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RESEARCH PAPER

The Influence of Artificial Intelligence to Enhancing Supply Chain Performance Under the Mediating Significance of Supply Chain Collaboration in Manufacturing and Logistics Organizations in Pakistan

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ABSTRACT

In contemporary industrial organizations, there has been a growing recognition of the significance of supply chain performance. Furthermore, the advent digital technologies and supply chain globalization has led in growing of recognition of significant strategies of processing of information like artificial intelligence in enhancing performance. In addition, supply chain collaboration helps mediate artificial intelligence and performance. The intelligent machine lies within the context of the information processing theory. The survey data were obtained from a sample size of 351 manufacturing and logistic organization employees in Pakistan. The results indicate that the application of artificial intelligence has a significant influence on the performance of supply chains. Additionally, supply chain collaboration partially mediates the relationship between artificial technology and supply chain performance. This study offers how to optimize the advantages of artificial intelligence abilities to achieve sustainable supply chain performance.

Keywords: Artificial Intelligence, Supply Chain, Manufacturing and Logistics Organizations in Pakistan

INTRODUCTION

Previous studies have provided indication usage of different digital transformations in identifying disruptions in the SCM, leading to enhanced performance in supply chain management (Choi et al., 2018). It is suggested that organizations have analytical skills in order to optimize their supply chain operations by using internal knowledge and collaboration (Scholten et al., 2019; Wong et al., 2020). Many previous studies have shown a good association with information technology, engineering, and analytics in the context of advancing digitalization. According to (Ivanov et al. 2019), there is significant enhancing analytics of risk and boosting performance

through artificial intelligence to enhancing tracking systems. Utilizing blockchain, a data-intensive technology, can include various aspects such as hacking, compromised privacy, financial sector instability, expensive devotion to governmental regulations, and conflicts (Cui et al., 2019). As (Mandal et al. 2019), was conducted toward assessment of the influence of skills, such as information organization, coordination, and control, on the essential factors of SC preparation. Organizations need to have a dynamic and proactive strategy to manage risks. As (Butler et al. 2018), the presence of risks and disruptions in the networks, sophisticated security risks, and changing consumer anticipations might serve as opportunities for organizations to enhance their supply chain performance through adaptation and collaboration. In order to enhance collaboration and cooperation, organizations should use technological advances in automation and artificial intelligence across all domains (Kamble et al., 2018; Butler et al., 2018). As (Grover et al. 2020), Artificial intelligence is recognized in the literature as an innovative analytics tool that can potentially improve performance within the supply chain domain. Artificial intelligence encompasses a range of statistical and predicting machine learning approaches that enhance human intellect (Dubey et al, 2020). As (Grover et al, 2020), artificial intelligence has been identified as a simplifying module that offers a range of alternatives and provides good inputs throughout the decision procedure in complex situations. The capacity relative to artificial intelligence serve as a foundation for decision process in deep observation about how artificial intelligence might enhance performance (Akter et al., 2020). Previous studies have recommended that process novelty is enhanced in occurrence of doubt, foremost to enhanced performance in operations (Kwak et al., 2018; Akter et al., 2020). However, the development of AI-driven innovation offers greater benefits as it can expedite the decision process involved in identifying and providing new results (Paschen et al., 2020). The influence of artificial intelligence provide innovation in enhancement of issues, facilitation of information exchange, processing of data, and integration of systems has been widely recognized as a crucial element for progress (Wamba et al., 2019). Previous studies have shown that artificial intelligence has effectively facilitated the advancement of innovation, resulting in enhanced performance of supply chains (Baryannis et al., 2019; Dubey et al., 2020). Contempt that artificial intelligence enhances the solutions of performance through collaboration. In contemporary context, supply chains progressively evolve in response to dynamic corporate conditions and technological advancements. The performance working is delayed due to different internal and external risks, requiring a continuous movement of information (Belhadi et al., 2019; Lee et al., 2016). Additionally (Wamba et al. 2020) suggested the significance of examining environmental dynamism while addressing performance-related concerns. Therefore, it is important to understand the association between (AI), collaboration, and supply chain performance (SCP). These associations are anticipated to provide valuable knowledge about developing and implementing AI capabilities inside ever-changing supply networks. As (Baryannis et al., 2019) suggested, the learning capacities of artificial intelligence in the context of SC risk control are in their early stages. To the greatest extent of our current understanding, this study represents an examination within the existing body of scholarly work that empirically explores the impact of artificial intelligence on supply chain performance, specifically through the mediating mechanism of collaboration. The study presents many novel findings and significant contributions. This work is to enhance the theoretical comprehension of artificial intelligence driven through the processing of information innovation. Furthermore, the research clarifies the

potential of creating artificial intelligence-driven information processing advancements in generating sustainable competitive advantage.

LITERATURE REVIEW

According to the Organizational Information Processing Theory (OIPT), a firm's data processing efficacy is determined by its information processing demands and capacity. The impact of uncertainty in supply chains on the correlation between information processing capacities and associated consequences has been explored in previous studies (Chen et al., 2015; Wong et al., 2020). Hence, it is vital to promote capacity actively participate in interaction with participants in order to enhance traceability and visibility in supply chain operations. The previous work conceptualizes has grounded on OIPT, focusing on studying its influence on effectiveness of performance (Kamble et al., 2020). As (Srinivasan et al., 2018), organizations that choose mechanistic models must implement a division of labor and centralize decision-making to coordinate interdependent processes. An organization can improve its information capacity through implementing vertical and horizontal systems of information (Srinivasan et al., 2018). As (Peng et al. 2014), vertical information systems provide efficient and intelligent data processing to address difficulties by quickly adapting plans with little resource utilization. The OIPT framework enhances organizational capacity to meet information process needs (Wamba et al. 2020). Significantly, (OIPT) asserts that organizations need the capability to effectively procedure data in the look of increasing ambiguity to keep a desired output level. The capacity information to effectively manage risk, fluctuation, and dynamics is a crucial organizational competency emphasized (Peng et al., 2014) and (Srinivasan et al., 2018). This research conceptualizes artificial intelligence (AI) as a facility for processing information, which should be designed to reduce the complexity and uncertainties associated with its operation naturally. In addition, the OIPT asserts that enterprises should promote capacity barriers and possess information processing capabilities to handle supply chain disruptions and enhance performance effectively (Srinivasan et al., 2018). Many other theories support the assumptions of the Open Innovation Paradigm Theory (OIPT). The dynamic capability view (DCV) suggests that artificial intelligence and systems are classified as resources of lower-order capabilities, which are the foundation for developing highly-order abilities such as collaboration, adaptability, and efficiency (Wamba et al., 2020).

Nevertheless, the dynamic capability view failed to adequately discourse the impact of a significant interruption at a large scale on the utilization and effectiveness of lower-level capabilities. In contrast, the theory of contingency suggests that establishments need to establish alignment between the capacity of information processing and their corresponding information processing requirements (Tushman et al., 1978). According to (Wong et al. 2020), the perspective suggests favorable outcomes for SC performance once the capacity for processing is the corresponding size of interruptions in the supply chain. However, this theory must provide an adequate explanation for the inter-organizational management of data skills necessary in a supply chain system to support growth of capabilities like cooperation and adaptability. The objective of our study is to address the deficiencies and constraints of existing theories developing a comprehensive theoretical foundation based on the Open Innovation Process Theory (OIPT). It

will enable the construction of a robust research framework for examining the impact of AI-driven creative thinking, teamwork, and supply chain effectiveness.

Artificial Intelligence and Supply Chain Performance:

Artificial Intelligence refers to the capacity to gain knowledge through analysis of outward environmental information and then use this knowledge to adapt or formulate new strategies in response to environmental changes (Grover et al., 2020). It includes a range of procedures and computational procedures that facilitate the acquisition of knowledge from input data, unrelatedly to whether prior knowledge about the desired output is available (Rodríguez et al., 2020; Baryannis et al., 2019). The domain of artificial intelligence is not inherently novel. Nevertheless, the phenomenon has seen fluctuating phases of substantial growth and severe decline since its first emergence in the nineteen sixties (Baryannis et al., 2019). The increasing computing capabilities, propagation of large datasets, and broader usage of (AI) in processes and SCM have led to an improved focus on expertise (Sharma et al., 2020). As (Grover et al. 2020), using (AI) methodologies produces enhancements in several aspects including product design, quality development and satisfaction of customers. Using technology improves a company's efficiency. Furthermore, (Klumpp et al., 2018) shown a study on the potential of AI-powered supply chain intelligence, specifically self-driving systems, to enhance the efficiency of transportation and logistics operations. Similarly, (Bottani et al. 2019) developed an AI outline to facilitate processes within the distribution. (Dubey et al., 2020) have provided evidence that artificial intelligence potentially enhances the performance of firms, but the specific mechanisms by which this enhancement occurs remain unclear. According to the OIPT approach, it is suggested that the adoption of artificial intelligence (AI) facilitates the development of information-processing skills inside supply chains (Srinivasan et al., 2018). According to (Grover et al. 2020), this capability enables individuals to interpret, analyze, and acquire knowledge from involved data obtained from many sources, hence reducing uncertainty about needs, capabilities, and the availability of supplies. Alternatively, companies need help maintaining a considerable inventory or depending on limited human capacities to establish an adaptable supply chain, impacting profitability and operational efficiency (Dubey et al., 2020). Moreover, the many viewpoints and supporting data about the incorporation of AI have the potential to result in enhanced supply chain performance. Therefore, we propose a hypothesis:

H1 Artificial Intelligence has a statistically significant impact on the performance of supply chains (SCP).

The mediating role of supply chain collaboration

According to previous works, enterprises must be able to access external information and innovations to participate in marketplaces effectively. Adopting an open innovation-driven capacity for adaptation is a crucial view for organizations seeking to improve their global awareness. The literature emphasizes that adaptable capacities and supply chain collaboration are widely recognized as key factors contributing to the development of the supply chain's efficiency (Scholten et al., 2019; Chowdhury et al., 2019; Jain et al., 2017). As (Dovers et al., 1992), collaborative, e.g., stability and persistence, denote the firm to admit and organize new necessities.

As (Jain et al. 2017), it has been said that collaborative enterprises play a crucial role in effectively modifying supply chain risks in the face of distractions. As (Dubey et al. 2020), establishing collaborative relationships among the various supply chain is crucial for developing supply chain resilience. It is achieved by implementing strategies such as fostering mutual trust, effective communication, making informed sourcing choices, and exchanging essential data, all of which reduce the risk of disruptions. It enhances the efficiency of reaction time and facilitates the creation of novel company prospects. Additionally, (Chowdhury et al. 2019) have shown that inadequate cooperation among supply chain partners may have an unfavorable impact on the overall supply chain integration. Thus, this can result in increased weakness in the supply chain, compromising resilience and performance. Therefore, the SC performance must establish a favorable environment that promotes open and effective communication, efficient cooperation, seamless organization, and relationships among partners. It will ultimately improve the supply chain and favorably impact supply chain performance (Fahad et al, 2023). Thus, we propose the hypothesis,

H3, the supply chain collaboration mediates between supply chain performance and artificial intelligence.

Conceptual Framework
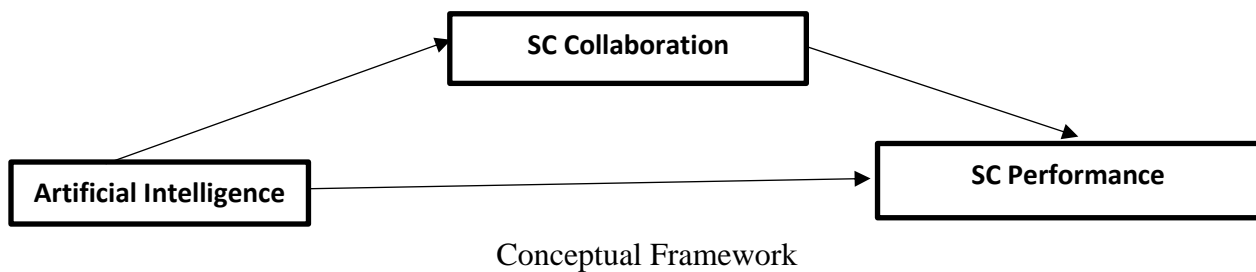
RESEARCH METHODOLOGY

The methodology of the research had been designed to provide the quantitative study method This study is based on primary source data that was collected from construction companies in Lahore, Pakistan (Mushtaq et al., 2021). This survey respondent's response was ensured to be completely confidential (Saddique et al., 2021; Fahad et al., 2023). The questionnaire collected data on artificial intelligence, supply chain collaboration, supply chain performance, and demographic variables. The population sample was based on 351 employees of manufacturing and logistic companies Pakistan.

Variable	Items	Reference
Artificial Intelligence	5	(Dubey et al, 2020)
Supply Chain Collaboration	3	(Srinvasan et al, 2018)
Supply Chain Performance	3	(Srinvasan et al, 2018)

Table # 1: No. of Items, Sample Items, Measures and Reference

Results and Findings: The results and findings include the following types of results and analysis: descriptive analysis, inferential analysis, reliability, correlation, and regression analysis. All the findings in detail are given below.

Table #, 2: Descriptive analysis:

Characteristics	Frequency
Male	247
Female	104
Ages	
Below 22	96
23-35	135
36-55	78
Above 55	42
Matric	70
Intern	93
Bachelor	132
Master	56

Explanation: The current study was based on data from male (n = 247) and female (n = 104) respondents. In the sample data, the most age in between 23 to 35 (n = 135) and lowest lies above 55 (n = 42). In the study, most respondents were bachelor (n = 132), and very few were master degree (n = 56).

Table#, 3: Inferential Analysis

Variable	Mean	Standard Deviation
Artificial Intelligence	3.78	0.83
SC Collaboration	3.79	0.81

Supply chain Performance	3.95	0.88

Explanation: As shown in Table 3, to add more appreciation characteristics, mean and standard deviations were calculated and discussed as follows: the value of the artificial intelligence is (mean = 3.78, standard deviation = 0.83), the SC Collaboration value is (mean = 3.79, standard deviation = 0.81), and the supply chain performance is (mean = 3.95, standard deviation = 0.88).

Furthermore, the reliability analysis is given below.

Table#, 4: Reliability Analysis

Variable	No of Items	Cronbach's Alpha
Artificial Intelligence	5	0.823
SC Collaboration	3	0.845
Supply chain Performance	3	0.879

Explanation: As shown in Table 4, all scale reliability was checked using Cronbach's alpha test, and all scales show that the measures reliability is greater than 0.70, which is sufficient for further analysis. Moreover, the correlation analysis is discussed below.

Table#, 5: Correlation Analysis

Items	Values	Values
Artificial Intelligence		
SC Collaboration	.145**	
Supply chain Performance	.158**	.312**

Explanation: As shown in Table 5, the correlation analysis is shown. The artificial intelligence has a significant positive relationship with supply chain performance (r =0.145, P <0.05). At the same time, the artificial intelligence has a significant relationship with SC collaboration (r = 0.145, p <0.05). In addition, SC Collaboration and supply chain performance have a significant and positive relationship (r = 0.312, p<0.05).

Table #, 6: Regression

Variable	R^2	β	F	F- sign
Artificial Intelligence	0.021	0.149	6.19	0.000

| SC Collaboration | 0.267 | 0.362 | 120.0 | 0.000 |

Dependent variable: Supply chain performance.

Table No 7: Mediating Analysis:

Variable	R2	β	F	F-Sign
Artificial Intelligence → SC performance	0.017	0.149	6.19	0.000
Artificial Intelligence → SC Collaboration	0.018	0.128	120.0	0.000
Artificial Intelligence → SC collaboration → SC Performance	0.268	0.258	131.0	0.000

Note ***p<0.01, **p<0.05

Explanation: As shown in Table 7, the regression analysis is done. It is found that the direct relation of artificial intelligence with SC performance (β =0.149, p = 0.00) is significant. So, Hypothesis H1 is accepted. Similarly, the effect of artificial intelligence on SC Collaboration (β =0.128, p = 0.000) is significant. So, hypothesis H2 is accepted. The effect of SC Collaboration on supply chain performance (β =0.258, p = 0.000) is statistically significant. So, Hypothesis H3 is accepted. Therefore, SC Collaboration has partially mediated the association between artificial intelligence performance and supply chain performance. So, Hypothesis H4 is accepted.

DISCUSSIONS AND IMPLICATIONS

This study aimed to investigate a conceptual framework of Artificial Intelligence (AI), the performance of (SCP), and collaboration (SCC). Based on the theoretic framework of (OIPT), our research results propose that using artificial intelligence (AI) methods may enable the Supply Chain to manage and improve its performance effectively. This is achieved through the capabilities of information processing and adaption facilitated by AI. Although limited in quantity, previous scholarly works have shown an association between (AI) and (SCP) (Dubey et al., 2020; Nwagwu et al, 2021; Saddique et al, 2022 Grover et al., 2020; Baryannis et al., 2019). As (Srinivasan et al., 2018), it was determined that the maintenance of an organization's performance is contingent upon its information-processing skills. The objective of our research is to conduct an empirical analysis of the correlation between AI and creativity and organizational success within the supply chain domain, particularly in the context of a highly unpredictable and dynamic environment. Consequently, our research results provide empirical support for the existing assertions that the adoption of AI-driven innovations has significant promise for enabling organizations operating in rapidly changing environments to improve or sustain their present level of strategic control and performance. The feasibility of this outcome may be attributed to the capacity of artificial intelligence (AI) to acquire knowledge from data, so enabling it to adjust its decision-making processes, foster innovation within supply chain management, and promptly react to disruptive events (Grover et al., 2020; Numan et al, 2021; Akter et al., 2020). This implies that companies who can nurture a robust state of preparation before a disruption, exhibit effective responsiveness during the disturbance, and demonstrate a prompt recovery as a result of the disruption are more

inclined to sustain enduring sustainable competitive advantage (Chowdhury et al., 2019; Datta et al., 2017). Hence, it is practical to consider a more enduring approach to get enhanced SCP through AI over an extended period. This may be achieved through capacities of efficient performance (Chowdhury et al., 2019). However, the potential of AI-driven information processing skills and advancements in enhancing the resilience and performance of supply systems. This includes improving events, ultimately leading to enhanced sustainable performance of the supply chain. (Wamba et al, 2019; Akter et al., 2020), arises the main approach, which treats artificial intelligence (AI) as a technological system to improve supply chain innovation (Trabucchi et al., 2019). (Scholten et al. 2019) & (Chowdhury et al. 2019) have emphasized the significance of SCC on organizational facilitators. Hence, our research aimed to address the gap in investigating the impact of artificial intelligence (AI)-based innovation on the development of these facilitators, thereby leading to the establishment of sustainable performance. The findings provide evidence that the development of AI-based innovation is favorably and substantially associated with the improvement of collaboration (Baryannis et al., 2019). These studies have explored the effectiveness of AI-driven adaptive capabilities and collaboration in facilitating the development of supply chain resilience and performance (Wamba et al., 2019).

CONCLUSION

This research aimed to examine the impact of artificial intelligence (AI) systems on increasing performance (SCP) in the presence of collaboration SSC. The study was shown using Theory (OIPT). This framework included artificial intelligence concepts in the supply chain through mediating role of supply chain collaboration (SCC). The results of this study provide empirical support for the suggested theoretical framework. The findings indicate that the information capabilities of artificial intelligence positively impact performance (SCP). Creating a sustainable supply chain performance (necessitates enterprises to use artificial intelligence (AI) skills to boost supply chain resilience and performance through the positive mediating role of supply chain collaboration. (AI)-driven innovations help in generating sustainable competitive advantages.

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