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ENHANCING SUSTAINABILITY IN THE LOGISTICS INDUSTRY THROUGH BIG DATA ANALYTICS CAPABILITIES

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ABSTRACT

The logistics sector is experiencing accelerated growth, driven by global sustainability agendas and increasing commitments to achieving net-zero emissions. Big Data Analytics (BDA) has been widely recognized for its potential to enhance operational efficiency and supply chain performance. Nevertheless, its role in advancing sustainability outcomes particularly through an integrated capability perspective—remains insufficiently theorized and empirically examined.

Prior research has predominantly approached BDA from a fragmented perspective, focusing on discrete dimensions such as technological infrastructure, data governance, or human competencies. This reductionist approach has limited the understanding of how BDA capabilities, as a multidimensional construct, interact to influence sustainability outcomes across economic, environmental, and social domains. Addressing this gap, the present study develops and applies an integrative theoretical framework that synthesizes the Resource-Based View (RBV), Dynamic Capability View (DCV), Technology–Organization–Environment (TOE) framework, and the Technology Acceptance Model (TAM).

The findings demonstrate that BDA capabilities function as a strategic enabler, facilitating opportunity recognition, strengthening competitive positioning, and supporting the reconfiguration of organizational resources in response to dynamic environmental pressures. This study contributes to the literature by advancing a holistic understanding of the BDA–sustainability nexus and extending capability-based perspectives in the context of logistics management.

1. INTRODUCTION

Over the past two decades, the volume of data generated across both personal and organizational contexts has increased exponentially, largely driven by the widespread adoption of digital technologies for communication, entertainment, and operational efficiency [1,2]. Organizations continuously generate and process vast and heterogeneous datasets, including user interactions, transactional records, and social media content. In response to the growing scale and strategic importance of data, Big Data Analytics (BDA) has emerged as a critical organizational capability [3]. Although interest in BDA has significantly expanded in both academic and practical domains, the absence of standardized approaches for effectively managing and extracting value from large-scale data remains a persistent challenge [4]. Consequently, the concept of Big Data Analytics Capability (BDAC) has been introduced, referring to an organization's ability to systematically acquire, process, and derive actionable insights from complex data environments [5]. BDA enables the transformation of raw data into meaningful information, thereby supporting evidence-based decision-making and enhancing organizational performance. However, the extent to which organizations benefit from big data depends largely on their capacity to collect, store, and process high-volume, high-velocity, and high-variety data generated from both real-world operations and analytical models [6]. Within this context, the logistics sector plays a pivotal role in fostering both economic growth and environmental sustainability [7]. The integration of BDA into logistics operations has significantly transformed the sector by improving operational efficiency, reducing waste, and minimizing environmental impact [8]. In particular, data-driven logistics practices contribute to sustainability through optimized route planning, reduced emissions, and enhanced transportation efficiency [9].

Despite these advancements, the relationship between Big Data Analytics and sustainability remains insufficiently explored, particularly in terms of how BDA capabilities facilitate innovation and influence the three dimensions of sustainability—economic, environmental, and social performance—within organizational settings. This research gap is especially evident in studies that examine the intersection of BDA and logistics, where comprehensive and integrative analyses remain limited [10–13].

2. PROBLEM STATEMENT

The global logistics industry continues to face significant sustainability challenges, including high energy consumption, substantial carbon emissions from freight transportation, suboptimal route planning, and limited data integration across supply chains [14]. These challenges underscore the critical need for advanced analytical approaches to support sustainability-oriented decision-making. Although Big Data Analytics Capability (BDAC) has increasingly been acknowledged as a strategic enabler for enhancing operational efficiency and performance, its role in advancing environmental, social, and economic sustainability remains insufficiently conceptualized and empirically validated. Consequently, the logistics sector encounters persistent difficulties in balancing rapid economic growth with social equity and environmental responsibility [15]. Existing literature has predominantly emphasized the efficiency-enhancing aspects of BDAC, while its potential contribution to sustainability transformation has received comparatively limited attention.

In parallel, the logistics sector has been positioned as a key driver of economic diversification and development within broader national and global strategic agendas. Substantial investments in infrastructure, digitalization, and international trade connectivity have accelerated the transformation of logistics systems. Despite these advancements, critical challenges persist, particularly in terms of data integration, digital maturity, and environmental performance [16–18]. The energy-intensive nature of logistics operations further amplifies the need for data-driven solutions aimed at reducing carbon emissions, optimizing fleet utilization, and enhancing supply chain transparency [18]. Achieving alignment between sectoral growth and sustainability objectives therefore necessitates the adoption of innovative approaches that mitigate the environmental impacts associated with transportation and warehousing activities [21].

From a theoretical perspective, contemporary studies on BDAC predominantly rely on single-theory frameworks to explain specific dimensions, such as technology adoption or capability development. While these approaches provide valuable insights, they offer a limited understanding of the complex and multidimensional mechanisms through which BDAC influences sustainability outcomes.

Notably, prior research rarely integrates multiple theoretical perspectives into a unified framework capable of capturing BDAC's impact across micro (individual), meso (organizational), and macro (environmental and institutional) levels. This fragmentation creates a critical gap in explaining the dynamic interplay between technological capabilities, user acceptance, organizational transformation, and external environmental pressures in driving sustainability transitions within the logistics sector.

Addressing these limitations, the present study adopts an integrative analytical approach, employing a comprehensive framework that synthesizes multiple theoretical perspectives to examine the role of BDAC in promoting sustainability. Through an in-depth qualitative investigation, the study aims to provide a holistic understanding of how data-driven capabilities contribute to sustainable development within the logistics industry.

3. STUDY OBJECTIVE

The central research question guiding this study is: *How does Big Data Analytics Capability (BDAC) contribute to enhancing the three dimensions of sustainability—economic, environmental, and social—within the logistics sector?*

The primary contribution of this study lies in its comprehensive qualitative examination of the relationship between BDAC and sustainability outcomes. Specifically, the research advances a multi-level analytical perspective by integrating four complementary theoretical frameworks: the Resource-Based View (RBV), Dynamic Capability View (DCV), Technology–Organization–Environment (TOE) framework, and the Technology Acceptance Model (TAM). Within this integrative framework, RBV and DCV elucidate the strategic value and adaptive capacity associated with BDAC, while the TOE framework captures the contextual technological, organizational, and environmental determinants influencing its adoption. Simultaneously, TAM provides insight into individual-level acceptance and utilization of BDA tools.

By synthesizing these theoretical perspectives, the study offers a more holistic understanding of the BDAC–sustainability nexus across multiple levels of analysis. Furthermore, it extends the predominantly quantitative and context-limited body of existing literature by delivering nuanced, qualitative insights applicable to diverse and evolving logistics environments.

4. RESEARCH GAP AND CONTRIBUTIONS

In recent years, scholarly interest in Big Data Analytics Capability (BDAC) within logistics and supply chain management has expanded considerably. Despite this growing body of research, the literature remains predominantly focused on operational performance outcomes. Empirical studies frequently conceptualize BDAC as a strategic resource that enhances efficiency, responsiveness, resilience, and competitive advantage through improved forecasting accuracy, system integration, and data-driven decision-making processes [4,17–21]. Similarly, large-scale quantitative investigations have reinforced this perspective by establishing positive relationships between BDAC and both operational and financial performance indicators [19,22–24]. However, within these studies, sustainability is rarely treated as a primary objective; instead, it is often considered a secondary or indirect outcome. More recently, a subset of research has begun to explore the relationship between Big Data Analytics and sustainability. Nevertheless, this emerging domain remains fragmented and limited in scope. Existing studies tend to emphasize environmental dimensions—such as emissions reduction and energy efficiency—while comparatively neglecting the social dimension of sustainability and failing to adequately address the interdependencies among the three pillars of the Triple Bottom Line (economic, environmental, and social performance) [25–29]. Consequently, comprehensive analyses examining how BDAC simultaneously supports all dimensions of sustainability within logistics systems remain underdeveloped.

Furthermore, contextual limitations represent a critical gap in literature. The majority of BDAC-related studies have been conducted in technologically advanced environments, primarily within developed economies characterized by high levels of digital maturity and institutional stability [1,30–33]. In contrast, empirical evidence from emerging and developing logistics contexts remains scarce, particularly in environments marked by limited technical expertise, fragmented data infrastructures, and evolving regulatory frameworks. This imbalance restricts the generalizability of existing findings and results in an incomplete understanding of the role of BDAC in driving sustainability outcomes across diverse contexts [13,34–37]. Addressing these gaps, the present study advances a sustainability-oriented and multi-level perspective on BDAC within the logistics sector. Rather than prioritizing operational or financial performance, the study conceptualizes BDAC as an enabler of Triple Bottom Line sustainability, treating economic, environmental, and social outcomes as interconnected and mutually reinforcing dimensions. The principal contribution of this research lies in its comprehensive qualitative analysis of the BDAC–sustainability relationship. Specifically, the study makes three key contributions. First, it develops an integrative analytical framework by combining four complementary theoretical perspectives: the Resource-Based View (RBV), Dynamic Capability View (DCV), Technology–Organization–Environment (TOE) framework, and the Technology Acceptance Model (TAM). This approach enables a holistic understanding of BDAC, demonstrating that sustainability outcomes are contingent not only upon technological investments but also on human analytical capabilities, governance structures, and organizational learning processes. Second, the study advances theoretical development by incorporating micro-, meso-, and macro-level dynamics into the analysis of BDAC, thereby offering a more nuanced explanation of variations in sustainability performance across organizations. Third, it contributes empirically by providing in-depth insights from an emerging logistics context, repositioning BDAC research beyond operational optimization toward a broader conceptualization of analytics capability as a driver of sustainable logistics development.

Overall, this study extends the predominantly quantitative and context-constrained literature by offering a rich, qualitative, and integrative perspective on the role of Big Data Analytics in advancing sustainability within the logistics sector.

5. DATA SATURATION

Data saturation was conceptualized as a two-stage process, distinguishing between code saturation and meaning saturation, in accordance with established qualitative research protocols. Code saturation refers to the point at which additional data collection no longer yields novel first-order codes or emergent categories. In contrast, meaning saturation pertains to the extent to which identified themes are conceptually rich, fully developed, and analytically comprehensive. During the initial stages of analysis, open coding was conducted concurrently with data collection. After approximately 20 semi-structured interviews, no substantively new codes related to Big Data Analytics Capability, sustainability, or logistics practices emerged, indicating that code saturation had been attained. Nevertheless, data collection continued, resulting in a total of 25 interviews, to ensure that meaning saturation was fully realized.

The final five interviews did not introduce additional thematic categories or alter the overarching structure. Instead, they contributed to deepening and refining the analysis, particularly by highlighting variations across organizational sizes and logistics subsectors. These interviews enhanced interpretive depth regarding the practical enactment of analytics capabilities without expanding the thematic framework itself. The persistent absence of new themes in the latter interviews provided robust evidence of thematic stability. Accordingly, the decision to conclude data collection was based not only on the attainment of code saturation but also on the assurance that sufficient analytical completeness and interpretive depth had been achieved across the dataset.

Sample Composition

Table 1 presents a detailed overview of the study participants. The sample comprises individuals occupying leadership, operational, technical, and sustainability-focused roles within logistics organizations. This diverse composition ensures the inclusion of multiple perspectives—strategic, managerial, and technical—on the adoption and utilization of Big Data Analytics Capability (BDAC) and associated sustainability practices.

No.	Job Level / Functional Area	Positions	Number of Participants
1	Executive Leadership	CEO, VP, GM, Chief Commercial & Administrative Officer, Deputy CEO, Assistant GM	6
2	Sustainability, Safety, and Energy	VP, Energy Expert	5
3	Operations and Logistics Management	Manager, Assistant Manager, Specialist, Officer	5
4	Information Technology and Data Analytics	Manager, Head, Analyst, Specialist, Project Manager, Business Intelligence Analyst, Senior Systems Administrator	5
5	Human Capital, Administration, and Business Development	Manager	4

Total Participants: 25

This purposeful sampling strategy was designed to capture a broad range of insights into BDAC deployment and its role in promoting sustainable logistics practices. The inclusion of participants from executive leadership to specialized technical roles ensures comprehensive coverage of organizational processes, decision-making structures, and operational nuances relevant to the research objectives.

Data Analysis

The interview data were analyzed using thematic analysis, following the six-phase procedure proposed by Braun and Clarke (2006). This approach comprised the following stages: data familiarization, initial coding, theme development, theme review, defining and naming themes, and reporting. All coding and thematic organization were conducted using MAXQDA software, facilitating systematic data management and ensuring rigor in the qualitative analysis. This methodology enabled the identification of salient patterns and the extraction of nuanced insights regarding the enactment of Big Data Analytics Capability (BDAC) and its influence on sustainability practices within logistics organizations.

6. FINDINGS AND THEMATIC ANALYSIS

Quantifying Qualitative Insights- Although the primary objective of this study is interpretive rather than statistical, descriptive quantification was employed to enhance transparency and analytical clarity. Consistent with established qualitative research practices, the number and proportion of participants referring to each theme and sub-theme are reported to indicate their prevalence within the dataset, without implying statistical generalizability beyond the study sample.

Across the 25 interviews, three core themes were identified as particularly salient. Personnel capability emerged as the most frequently discussed theme, referenced by 21 participants (84%), often in relation to data literacy, analytical confidence, and organizational learning practices. Traceability was mentioned by 18 participants (72%), primarily in the context of data visibility, integration challenges, and trust in analytics outputs. Eco-friendly or green logistics was highlighted by 16 participants (64%), commonly associated with fuel efficiency, route optimization, and waste reduction.

At the sub-theme level, individual analytical competence was emphasized by 19 participants (76%), underscoring its centrality for effective utilization of analytics. Issues related to governance clarity and data ownership appeared in 17 interviews (68%), highlighting the importance of defined roles and accountability structures. Additionally, planning and environmental efficiency practices were referenced by 15 (60%) and 14 (56%) participants, respectively. Social sustainability concerns, including workforce well-being and transparency, were less frequently expressed, appearing in 9 interviews (36%).

These descriptive frequencies are not intended to indicate causal importance but provide context for the qualitative interpretations that follow. Less frequently mentioned themes were analyzed in relation to their contextual significance, sectoral relevance, and the depth of discussion in which they appeared. This approach strengthens interpretive rigor by linking thematic prevalence with rich explanatory insights while adhering to qualitative research standards.

Thematic Analysis

The thematic analysis revealed significant insights regarding the perception and utilization of BDAC in promoting sustainability within the logistics sector.

2.1 Theme 1: BDAC as a Facilitator of Eco-Friendly Logistics (Environmental Sustainability)

A prominent finding was the clear positive relationship between BDAC and environmental sustainability, particularly in the context of green logistics. Participants emphasized BDAC as a critical tool for collecting comprehensive, real-time data that enables proactive decision-making and adaptive resource management, aligning with principles of the Dynamic Capability View (DCV).

Sub-Theme: Optimized Route Planning and Load Management

Participants reported that advanced BDAC tools leveraging real-time traffic, weather, and delivery data allow for dynamic and optimized route planning beyond static scheduling. For instance, enhanced route analysis helps minimize unnecessary trips, thereby conserving fuel and reducing emissions. Additionally, monitoring systems such as refrigeration sensors support waste reduction by ensuring perishable goods are properly maintained. Collectively, these capabilities enable organizations to capitalize on opportunities for operational efficiency while simultaneously mitigating environmental impacts.

Sub-Theme: Predictive Maintenance for Fleet Efficiency

The use of telematics and sensor-driven predictive maintenance was highlighted as a critical mechanism for ensuring fleet efficiency. By anticipating equipment failures and scheduling preventive maintenance, organizations can optimize fuel efficiency, reduce unexpected breakdowns, and avoid costly emergency rerouting. Participants emphasized that collecting and analyzing operational data on assets allows maintenance teams to make proactive decisions, thereby enhancing the environmental performance of logistics operations.

Theme 1: Energy-Efficient Logistics and Warehousing (Environmental Sustainability)

Big Data Analytics Capability (BDAC) was instrumental in optimizing energy consumption across warehouses and distribution centers. By integrating data from smart meters and environmental sensors, organizations were able to enhance lighting, cooling, and space utilization, leading to substantial energy savings and a reduction in carbon emissions. This theme exemplifies the *reconfiguring* dimension of the Dynamic Capability View (DCV), in which insights derived from data drive the redesign of operational processes.

Participants emphasized the dual benefits of energy optimization: reducing environmental impact while enhancing economic efficiency. For example, one participant noted, “Efficient energy use allows us to reduce emissions while simultaneously improving financial performance,” illustrating the intertwined environmental and economic advantages of data-informed operational redesign.

Theme 2: The Critical Role of Personnel Capability (Economic Sustainability)

Findings highlighted that, while robust Big Data infrastructure is essential, the competencies and skills of personnel utilizing these systems are pivotal for achieving economic sustainability. Personnel capability emerged as the central component of BDAC, enabling technological and infrastructural investments to deliver tangible value. Analytical skills, critical thinking, and a digital mindset were identified as essential for producing actionable, reliable, and high-quality insights.

Two key sub-themes were identified:

Advanced Risk Management and Cost Optimization

Participants emphasized that BDAC-enabled staff transform complex analytical outputs into strategies that reduce costs and optimize operations. Beyond route optimization, these capabilities enhance demand forecasting, minimize inventory holding costs, and reduce waste—yielding both economic and environmental benefits. Furthermore, data-driven insights allow organizations to mitigate financial risks associated with supply chain disruptions, fluctuating fuel prices, and operational delays. One participant stated, "Logistics involves moving goods from one point to another, but data analytics allows us to reduce costs, improve efficiency, and manage risks effectively," illustrating the role of personnel in translating BDAC into operational and strategic value.

Addressing the Strategic Talent Gap

A recurring challenge identified was the lack of personnel with advanced data analytics expertise combined with in-depth logistics knowledge. This talent gap constrains the effective deployment of BDAC for long-term economic growth. Participants highlighted the need for targeted educational initiatives, specialized training, and capacity-building programs to strengthen workforce capabilities. The findings underscore that *reconfiguring human resources* represents both the most challenging and critical dynamic capability for achieving sustainable economic outcomes in logistics contexts.

Enhancing Traceability and Transparency (Social Sustainability)

BDAC was reported to facilitate traceability and transparency, addressing social sustainability dimensions that are often difficult to quantify. Enhanced visibility enabled more accountable interactions with employees, partners, and broader stakeholder communities, fostering trust and improving collaborative decision-making. Two primary sub-themes emerged from this domain, illustrating how analytics capabilities contribute to socially sustainable logistics practices.

Enhanced Worker Safety and Well-Being

Participants reported that BDAC-enabled monitoring tools, including telematics, wearable devices, and internal tracking systems, enhanced worker safety and compliance with labor standards. Real-time alerts for driver fatigue, unsafe behaviors, or exposure to hazardous materials were described as crucial mechanisms for risk mitigation. One participant explained, "Continuous monitoring ensures that deviations, such as extended breaks or exposure to chemicals, trigger immediate alerts and necessary interventions," illustrating the role of analytics in fostering a safer and more responsible work environment.

Supply Chain Ethics and Community Trust

BDAC also supported ethical sourcing and community trust by providing full visibility into supply chain activities. Participants emphasized that tracking material provenance and integrating data-driven transparency mechanisms reduced the risk of unethical practices, such as forced labor, and reinforced accountability with consumers and regulators. Additionally, analytics was applied to optimize operational impacts on local communities, including minimizing noise and traffic disruptions, further demonstrating organizational commitment to social responsibility. A participant noted, "Environmental sensors and algorithmic monitoring allow us to manage emissions and operational impacts, generating daily insights to guide socially responsible practices."

Robustness and Generalization Analysis

Across organizations of varying sizes and subsectors, the same three primary themes—green logistics, personnel capability, and traceability/transparency consistently emerged, although their prominence varied. Larger firms typically possessed more formal analytics infrastructures and clearly defined governance structures. However, these advantages did not uniformly translate into superior sustainability outcomes. Factors such as organizational inertia, fragmented data ownership, and limited cross-functional utilization of insights often constrained the effectiveness of otherwise well-developed systems.

Smaller firms, while facing technological limitations, frequently demonstrated greater agility in applying analytics capabilities. In these contexts, personnel competency and managerial commitment were central to transforming data into actionable sustainability improvements. Several smaller organizations reported notable environmental and operational gains despite comparatively simple analytics infrastructures, highlighting that the organization and application of capabilities can be more decisive than the scale of technological investment alone.

Subsector-specific observations revealed that traceability and environmental monitoring were particularly salient in ports due to regulatory pressures and safety requirements, with personnel capabilities determining whether analytics informed routine operations or remained limited to compliance reporting. In warehousing, green logistics and personnel capability dominated, with sustainability outcomes closely linked to energy efficiency, space utilization, and day-to-day operational practices. In land transportation, traceability and green logistics were interconnected through route optimization, fuel monitoring, and delivery tracking, although fragmented data sources and reliance on external partners often limited full supply chain visibility.

Robustness and Contextual Transferability of Findings

The patterns observed across organizations of varying sizes and subsectors indicate the robustness of the three core themes—green logistics, personnel capability, and traceability/transparency—across different operational contexts. While firm size and industry subsector influence how these themes manifest, the study demonstrates that sustainability outcomes derived from BDAC are influenced far more by how analytics capabilities are configured, governed, and embedded in routine decision-making, rather than the scale of investment or technological sophistication.

This observation supports the analytical transferability of the findings to other emerging logistics economies, although contextual sensitivity remains critical. Boundary conditions affecting applicability include institutional and regulatory frameworks, cultural and organizational norms, digital maturity, labor-market skill availability, and the structural fragmentation of logistics systems. The study's qualitative insights are intended for analytical generalization rather than statistical extrapolation, offering mechanisms expected to be held in similar operational and organizational contexts.

Linking BDAC Components to Sustainability Outcomes-The study further examined the relationship between the three primary BDAC components technological infrastructure, management capability, and personnel capability—and sustainability performance indicators reported by participants. Although sustainability outcomes were not directly measured quantitatively, interview evidence consistently linked operational KPIs to environmental, economic, and social dimensions of sustainability.

Technological Infrastructure-Technological infrastructure was most strongly associated with environmental efficiency, including fuel consumption, route optimization, and CO_2 emissions reduction. Participants described how telematics, real-time vehicle monitoring, and route-planning systems facilitated optimized operations and more efficient fleet utilization. However, technology alone was insufficient; when systems were poorly integrated or analytics outputs were not regularly reviewed, gains in environmental performance were limited.

Management Capability-Management practices and governance were critical for translating analytics into action. Clear data ownership, structured reporting procedures, and well-defined responsibilities enabled integration of sustainability metrics—such as fuel efficiency, emissions, and health, safety, and environmental (HSE) indicators—into operational performance assessments. In contrast, fragmented data systems reduced the operational impact of analytics on sustainability outcomes.

Personnel Capability-Personnel capability was particularly salient for social sustainability outcomes, including worker safety, risk mitigation, and ethical compliance. Analytical skills, data literacy, and confidence in interpreting insights determined whether BDAC outputs were effectively operationalized. Organizations with higher personnel capability were better able to leverage dashboards and alerts to prevent incidents and promote responsible practices, whereas organizations with lower capabilities struggled to translate available data into actionable outcomes.

Integrated BDAC Impact-Sustainability outcomes were not driven by any single BDAC component in isolation. Environmental improvements depended on alignment between technology and management processes, while social and safety outcomes relied heavily on personnel capability. Overall, BDAC contributes most effectively to sustainability when analytics capabilities are actively utilized, well-governed, and embedded in everyday decision-making.

Study Contribution- This study integrates micro-level technology adoption frameworks such as the Technology-Organization-Environment (TOE) framework and Technology Acceptance Model (TAM) with macro-level strategic management theories, including the Resource-Based View (RBV) and Dynamic Capabilities Theory (DCT). By doing so, it provides a multi-level framework linking BDAC adoption, effective use, and long-term sustainability outcomes in logistics.

The study also emphasizes the dynamic nature of analytics capabilities, which are shaped not only by technological tools but also by ongoing organizational learning and adaptation. This demonstrates that effective BDAC deployment is contingent on continuous capability development, organizational flexibility, and the capacity to respond to rapidly evolving digital environments.

Through this multi-tiered perspective, the research shows how BDAC facilitates sustainability across environmental, economic, and social dimensions, highlighting its strategic importance for logistics organizations in emerging markets.

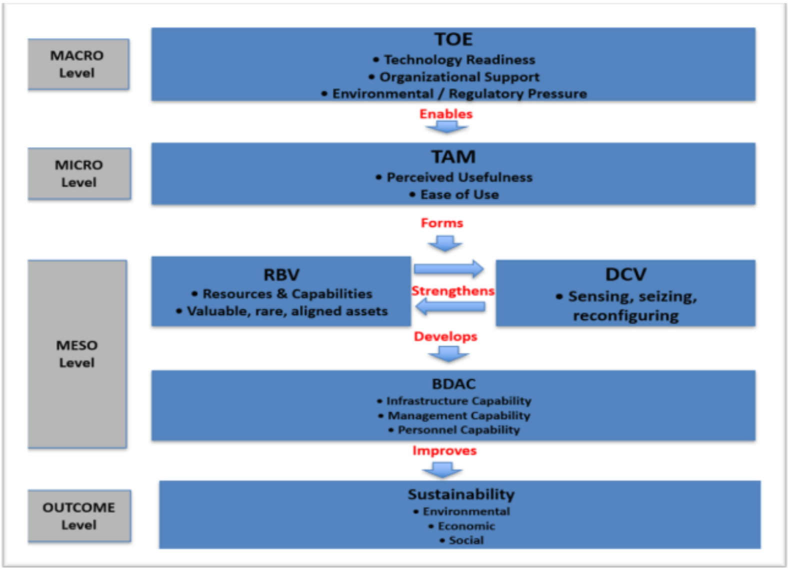

***Figure 1**.A Relationship comprehensive proposed framework.*

Multi-Level Framework for BDAC and Sustainability in Logistics- The study conceptualizes the role of Big Data Analytics Capability (BDAC) in logistics sustainability through a multi-level theoretical framework that integrates Micro, Meso, Macro, and Outcome perspectives.

Macro-Level (External Context): The Technology-Organization-Environment (TOE) framework captures external pressures and contextual factors that influence organizational investments in analytics. These environmental drivers, including regulatory requirements, competitive dynamics, and broader market or institutional conditions shape the timing and extent to which logistics organizations prioritize BDAC adoption.

Micro-Level (Individual Employees): At the individual level, the Technology Acceptance Model (TAM) highlights the critical role of user perceptions in determining effective technology utilization. Employee beliefs about the usefulness and ease of use of analytics tools influence how seamlessly these technologies are incorporated into daily workflows. This personal acceptance is crucial for ensuring that organizational investments in analytics yield meaningful operational and sustainability outcomes.

Meso-Level (Organizational Capabilities): The organizational level considers the internal configuration of analytics capabilities. The Resource-Based View (RBV) frames BDAC as a strategic, unique, and inimitable resource that generates competitive advantage when supported by strong management practices and robust data governance. Meanwhile, Dynamic Capabilities Theory (DCT) emphasizes how organizations leverage analytics to identify opportunities, reconfigure operations, and respond flexibly to evolving sustainability demands. Together, RBV and DCT illustrate the evolution of BDAC from a technological asset to an embedded organizational capability that continuously adapts and improves.

Outcome-Level (Sustainability Impacts): The framework demonstrates that the effective alignment of BDAC across micro, mesa, and macro levels drives tangible sustainability outcomes. Specifically, organizations with well-developed analytics infrastructure, skilled personnel, and structured governance mechanisms achieve improvements across environmental, economic, and **social dimensions**. Notably, these outcomes are contingent not solely on technology adoption but also on contextual integration, employee acceptance, and ongoing organizational development.

Contextual Variations in Adoption Pathways: Empirical evidence highlights that BDAC adoption is influenced by distinct contextual drivers. In state-led or policy-driven environments, adoption is often incentivized through regulatory frameworks, strategic development plans, or public-sector investment priorities. Here, adoption is capability-contingent, meaning that the mere presence of analytics infrastructure does not automatically generate sustainability benefits; it must be paired with organizational learning and personnel capability. In contrast, in market-driven economies, adoption is predominantly performance-driven, shaped by competitive pressures, cost considerations, and customer expectations for efficiency, transparency, and sustainability. This comparison underscores a key causal insight: while the structural enablers for adoption differ, the realization of sustainability impacts depends on the integration of technological, managerial, and human capabilities.

7. DISCUSSION OF FINDINGS

The thematic analysis provides robust, context-specific evidence that Big Data Analytics Capability (BDAC) is a key determinant of sustainability in the logistics sector. Integrating four theoretical perspectives—TOE, TAM, RBV, and DCV—offers a multi-level understanding of how BDAC influences environmental, economic, and social outcomes.

1. BDAC as an Enabler of Green Logistics (Environmental Sustainability)

The findings confirm that BDAC significantly supports Green Logistics, primarily through the lens of the TOE framework and the RBV/DCV perspectives.

- TOE Context: External pressures, such as national sustainability agendas and strategic logistics policies, drive firms to adopt BDAC. Technological readiness, particularly advanced analytics infrastructure, serves as an essential enabler.
- RBV/DCV Link: BDAC infrastructure and management capabilities constitute strategic, inimitable resources that allow organizations to optimize route planning, reduce fuel consumption, and implement predictive maintenance. Through the dynamic capability's lens, firms leverage analytics to sense environmental risks and reconfigure operations for improved sustainability performance over time.

These results align with prior studies demonstrating that BDAC enhances environmental outcomes in logistics through route optimization, emissions reduction, and predictive maintenance [41–45]. However, unlike market-driven adoption in technologically advanced economies, the findings show that in Oman, state-led sustainability initiatives strongly influence the motivation and scope for BDAC adoption. This highlights the role of institutional and policy contexts in shaping environmental sustainability outcomes.

The Critical Role of Personnel Capability (Economic Sustainability)

Personnel capability emerged as the most influential factor for economic sustainability, emphasizing the importance of TAM and RBV/DCV perspectives.

- RBV/DCV Link: Skilled personnel capable of translating BDAC insights into actionable strategies constitute a rare, non-substitutable resource. The "Strategic Talent Gap" identified in the study underscores that human capability is central to seizing economic opportunities, including cost optimization, demand forecasting, and risk management.
- TAM Link: The successful application of BDAC depends on employees' acceptance and effective use of analytics tools. Without sufficient digital literacy and analytical competence, even advanced systems fail to generate economic value.

These findings reflect global patterns, where advanced economies generally have a workforce with integrated analytics skills [42–47]. In contrast, developing economies—including Oman, GCC countries, and nations such as India and Brazil—face persistent skills shortages, limiting BDAC's effectiveness [48–60]. The study reinforces that in emerging contexts, personnel capability is the principal bottleneck for realizing economic sustainability.

3. Enhancing Traceability and Transparency (Social Sustainability)

BDAC's contribution to social sustainability operates through traceability and transparency, best explained via TOE and DCV.

- TOE Context: Organizational support for ethical practices and societal expectations for transparency create the motivation to leverage BDAC for social outcomes.
- DCV Link: Analytics enables firms to sense, integrate, and act upon information that enhances operational policies, worker safety, and social legitimacy. Predictive and real-time monitoring systems facilitate compliance with labor regulations and foster trust with stakeholders.

The findings align with prior research showing that BDAC can enhance transparency, ethical sourcing, and employee well-being [14, 15, 66]. Importantly, the study indicates that in emerging markets, BDAC often has a stronger impact on social responsibility and public trust than in developed economies [14, 36, 45, 67, 68].

4. Integrative Insights

Overall, the findings challenge the notion that BDAC's impact on sustainability is solely technology-driven [7, 45, 69]. Instead, the study demonstrates that sustainability outcomes emerge from the interaction of three distinct capability dimensions:

1. Big Data Infrastructure Capability – supporting environmental efficiency,
2. Big Data Management Capability – ensuring governance and integration, and
3. Big Data Personnel Capability – enabling strategic interpretation and action.

These dimensions interact with contextual pressures (TOE), dynamic reconfiguration processes (DCV), and individual acceptance behaviors (TAM), collectively shaping environmental, economic, and social performance. This multi-level understanding addresses recent calls to examine microfoundations of BDAC [31, 66, 70, 71] and provides practical insights for implementing analytics-driven sustainability in emerging logistics economies.

Table 2 synthesizes the differences in BDAC-driven sustainability practices across developed, developing, and general logistics contexts.

Theme	Developed Countries	Developing Countries	Current Study (Oman)
Green Logistics (Environmental Sustainability)	BDAC-enabled green logistics is integrated into formal sustainability strategies and governance systems. Analytics support efficiency activities such as route optimization, emission monitoring, and energy management. Outcomes are driven more by governance and readiness than technology alone [61–65].	Sustainability outcomes are uneven and indirect. Environmental gains mainly stem from efficiency and cost reduction. Social sustainability is weak and dependent on complementary capabilities rather than analytics investment [66–69].	Sustainability occurs only when technology, skilled personnel, and governance are aligned. BDAC supports a shift from efficiency-focused interventions to **Triple Bottom Line** sustainability through integrated decision-making rather than isolated optimization.
Personal Capability (Economic Sustainability)	Personal capability is an embedded organizational resource enabling BDAC to shape outcomes through broader supply chain capabilities such as integration, resilience, and flexibility. Effectiveness depends on analytical skills, learning routines, and managerial support [66–68].	Personal capability is often a constraint. Sustainability outcomes heavily depend on analytical skills, data literacy, absorptive capacity, and ongoing learning. Without capability development, technology rarely brings meaningful value [69–71].	Personal capability functions as a multi-level mechanism connecting individual competence (Micro), organizational learning and role clarity (Meso), and market-level constraints (Macro). Explains variation in BDAC-driven sustainability across firms.
Traceability (Social Sustainability)	Traceability is a socio-technical capability enabled by technologies such as blockchain, IoT, and AI, strengthened by governance, standardization, and supply chain coordination. Effective traceability requires aligned incentives and organizational support [72–73].	Traceability remains fragmented and uneven. Sustainability impacts often come from partial visibility and connectivity due to governance gaps, adoption readiness, and weak ecosystem alignment [73-74].	Traceability becomes meaningful only when data ownership, system usability, and cross-organizational integration are firmly in place. Otherwise, visibility is superficial and fails to support environmental or social objectives.

Implications, Conclusion, and Future Research

This study demonstrates that Big Data Analytics Capabilities (BDAC) play a pivotal role in enhancing sustainability within Omani logistics. The findings indicate that BDAC should not be regarded solely as a technological investment but as a strategic resource that integrates infrastructure, management, and personnel capabilities to drive environmental, economic, and social outcomes. Theoretical insights from RBV, DCV, TOE, and TAM illustrate how these capabilities operate across micro, meso, and macro levels, transforming analytics from a functional tool into a dynamic capability that supports long-term sustainability. From a managerial perspective, the study emphasizes the importance of developing human capital alongside technological infrastructure. Personnel capability—data literacy, analytical confidence, and decision-making skills—emerges as a critical enabler for translating analytics insights into operational improvements, such as optimized routing, reduced emissions, and improved safety performance. Organizational governance further strengthens BDAC's impact by embedding analytics into routine decision-making, standardizing performance metrics, and clarifying data ownership.

These elements ensure that sustainability initiatives are actionable and not merely symbolic.

Policy implications highlight the role of targeted incentives and regulatory support in fostering BDAC adoption. Programs that link training, data-sharing standards, green logistics incentives, and ESG governance to measurable outcomes can enhance the sector's contribution to Oman Vision 2040, the Logistics Strategy 2040, and Net-Zero 2050. In particular, aligning digital transformation with national sustainability goals enables both organizational competitiveness and societal benefits.

The study also recognizes limitations inherent in single-country, qualitative research. Findings are context-specific and rely on interview data rather than objective performance metrics, suggesting caution when generalizing to other settings. Future research could extend this work through comparative studies in other GCC countries, mixed-method designs, and the integration of quantitative performance data to validate sustainability outcomes.

Finally, the study proposes a capability roadmap that underscores the sequential development of personnel, governance, infrastructure, and continuous learning. Sustainability gains are maximized when human skills and organizational practices precede large-scale technological investment, ensuring that BDAC remains adaptive, relevant, and aligned with evolving operational and environmental priorities. Overall, this research provides both theoretical and practical insights into leveraging BDAC for sustainable logistics in emerging economies, highlighting the interplay between technology, people, and governance as essential for long-term impact.

8. OPERATIONAL MATURITY MODEL

This study further introduces an operational maturity framework that delineates the evolutionary progression of logistics organizations from elementary data utilization to a dynamic, sustainability-driven analytics reconfiguration. Rather than framing maturity as a simple binary state of adoption, the model conceptualizes it as a continuous trajectory of capability development, emphasizing the gradual accumulation of technological, managerial, and human competencies necessary for embedding sustainability into operational decision-making.

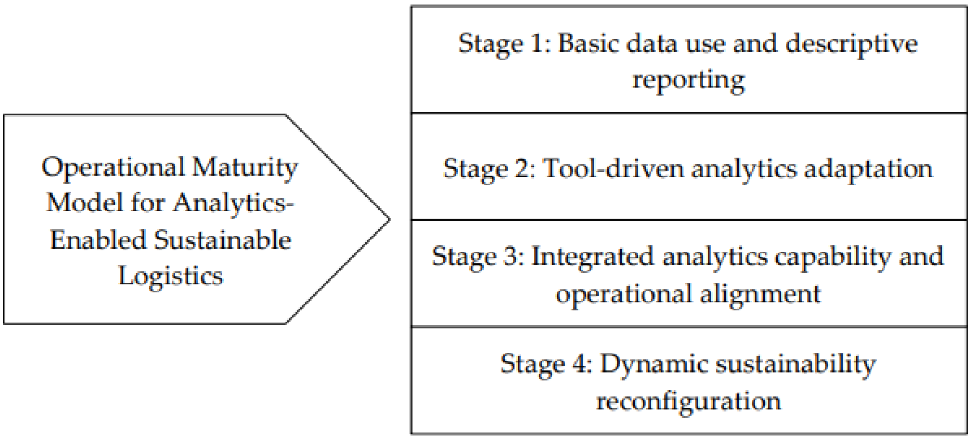

Figure 2. *Operational Maturity Model for AnalyticsEnabled Sustainable Logistics.*

REFERENCES

1. Abdullah, F., Naeem, H. M., & Aslam, H. (2025). Big data, bigger ideas: The role of big data analytics management capability in supply chain sustainability. *Industrial Management & Data Systems*.
2. Adiguzel, Z., Sonmez Cakir, F., & Özbay, F. (2025). Big data analytics capability and sustainability in company innovation. *International Journal of Innovation Science*.
3. Al Kamzari, M., Asad Mir, F. A., & Suliman, A. (2024). Big data governance and innovation performance: The mediating role of big data analytic capabilities and organisational agility. *International Journal of Innovation Management*, 28(01n02), 2450003.
4. Al-Khatib, A. W. (2023). The impact of big data analytics capabilities on green supply chain performance: Is green supply chain innovation the missing link? *Business Process Management Journal*, 29(1), 22–42.
5. Alorfi, A. S., & Alsaadi, N. (2025). Barriers to the adoption of big data analytics in Saudi Arabia's manufacturing sector: An interpretive structural modeling approach. *Systems*, 13(4), 250.
6. Ali, M., & Essien, A. (2025). How can big data analytics improve outbound logistics in the UK retail sector? A qualitative study. *Journal of Enterprise Information Management*, 38(2), 424–449.
7. Alyahya, M., & Agag, G. (2025). How does corporate environmental performance contribute to firm performance and customer satisfaction? A longitudinal investigation. *Sustainability*, 17(4), 1644.
8. Arshad, M., Qadir, A., Ahmad, W., & Rafique, M. (2024). Enhancing organizational sustainable innovation performance through organizational readiness for big data analytics. *Humanities and Social Sciences Communications*, 11(1), 1–15.
9. Arias-Pérez, J., Coronado-Medina, A., & Perdomo-Charry, G. (2022). Big data analytics capability as a mediator in the impact of open innovation on firm performance. *Journal of Strategy and Management*, 15(1), 1–15.
10. Ateeq, A., Almuraqab, N. A. S., & Ateeq, R. A. (2025). Enhancing efficiency and innovation: The impact of advanced digital technologies on business operations in GCC countries. In *Sustainable data management: Navigating big data, communication technology, and business digital leadership* (Vol. 2, pp. 497–504). Springer.
11. Bahrami, M., & Shokouhyar, S. (2022). The role of big data analytics capabilities in bolstering supply chain resilience and firm performance: A dynamic capability view. *Information Technology & People*, 35(5), 1621–1651.
12. Barbosa, T. S., de Castro, D., Singh, A. K., & Vitale, S. (2026). An Experimental Assessment of AI-Based Legal Decision-Making Systems in Contract Analysis and Risk Detection. *Qubahan Techno Journal*, 5(1), 37–65.
13. Bag, S., Luthra, S., Mangla, S. K., & Kazancoglu, Y. (2021). Leveraging big data analytics capabilities in making reverse logistics decisions and improving remanufacturing performance. *The International Journal of Logistics Management*, 32(3), 742–765.
14. Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120.
15. Benayoune, A., Hamid, A. A., Rahman, N. S. F. A., & Al, K. (2021). Logistics 4.0 skills requirements: Evidence from a developing country. *Canadian Journal of Business and Information Studies*, 4(2), 24–36.
16. Benzidia, S., Leroux, J., Fosso Wamba, S., & Maugran, J. (2025). The contribution of big data in green supply chain: A systematic review. In *Supply Chain Forum: An International Journal* (Vol. 26, No. 1, pp. 39–54).
17. Bertello, A., Ferraris, A., Bresciani, S., & De Bernardi, P. (2021). Big data analytics and degree of internationalization: The interplay between governance of BDA infrastructure and capabilities. *Journal of*

Management and Governance, 25(4), 1035–1055.
18. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
19. Cantoni, F., Ricciardi, A., Bisogni, P. G., & Zsifkovits, H. (2024). The unravelled role of soft skills in the logistics and supply chain management field. *Journal of Innovation & Knowledge*, 9(4), 100615.
20. Cetindamar, D., Shdifat, B., & Erfani, E. (2022). Understanding big data analytics capability and sustainable supply chains. *Information Systems Management*, 39(1), 19–33.
21. Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage.
22. Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, 35(8), 982–1003.
23. Dang, H. C. T., Nguyen, P. L. T., Le, P. L. T., Nguyen, T. T. H., & Vu, B. T. (2025). Impact of big data analytics capabilities on sustainable performance of Vietnamese retail companies: The mediating role of innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 100569.
24. Garcia-Torres, S., Rey-Garcia, M., & Sáenz, J. (2024). Enhancing sustainable supply chains through traceability, transparency, and stakeholder collaboration: A quantitative analysis. *Business Strategy and the Environment*, 33(7), 7607–7629.
25. Gupta, A., Dwivedi, A., & Paul, S. K. (2025). Developing a sustainability index for implementing big data analytics in the logistics sector. *Sustainable Development*, 33, 1271–1291.
26. Gupta, H., Kumar, S., Kusi-Sarpong, S., Jabbour, C. J. C., & Agyemang, M. (2021). Enablers to supply chain performance on the basis of digitization technologies. *Industrial Management & Data Systems*, 121(9), 1915–1938.
27. Gupta, Y., Khan, F. M., Kumar, A., Luthra, S., & Queiroz, M. M. (2024). Mobilising big data analytics capabilities to improve performance of tourism supply chains: The moderating role of dynamic capabilities. *The International Journal of Logistics Management*, 35(2), 649–679.
28. Hamed, A., & Bohari, A. M. (2022). Adoption of big data analytics in medium-large supply chain firms in Saudi Arabia. *Knowledge and Performance Management*, 6(1), 62–74.
29. Haylemariam, L. G., Umar, R. M., & Oduro, S. (2025). Modeling the role of big data analytics capabilities in impacting corporate environmental performance: A serial mediation analysis. *Business Strategy and the Environment*.
30. Hasan, R., Kamal, M. M., Daowd, A., Eldabi, T., Koliousis, I., & Papadopoulos, T. (2024). Critical analysis of the impact of big data analytics on supply chain operations. *Production Planning & Control*, 35(1), 46–70.
31. Hennink, M. M., Kaiser, B. N., & Marconi, V. C. (2017). Code saturation versus meaning saturation: How many interviews are enough? *Qualitative Health Research*, 27(4), 591–608.
32. Huynh, M. T., Nippa, M., & Aichner, T. (2023). Big data analytics capabilities: Patchwork or progress? A systematic review of the status quo and implications for future research. *Technological Forecasting and Social Change*, 197, 122884.
33. Hussien, L. F., Alshaketheep, K., Al-Ahmed, H., Shajrawi, A., Alghizzawi, M., Zraqat, O., & Deeb, A. (2025). The impact of big data analytics on the sustainability reports quality. *Discover Sustainability*, 6(1), 776.
34. Ikram, M., & Ismail, A. (2025). Role of big data analytics capabilities on green supply chain performance in Pakistan. *The Asian Bulletin of Big Data Management*, 5(4), 14–31.
35. Jalali, A., Palalić, R., Razzak, M. R., & Al-Kharusi, S. (2025). Big data analytics, company innovation, and risk-taking: Influence of absorptive capacity. *Management Decision*, 63(5), 1473–1497.
36. Jaouadi, M. H. O. (2022). Investigating the influence of big data analytics capabilities and human resource factors in achieving supply chain innovativeness. *Computers & Industrial Engineering*, 168, 108055.
37. Jiang, W., Feng, T., & Wong, C. Y. (2025). How big data analytics capabilities drive supply chain resilience: The mediating roles of supply chain visibility and flexibility. *International Journal of Physical Distribution & Logistics Management*, 55(5), 505–539.
38. Kalaitzi, D., & Tsolakis, N. (2022). Supply chain analytics adoption: Determinants and impacts on organisational performance and competitive advantage. *International Journal of Production Economics*, 248, 108466.
39. Kalyar, M. N., Pierscieniak, A., & Shafique, M. (2024). Leveraging green innovation from big data analytics: Examining the role of resource orchestration and green dynamic capabilities. *Journal of Entrepreneurship, Management and Innovation*, 20(4), 73–87.
40. Karaboga, T., Zehir, C., Tatoglu, E., Karaboga, H. A., & Bouguerra, A. (2023). Big data analytics management capability and firm performance: The mediating role of data-driven culture. *Review of Managerial Science*, 17(8), 2655–2684.
41. Karaman, A. S., Kilic, M., & Uyar, A. (2020). Green logistics performance and sustainability reporting practices of the logistics sector: The moderating effect of corporate governance. *Journal of Cleaner Production*, 258, 120718.

42. Lin, J., Wu, S., & Luo, X. (2025). How does big data analytics capability affect firm performance? Unveiling the role of organisational resilience and environmental dynamism. *European Journal of Information Systems*, 34(3), 502–528.
43. Manikas, I., Sundarakani, B., & Shehabeldin, M. (2023). Big data utilisation and its effect on supply chain resilience in Emirati companies. *International Journal of Logistics Research and Applications*, 26(10), 1334–1358.
44. Meathawiroon, C., Songkhwan, S., & Thunyachairat, A. (2025). Enhancing financial performance through big data analytics capability, supply chain agility, and supply chain performance. *ABAC Journal*, 45(3), 77–92.
45. Mikalef, P., Krogstie, J., Pappas, I. O., & Pavlou, P. A. (2020). Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities. *Information & Management*, 57(2), 103169.
46. Mousa Mousa, M., Abdulrahman Al Moosa, H., Naim Ayyash, I., Omeish, F., Zaiem, I., Alzahrani, T., … & Zamil, A. M. (2025). Big data analytics as a driver for sustainable performance: The role of green supply chain management in advancing circular economy in Saudi Arabian pharmaceutical companies. *Sustainability*, 17(14), 6319.
47. Murad, M. A. U., Cetindamar, D., & Chakraborty, S. (2023). Big data analytics capability and sustainability: A systematic literature review. In *Proceedings of the Portland International Conference on Management of Engineering and Technology (PICMET)* (pp. 1–8). IEEE.
48. Nicoletti, B., & Appolloni, A. (2024). Green logistics 5.0: A review of sustainability-oriented innovation with foundation models in logistics. *European Journal of Innovation Management*, 27(9), 542–561.
49. Novicka, J., & Volkova, T. (2025). Bridging big data analytics capability with sustainability business performance: A literature review. *Sustainability*, 17(6), 2362.
50. Ojadi, J. O., Odionu, C., Onukwulu, E., & Owulade, O. (2024). Big data analytics and AI for optimizing supply chain sustainability and reducing greenhouse gas emissions in logistics and transportation. *International Journal of Multidisciplinary Research and Growth Evaluation*, 5(1), 1536–1548.
51. Oman Vision 2040. (2023). Oman Vision 2040 implementation follow-up unit.
52. Okoduwa, I. O., Ashiwaju, B. I., Arowoogun, J. O., Awonuga, K. F., Asuzu, O. F., & Ndubuisi, N. L. (2024). Reviewing the use of big data in supply chain optimization in the USA. *World Journal of Advanced Research and Reviews*, 21(2), 33–40.
53. Pawar, P. V., & Paluri, R. A. (2022). Big data analytics in logistics and supply chain management: A review of literature. *Vision*.
54. Pathak, S., Krishnaswamy, V., & Sharma, M. (2024). Unveiling the evolution of big data analytics capability: A comprehensive analysis. *Journal of Scientometric Research*, 13(3), 791–805.
55. Perevozova, I., Gubernat, T., Hontar, L., Shayban, V., & Bocharova, N. (2024). Using big data analytics to improve logistics processes and forecast demand. *Pacific Business Review International*, 17(4).
56. Raj, R., Kumar, V., & Verma, P. (2023). Big data analytics in mitigating challenges of sustainable manufacturing supply chains. *Operations Management Research*, 16(4), 1886–1900.
57. Razaghi, S., & Shokouhyar, S. (2021). Impacts of big data analytics management capabilities and supply chain integration on global sourcing: A survey on firm performance. *The Bottom Line*, 34(2), 198–223.
58. Rehman, S. U., Hamdan, Y. H., & Abidi, N. (2024). Big data analytics capabilities, green intellectual capital, supply chain innovations, and sustainable supply chain performance. *Operations and Supply Chain Management*, 17(3), 222–235.
59. Resmi, A. G., & Popovs, A. (2024). Big data analytics and innovation in the sustainable performance of electronic waste reverse logistics. *Acta Prosperitatis*, 15(1).
60. Richly, M. A. (2022). Big data analytics capabilities: A systematic literature review on necessary skills to succeed in big data analytics. *Junior Management Science*, 7(5), 1224–1241.
61. Riggs, R., Roldán, J. L., Real, J. C., & Felipe, C. M. (2023). Opening the black box of big data sustainable value creation: The mediating role of supply chain management capabilities and circular economy practices. *International Journal of Physical Distribution & Logistics Management*, 53(7–8), 762–788.
62. Sarioguz, O., & Miser, E. (2024). Data-driven decision-making: Revolutionizing management in the information era. *Journal of Artificial Intelligence General Science*, 4(1), 179–194.
63. Shamout, M. D. (2024). The role of supply chain analytics on supply chain responsiveness, resilience, and restoration (3Rs) capabilities in the United Arab Emirates. *Business Strategy & Development*, 7(2), e374.
64. Sultan, S., Hamid, A. B. A., Yasin, I., Malik, M. H., & Humayun, S. (2024). Examining the nexus between big data analytics capabilities and organizational performance: The mediating role of supply chain visibility in manufacturing organizations. *Qlantic Journal of Social Sciences*, 5(4), 49–63.
65. Takdir, M. A., & Kirima, K. (2024). Big data analytics in enhancing logistics efficiency at the Independent Electoral and Boundaries Commission of Kenya. *Journal of Applied Social Sciences in Business and Management*, 3(2), 299–315.

66. Tipu, S. A. A., & Fantazy, K. (2024). Linking big data analytics capability and sustainable supply chain performance: Mediating role of innovativeness, proactiveness, and risk taking. *International Journal of Productivity and Performance Management*, 73(5), 1587–1608.
67. Topcu, I., Karpak, B., Ülengin, F., & Aktas, E. (2025). Big data analytics in supply chain management: Uncovering emerging trends through bibliometric analysis. *Journal of Enterprise Information Management*.
68. Tornatzky, L. G., Fleischer, M., & Chakrabarti, A. K. (1990). *The processes of technological innovation*. Lexington Books.
69. Usman, M., Zahoor, N., Boğan, E., Akhtar, M. W., & Dedeoğlu, B. (2026). Big data analytics and green core competencies: Important role of data-driven decision-making culture and leader conscientiousness. *IEEE Transactions on Engineering Management*.
70. Vachkova, M., Ghouri, A., Ashour, H., Isa, N. B. M., & Barnes, G. (2023). Big data and predictive analytics in Malaysian micro-, small, and medium businesses. *SN Business & Economics*, 3(8), 152.
71. Vasiulis Ferreira Rodrigues, N., De Camargo Fiorini, P., Piato, É. L., Lopes de Sousa Jabbour, A. B., & Chiappetta Jabbour, C. J. (2025). Resources and capabilities for logistics 4.0 and sustainable value creation: A study of logistics service providers in an emerging market. *The International Journal of Logistics Management*, 36(5), 1385–1409.
72. Wang, N., Chen, B., Wang, L., Ma, Z., & Pan, S. (2024). Big data analytics capability and social innovation: The mediating role of knowledge exploration and exploitation. *Humanities and Social Sciences Communications*, 11(1), 1–18.
73. Wu, D., Lin, X., Gupta, S., & Kar, A. K. (2024). Big data analytics capability, dynamic capability, and firm performance: The moderating effect of IT-business strategic alignment. *IEEE Transactions on Engineering Management*.
74. Ziaee, M., Shee, H. K., & Sohal, A. (2023). Big data analytics in Australian pharmaceutical supply chain. *Industrial Management & Data Systems*, 123(5), 1310–1335.
75. Zhao, G., Xie, X., Wang, Y., Liu, S., Jones, P., & Lopez, C. (2024). Barrier analysis to improve big data analytics capability of the maritime industry: A mixed-method approach. *Technological Forecasting and Social Change*, 203, 123345.
76. Zhou, X., Lu, H., & Kumar Mangla, S. (2024). The impact of digital traceability on sustainability performance: Investigating the roles of sustainability-oriented innovation and supply chain learning. *Supply Chain Management: An International Journal*, 29(3), 497–522.