meet their own needs" (Park & Li, 2021). It includes making decisions and implementing steps to mitigate the negative environmental impacts of the company's operations, enhance biodiversity, and reduce pollution and waste. Economic sustainability is the economic system's or a company's contributions to long-term economic development, stability, and prosperity. It requires combining short-term goals with stakeholder welfare via managing finances, resources, and economic activity. Social sustainability is a society's ability to satisfy its members present and potential needs while fostering social welfare, equality, and solidarity. It entails building inclusive communities based on equity values that emphasize equal opportunity and respect for human rights.

2.3 Big data analytics capabilities and supply chain sustainability

Companies rely on their ability to interpret the massive flow of data received from the internal and external environments in order to make effective judgments on the foundations of sustainability. Using a dynamic capabilities perspective, Bag et al. (2020) performed research for 520 South African CEOs to investigate the influence of big data analytics capability as an operational excellence approach for enhancing sustainable supply chain performance using partial least squares structural equation modeling. According to the findings, big data analytics management capabilities play a significant role in generating new green goods and achieving sustainable supply chain results. Furthermore, Zhu et al. (2022) offered empirical evidence on the effect of corporate social responsibility on sustainable supply chain management practices through the mediation role of big data analytics capabilities. The analysis of 320 valid replies revealed that the power of big data analytics mediates the relationship between corporate social responsibility and sustainable supply chain management practices. Accordingly, the research hypotheses were formulated as follows:

H_1: *Infrastructure flexibility has a positive impact on supply chain sustainability.*

H2: *Management capabilities have a positive impact on supply chain sustainability*.

H3: *Personnel capabilities have a positive impact on supply chain sustainability.*

Fig. 1 illustrates the proposed theoretical framework for the research and the hypotheses it seeks to verify.

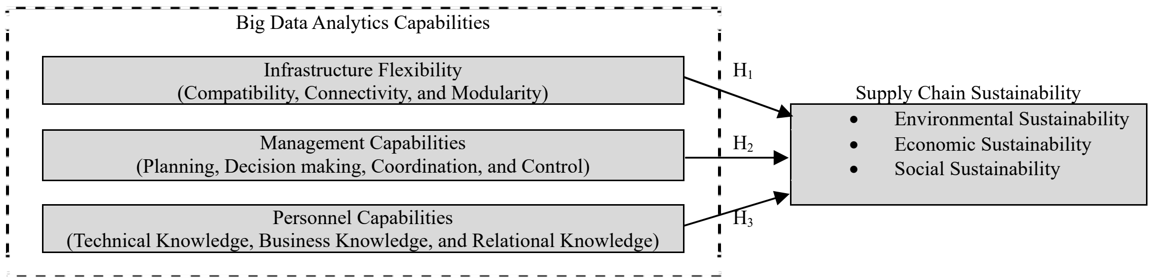

Fig. 1. Research model

3. Methodology

3.1 Data collection and sample

The present investigation employs a cross-sectional research approach supported by a quantitative paradigm to collect primary data on the implications of big data analytics capabilities on supply chain sustainability in Jordan's hotel sector. In accordance with this methodological method, the study rigorously identifies its cohort of participants, an assemblage entirely of a managerial cadre entrenched within Jordan Hotel Association (JHA)-accredited hotel facilities. Consequently, the study's survey instrument was disseminated simultaneously among a purposefully selected sample of 512 managers in these organisations' senior and middle strata, with digital conduits acting as the preferred distribution manner at present.

Following the completion of the data collection phase, a corpus of 450 completed replies was acquired, meeting the required conditions applicable to further steps of statistical examination. This trove of garnered responses, which accounts for 87.9% of the overall response rate, meets the description of a representative collection chosen from the planned sample for this research. In doing so, the study meets the strict requirements for sampling technique adequacy proposed by Sekaran and Bougie (2016).

3.2 Measurement instrument

An electronic survey instrument was the major data-gathering tool in this investigation. The research instrument included an introductory segment that confirmed the authors' adherence to research ethical issues while also elucidating the study's key aims. It also included a section dedicated to collecting demographic information from respondents, as well as two other sections focused on capturing responses on the research's main variables. Participants were tasked with providing ratings to specific questions in these sections relevant to the main dimensions using a five-point Likert scale rating from 1 designating "strongly disagree" to 5 denoting "strongly agree".

The first section focused on the independent variable, which was big data analytics capability. This section included 22 items culled from the work of Shokouhyar et al. (2020). The collection of items created three separate dimensions defining the dimensions of big data analytics capabilities. These dimensions included six items that measured infrastructure flexibility, encompassing aspects of compatibility, connectivity, and modularity. Eight items assess managerial capabilities, spanning the realms of planning, investment and decision-making, coordination, and control. Additionally, eight items assess personnel capabilities, encompassing domains of technical knowledge, business knowledge, and relational knowledge.

In contrast, the survey instrument's concluding section included items pertaining to the dependent variable, which was supply chain sustainability. These items, totalling 12, were chosen from the scholarly work of Govindan et al. (2020). The items of supply chain sustainability have been separated into three dimensions: environmental sustainability, economic sustainability, and social sustainability, with each dimension consisting of four separate items.

4. Findings

4.1 Measurement model evaluation

The analytical framework of structural equation modeling (SEM) was employed to analyze the impact of big data analytics capabilities on supply chain sustainability in Jordan's hotel sector. SEM is a contemporary methodological manner based on the maximum likelihood method for investigating the interrelationships between latent constructs that are measured by their corresponding observable variables (Wang & Rhemtulla, 2021). Prior to examining the degree of the impact, this statistical approach requires preliminary scrutiny to assess the validity and reliability of the research's measuring instrument. In accordance with the aforementioned procedure, the current study used Confirmatory Factor Analysis (CFA), a component of the SEM technique assisted by the AMOS program, to determine the validity and reliability of the measurement model. Table 1 exhaustively documents the results of this research in terms of the derived metrics of validity and reliability.

Table 1
Results of validity and reliability tests

Constructs	IF	MC	PC	ENS	ECS	SOS
IF	**0.742**					
MC	0.425	**0.758**				
PC	0.465	0.405	**0.744**			
ENS	0.525	0.582	0.521	**0.739**		
ECS	0.556	0.535	0.548	0.526	**0.756**	
SOS	0.514	0.564	0.576	0.574	0.529	**0.775**
VIF	1.338	1.528	1.692	---	---	---
LR	0.702-0.794	0.711-0.814	0.678-0.822	0.703-0.774	0.715-0.791	0.728-0.805
AVE	0.551	0.575	0.554	0.547	0.571	0.600
MSV	0.415	0.439	0.427	0.411	0.403	0.462
IC	0.878	0.912	0.907	0.825	0.840	0.854
CR	0.880	0.915	0.908	0.828	0.842	0.857

Note: IF: infrastructure flexibility, MC: management capabilities, PC: personnel capability, ENS: environmental sustainability, ECS: economic sustainability, SOS: social sustainability, LR: loading range, IC: internal consistency, CR: composite reliability, bold fonts refer to square root of AVE.

The item loadings corresponding to the constructs of big data analytics capabilities and supply chain sustainability were observed to fall within the range of 0.678 to 0.822. This range of values suggests that all items were retained, given that they exceeded the minimum threshold of 0.50, as established by previous studies (Sung et al., 2019). Moreover, the calculated average variance extracted (AVE) values attributed to the latent constructs of the research surpassed the 0.50 benchmark, thereby fulfilling the criteria for convergent validity as outlined by Howard (2018).

Besides, comparative analyses revealed that the AVE values not only exceeded the maximum shared variance (MSV) but also the square root of their values exhibited superiority over the correlation coefficients linking other constructs within the model. These outcomes, in concurrence with the Fornell-Larcker criteria, serve as empirical evidence substantiating the attainment of discriminant validity (Rimkeviciene et al., 2017). In parallel, the reliability assessment of the measurement model constructs was established through the utilization of Cronbach's alpha coefficients (α) for gauging internal consistency and McDonald's omega coefficients (ω) for measuring composite reliability. Both indices, attaining values greater than 0.70 as indicated in Table 1, underscore the reliability of the model constructs (de Leeuw et al., 2019).

4.2 Structural model

Derived from the findings presented in Table 1, it is evident that a lack of multicollinearity prevails amongst the three dimensions of big data analytics capabilities. This inference is substantiated by the variance inflation factor (VIF) scores of said constructs, all of which fall below the threshold of 5, as stipulated by Hair et al. (2017). Within this analytical framework, the avenue remains open to proceed with hypothesis testing, as delineated by the structural equation modeling (SEM) process elucidated in Fig. 2.

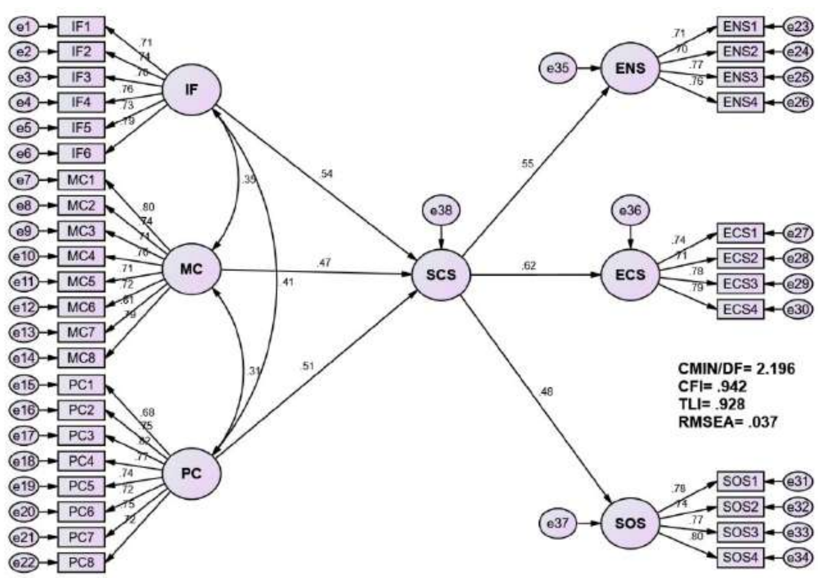

Fig. 2. SEM results of the big data analytics capabilities effect on supply chain sustainability

The outcomes derived from the depiction offered in Figure 2 affirm the appropriateness of the structural model deployed to scrutinize the influence exerted by big data analytics capabilities upon supply chain sustainability within Jordan's hospitality industry. The indices indicative of model fit attained commendable values, with the ratio of the comparative fit index (CFI) and Tucker-Lewis index (TLI) surpassing the threshold of 0.90, while the ratio of χ^2 to degrees of freedom (CMIN/DF) remained below 3. Additionally, the value attributed to the root mean square error of approximation (RMSEA) adhered to a standard less than 0.08, in congruence with the precepts laid out by Shi et al. (2019). In light of these model-fit assessments, both standardized and unstandardized effect parameters were gleaned and duly documented in Table 2.

Table 2: Hypothesis testing

Hypothesis	**Relation**	**Standard Beta**	***t* value**	***p* value**
H1	IF → SCS	0.544	9.64	0.000
H2	MC → SCS	0.467	7.75	0.008
H3	PC → SCS	0.514	8.57	0.002

Note: IF: infrastructure flexibility, MC: management capabilities, PC: personnel capability, SCS: supply chain sustainability.

The findings presented in Table 2 unveil a hierarchy of impact, wherein the utmost influence is attributable to infrastructure flexibility (β= 0.544, t= 9.64, p= 0.000), followed by personnel capabilities (β= 0.514, t= 8.57, p= 0.002), with management capabilities registering the relatively lowest effect (β= 0.467, t= 7.75, p= 0.008). Evidently, these outcomes provide substantiation for the affirmation of all subsidiary hypotheses posited within the ambit of this investigation.

5. Conclusion

The research attempted to investigate the role of big data analytics capability in the supply chain sustainability of the hotel industry in Jordan. The research revealed that the components of big data analytics capability, including infrastructure flexibility, management capabilities, and personnel capabilities, had a positive effect on supply chain sustainability, which agree with Zhuet al. (2022). Companies may enhance inventory management and demand forecasting by making decisions based on big data analysis, resulting in reduced waste, improved productivity, and lower environmental consequences. Besides, big data analytics assists in environmentally friendly supplier choice and management by allowing companies to evaluate and monitor their vendors' sustainability performance. This encourages ethical purchasing and also helps in the management of supply chain risks associated with noncompliance or unethical behaviour. Big data analytics, on the other hand, might be helpful in route planning and efficient logistics, reducing transportation distances, minimizing fuel usage to trim emissions, and improving the effectiveness of the supply chain.

Based on the findings, the research presents a variety of practical implications that may be of interest to Jordanian hotel managers or company executives. First, allocating significant investments in modern data-collecting technologies to record key changes across the supply chain, including manufacturing, transportation, and distribution, for making a comprehensive perspective of the supply chain and enabling effective analysis. Second, encouraging managers to establish a team of data analysts or engage with outsourced professionals who are knowledgeable in big data analytics. Third, implementing predictive modelling to properly estimate demand, increase inventory levels, and eliminate waste through historical data, market trends, and external factors. Finally, collaborating with stakeholders on initiatives related to sustainability and corporate social responsibility, such as government agencies, industry groups, and consumers.

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