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DRIVING FINANCIAL SUCCESS WITH AI SUPPLY CHAINS: THE CRUCIAL ROLE OF SUSTAINABLE DEVELOPMENT IN EMERGING ECONOMIES

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Abstract

This research is directed at examining the effect of the Artificial Intelligence (AI) based Supply Chain Management (SCM) on the financial performance of companies in emerging economies. Specifically, it investigates the role of sustainable development practices (environmental, social and economic aspects) as a mediator in the process of transforming the technological potential of the supply chain into real profit.

A quantitative research design is used, and survey data from a cross-sectional sample of supply chain managers, sustainability officers and financial executives in a sample of key emerging markets were disseminated and subsequently analysed, resulting in 276 valid responses. Using PLS-SEM technique, the study aims to test the hypothesized relationships empirically between AI-SCM adoption, SD initiatives, and firm profitability.

The empirical results showed that AI-SCM has a positive and significant direct effect on financial performance. More important, the analysis shows that sustainable development is an important mediating factor between the two. In turn, the efficiency of the resources used, waste reduction, and ethical sourcing (sustainable development) are improved, leading to cost savings, premium pricing, and an increase in market share (financial success). While existing literature has been extensive on the role of AI and sustainability in developed contexts, this study delves into the distinctive challenges of institutions and resources faced in emerging economies. It provides a new model integrated approach that shows that technological advancement (AI) and ecological/social responsibility (sustainability) do not necessarily contradict, but are complementary, and is the force that drives competitive advantage in emerging markets.

Investments in emerging economies that are directly linked to a specific sustainable development goal (SDG) have the highest economic payback and should be the priorities for executives. The study highlights the need for creating policies and regulations to support the adoption of green AI, fostering economic growth and environmental sustainability.

Keywords: Artificial Intelligence (AI), Supply Chain Management, Financial Performance, Sustainable Development, Emerging Economies, Structural Equation Modeling.

1. Introduction

Artificial Intelligence (AI) is rapidly changing the business landscape all over the world and impacting the operational structure of Supply Chain Management (SCM). In today's digital era, AI powered technologies are playing a growing role in enhancing efficiency, optimizing decision making processes, cutting down on operational expenses and boosting their competitive edge. Traditional supply chains, that rely on manual

coordination and forecasting tools, are now becoming intelligent supply chains, based on data and capable of predictive analysis, automation and responsiveness in real-time (Helo & Hao, 2022). This change is particularly important for businesses operating in new markets, as the environment of unpredictable markets, inadequate infrastructure, fluctuating demand and unstable financials poses a challenge to companies. This has given rise to the importance of AI in supply chain management in enhancing the performance of the organization and enabling sustainable growth and development (Singh, 2023).

The management of the supply chain is the coordination of activities related to the sourcing, procurement, production, inventory management, logistics and product distribution. An advantage of SCM is that it enables companies to meet customer needs, reduce costs and stay competitive in the market (Christopher, 2016). However, the traditional supply chain system suffers various inefficiencies in order to achieve delayed communication, inaccurate forecasting, lack of transparency and resources wastage in the chain. Challenges are higher in emerging economies because of technological limitations and not well-developed digital infrastructure. Organizations are increasingly adopting AI technologies like machine learning, predictive analytics, robotics and intelligent automation to overcome these challenges and optimize their supply chain processes.

AI optimizes supply chain execution, assisting companies to predict demand with precision, automate tedious tasks, and optimize resources. By leveraging AI-driven SCM systems, companies can gain real-time insights and predictive capabilities, enhancing process efficiency and agility. For example, machine learning can help to optimise stock levels and predictive analytics can forecast market trends and demand patterns (Ivanov & Dolgui, 2020). Similarly, warehouse management, transportation planning, and order fulfilment are made easier by using AI automation, reducing operational errors and enhancing productivity. These improvements directly contribute to improving the efficiency of the organization and its profitability.

Financial performance is one of the most important measures of the success of an organisation. It is a measure of a firm's profitability, efficient use of resources, and economic growth potential. Some common measures of financial performance are profitability, return on investment (ROI), return on assets (ROA), and revenue growth. Competitive markets make businesses constantly strive to deliver financial results and resilience in operations. AI's role in supply chain management is one of the most significant factors for improving financial results, as it lowers operation costs, waste, improves productivity and customer service quality. (Danach et al., 2024). AI technologies facilitate streamlined decision-making processes and efficient resource usage, contributing to better financial outcomes and sustainable competitive advantage for businesses.

Although companies are embracing AI technologies, the connection between AI-powered SCM and ROA is not straightforward, particularly in emerging economy companies. Emerging economies are distinguished by their high growth rates of industry, changing market conditions and technological change. Some of the economic challenges that firms in these economies may encounter include weak institutional support, lack of technological infrastructure, and regulatory uncertainty (Bag et al., 2021). These are the factors that affect the impact of AI and its effectiveness in implementing it. Furthermore, AI technologies can enhance operations, but the sustainability of long-term business success also relies on the incorporation of sustainability principles into the business operations.

There's a growing focus on sustainable development among organizations around the world. The idea is about achieving the economic, environmental and social aspects in balance for long-term organizational and societal well-being (Danach et al., 2024). In today's business environment, sustainability is an increasingly desired characteristic of business to minimize environmental impact and ensure ethical functioning. Sustainability is closely related to supply chains as these have a direct impact on the use of resources, waste generation, energy usage and carbon emissions. Conventional supply chains tend to focus on productivity and profitability, while ignoring environmental and social impacts. AI-powered technologies, however, have the potential to revolutionized sustainable supply chain systems that can meet financial and environmental goals.

AI-powered SCM plays a significant role in sustainable development in the following aspects: AI enhances the efficiency of resources, optimizes production planning, reduces energy usage, and prevents material waste, among other things. The use of intelligent forecasting systems reduces overproduction and the

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buildup of excess stocks, reducing the environmental impact of the company. Second, AI improves logistics optimisation by optimising the routes and transportation plans, thus minimising fuel usage and carbon footprint. Thirdly, AI-based monitoring systems boost transparency and traceability throughout the supply chain, which helps to facilitate ethical sourcing, regulatory compliance, and responsible business practices (Bag et al., 2021). So, AI-driven SCM not only enhances performance and financial results but also boosts sustainability and organizational agility.

This mediation between the sustainable development and financial performance is especially important to understand the link between AI-driven SCM and financial performance. Sustainable development practices can build on and amplify the benefits that AI technologies can bring to efficiency and profitability. Companies that incorporate sustainability into their AI-powered supply chain strategies can achieve long-term financial success, as sustainable practices can boost brand reputation, build customer trust and foster stakeholder relationships. In addition, sustainability measures lower risks to the environment and enhance the operational resilience, thus impacting positively on financial results. Thus, sustainable development is an important lever and AI-based SCM creates economic value and competitiveness of organizations.

The relevance and importance of AI in SCM and sustainable development is impressive in emerging economies where environmental issues are becoming more relevant and more important in the bigger sustainability challenges of the world. Governments, investors and consumers today demand transparency and accountability in how the environmental and social performance are done. No action can harm companies' reputations, reduce their competitiveness and expose them to regulatory penalties. In resource-deprived regions, the need of the hour is to build good and sustainable systems to play the game. These technologies powered by AI offer these companies chances to modernize supply chains, enhance sustainability metrics and bolster their monetary health (Bag et al., 2021).

AI and SCM are discussed in previous studies, but there are still some important research gaps. While the concepts of Artificial Intelligence (AI), supply chain management (SCM), sustainability, and organizational performance have been extensively explored, there remain several gaps in research focus. Firstly, there have been limited studies to date that have focused on how the use of AI in supply chain management (SCM) relates to a company's financial performance. While the use of AI in SCM remains a nascent field, especially regarding long-term economic results, there is ample opportunity for continued advancement. The use of AI in SCM is still in its early stages, and while the economic implications of these technologies are still being studied, significant potential exists for the continued development and improvement of such tools.

Second, previous studies have been focused on more technologically advanced countries with a well-developed technological infrastructure, digital capabilities and institutional framework. On the other hand, there is a lack of empirical research on the implementation and impact of AI-powered SCM in emerging economy companies. Emerging economies have distinct issues, including limited technological infrastructure, financial limitations, market volatility, and regulatory shortcomings, that can potentially shape the interplay of AI-enabled SCM and financial results. The correlation between AI in SCM and financial outcomes might be different in emerging economies due to various challenges, such as weak regulatory frameworks, financial constraints, market volatility, and the lack of technological infrastructure.

Third, although sustainable development is a prominent issue in today's business, previous studies have not explored its mediating role between AI-based supply chain management and financial performance. The majority of the studies have examined the sustainability outcomes or financial performance individually, without looking at the interaction of sustainable development and how AI-based SCM bolsters organizational financial performance.

In addition, the literature primarily focuses on operational efficiency, automation, and productivity gains from the use of AI technologies, with limited attention paid to the synergic link between AI-driven SCM and sustainable development and financial performance in a unified framework. This is a theoretical and practical mismatch in the understanding of the economic value of sustainability practices in connection with the adoption of AI in supply chains.

Hence, the aim of this study is to fill the foregoing gaps and investigate how AI-based supply chain

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management affects firm financial performance with the examination of the mediating effect of sustainable development in the firms that are located in the emerging economies. The study is a valuable addition to the literature because of the holistic view it brings together technological innovation, sustainability and financial performance issues in the context of emerging markets.

Existing studies have explored the effect of AI adoption, SCM, sustainability and organizational performance but very few studies have explored the role of sustainable development as a mediator between AI-driven SCM and financial performance in emerging economies. There are few existing studies to focus on the technology infrastructures in developing countries. To understand the present use of AI technologies in the emerging economy firms to increase the efficiency of their supply chains, achieve sustainability goals and improve financial performance, an empirical study is needed.

The aim of this research is to address this research gap and to study the association between the use of AI in SCM and firm's financial performance in emerging economy companies and the role of sustainable development as a medium variable. This study combines the use of AI, supply chain and sustainability in an extreme manner. The outcomes can inform managers and policymakers of the potential gains that can be achieved from AI technologies and decisions on their implementation. The findings can be practically used to inform the managers and policymakers about the potential benefits of the AI technologies and make informed decisions on their implementation.

Research Objectives

1. To examine the impact of Artificial Intelligence Supply Chain Management (Artificial Intelligence-SCM) on the financial performance of the companies in the emerging economies.
2. To explore the relationship between the AI application of Supply Chain Management (SCM) and sustainable development of emerging economy business.
3. To investigate the mediator variable between AI based Supply Chain Management and Financial performance as Sustainable development.

Research Question

What is the mediating role of Artificial Intelligence (AI) based Supply Chain Management (SCM) between companies' financial performance and emerging economies?

2. Literature Review

Artificial Intelligence (AI) has revolutionized the world of business operations and supply chain management (SCM) has undergone a significant change. AI is now being used across various industries to enhance efficiency, decision making, and financial outcomes throughout their supply chain, from healthcare to manufacturing. With AI technologies like machine learning, predictive analytics, robotics, and intelligent automation, companies are able to create more agile, data-driven supply chains. Meanwhile, sustainable development and responsible business are more and more on the world's agenda, and this has caused organisations to make their supply chain sustainable. Whereas this is the case of emerging economies where market uncertainty and lack of infrastructure are problems, and where AI tools in SCM have become a key enabler in operational excellence and financial sustainability (Pournader et al., 2021). This literature review investigates the existing studies regarding AI in supply chain management, financial impacts, sustainable development, and sustainability's moderating impact. The review also pinpoints the key gaps in the literature, both theoretical and empirical, especially in the context of emerging economy firms.

2.1 AI and Supply Chain Management

Artificial Intelligence is the capability of artificial machines or computer systems that can mimic human intelligence, such as learning, reasoning, problem-solving and decision making (Russell & Norvig, 2021). AI technologies have increasingly become a part of the supply chain landscape, enabling companies to process massive amounts of data, uncover patterns, forecast future trends, and automate different areas of the chain. SCM is the coordination of procurement, production, inventory management, transportation, logistics and distribution processes to provide products and services efficiently (Christopher, 2016). The traditional supply chain has a range of inefficiencies, such as forecasting inaccuracies, communication delays, and a lack of visibility along the chain, among other issues. AI technologies have emerged as solutions to these constraints, offering intelligent and automated solutions.

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They can, for example, use machine learning algorithms to leverage past sales data and market trends to make more accurate predictions. Companies can use predictive analytics to anticipate disruptions and control their inventory (Richey et al., 2023). Likewise, AI-powered robotics and automation systems optimize warehouse operations, minimize human mistakes, and boost productivity (Ivanov & Dolgui, 2020). By providing a comprehensive view of the entire supply chain network, AI can assist in making real-time decisions, enabling businesses to respond swiftly to customer needs and market fluctuations.

There are a few studies which have pointed out the benefits of AI in the supply chain. Based on their analysis, Choi et al. (2018) proposed that operational flexibility & organizational responsiveness of SCM could be assisted by using AI. (Dubey et al. 2021) discovered that AI technologies are very beneficial for improving the supply chain's resilience and efficiency. Moreover, AI-powered predictive systems enable businesses to reduce operational risks and enhance customer satisfaction. But the application of AI in SCM has challenges too. Some of the key challenges involved with AI adoption include high implementation costs, a lack of technological expertise, cybersecurity concerns and resistance to organizational change (Bag et al., 2021). In underdeveloped countries, especially emerging economies, these issues are more critical in the absence of technological infrastructure and digital capacities.

2.2 Benefits and challenges of implementing AI in SCM and its impact on financial performance

Financial performance is a key measure of organizational success. It is a measure of the firm's capacity to make profits, increase productivity, and to achieve long-term growth. Financial performance indicators are commonly used metrics for measuring the performance of a company's financial operations and include return on assets (ROA), return on investment (ROI), profitability, revenue growth and operational efficiency. The Resource Based View (RBV) theory states that organizations are able to secure sustainable competitive advantage by leveraging valuable, rare and innovative resources, including AI technologies (Dubey et al. 2021). AI-based SCM is seen as a strategic capability of an organization since it enhances operational efficiency and aids in informed decision making. Previous studies indicate that AI-based SCM can have a positive impact on financial outcomes. AI technologies can cut down operational expenses, minimize forecasting mistakes, and optimize resource utilization by automating repetitive tasks. AI-powered systems also enhance customer satisfaction by delivering faster order fulfilment, customization, and improved product availability, leading to increased revenue and profitability (Ivanov & Dolgui, 2020).

It is crucial to note that companies that employ AI-powered analytics in their supply chain operation report improved financial results, thanks to the boost in operational efficiency and strategic planning (Wamba et al., 2020). Likewise, (Queiroz et al., 2021) have concluded that AI-powered SCM improves organizational agility and competitiveness in the market, thereby affecting the financial performance. Besides, AI technologies play a role in reducing costs by optimizing the logistics and transportation systems. Intelligent route optimization strategies boost fuel use, transportation costs, and delivery delays. AI-powered inventory management software can also reduce overstock situations and prevent shortages. Yet, while these advantages may be present, certain researchers question the financial implications of the implementation of AI in different industries and company environments. For AI to be effective, there is a need for both the employees and management to be prepared, as well as the technological tools and infrastructure (Kamble et al., 2019). However, in emerging economies, businesses face financial limitations and limited access to cutting-edge technologies that can hinder the efficiency of AI-enhanced SCM systems.

2.3 Incorporating sustainable development into Supply Chain Management.

Sustainable development is defined as the development which satisfies the needs of the current generation without adversely affecting the capacity to meet the needs of future generations. The idea is to achieve economic, environmental and social sustainability. Sustainability is a vital issue in supply chain management, as supply chains have a substantial impact on environmental and social outcomes (Oelze et al., 2016). However, the traditional supply chain processes can be harmful to the environment by using lots of energy, making a lot of waste, polluting the environment, and emitting lots of carbon. As a result, organizations are increasingly moving towards implementing sustainable supply chain management (SSCM) initiatives to minimize environmental footprint and increase their social responsibility.

A sustainable supply chain management is a supply chain management that incorporates

environmental, social and economic goals (Hong & Xiao, 2024). Environmental sustainability is about minimizing waste, energy and greenhouse gas emissions. Social sustainability focuses on ethical labour practices, employee wellbeing and community development; economic sustainability is related to business continuity and profitability in the long term. Previous research shows that companies that practice Sustainable Supply Chain have better reputation, customer trust, and stakeholder relations. (Morali & Searcy, 2013). state that sustainability efforts can provide long-term competitive advantage by adding to the operational resilience and minimizing environmental risk. Likewise, the use of sustainable practice is more likely to lead to regulatory compliance and to appeal to environmentally conscious consumers. Rapid industrialization and lack of environmental legislation, as well as resource constraints, are special challenges for emerging markets. Governments, investors and consumers are more demanding that companies in these economies practice sustainability in their business operations. Thus, it has become imperative to incorporate sustainability within supply chain for the long-term success of the organization.

2.4 AI-Driven SCM and Sustainable Development

Technologies are vital in Sustainable Supply Chain Management. AI-based SCM has the potential to boost sustainability by ensuring more efficient use of resources, minimizing waste, and providing greater transparency in operations. AI's role in sustainability is one of its significant contributions: better energy efficiency. AI systems streamline production schedules and resource management, minimizing energy waste and unnecessary usage. Smart forecasting systems also enable businesses to reduce overproduction and unnecessary stock accumulation, reducing the impact on the environment (Qu & Kim, 2024). AI technologies also contribute to the sustainable logistics and transportation management. Predictive analytics and route optimization systems optimize fuel usage and lower carbon emissions by determining the most efficient transportation routes. Furthermore, AI-based monitoring tools can enhance supply chain visibility and traceability, helping companies promote ethical sourcing practices and adherence to environmental laws (Bag et al., 2021).

AI-powered supply chains can have a notable impact on enhancing environmental sustainability, for example, by boosting waste management and resource efficiency as identified by (Benzidia et al., 2021). Likewise, (Gupta et al. 2022) indicated that AI technologies support sustainable manufacturing and enhance organization sustainable performance.

AI also plays a role in social sustainability by enhancing worker safety in the workplace and minimizing or automating dangerous work activities. In addition, AI-powered data analysis can enable companies to track their suppliers' adherence to labour laws and ethical practices. But there are some concerns about the sustainability of AI technologies. While large-scale AI systems can benefit the environment in certain ways, they also have the potential to generate significant energy usage and environmental impacts if not implemented properly (Vinuesa et al., 2020). Hence, there is a need to ensure responsible and energy-efficient implementation of AI in organizations.

2.5 Sustainable Development as a Mediator

Recently, the role of sustainable development in the connection between AI-supported SCM and financial performance has received more attention. Incorporating sustainability practices with AI-driven SCM can amplify the positive impact on financial outcomes by enhancing the reputation, trust, and resilience of the organization. (Elkington 1997) has introduced the concept of the Triple Bottom Line (TBL) theory which highlights the need to pay attention to organizations' economic, environmental and social performance together. From this point of view, sustainability projects create long term economic value by minimizing risks and optimizing operational efficiency. Research indicates that actions taken for sustainable supply chain management have a positive impact on financial performance. Companies that are implementing green practices can also benefit from cost reductions in waste, energy usage and resource optimization. Sustainable practices also help to build customer loyalty and brand image, leading to greater profitability.

Sustainability improves performance through AI-driven SCM, thereby improving financial results as well. For instance, logistics solutions can be optimized to lower both transport expenses and environmental footprint. Likewise, clear and ethical supply chains enhance confidence and trust among consumers and investors (Wang & He, 2022). Although sustainability is gaining relevance, there has been limited empirical

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research that investigates the relationship between AI for SCM and financial performance, particularly in emerging economies, and its mediating effect. Most existing studies on direct relationships only take into account the direct relationships, excluding the effects of sustainability mechanisms on the outcomes of financial events. Thus, more research is required to gain insights into the interconnection between AI-based SCM, sustainable development, and financial performance (Jan et al., 2024).

The literature review identified that while there has been some research on the adoption of AI, supply chain management and sustainability, there were some gaps. First, most studies have concentrated on firms in developed economies, and few have examined the emerging economy enterprises. Emerging markets experience distinct challenges in technology, economy and institutions, which can impact the outcomes of implementation of AI. Secondly, the current literature typically investigates sustainable development as a moderating variable between AI-integrated SCM and financial performance separately. Secondly, the majority of literature tends to explore the relationship between AI-integrated SCM and financial performance, with sustainable development as an intervening variable, separately. It remains unclear how sustainability practices can enhance the financial performance of an organization and the relationship between sustainability and AI-based supply chain management from a practical perspective (Toorajipour et al., 2021). The practical evidence of how sustainability practices can improve the financial performance of an organization and the link between sustainability and AI-driven supply chain management is limited. Thirdly, the studies conducted so far focus primarily on operational efficiency and the technological benefits without considering the broader sustainability issues. While numerous studies focus on incorporating AI into SCM, others centre on sustainable development or financial outcomes, few studies integrate all three elements in one model.

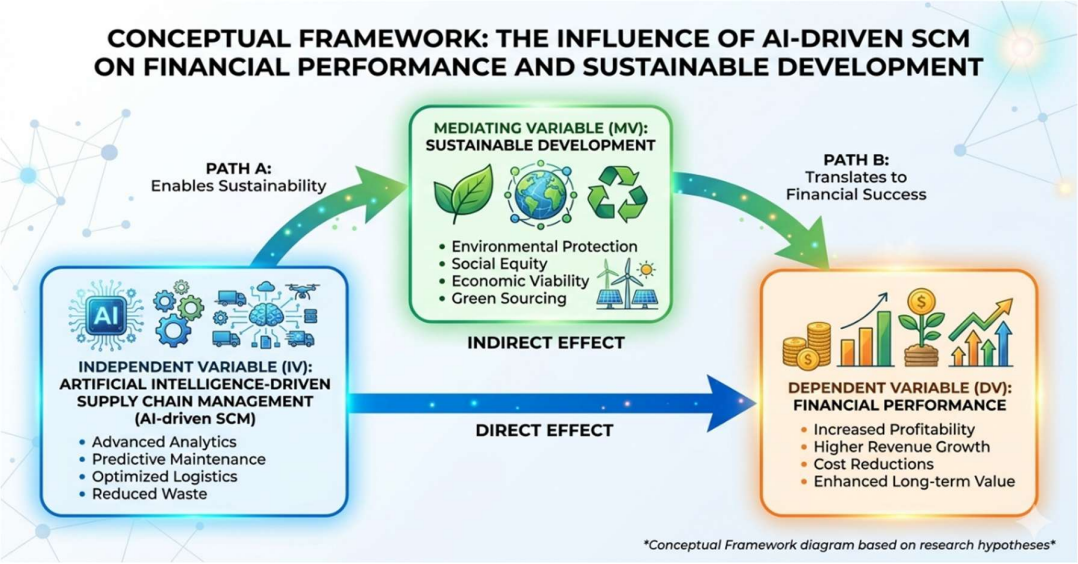
This study, therefore, aims to fill these gaps by investigating the effect of AI in the supply chain management on financial performance with the mediating role of sustainable development in emerging economy companies.

2.6 Conceptual Framework

The conceptual framework of this study is built around three core variables. Artificial Intelligence-driven Supply Chain Management (AI-driven SCM) serves as the independent variable, Financial Performance is treated as the dependent variable, and Sustainable Development functions as the mediating variable. The framework suggests that AI-driven SCM has a direct influence on financial performance while also exerting an indirect effect through sustainable development practices. In this way, the study proposes that the adoption of AI in supply chain processes not only improves organizational financial outcomes directly but also enhances sustainability initiatives, which in turn contribute to stronger financial performance.

Figure 1

Conceptual Framework



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The framework proposes that AI-driven SCM directly influences financial performance and indirectly affects financial performance through sustainable development practices.

3. Methodology

The methodology employed to analyse the link between Artificial Intelligence (AI) Supply Chain Management (SCM), sustainable development and financial performance of emerging economy firms is explained in this chapter. It explains the research philosophy, research approach, research design, data collection procedures, research instruments, data analysis techniques and ethics for research. The methodology is systematic and it aims to guarantee the reliability, validity and accuracy of the research results.

3.1 Research Philosophy

The study is based on positivist research philosophy as this type of research emphasizes on objective measurement and statistical testing of relations between variables. Positivism is apt for quantitative research as it emphasizes on the empirical basis, hypothesis testing and scientific analysis (Pearlson et al., 2024). Based on the positivist philosophy, the researcher can analyse the causal relationship between AI-driven SCM, sustainable development and financial performance using structured questionnaires and statistical analysis techniques. The study is aimed at the measurement of organizational phenomena, so positivism is a good approach.

3.2 Research Approach

In this study deductive research approach is used. A deductive method assumes that findings from existing theories and literature will lead to the formation of hypotheses, which will then be tested with data collection and analysis. The Resource Based View (RBV) theory and Triple Bottom Line (TBL) theory are used to guide this research in explaining the relationship between AI-driven SCM, sustainable development, and financial performance. The deductive approach is suitable because the study is directed to testing the hypothesis of whether the use of AI in the SCM has a positive effect on the financial performance of companies and if the use of sustainable development mediates such an influence.

3.3 Research Design

This is a quantitative cross-sectional survey. Quantitative research allows the researcher to measure (numerically and statistically) objectively the relationships existing between variables. The cross-sectional design is one in which data are collected from the respondents at one time. This is an appropriate approach due to the study's objectives to assess the role of AI-based SCM in financial performance and to explore the relationship between AI-based SCM and the concept of sustainable development, as well as to investigate the mediating effect of sustainable development. The cross-sectional survey design also proves to be time efficient, economical and suitable for gathering data from a large number of respondents.

3.4 Conceptual Framework

The conceptual framework of the study is that AI-driven Supply Chain Management as an independent variable will mediate the relationship between financial performance and sustainable development as dependent variables. The framework suggests that AI-based SCM directly impacts the financial performance and indirectly impacts the financial performance via sustainable development practices.

3.5 Hypotheses Formulation

The result of the literature review and conceptual framework leads to the formulation of four hypotheses:

H1: The use of AI in SCM has an important positive impact on financial performance.

H2: Sustainable development is positively affected by AI in the context of SCM.

H3: There is a strong positive relationship between sustainable development and financial performance.

H4: Sustainable development plays a mediating role between AI-driven SCM and financial performance.

3.6 Target Population

The study's target population are professionals and employees in emerging economies' organizations, particularly in areas of supply chain management, logistics, operations management, information technology,

sustainability management, and strategic planning. These respondents have been chosen due to their knowledge and practical experience working with AI technologies, supply chain and sustainability practices.

3.7 Sampling Technique and Sample Size

The sampling technique employed in the study is purposive sampling. Purposive sampling enables the researcher to identify and include respondents that have a relevant level of expertise and experience in the field of AI-supported SCM and SD initiatives. This type of sampling is appropriate since not everyone in the organization understands AI technologies and supply chain systems. The study will include close to 200-400 respondents. Hair et al. (2019) stated that the number of samples in SEM analysis must be more than 200. Selected sample size provides reliability, validity, and generalizability of the research findings.

3.8 Data Collection Method

This research uses primary data collection techniques in the form of a structured questionnaire survey. The questionnaire is sent online via Google Forms, e-mail and professional networks. The use of online surveys is inexpensive and allows the researcher to gather responses from people from various organizations and geographical areas quickly.

3.9 Research Instrument (Structured Questionnaire)

The main tool used in the research is the structured questionnaire. This questionnaire is broken down into four sections:

- **Section A (Demographic data):** Includes gender, age/years, education level, work experience, industry type, job position.
- **Section B:** AISCM practices and AI adoption of the supply chain activities are measured.
- **Section C:** Sustainable development practices in environmental, social, and economic sustainability are measured.
- **Section D:** Financial performance indicators like profit, revenue expansion, operational efficiency, and cost reduction are measured.

Measurements are based on a 5-point Likert scale (1 = “Strongly Disagree” to 5 = “Strongly Agree”).

Variable Measurement

Measurement of variables is based on previous studies:

- **AI-powered SCM:** Gauged through predictive analytics metrics, intelligent automation, inventory optimization, demand forecasting, and real-time tracking metrics.
- **Sustainable development:** Measured based on resource efficiency, reduction of waste, ethical sourcing, compliance with the environment, and sustainable operational practices.
- **Financial performance:** Measured using profitability, revenue growth, operational performance, return on investment, and cost reduction metrics.

3.10 Pilot Study and Reliability Testing

Before the final data collection process, a pilot study is carried out with around 30 respondents. The pilot test is used to detect ambiguities in the questions, errors in the measurements, and problems with the reliability of the questions in the questionnaire. Cronbach's alpha is used to evaluate the reliability of the instruments with an acceptable value of 0.70 as determined.

3.11 Data Analysis Techniques

Data collected in this study were analysed using SPSS and SmartPLS 4 software. Descriptive statistics were employed to summarize the demographic characteristics of respondents and the distribution of study variables. Reliability analysis was conducted using Cronbach’s Alpha and Composite Reliability (CR) to assess the internal consistency of the measurement scales. Validity analysis was also performed through Average Variance Extracted (AVE), convergent validity, and discriminant validity to ensure the accuracy of the constructs. In addition, Structural Equation Modelling (SEM), specifically Partial Least Squares SEM (PLS-SEM), was used to examine direct and indirect relationships as well as the mediating effects among the study variables. This technique was considered appropriate because the study involved multiple constructs and mediation analysis.

3.12 Bootstrapping Procedure

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In order to check the significance of path coefficients, t-values, p-values and mediation effects, a bootstrapping procedure with 5,000 resamples is carried out using SmartPLS 4 software. Bootstrapping provides for increased reliability and robustness of statistical findings.

3.13 Research Ethics

The ethical standards used in the research process are strictly adhered to. The study ensures the respondents' voluntary participation, informed consent, confidentiality and anonymity. Participants are provided with instructions that the information they provide will be used only in an academic context, and that they can withdraw anytime from the study.

Lastly, the methodological approach used to investigate the link between AI-powered Supply Chain Management, sustainable development and financial performance in emerging economy companies was described. The philosophy of research in this study is positivist, research approach used is deductive and the type of research is quantitative cross-sectional research. Data collection is done by using structured questionnaires which will be analysed by using software SPSS and SmartPLS 4. The methodology will give a reliable framework to test the proposed hypotheses and attain the research objectives.

4. Results and Findings

This study aimed to investigate the association among Artificial Intelligence-driven Supply Chain Management (AI-driven SCM), sustainable development and financial performance in emerging economy firms and answer the study's research question. The chapter features a demographic analysis, descriptive statistics, reliability and validity analysis, and results of Structural Equation Modeling (SEM), as well as hypothesis testing and mediation analysis performed by SmartPLS 4. The results are analyzed according to the research purpose and hypothesis formulated in the study. The study gathered responses from professionals from organizations in emerging economies in the supply chain management, logistics, operations management, information technology and sustainability departments. An effective response rate of 86.2% was achieved, with a total of 320 questionnaires distributed and 276 valid responses received and analyzed.

The demographic analysis shows that majority of the respondents were male (62%) and the female respondents were 38% of the sample. The age range of the respondents was the most frequent one between 26 and 40 years, which means that the participants had quite a bit of professional experience and organizational technologies know-how. In terms of education, most respondents had bachelor's and master's degrees, which means that they were a qualified sample. When asked about working experience, majority of respondents were at 5-10 years of working experience. The respondents were working in various industries such as manufacturing, logistics, retail, information technology, and services. This diversity enhanced the generalizability of the research results.

Table 1

Demographic Characteristics of Respondents (N=276)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Questionnaire Distribution	Distributed Questionnaires	320	100.0
	Valid Responses Received	276	86.2
	Invalid/Unusable Responses	44	13.8
Gender	Male	171	62.0
	Female	105	38.0
Age Group	26–40 Years	165	59.8
	Below 25 Years / Above 40 Years	111	40.2
Education Level	Bachelor's Degree	138	50.0
	Master's Degree	124	44.9
	Other (e.g., PhD/Diploma)	14	5.1
Work Experience	5–10 Years	152	55.1
	Less than 5 Years / More than 10 Years	124	44.9
Industry Sector	Manufacturing	70	25.4
	Logistics	58	21.0
	Retail	50	18.1

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	Information Technology	48	17.4
	Services	50	18.1

4.1 Descriptive Statistics

Descriptive statistics was used to analyse the central tendency and dispersion of the study variables. The findings revealed that the participants had a positive attitude towards AI in SCM, sustainable development activities and financial outcomes. The average score for AI-driven SCM was relatively high, which shows that organisations are making more use of AI technologies like predictive analytics, automation, inventory optimization and intelligent forecasting in their supply chain operations. Likewise, the mean scores for sustainable development practices were positive, indicating that sustainable development is becoming more prominent in the decisions of firms.

The mean values of financial performance also showed positive results, highlighting the benefits of AI-driven supply chain systems for profitability, operational efficiency and cost reductions in companies that adopted them. The SD values were reasonable and showed that the opinions given by the respondents were not too far apart and did not show extreme deviations within the data collected.

4.2 Reliability Analysis

Reliability analysis was performed to assess internal consistency of the measures on the different scales of the questionnaire, using Cronbach's Alpha or Composite Reliability (CR). (Hair et al. 2019) state that 0.70 and higher is acceptable. All findings had values of Cronbach's Alpha above the recommended level. The Cronbach's Alpha value for the AI-driven SCM was 0.89, the sustainable development was 0.87, and the financial performance was 0.91. The results show that there is good internal consistency and reliability of the measurement items. Likewise, the measurement model was found to be reliable with Composite Reliability (CR) values for all constructs greater than 0.70.

Table 2

Reliability Analysis

Construct	Cronbach's Alpha	Composite Reliability (CR)	Threshold Value	Result
AI-driven Supply Chain Management (AI-SCM)	0.89	0.92	> 0.70	Reliable
Sustainable Development	0.87	0.90	> 0.70	Reliable
Financial Performance	0.91	0.93	> 0.70	Reliable

Reliability analysis was conducted to assess the internal consistency of the measurement scales using Cronbach's Alpha and Composite Reliability (CR). According to Hair et al. (2019), values greater than 0.70 indicate acceptable reliability. The results revealed that all constructs exceeded the recommended threshold. AI-driven Supply Chain Management achieved a Cronbach's Alpha value of 0.89 and a Composite Reliability value of 0.92. Sustainable Development recorded a Cronbach's Alpha of 0.87 and a Composite Reliability of 0.90. Financial Performance showed the highest reliability with a Cronbach's Alpha of 0.91 and a Composite Reliability of 0.93. These findings confirm that all measurement constructs demonstrate strong internal consistency and reliability, indicating that the questionnaire items consistently measure their intended constructs. Therefore, the measurement model is considered reliable and suitable for further validity and structural model assessment.

4.3 Validity Analysis

Validity analysis was performed to examine convergent validity and discriminant validity.

4.3.1 Convergent Validity. Convergent validity was assessed using factor loadings and Average Variance Extracted (AVE). The factor loadings for all measurement items exceeded the recommended threshold of 0.70, indicating that the items strongly represented their respective constructs. The AVE values for AI-driven SCM, sustainable development, and financial performance were above 0.50, confirming adequate convergent validity. These findings indicate that the constructs explained a sufficient proportion of variance in their measurement indicators.

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Table 3
Convergent Validity Assessment

Construct	Factor Loading Range	Average Variance Extracted (AVE)	Threshold Value	Result
AI-driven Supply Chain Management (AI-SCM)	0.74 – 0.89	0.68	> 0.50	Valid
Sustainable Development	0.72 – 0.87	0.65	> 0.50	Valid
Financial Performance	0.76 – 0.91	0.71	> 0.50	Valid

Convergent validity was evaluated using factor loadings and Average Variance Extracted (AVE). According to Hair et al. (2019), factor loadings should exceed 0.70, while AVE values should be greater than 0.50 to establish convergent validity. The results demonstrated that all measurement items achieved factor loadings above the recommended threshold, ranging from 0.72 to 0.91. This indicates that the indicators strongly represented their respective constructs. Furthermore, the AVE values for AI-driven Supply Chain Management (0.68), Sustainable Development (0.65), and Financial Performance (0.71) exceeded the minimum requirement of 0.50. These findings confirm that the constructs explain a substantial proportion of variance in their indicators and possess adequate convergent validity. Therefore, the measurement model demonstrates satisfactory construct validity and is suitable for further structural model analysis.

4.3.2 Discriminant Validity. Discriminant validity was evaluated using the Fornell-Larcker Criterion and Heterotrait-Monotrait Ratio (HTMT). The results confirmed that each construct was distinct from the others. HTMT values were below the recommended threshold of 0.90, indicating satisfactory discriminant validity.

Table 4
Discriminant Validity Assessment (Fornell-Larcker Criterion)

Constructs	AI-Driven SCM	Sustainable Development	Financial Performance
AI-Driven SCM	**0.825**		
Sustainable Development	0.672	**0.806**	
Financial Performance	0.714	0.689	**0.843**

Diagonal values (bold) represent the square root of AVE and are greater than the correlations with other constructs, satisfying the Fornell-Larcker criterion.

Table 5
Heterotrait-Monotrait Ratio (HTMT)

Constructs	HTMT Value	Threshold (< 0.90)	Result
AI-Driven SCM ↔ Sustainable Development	0.781	< 0.90	Accepted
AI-Driven SCM ↔ Financial Performance	0.842	< 0.90	Accepted
Sustainable Development ↔ Financial Performance	0.798	< 0.90	Accepted

Moreover, all the HTMT values given in Table 4.5 were found to be less than the recommended value 0.90. More specifically, the HTMT values were between 0.781 and 0.842, which suggests that each construct is empirically different from the others. The results validate that there is not strong overlap between these three AI-related topics, such as Supply Chain Management, Sustainable Development, and Financial Performance. Thus, the measurement model has acceptable discriminant validity and it is appropriate for assessing the structural model.

4.4 Structural Model Assessment

To analyze the relationships between AI-driven SCM, sustainable development and financial performance, Structural Equation Modeling (SEM) with SmartPLS 4 software was used. The coefficient of determination (R^2) was used to measure the predictive accuracy of the model. The R2 value of sustainable

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development is 0.58, which means that the AI-based SCM explained 58% of the variance in sustainable development. Likewise, the R^2 for financial performance was 0.64, indicating that financial performance could be explained by both AI-driven SCM and SD variables to a combined 64%.

The obtained results suggest that the structural model has medium to high explanatory power.

Table 6

Structural Model Assessment (R^2 Values)

Endogenous Construct	R^2 Value	Variance Explained (%)	Interpretation
Sustainable Development	0.58	58%	Moderate Predictive Power
Financial Performance	0.64	64%	Moderate to Strong Predictive Power

Structural Equation Modelling (SEM) using SmartPLS 4 was employed to assess the relationships among AI-driven Supply Chain Management (AI-driven SCM), Sustainable Development, and Financial Performance. The coefficient of determination (R^2) was used to evaluate the predictive accuracy of the structural model. As shown in Table 4.6, the R^2 value for Sustainable Development was 0.58, indicating that AI-driven SCM explained 58% of the variance in sustainable development practices. Similarly, the R^2 value for Financial Performance was 0.64, suggesting that AI-driven SCM and Sustainable Development jointly explained 64% of the variance in financial performance. According to Hair et al. (2019), R^2 values of 0.25, 0.50, and 0.75 can be considered weak, moderate, and substantial, respectively. Therefore, the obtained R^2 values indicate that the model possesses moderate to strong explanatory power and demonstrates satisfactory predictive capability for explaining organizational sustainability and financial outcomes.

4.5 Hypothesis Testing

Bootstrapping procedures were applied to carry out the hypothesis test with 5,000 resample in SmartPLS 4. The significance of the proposed relationships was assessed using path coefficients, t values and p values.

AI-driven SCM -> Financial Performance

The results showed that financial performance significantly and positively influenced by AI-driven SCM ($\beta = 0.41$, $t = 6.78$, $p < 0.001$). Thus, H1 was confirmed.

The findings suggest that companies that are using AI technologies in their supply chain operations are benefiting in terms of profitability, operational efficiency, and overall financial performance. AI systems can assist companies in lowering their operational expenses, streamlining stock management, and enhancing decision-making processes.

H2: AI-based SCM → Sustainable Development

The results showed that the adoption of AI in SCM was positively affecting sustainable development, with a β value of 0.76, t value of 14.32, and p value < 0.001. Therefore, H2 was recommended.

The discovery indicates that AI technologies play a role in fostering environmental sustainability by enhancing resource use, minimizing waste, optimizing logistics, and increasing transparency in the supply chain. The essentials of sustainable development are connected to the financial performance.

The findings of the analysis indicate that the financial performance was significantly and positively influenced by the sustainable development, with a β value of 0.38, t value of 5.91, and p value less than 0.001. Thus, it was agreed that H3 should be supported. The results indicate that organizations that implement sustainable business have financial advantages, due to the high levels of efficiency in their business processes, corporate image, customer trust and long-term organization resilience.

Table 7

Hypothesis Testing Results

Hypothesis	Relationship	Path Coefficient (β)	t-value	p-value	Decision
H1	AI-driven SCM → Financial Performance	0.41	6.78	< 0.001	Supported
H2	AI-driven SCM → Sustainable Development	0.76	14.32	< 0.001	Supported

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H3	Sustainable Development → Financial Performance	0.38	5.91	< 0.001	Supported

The bootstrapping procedure with 5,000 resamples has been conducted to perform hypothesis testing in SmartPLS 4. Path coefficients (β), t-values and p-values were used to assess the significance of the proposed relationships.

The results revealed that AI-driven Supply Chain Management (AI-driven SCM) had a significant positive effect on Financial Performance ($\beta = 0.41$, $t = 6.78$, $p < 0.001$), supporting H1. The discovery shows that companies using AI in their supply chain operations have increased profit margins, better operational efficiency, and better financial results.

Likewise, there was a strong positive impact of AI-driven SCM on Sustainable Development with the value of $\beta = 0.76$, $t = 14.32$, and $p < 0.001$, which is in line with the hypothesis H2. The finding indicates that AI technologies play a supportive role in sustainability, primarily through better resource use and waste reduction, optimizing logistics workflows, and providing visibility of the supply chain.

In addition, SD was positively associated with Financial Performance ($\beta = 0.38$, $t = 5.91$, and $p < 0.001$), thus supporting H3. The results suggest that companies that implement sustainable business have better financial performance as a result of improved operational efficiency, better corporate reputation, improved customer trust and improved long-term organizational resilience.

Overall, all three direct hypotheses were confirmed, which established the importance of AI-based supply chain management and sustainable development in an organization's financial performance.

Table 8

Mediation Analysis Results

Hypothesis	Indirect Relationship	Path Coefficient (β)	t-value	p-value	Decision
H4	AI-driven SCM → Sustainable Development → Financial Performance	0.29	4.87	< 0.001	Supported

Mediation analysis was conducted using the bootstrapping procedure in SmartPLS 4 to examine the indirect effect of Sustainable Development (SD) on the relationship between AI-driven Supply Chain Management (AI-driven SCM) and Financial Performance (FP). The significance of the mediation effect was assessed using the indirect path coefficient, t-value, and p-value.

As presented in Table 8, the indirect effect of AI-driven SCM on Financial Performance through Sustainable Development was significant ($\beta = 0.29$, $t = 4.87$, $p < 0.001$). Therefore, H4 was supported. The results indicate that Sustainable Development acts as a significant mediator between AI-driven SCM and Financial Performance.

This finding suggests that AI-driven supply chain initiatives enhance financial performance not only through direct operational improvements but also through the promotion of sustainable development practices. Organizations that integrate sustainability principles into their AI-enabled supply chain strategies are more likely to achieve greater long-term financial benefits, improved resource efficiency, stronger stakeholder trust, and enhanced organizational resilience. The significant mediation effect highlights the importance of sustainability as a strategic mechanism through which AI technologies generate economic value and competitive advantage.

Table 9

Summary of Hypothesis Testing Results

Hypothesis	Relationship	β	t-value	p-value	Decision
H1	AI-driven SCM → Financial Performance	0.41	6.78	< 0.001	Supported
H2	AI-driven SCM → Sustainable Development	0.76	14.32	< 0.001	Supported
H3	Sustainable Development → Financial Performance	0.38	5.91	< 0.001	Supported

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H4	AI-driven SCM → Sustainable Development → Financial Performance	0.29	4.87	< 0.001	Supported

The four hypotheses were confirmed and Sustainable Development plays a positive and significant role in the Financial Performance, which is positively influenced by AI-driven Supply Chain Management.

5. Discussion of Findings

The findings are consistent with the research from previous studies, which have widely investigated the impact of AI technologies on improving supply chain performance and competitiveness of companies. The results on the importance of the relationship between the artificial intelligence-based SCM and financial performance are consistent with the Resource Based View (RBV) theory which emphasizes that technological capabilities can be regarded as strategic resources for the organization that can create a competitive advantage. In addition, the positive association between AI-driven SCM and sustainable development was supported by the previous study in which the environment efficiency and operation sustainability of AI was explored. AI systems help to optimize the use of energy, minimize waste, and enhance logistics, all of which contribute to sustainable business practices. Moreover, the strong mediation effect of sustainable development shows that the positive effect of AI-driven SCM on financial performance is enhanced by sustainability. Embracing technology innovations and sustainability measures can help companies thrive and withstand shocks.

The findings are particularly relevant to the emerging economy companies as they are increasingly facing pressures to improve their operational performance and to have sustainable practices in a limited resource environment. The results and findings of the study were presented in this chapter. The analysis showed that the use of AI in Supply Chain Management is beneficial for sustainable development and financial results. Sustainable development, too, had a significant positive effect on financial performance and was a mediator between the AI-driven SCM and financial outcomes. The findings confirm the importance of the role of AI technologies and sustainable strategies on the success of organizations in the emerging economy companies for the long-term.

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Contribution of Authors

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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Informed Consent

Informed consent was obtained from all individual participants included in the study.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of 1964 Helsinki declaration and its later amendments.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

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