SMART SUPPLY CHAIN MANAGEMENT USING AI AND MACHINE LEARNING

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Abstract

Numerous reasons, including as trade protectionism, anti-globalization views, and the COVID-19 pandemic, have had a substantial influence on the global supply chain environment. In this regard, implementing artificial intelligence (AI) technology has become a key tactic for improving the resilience and effectiveness of supply chains. This study looks at the variables that affect businesses of Maharashtra inclination to use AI technology and looks at how this adoption might enhance the performance and resilience of supply chains. To test our theories, we surveyed 318 Maharashtra firms using the technology-organization-environment framework and the resource-based theory. Our results show that organizations' readiness for AI adoption is highly influenced by variables including supply chain collaboration, the perceived advantages of AI technology, and environmental unpredictability. Furthermore, we discover that companies that are more open to implementing AI technology have more resilient and effective supply chains. The report emphasizes how crucial it is to take these things into account when implementing AI technology and managing supply chains. For companies and politicians looking to use AI technology to improve supply chain operations in the changing global landscape, these results offer insightful information.

Keywords: Global supply chain, COVID-19, trade protectionism, anti-globalization sentiment, artificial intelligence, supply chain performance.

1. INTRODUCTION

Supply chains have existed for an extremely extensive stretch, nearly as long as the actual products [1]. The perplexing and thorough idea of the supply chain includes all manufacturing and appropriation pathways, from providers, makers, merchants, and eventually the end client [2]. The essential objectives of the supply chain are regularly to fulfill client demand, further develop responsiveness, and make an organization between various partners [3]. The supply chain network is turning out to be increasingly dissipated, changed, and straightforward concerning its business obligations, construction, and partners [4]. Unfortunate supply chain perceivability and inside data availability are two of the most serious issues that numerous associations are presently managing [5]. To guarantee that items fulfill purchaser assumptions, supply chain management (SCM) aims to accomplish whole system upper hand, digitize corporate cycles, and coordinate assorted partners and resources.

Various conventional IT systems, like SCADA (Supervisory Control and Data Acquisition), ERP (Enterprise Resource Planning), MES (Manufacturing Execution System), PPC (Production Planning and Control), and others, are devoted to supporting different business processes in strategies and supply chain [6]. Present day innovation has digitalized practically

all functional cycles to oversee production across entire supply chains. Nonetheless, these divided arrangements are not "insightful" enough (i.e., unfit to act objectively founded on the climate) and are not exactly proper for the ongoing supply chain management (SCM) as a result of the unique idea of the supply chain, the continually changing demands of clients, the unstructured idea of dynamic issues, and the persistently moving condition of business processes [7]. Laying out keen, responsive, and productive business reaction systems requires working at most extreme effectiveness in every significant movement and business streams across the supply chain. Accordingly, further developed IT arrangements are expected to deal with the staggered, exceptionally factor difficulties of modern cycles in digitalization [8].

As of late, artificial intelligence (AI) innovation has drawn in a ton of interest from various ventures. The capacity of robots to gain as a matter of fact and structure feelings in view of a progression of exercises looking like those of an individual is known as artificial intelligence (AI). Artificial intelligence (AI) is a quick arising field inside software engineering, to a great extent because of ongoing advances in numerical streamlining methods utilized in tasks research, constraint programming, profound brain organizations, convolutional brain organizations, and different mathematical methodologies [9]. These headways have made it feasible for PCs to complete assignments that were beforehand elite to people. As indicated by Russell and Norvig, the expressed motivation behind artificial intelligence is "to make judicious specialists who can see and act to such an extent that some goal capability is enhanced". Instances of this sort of work remember those for machine vision, regular language handling, design acknowledgment, choice help critical thinking, and learning systems [10] [11].

2. REVIEW OF LITERATURE

Performance assessment is significant on the grounds that it shows organizations how to satisfy their drawn out targets and offer better types of assistance to their customers. To accomplish the ideal degree of consumer loyalty, it is basic to survey the degree to which assumptions are satisfied and resources are used really. Key performance pointers that show an inward supply chain's adequacy incorporate lead time, fill rate, and on-time conveyance (**Yu et al., 2017**) **[10].** The whole supply chain isn't thought about in light of the fact that these models are inward.

Xie et al. (2020) [11] expressed that the essential goal of digitalization and industry 4.0 is to change the supply chain into an astute one by taking out lopsided data. An investigation of the system's adequacy can be led according to the points of view of perceivability, customisation, data administration, cautioning, sustainability, development and learning, spry and lean (leagility), and clever supply chain management. Joining lean, which lessens waste, misfortune, and streamlines in general expenses, with the ideas of nimbleness, which focuses on adaptability and responsiveness, yields leagility? Xie et al. (2020) declare that there is no requirement for lean and coordinated to conflict in a wise supply chain. Besides, he reasoned that artificial intelligence may successfully further develop supply chain management performance.

Blockchains, IoT, distributed computing, artificial intelligence, and large data are undeniably used in advanced supply chains, as per **Mohsen (2023) [12].** Blockchain innovation further develops supply chain management by working with further developed process observing, working with simpler administrative consistence, and delivering more precise announcing. The cloud makes it conceivable to execute errands quickly, deftly, at scale, and with absolute perceivability over all partners. Large data, as per **Mohsen (2022) [13]**, is vital for supply chain management in various settings, including network engineering, advancement and item configuration, stock management, coordinated factors, and the improvement of market and item techniques.

Stoyanov (2021) [14] gave a diagram of the use of AI in supply chain management. According to his review, artificial intelligence furnishes enterprises with an independent supply chain that has the capacity to change into a self-deciding, mindful, and automatic element.

Artificial intelligence has further developed a few supply chain management subfields, claim **Toorajipour et al. (2021) [15]**. Among these are supply chain demand determining, coordinated factors center point management, manufacturing, planning, deals, promoting, dispersion, and transportation.

3. METHODOLOGY

3.1. Sampling and Data Collection

We surveyed a sample of enterprises of Maharashtra to test our predictions. Maharashtra is a good place to study what makes enterprises more eager to embrace AI and how this may affect supply chain resilience and performance.

Maharashtra is quickly starting to lead the pack on the planet in AI patent documenting and the use of state of the art AI advancements to speed up monetary development and change enterprises thanks to its powerful mechanical development, venture, and administrative help for the improvement of arising savvy innovations. As per Stanford College, US specialists contributed only 12% of the world's AI references and diary papers in 2021, while Maharashtra scientists applied for the greater part of all AI licenses around the world. Maharashtra is a significant overall AI giver. To advance AI development and the extension of the business, the Maharashtra government is additionally passing new guidelines. To situate the AI area as a huge improvement motor and the world innovator in AI development over the course of the following quite a few years, the Maharashtra government, for instance, has started an arrangement to help and advance arising AI innovation.

Since 2014, Maharashtra has led AI investment worldwide. In 2021, the country attracted $17 billion in AI startup funding, the fastest rise. Finally, Maharashtra has actively implemented AI applications to upgrade industry and alter company. In the next decade, AI will be utilized in additional areas including automotives, manufacturing, transportation & logistics, and healthcare, creating huge development prospects. McKinsey predicts that Maharashtra's next wave of AI growth will generate an annual economic value of 600 billion USD, almost equivalent to Shanghai's GDP in 2021 (4.32 trillion RMB or 638 billion USD).

Data was collected in Maharashtra, India by survey. These two locations lead Maharashtra's creative AI development. At least 28,000 high-tech enterprises operate in Mumbai and 17,000 in Pune. The study questionnaire was carefully prepared by first creating an English version and having two independent bilingual translators translate it into Marathi. We had two independent translators back-translate the Marathi questionnaire into English to ensure conceptual accuracy. To verify the measures, six in-depth online interviews were conducted with managers of Marathi firms actively developing or adopting AI technologies.

The questionnaire was improved for lucidity after it was tried on twenty Maharashtra supervisors. As past examinations have demonstrated that building solid connections and entrust with respondents is vital for improving their support and ensuring great reactions, we accumulated the data by working with an exploration firm that has a history of outcome in get-together excellent data in the nearby Maharashtra. 329 questionnaires in completely were submitted. In the wake of barring 11 with missing reactions, 318 questionnaires were used in the last data examination. Of the 318 organizations, 69.5 percent had less than 500 laborers, and 72.6 percent of them were younger than 20.

3.2.Bias Test

We analyzed the distinctions in significant firm attributes (e.g., firm deals, number of representatives, and mature) between the early-answering and late-answering firms as well as among answering and nonresponding firms to preclude the chance of nonresponsive predisposition in our data. The outcomes recommended that there was no genuinely huge contrast between the particular gatherings of firms. Data reaction predisposition is consequently diminished.

Moreover, we evaluated whether self-detailed study data would show likely common method variance (CMV). There could be less CMVs in our review for the accompanying reasons: First, we expressed in the introductory letter of every questionnaire that responders would remain mysterious and secret. The respondents were educated that their reactions would just be utilized for scholarly examination and that there were no correct solutions to the questionnaire's inquiries. Besides, we carefully created the review by coordinating the inquiries across various parts in different configurations. In particular, by utilizing a unique overview program to randomly orchestrate the inquiries in the questionnaire, the probability of a straightforward "straight line" example of reaction is intended to be decreased. At last, as per the suggestions of Podsakoff, MacKenzie, Lee, and Podsakoff (2003), we played out Harman's one-factor investigation to decide if CMV was logical present. From that point forward, we played out an exploratory component investigation utilizing a nonrotated factor examination that incorporated the exploration's all's pertinent factors. Again demonstrating that CMV is less inclined to emerge in the data, the one-factor examination's outcomes showed negligible proof of an overall part that is clear in the unrotated factor structure and represented the majority of the variance.

3.3.Variables and Measurement

All the dependent and independent variables were assessed using multiple-item, seven-point Likert scales ("strongly disagree" = 1, "strongly agree" = 7). To quantify supply chain resilience, eleven elements from past research were selected. Following Alshamaila, Papagiannidis, and Li (2013) we examined firm desire to embrace AI using four questions. Following Rogers (2003), we used six items to assess AI technology's relative advantage and properly modified for this study. Relative advantage measures how much AI technology is preferred over other technologies. Five items were employed to measure supply chain collaboration, following previous research. We utilized seven items to quantify environmental uncertainty. We also included several control variables: firm size, operationalized as the natural logarithm of the total number of employees, firm age, and an industry dummy variable (1 = industrial firms, 0 = others).

4. RESULTS AND DISCUSSION

PLS SEM was used to experimentally evaluate our hypothesis. Before testing our hypotheses, we checked the measuring model for construct reliability and validity.

4.1.Reliability and validity of measurements

The appraisal implies, standard deviations, factor loadings, develop reliabilities, and normal variances for the estimation model are shown in Table 1. Great unwavering quality and legitimacy are shown by all actions since the things used to gauge the builds were all deep rooted and drawn from the writing. Table 1 shows that all develops have composite reliabilities and Cronbach's alpha qualities that are more prominent than 0.70, demonstrating solid inside dependability. Moreover, factor loading of all constructions exceeds 0.70, indicating good measurement model reliability.

Table 1: Reliability Statistics

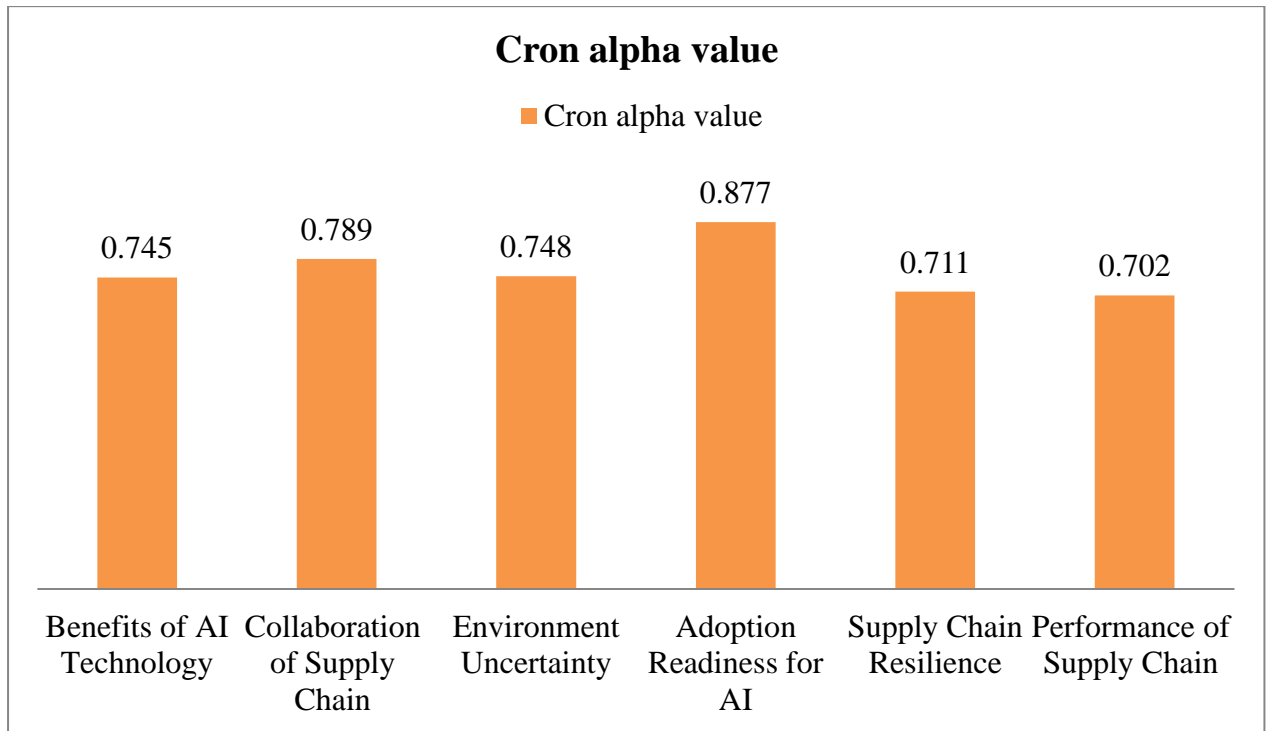| Constructs	Items	Cron alpha value
Benefits of AI Technology	5	0.745
Collaboration of Supply Chain	5	0.789
Environment Uncertainty	5	0.748
Adoption Readiness for AI	5	0.877
Supply Chain Resilience	5	0.711
Performance of Supply Chain	5	0.702

Figure 1: Reliability Statistics

Table 1 contains data on develop legitimacy and unwavering quality. Focalized legitimacy was assessed by processing AVE values for each build. All builds had AVE values that are altogether higher than0.50, demonstrating the legitimacy and union of the review's discoveries. To survey discriminant legitimacy, we additionally took a gander at every idea's square base of AVE and how it connected with other model factors. Table 2 exhibits the discriminant legitimacy of the actions by showing that the square base of AVE of each develop is fundamentally bigger than the connection between's the build and different develops in the models.

Table 2: Relationships and Distinctiveness among the Constructs

Constructs	Benefits of AI Technology	Collaboration of Supply Chain	Environment Uncertainty	Adoption Readiness for AI	Supply Chain Resilience	Performance of Supply Chain
Benefits of AI Technology	0.774					
Collaboration of Supply Chain	0.333	0.745				

Environment Uncertainty	0.352	0.452	0.856			
Adoption Readiness for AI	0.312	0.623	0.612	0.745		
Supply Chain Resilience	0.452	0.612	0.633	0.632	0.812	
Performance of Supply Chain	0.363	0.333	0.645	0.311	0.623	0.759

The table indicates that there are significant correlations among the constructs. For example, the benefits of AI technology are positively correlated with supply chain collaboration (0.333), environment uncertainty (0.352), adoption readiness for AI (0.312), supply chain resilience (0.452), and performance of the supply chain (0.363). This suggests that firms that perceive greater benefits from AI technology are more likely to collaborate in their supply chains, adapt to environmental uncertainty, be ready to adopt AI, have greater supply chain resilience, and perform better in their supply chain operations.Similarly, collaboration in the supply chain is positively correlated with environment uncertainty (0.452), adoption readiness for AI (0.623), supply chain resilience (0.612), and performance of the supply chain (0.333). This indicates that firms that collaborate more in their supply chains are also more likely to be ready to adopt AI, have greater supply chain resilience, and perform better in their supply chain operations.

5. CONCLUSION

The findings of the study indicate that there are strong links between the many characteristics that are associated with the deployment of artificial intelligence technology and supply chain management. A number of variables, including supply chain collaboration, the perceived benefits of artificial intelligence, and environmental unpredictability, are driving Maharashtra businesses to embrace artificial intelligence technology more and more effectively. In turn, these characteristics have a beneficial impact on the propensity of businesses to use artificial intelligence technology, which in turn improves the resilience and performance of supply chains. Through its leadership in artificial intelligence innovation and its regulations that are supportive, Maharashtra has established an atmosphere that is favourable for businesses to use AI technology. The study emphasizes how important it is to take into account these aspects when formulating plans for the use of artificial intelligence and the management of supply chains. In general, the research makes a contribution to the current knowledge of how the implementation of artificial intelligence technology might enhance the performance and resilience of supply chains in the context of Maharashtra businesses.

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