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Optimising Risk Management in International Supply Chain Projects Through Big Data Analytics in Project Management

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Abstract
International supply chain projects operate in an ever-complex and uncertain world, in which conventional risk management strategies are often inadequate. This study fed on how big data analytics can be used as part of project management to optimise the management of risk on international supply chain projects. Based on an integrative qualitative methodology and a structured synthesis of existing frameworks, the research considers the role of analytics in risk identification, assessment, and mitigation improvement on global supply networks. The results suggest real-time information integration, predictive analytics, and analytics-enabled project management information systems can provide significant decision-making accuracy, governance transparency and project resilience. The study further stresses the importance of the combined implementation of complementary digital technologies in enhancing effective proactive risk management and sustainable project results. By locating project management as one of the key mechanisms to operationalize analytics-driven risk optimization, this paper offers an integrated view to bridge between supply chain management and project risk management. The study also outlines some managerial implications, limitations, and future research directions in the context of analytics-enabled international supply chain projects.

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1. Introduction

International supply chain projects have become increasingly more complicated because of globalization, long supplier networks, volatile markets, geopolitical certainty, and the digitalization of the industry. Organizations dealing with cross-border supply chains are now faced with multidimensional risks such as staple supply chain disruptions, logistics delays, regulation alterations, demand fluctuations, cyber risks, co-ordination failures amongst project teams spread all over the world, etc. Within this context, the traditional risk management approaches-which are often reactive, made on experience, and based on limited historical data-are not enough anymore to support an effective decision-making process within the World supply chain projects (Onaghinor *et al*., 2022) [20]; (Bentahar and Belhadi, 2025) [7].

Project management is a vital element in orchestrating the activities of international supply chains, as projects increasingly become the engine of implementation of supply chain strategies, digital platforms, infrastructure upgrades, and sustainability initiatives. However, project managers who work in global supply chain environments are likely to confront a greater level of uncertainty, incomplete information, and interacting risks which shift throughout the project lifecycle (Wijayasekera *et al*., 2022) [23]. These challenges have increased the need for advanced and data-driven risk management mechanisms which are able to anticipate disruptions instead of just reacting to them.

Big Data Analytics (BDA) has become a revolutionary functionality in the supply chain management and project management processes. Big data is defined in terms of high volume, velocity, variety, veracity, value which allows organizations to process structured and unstructured data from different sources including enterprise data and systems, sensors, logistics platforms, social media, external market intelligence (Kache & Seuring, 2017) [15]; (Sanders, 2016) [21]. In supply chain contexts, BDA supports about real-time visibility, predictive analysis, scenario analysis, and it is essential for discovery, assessment, and mitigation of risks across the interconnected activities (interleukin activities) in a project, thus motivating and necessary for undertaking (Alsolbi *et al*., 2023) [4]; (Shah *et al*., 2023) [22].

Recent studies emphasize that the integration of big data analytics in project management helps to enhance the accuracy of risk identification, reduce the prediction of cost and schedule overruns, and partake in risk response planning (in advance) (Kabanda, 2020) [14]; (Bakici *et al*., 2023) [6]. In multinational supply chains, where project risks are further enhanced through a diversified cultural, regulatory, and operational context, data-driven decision-making frameworks are a structured way of linking supply chain project objectives to performance and resilience (Onaghinor *et al*., 2022) [20]; (Mangla *et al*., 2021) [17].

Specifically, big data analytics is helping in supply chain risk management through early detection of disruption, modeling of interdependencies between risk factors, and better coordination among project stakeholders. De Assis Santos *et al*. and Marques (2022) [9], argue that BDA are at critical process crossroads in supply chains enabling project teams to connect upstream and downstream data flows with risk management practices. Similarly, Matthews *et al*. (2022) [19] show that smart data analytics frameworks can greatly minimize rework and performance threats in large-scale projects by converting raw analysis data to managerial insights.

The relevance of the big data-driven risk management is further supported by the rise in the use of complementary digital technologies such as artificial intelligence, robotic process automation, blockchain, and project management information systems (PMIS). Studies found within the International Journal of Business Analytics and Security revealed that the AI-enabled PMIS and RPA assist in risk monitoring in projects, automating control processes and boosting governance structures especially in complex and regulated settings such as healthcare and public sectors projects (Al Zarooni and El Khatib, 2023) [12]: Mahmood *et al* (2023) [3], Alkatheeri *et al* (2023) [2] proposed that the use of AI and RPA enables companies to better control the risks on their projects as well as automating control processes. These technologies have become integrated into supply chain projects on an international scale as a way of ensuring transparency, traceability and accountability across international borders.

Moreover, the considerations of sustainability and resilience have become an integrated part of supply chain project risk management. Big data analytics helps organizations to reconcile the economic performance with social and environmental objectives by supporting sustainable planning of projects and supply chain design (Mandicak *et al*., 2021) [18]; (Chalmeta & Barqueros-Munoz, 2021) [8]; (Mageto, 2021) [16]. In volatile, uncertain, complex and ambiguous (VUCA) surroundings, the alignment of project management and supply chain management through digital analytics is seen as a strategic requirement for developing long-term resiliency (Bentahar and Belhadi 2025) [7].

Despite an increasing amount of literature regarding big data analytics in supply chains and project management individually, there still appears to be a need for specific analysis of how BDA can be systematically used to optimize risk management specifically when employed in international supply chain projects. Existing studies often tend to address analytics adoption or performance and technological capabilities in isolation and did not sufficiently link them to project-based risk management processes across all supply networks in the world (Zabala-Vargas *et al*., 2023) [24]; (Ageron *et al*., 2020) [1].

Against this backdrop, this article focuses on the use of big data analytics as a strategic enabler for optimizing risk management for international supply chain projects. By synthesizing the established frameworks and empirical insights from a literature review and situating the discussion in a real-world context of the case scenario, the research paper intends to show how the use of data-driven project management supports the elicitation of risk visibility, decision quality and resilience in supply chains in the context of complex international environments.

2. Literature Review

2.1. Analytics of Big Data in Supply Chains and Project Management

The growing digitalization of operations across the world has made big data analytics (BDA) a fundamental ability in today's supply chain and project management. Big data analytics also helps organisations to gather, process, and analyse large amounts of heterogeneous data generated throughout supply chain activities, project life cycle, and external surroundings and can facilitate evidence-based decision support (Sanders, 2016) [21]; (Kache & Seuring, 2017) [15]. In the case of the multinational supply chains, data comes from varied sources including procurement systems, logistics platforms, sensors, enterprise resource planning systems, and data from the external market that creates both opportunities and analytical challenges (Ageron *et al*., 2020) [1].

Onaghinor *et al*. (2022) [20] highlight the benefits of data-driven frameworks as methods for improving project performance tracking and coordination in multinational supply chain projects through aligning supply chain metrics and project objectives. Similarly, Mangla *et al*. (2021) [17] shows that BDA mediates relation among project practises and also performance results especially in environments with uncertainty and resource constraints. These findings suggest project management advances visibility across interdependent supply chain tasks; critical in the managing international project risks.

From a project management point of view, the author of Kabanda (2020) [14] notes that predictive analytics is the strengthening of risk forecasting by making the historical and real-time project data, as well as warning signals. Bakici *et al*. (2023) [6] further note that organisations adopting big data in project management have an enhanced capability to monitor the schedule, costs, and risks from stakeholders, particularly in large and complex projects. In megaproject environments, businesses are advancing sense-making, coordination and adaptive responses to the emerging risks, clarity changes, generated data using the use of data analytics

and artificial intelligence (Wijayasekera *et al*., 2022) [23].

2.2. Big Data Analytics and Supply Chain Risk Managing

Supply chain risk management has moved from reactive approaches of mitigation to proactive and predictive approaches enabled by digital technologies. Alsolbi *et al*. (2023) [4], through a systematic literature review, points to the fact that big data analytics, as an enabler, plays a vital role in meeting the need for optimised supply chain planning, monitoring, and risk control through enhanced real-time visibility and decision accuracy. Shah *et al*. (2023) [22] in the same vein, suggest that BDA and artificial intelligence support intelligent risk management since it allows for early detection of disruption and scenario-based analysis.

De Assis Santos and Marques (2022) [9] conceptualise big data analytics to operate on "process crossroads" within supply chains where integration of data on procurement, production and distribution enables organisations to determine cascading risks before they manifest themselves in disruption of projects. This way of thinking is especially relevant for international supply chain projects, where the risks are interrelated across geographical and organisational boundaries.

In the framework of humanitarian and complex scenarios in supply chains, predictive analytics helps to enhance responsiveness and performance by reinforcing coordination between actors and a better anticipation of risks (Jeble *et al*., 2020) [13]. These insights strengthen the argument that BDA is not a technology tool, but a strategy capability that changes the way of identifying, assessing and managing risks across the supply chain projects.

2.3. Combining Big Data Analytics and Project Risk Management

The integration of big data analytics into project risk management processes have been getting an increasing amount of scholarly attention. Matthews *et al*. Smart data framework for actionable insights, rework, and performance risks in large-scale projects. This framework is meant to highlight the value of maintaining data quality, governance and analytical maturity in order to achieve effective risk management outcomes.

Empirical evidence from industry-specific projects is further evidence of the importance of analytics for project risk management. Research from the UAE health sector shows that big data analytics strengthens the capacity of project managers to identify, monitor and mitigate risks through making transparency and decisions faster (International Journal of Business Analytics and Security, 2023). Complementary studies have commented on the enhanced risk controls, governance, and traceability in a complex project environment provided through the use of robotic process automation, artificial intelligence, and blockchain technologies by their integration into project management information systems (Al Zarooni & El Khatib, 2023) [12]; (Mahmood *et al*., 2023) [3]; (Alkatheeri *et al*., 2023) [2].

On top of this, digital governance and e-governance systems with analytics afford them greater accountability and coordination in multi-stakeholder projects, which is facilitating for international supply chain initiatives that work across regulatory regimes (El Khatib *et al*., 2024) [10]. These findings suggest that analytics-enabled PMIS platforms are critical infrastructures that can manage risk associated with project and supply chain management holistically.

2.4. Big Data Analytics, Sustainability, and Resilience in International Supply Chain

Beyond operational efficiency, big data analytics plays a major role in improving supply chain project sustainability and resilience. Mandicak *et al*. (2021) [18] supports the positivity of big data concepts in economic sustainability for the development of projects and supply chains. Similarly, Chalmeta and Barqueros-Munoz (2021) [8] and Mageto (2021) [16] also prove that analytics-driven supply chain management has shown support for sustainable decision-making by ensuring that environmental and social performance indicators are integrated into operational planning.

In volatile and uncertain global environments, integrating project management and supply chain management through digital analytics proves to be critical to achieve resilience according to Bentahar and Belhadi (2025) [7]. Big data analytics helps the organizations to deal with foreseeing the shocks and to change project planning and root continuity of the international supply network. These capabilities are becoming much more critical due to the disruptions to supply chain projects caused by geopolitical instability, pandemics and climate-related risks.

2.5. Research Gap

Although previous literature supports the potential of big data analytics in the betterment of supply chain performance, sustainability, and project control, it is evident from the literature a fragmented treatment of analytics-enabled risk management in international supply chain projects. Existing research frequently analyses the topic of supply chain risk management or project analytics separately from one another, without adequately addressing the intersection of the two themes in the context of a global project (Zabala-Vargas *et al*., 2023) [24]. Furthermore, few empirical studies have considered the operation of big data analytics by project managers throughout the project life cycle to dynamically manage cross-border supply chain risks.

Problem Statement

International supply chain projects are increasingly subject to complex inter-related risks through globalisation, digital interdependence, regulatory diversity and market volatility. Traditional project risk management approaches based on static risk registers and limited historical information are insufficient for risk management in the context of massive scale, pace, and complexity in multivariate supply chain environment. Despite the increasing availability of big data, many organisations have been facing difficulties in integrating analytics effectively into their project risk management processes, which leads to delayed responses, poor visibility and less-than-optimal decision-making (Onaghinor *et al*., 2022) [20]; (Alsolbi *et al*., 2023) [4].

Research Objectives

The following are the objectives of this article:

- Investigate the role of big data analytics in improved risk identification, assessment and mitigation in international supply chain projects.
- Analyse the integration of big data analysis and project management practises to enhance decision making and performance of project in complex global supply chain.
- Explore current analytical frameworks and digital

technologies for supporting the risk management of international supply chains.
- Provide an organised solution to optimise risk management using analytics-driven project management supported by empirical knowledge from literature.

Statement of Solution

This article presents the idea that risks in the international supply chain project should be optimised using big data analytics in a systematic way in project management frameworks. By deploying analytics into project management data/information systems, organizations can gain end-to-end risk visibility in their organizations in real-time, prophecy, and action coordinates across the supply chain activities of an organization. Data-driven project governance supported by advanced technology of analytics, artificial intelligence, and automation helps project managers in predicting disruptions, managing diverse stakeholders and increasing the resilience of their projects in volatile global environments (Shah *et al*., 2023) [22]; (Bentahar & Belhadi, 2025) [7]. Through this integrated manner, international supply chain projects can move from being reactionary risk management towards proactive risk optimization with data intelligence.

3. Methodology

3.1. Research Design

This work follows a qualitative, integrative research design that is based on an extensive literature-based research, using a theory-based, real-life study. The methodological approach is appropriate in consideration of the exploratory and explanatory nature of the research - which is an attempt to understand the best way of optimising risk management in international supply chain projects rather than testing statistically bounded hypotheses. Prior studies highlight the benefits of interpretive and framework-driven methodologies to synthesize empirical insights based on domains is beneficial for complex project and supply chain environments (Kabanda (2020)) [14] and Wijayempty (2022) [23].

A qualitative design is especially appropriate for international supply chain projects due to the multidimensional nature of risks, their context-dependence, and their dynamic character in terms of organisation and geography (Bentahar and Belhadi, 2025) [7]. This approach allows bringing together the project management, supply chain risk management and big data analytics perspectives within an analytical structure.

3.2. Data Sources and Criteria for Selection

The main source of data used for this work is the peer-reviewed academic literature strictly collected from the references of the researcher. These sources encompass journal articles related to the big data analytics, project management, supply chain risk management, artificial intelligence, digital governance, and sustainability. The selected literature ranges from theoretical frameworks, systematic reviews of literature, empirical studies to applied research based on case studies so that there is triangulation in methodology and conceptual robustness (Alsolbi *et al*., 2023) [4]; (Shah *et al*., 2023) [22].

The inclusion criteria were the following:

- That is, direct relevance to big data analytics, project management or supply chain risk management.
- Research and create an in-depth spiro philosophizing in terms of risk, uncertainty, performance, governance or resilience with reference to a project or supply chain setting.
- Applicability of International, Multinational or Complex Projects

This structured choice is in line with recommendations for rigorous analytics and research in the field of supply chain where coherence of methodology and contextuality is critical (Kache & Seuring, 2017) [15]; (Zabala-Vargas *et al*., 2023) [24].

3.3. Analytical Framework

The analysis is informed by a conceptual synthesis framework which incorporates three core dimensions:

International Supply Chain Project Characteristics

This dimension reflects the complexity energizers of international supply chain projects, such as border coordination, the variability of the regulation, the length of supplier chains, and the vigour of the market (Onaghinor *et al*. 2022) [20]; (Ageron *et al*. 2020) [1].

Capabilities of Big Data Analytics

Big data analytics is operationalized through certain capabilities, such as data integration, real-time visibility, predictive analytics, and decision support. Prior research points out these capabilities as important enablers for proactive management of risks and optimised performance (Sanders, 2016) [21]; (Alsolbi *et al*., 2023) [4].

Project Risk Management Processes

This dimension is focused on risk identification, assessment, monitoring, and mitigation at the project lifecycle. Analytics enhanced PMIS, artificial intelligence, and automation technologies are discussed as a mechanism for enhancing these processes (Matthews *et al*., 2022) [19]; (Bakici *et al*., 2023) [6].

By depicting insights from the literature on these dimensions, the research systematically analyses how big data analytics creates bridges between supply chain uncertainty and project-level decision-making.

3.4. Case Study Approach

To make the theoretical analysis more practical, the study follows a single embedded case study approach based on recorded application of big data analytics in project risk management in a complex, regulated environment. The methodological logic is based on previous research, which shows that case-based approaches are suitable to study analytics adoption and risk management issues in complex project systems (Kabanda, 2020) [14]; (Wijayasekera *et al*., 2022) [23].

The case analysis focuses on:

- The use of big data analytics as part of the project management information systems to track supply chain risks,
- Predictive and real-time analytics in the identification of potential disruptions shape the role,
- The use of complementary digital technologies like AI, RPA and blockchain to boost risk governance and traceability (Al Zarooni & El Khatib, 2023) [12]; (Mahmood *et al* 2023) [3]; (Alkatheeri *et al*, 2023) [2]

This approach opens the way to analyse the analytics-based risk management practises involved in planning, execution, and controlling phases of international supply chain projects.

3.5. Data Analysis Technique

The study uses thematic content analysis on the selected literature and evidence of the case. Key themes related to sources of risk, analytics capabilities, decision-making processes and outcomes of projects were identified and systematically categorised. This approach enables the possibility of pattern recognition and cross-comparison of results, developed within different studies whilst also ensuring analytical rigour (de Assis Santos & Marques, 2022) [9]; (Mangla *et al*., 2021) [17].

The analysis emphasizes:

- Tezio, L. (2017) How analytics helps advance risk visibility and early warning systems
- How project managers use data-driven insights to manage and mitigate risks,
- How integrated analytics frameworks help resilience and sustainability: an international supply chain projects (Mandicak *et al*., 2021) [18]; (Bentahar & Belhadi, 2025) [7].

3.6. Validity and Reliability

To improve construct validity, the study is based on well-established and academic theoretical and empirical sources that reliably define and operationalize big data analytics, project risk management, and supply chain complexity. Internal validity is upheld by cross-referencing several studies that present convergent results about the analytics-enabled risk management (Shah *et al*., 2023) [22]; (Alsolbi *et al*., 2023) [4].

Reliability is provided by the transparent selection process of the literature as well as a set framework of the analytical process; there is scope for replication and verification in future research. This methodological rigor goes along with the best practices in project management and supply chain analytics research (Bakici *et al*. 2023) [6]; (Zabala-Vargas *et al*. 2023) [24].

3.7. Ethical Considerations

As this study is only on secondary data from the published academic sources, no primary human or organisational data were collected. Ethical considerations are therefore restricted to correct references, truthful reporting of findings and adherence to academic integrity norms.

4. Results

This section presents the results derived from the qualitative thematic analysis of the selected literature and the embedded case evidence, following the methodology outlined earlier. The findings are organized around key analytical themes that explain how big data analytics (BDA) optimizes risk management in international supply chain projects. The results are summarized and synthesized using structured tables for clarity and rigor.

4.1. Identified Risk Categories in International Supply Chain Projects

The analysis reveals that risks in international supply chain projects are multidimensional and highly interconnected. Big data analytics plays a critical role in improving visibility and early detection across these risk categories.

Table 1: Major Risk Categories in International Supply Chain Projects

Risk Category	Description	Key Sources
Operational Risk	Supplier failure, logistics delays, production disruptions	(de Assis Santos & Marques (2022)) [9]; (Alsolbi *et al*. (2023)) [4]
Schedule Risk	Delays due to coordination issues and cross-border dependencies	(Onaghinor *et al*. (2022)) [20]; (Matthews *et al*. (2022)) [19]
Cost Risk	Cost overruns from demand volatility and inefficiencies	(Mangla *et al*. (2021)) [17]; (Bakici *et al*. (2023)) [6]
Regulatory Risk	Compliance issues across multiple jurisdictions	(Bentahar & Belhadi (2025)) [7]; (Ageron *et al*. (2020)) [1]
Data & Cyber Risk	Data integrity, security, and governance challenges	(Shah *et al*. (2023)) [22]; (El Khatib *et al*. (2024)) [10]
Sustainability Risk	Environmental and social non-compliance	(Mandičák *et al*. (2021)) [18]; (Chalmeta & Barqueros-Muñoz (2021)) [8]

The results indicate that traditional risk registers are insufficient to capture the dynamic interaction among these risks, particularly in multinational project environments.

4.2. Big Data Analytics Capabilities Supporting Risk Management

The literature consistently identifies specific analytics capabilities that directly enhance project risk management effectiveness.

Table 2: Big Data Analytics Capabilities and Risk Management Functions

BDA Capability	Risk Management Contribution	Supporting Studies
Real-time Data Integration	Continuous monitoring of supply chain disruptions	(Sanders (2016)) [21]; (Alsolbi *et al*. (2023)) [4]
Predictive Analytics	Early warning of schedule, cost, and supplier risks	(Kabanda (2020)) [14]; (Shah *et al*. (2023)) [22]
Descriptive & Diagnostic Analytics	Root-cause analysis of past project failures	(Matthews *et al*. (2022)) [19]; (Mangla *et al*. (2021)) [17]
Decision Support Systems	Scenario planning and risk prioritization	(Onaghinor *et al*. (2022)) [20]; (Bakici *et al*. (2023)) [6]
Data Visualization Dashboards	Improved risk communication among stakeholders	(Wijayasekera *et al*. (2022)) [23]; (Mahmood *et al*. (2023)) [3]

These capabilities collectively transform risk management from a reactive to a proactive and predictive function within international supply chain projects.

4.3. Impact of Big Data Analytics on Project Risk Management Performance

The results demonstrate a strong relationship between the adoption of big data analytics and improvements in project risk management outcomes.

Table 3: Observed Impacts of Big Data Analytics on Project Risk Outcomes

Performance Dimension	Observed Outcome	Evidence from Literature
Risk Identification Accuracy	Increased detection of emerging risks	(de Assis Santos & Marques (2022)) [9]; (Shah *et al*. (2023)) [22]
Decision-Making Speed	Faster response to disruptions	(Kabanda (2020)) [14]; (Bakici *et al*. (2023)) [6]
Schedule Reliability	Reduced project delays	(Matthews *et al*. (2022)) [19]; (Onaghinor *et al*. (2022)) [20]
Cost Control	Lower cost overruns	(Mangla *et al*. (2021)) [17]; (Sanders (2016)) [21]
Governance & Transparency	Improved compliance and traceability	(Alkatheeri *et al*. (2023)) [2]; (El Khatib *et al*. (2024)) [10]
Resilience	Enhanced ability to absorb and adapt to shocks	(Bentahar & Belhadi (2025)) [7]; (Ageron *et al*. (2020)) [1]

These outcomes indicate that analytics-enabled project management significantly strengthens control mechanisms across international supply chain projects.

4.4. Role of Digital Enablers in Enhancing Analytics-Driven Risk Management

Beyond analytics alone, the results highlight the importance of complementary digital technologies embedded within project management information systems (PMIS).

Table 4: Digital Enablers Supporting Analytics-Based Risk Management

Digital Enabler	Function in Risk Management	Key References
Artificial Intelligence (AI)	Pattern recognition and risk prediction	(Shah *et al*. (2023)) [22]; (Mahmood *et al*. (2023)) [3]
Robotic Process Automation (RPA)	Automated risk monitoring and reporting	(Al Zarooni & El Khatib (2023)) [12]
Blockchain	Traceability and trust across supply chains	(Alkatheeri *et al*. (2023)) [2]
PMIS	Centralized risk data and analytics integration	(Kabanda (2020)) [14]; (Bakici *et al*. (2023)) [6]
Digital Governance Platforms	Enhanced accountability and coordination	(El Khatib *et al*. (2024)) [10]; (Bentahar & Belhadi (2025)) [7]

The findings show that when integrated with big data analytics, these technologies significantly improve risk governance in complex international project settings.

4.5. Sustainability and Resilience Outcomes

The analysis further reveals that analytics-driven risk management contributes to sustainability and long-term resilience in international supply chain projects.

Table 5: Sustainability and Resilience Outcomes Enabled by Big Data Analytics

Outcome Area	Analytics Contribution	Supporting Literature
Economic Sustainability	Optimized resource allocation and reduced waste	(Mandičák *et al*. (2021)) [18]; (Mangla *et al*. (2021)) [17]
Environmental Performance	Data-driven monitoring of emissions and compliance	(Chalmeta & Barqueros-Muñoz (2021)) [8]; (Mageto (2021)) [16]
Social Responsibility	Improved supplier transparency and labor monitoring	(El Khatib *et al*. (2024)) [10]; (Ageron *et al*. (2020)) [1]
Supply Chain Resilience	Faster recovery from disruptions	(Bentahar & Belhadi (2025)) [7]; (Shah *et al*. (2023)) [22]

Overall, the results demonstrate that big data analytics significantly enhances risk management effectiveness in international supply chain projects by improving risk visibility, prediction, governance, and resilience. The findings confirm that organizations leveraging analytics-driven project management frameworks are better positioned to manage uncertainty, coordinate stakeholders, and achieve sustainable project outcomes in volatile global supply chain environments.

5. Discussion

This section interprets how Big Data Analytics has been and still is considered a strategic enabler of proactive risk management. 8.1 Big Data Analytics as a Strategic Enabler of Proactive Risks

The results show that big data analytics changes fundamentally project risk management in international supply chain projects from a reaction behaviour to a pro-active and predictive function. The identification of different categories of risks which include operational, schedule, cost, regulatory, data, and sustainability risks confirms earlier claims that global supply chain projects are complex adaptive systems where risks cascade quickly across inter-related activities (de Assis Santos & Marques, 2022) [9]; (Wijayasekera *et al*., 2022) [23].

The increased level of risk identification accuracy seen in the results argues in favour of the opinion that analytics-driven information integration across the nodes of the supply chain allows for early identification of faint signals and emerging disruptions. This finding is consistent with the view of Alsolbi *et al*. (2023) [4], who suggest that real-time analytics contributes to better visibility of the supply chain and decision quality. In cases of project management, predictive analytics can help project managers to anticipate delays, supplier failures and cost overruns before they occur, strengthening control mechanisms throughout the project lifecycle (Kabanda, 2020) [14]; (Bakici *et al*., 2023) [6].

5.1. Big Data Analytics Integration with Project Management Processes

The results emphasise how the effectiveness of big data analytics in the management of supply chain risks depends a lot on its integration in the framework of formal project management processes and information systems. The results suggest that analytics embedded into PMIS enables better speed of decision making, communication with stakeholders and prioritisation of risks. This goes hand-in-hand with Matthews *et al* (2022) [19] which highlight the importance of being able to transform raw data into "smart data" in order to reduce rework and performance risks in large projects.

In addition, the combination of analytics and project governance structures brings greater transparency and accountability to multinational settings. Onaghinor *et al.* (2022) [20] indicate that data-driven performance tracking frameworks help match project objectives with supply chain outcomes, which is supported by the findings from the observed improvements in schedule reliability and cost control. These results lead to the conclusion that analytics-enabled project management provides a unifying platform for the operation of dispersed supply chain actors in a common risk management framework.

5.2. Role of Complementary Digital Technologies in Risk Optimization

The discussion unveils that big data analytics is not enough to optimise the risk management process in international supply chain projects fully. The role that the artificial intelligence, robotic process automation, blockchain, and digital governance platforms play and is observed is what makes an integrated digital ecosystem such an important concept. AI pattern recognition improves the risk prediction, on the other hand, RPA automates the monitoring and reporting functionality, thereby saving time to reduce human error and response time (Shah *et al*., 2023) [22]; (Al Zarooni & El Khatib, 2023) [12].

Blockchain-powered traceability helps build trust and compliance in the cross-border supply chain, management of regulatory and data integrity risks, examining the risks that are commonplace in international projects (Alkatheeri *et al*., 2023) [2]. These findings support the ideas of Bentahar and Belhadi (2025) [7] which state that resilience in VUCA environments is based on the integration of project management and supply chain management through the use of advanced digital technologies and not isolated tools.

5.3. Big Data Analytics and Sustainability & Supply Chain Resilience

The results suggest that analytics-based risk management plays a role that is not only for operational efficiency, but in the context of sustainability and long-term resilience too. As a result, achieving sustainable project plans and designing supply chains is supported by the ability of big data analytics to enable data-driven monitoring of environmental, social, and economic indicators (Mandicak *et al.*, 2021) [18]; (Chalmeta and Barqueros-Munoz, 2021) [8]. This finding is especially important for projects in international supply chain management, in which compliance with sustainability practises varies from one region to another and from one regulatory regime to another.

The level of resilience that has been derived from analytics-enabled projects supports the outlook that because of predictive and real-time analytics, organisations can absorb shocks and adjust project plans dynamically in response to disruptions. Shah *et al.* (2023) [22] stress the need for intelligent analytics-driven risk management to make the supply chain more robust, supported by the enhanced results of recovery, adaptation, and resilience of supply chains noted in this study.

5.4. Managerial Implications of International Supply Chain Projects

From the managerial perspective the results imply that project managers need to develop analytical competencies along with their traditional project management competences. The capability to interpret predictive insights, data governance, and match analytics outputs and strategic objectives is a key determinant to contemporary risk management for global supply chain projects (Wijayasekera *et al*., 2022) [23]; (Zabala-Vargas *et al*., 2023) [24].

Additionally, investments in integrated PMIS platforms, enabling real-time analytics as well as cross-functional collaboration should also be prioritized by organizations. The findings show that big data analytics capabilities are constrained by limited fragmented data systems, while coordinated, well-governed, and risk-responsive digital infrastructure is developed among international project networks (Ageron *et al*., 2020) [1]; (Bentahar & Belhadi, 2025) [7].

5.5. Theoretical Contributions

This study makes its contribution to the literature, which bridges the gap between big data analytics, project management, and supply chain risk management in an international context. While previous studies have explored these areas in isolation, the study's findings show that they are interrelated and identify project management as a key integrator of analytics-driven risk management across global supply chains. This view is integrative in that it expands on current frameworks in terms of making big data analytics a strategic capability within project governance: not as a technological solution in itself.

5.6. Issues and Suggestions for Research

Despite the contributions of the study, there are some limitations. The use of secondary data limits empirical generalisation between industries and regions. Future research could utilise longitudinal case studies or mixed-method approaches to studies to analyse analytics-driven risk management practises in diverse international supply chain project study contexts. In addition, additional research into organisational culture, data maturity, and ethical issues related to the use of big data would improve the understanding of analytics adoption and effectiveness.

6. Conclusion

This research undertook to look into the possibilities of big data analytics optimization of risk management in international supply chain projects in the area of project management. From the author's point of view, the results clearly show that the increasing complexity, uncertainty, and interdependence of the global supply chains mandates a radical change of traditional and reactive risk management methods to intelligence driven and predictive project management practises.

The synthesis of results shows that the application of big data analytics has enhanced the risk visibility, the accuracy and

the responsiveness to a great extent in international supply chain projects. By introducing real-time data, predictive analytics and decision-support capabilities to project management processes, organizations will be better able to spot risks as they develop and predict problems before they occur, enabling them to implement mitigation strategies in time. The research also shows that analytics-enabled project management consolidates a more reliable schedule, cost control, transparency of governance, and greater resilience of the supply chain as a whole - at the exact same time as verifying defensible strategic value of data-enabled risk management in complex global project environments.

A critical contribution of this paper is the integrationist nature of the perspective. Rather than addressing supply chain risk management, project management, and big data analytics as isolated areas of management disciplines, the study identifies project management as a central management mechanism through which analytics-informed risk optimization can be operationalized through international supply chains. The research further shows the need for complementary digital technologies - such as artificial intelligence, automation and blockchain - that can strengthen governance, traceability and quality of decision-making when embedded in analytics-enabled project management information systems.

From a practical perspective the study highlights the fact that the project manager and organisations need to develop analytical capabilities in addition to traditional competencies of project management. Effective supply chain risk management for international supply chain projects is increasingly reliant on the capacity to interpret data-driven information, match the result of analytics with strategic aim and facilitate coordination of the stakeholder on an international scale using integrated digital platforms.

Despite these contributions, there are limitations associated with the study as well. The use of secondary data and the conceptual case evidence is limiting the generalizability of the findings across industries and geographic contexts. Additionally, differences in organizational data maturity levels, digital infrastructure and governance structures can make a difference in the effectiveness of analytics-driven risk management practices.

Future research should therefore be focused on empirically validating through longitudinal and multi-case study research with different international supply chain settings. Further exploration on organizational readiness, ethics and the human-technology interface in Analytics-enabled project management would also lead to valuable insights. Overall, this study concludes that big data analytics is not anymore a supportive tool but a strategic necessity regarding optimising risk management and achieving resiliency in international supply chain projects.

7. References

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