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The Impact of Artificial Intelligence in Modern Supply Chain Management in Textile Sector of Bangladesh

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Abstract

Artificial Intelligence (AI) is a revolution in modern technological growth that introduces the capabilities of a computer system for a human like system to solve problems and create new innovations. This research aims at assessing how AI affects Supply Chain Management (SCM) in Bangladesh's textile industry with reference to critical success factors which include inventory, demand prediction, transportation, suppliers, and sustainability. This work adopts the Interpretive Structural Modeling (ISM) framework to establish the hierarchical arrangement and interaction of these factors on AI's potential to revolutionize SCM processes for higher efficiency, flexibility, and sustainability. The study highlights how integration of AI is not only enhancing operational performance and controlling costs but also brings sustainability in Textile sector on international platform. Subsequent studies can expand on this literature to advance research on AI novel uses and work on issues such as data privacy and integration for the development of further SCM.

Keywords: artificial intelligence, supply chain management, textile industry in Bangladesh

1. Introduction

Supply chain management (SCM) is the area that has not been left behind when it comes to application of AI; it has greatly enhanced different fields ranging from procurement, manufacturing, order fulfillment, and even customer relations. Machine learning and predictive analytics, robotics are the supply chain technologies that create excellent advancements in the responsiveness of supply chain networks to market conditions and changes. This paper will discuss AI trends in the modern SCM environment in textile sector, areas of greatest change and opportunities. Among the major trends deployed to the AI function, the most significant is the demand forecasting. Fixed forecasts prove unsuitable in the irregular and fluctuating business environment concerning the market demand. AI or especially machine learning allows to analyze big amounts of historical data and look for patterns which forecast the demand more accurately in the future [1].The management of inventories has also not been left behind in being accorded benefits from AI innovations. With artificial intelligence the stocks being in the store can be monitored in real-time, even determine when the particular stock is low or even run an auto order for the stock. This level reduces the influence of human beings in inventory management, and ensures that stocks at the optimal quantities are always available [2]

The textile and clothing industry of Bangladesh is a key industry that contributes more than 80 percent export revenues and provides job opportunity to millions of Bangladeshi people. In the last decade or so, the application of modern SCM strategies has been vital for competitiveness aspirations and adapting to international markets in this industry. Main global buyers are focusing more on efficiency, transparency and sustainability, the Bangladeshi textile industries are expanding their SCM through JIT inventory, SCM tracking, and integration of logistics. As pointed out by[3], enhanced use of modern ideas in the management of supply chain including the aspects of automation and predictive analysis helps the textile companies in Bangladesh to lessen on their wastes and to achieve higher level of qualitative products. These modern SCM not only sustain the operational effectiveness but also embrace the global sustainability standards paramount for sustaining Bangladesh's dominance in exported textile[3]. Therefore, AI has greatly advanced the efficiency and effectiveness of the supply chain management in the modern world. Starting with demand forecasting followed by inventory management, logistics, risk management to customer services, the AI technologies are steadily redefining the contours of the supply chains. Organizations that implement these technologies can benefit from getting a competitive advantage by lowering costs, enhancing service delivery, and increasing the sustainability of the supply chain. AI's importance continues to progress and, as a result, SCM will see a heightened advancement in the future, fostering change in the supply chain. The research question is "How modern SCM impact on different areas of the textile sector of Bangladesh?".

This research question aims at identifying the various ways through which AI impacts SCM. The research will answer the question of this study and give a global perspective of AI's influence on the supply chain practices.

2. Literature Review

Among the aspects mentioned by Ivanov concerning how AI is transforming the healthcare industry, two are related to demand forecasting and consequently on the flow of patients, which increases organizational effectiveness [4]. According to Zhang and Wang there is now much faster discovery and development cycles in pharmaceuticals, hence the much faster time to market [5]. Continuing the contexts' examination Li and Zhao investigates the construction industry where AI improves the project management due to the application of AI-based scheduling and resource planning [6]. Through the use of the predictive maintenance, in renewable energy, Li & Lin explain that the distribution grid is enhanced as well as network optimality [7]. According to Ivanov and Das the application of AI in this set up is in healthcare logistics, to enhance the timely delivery of medical and health related products [8]. Lee and Lam present the topic of using AI for predictive maintenance of renewable structures [9]. Ivanov and Sokolov study the role of AI-backed supply chain recoverability in global health emergencies such as COVID-19 in the healthcare industry [10]. Chen, Hao and Chen reflect on artificial intelligence for the predictive maintenance of textile industry's machinery and equipment [11]. Here, Lee and Lam explore the subject of Artificial Intelligence energy prediction, and of the grids for renewable energy [12]. Thus, Carter and Easton underlined the application of inventory control in retail through the use of AI technologies, where retail stores can minimize overstocking and understocking products [13]. Kouhizadeh and Sarkis describe how AI contributed to supporting better analytical tools and self-learning clinical trials as well as the management of the regulation of pharmaceuticals. Therefore, it can be concluded from this systematic review that the widespread of AI applying in SCM will create various benefits and improve capability and handling of various industries [14].

Choi, T. M. described several implementation barriers of AI in SCM as follows: Data quality, System interfacing, and High implementation cost [15]. A study conducted by Ivanov, D. pointed out real-time data processing as a challenge, cybersecurity threats, and compliance. The telling point for managing AI in supply chain is that there is an immense necessity for the necessary data protection systems [16]. Kembro, Näslund, and Olhager identified some of the disadvantages of implementing smart manufacturing including; communication barrier, high initial cost, and trust with stakeholders. All of these issues can be explained with reference to the communication and management of stakeholders in AI projects [17]. Sari, K. discussed some issues which include; Adoption issues, Cost of maintenance, and Scalability issues. They influence the viability and the possibility of expanding the use of AI in supply chains in the long run [18]. This paper by Goodchild, A., and Toy, J. explained the constraints of infrastructures, technological degeneration, and legalities. The fast rate of advancement in technologies and constantly changing laws create a very complex environment for development of AI [19]. Net landfill resilience model that Saberi, Kouhizadeh, Sarkis, and Shen adopted in their research in 2019 highlighted data integration, cultural resistance concept, and system interconnectivity. Another factor is that various forms of data and multiple systems used in an enterprise must be linked in order to enable the use of AI [20]. The impact of AI in Textile sector in Bangladesh are summarized in Table 1.

Table 1. Description of Impact of AI

Serial No.	Impact Area	References
1	Inventory Management	[21][22][23][24][25]
2	Demand Forecasting	[21][27][28][29][30]
3	Logistic & Transportation	[31][22][32][33][34]
4	Supplier Selection	[35][36][37][38][39][29]
5	Sustainability	[31][40][23][26]

3. Research Methodology

In this study the method chosen to evaluate the effects of artificial intelligence on supply chain management of Bangladesh textile sector is the Interpretive Structural Modeling (ISM) methodology. ISM is a systematic and well-defined approach toward mapping relationships between different entities that potentially influence SCM performance with focus on the AI system integration. This process involves establishing a framework of a tree structure that was aimed at showing the interactions and impacts of the various elements, from this tree structure we would then be able to see the direct and indirect impacts of AI technologies on the supply chain complexities. These include identification of variables of concern, validating the existence of the relationships through the use of experts, and the development of a structural model to display the complex interdependent and hierarchical

patterns of the variables of concern. ISM enables this study to map interactions in AI enabled SCM, allowing for understanding what applications exert the greatest effects and how they interact within the context of textile supply chain. The steps of the research methodology are shown in figure 1.

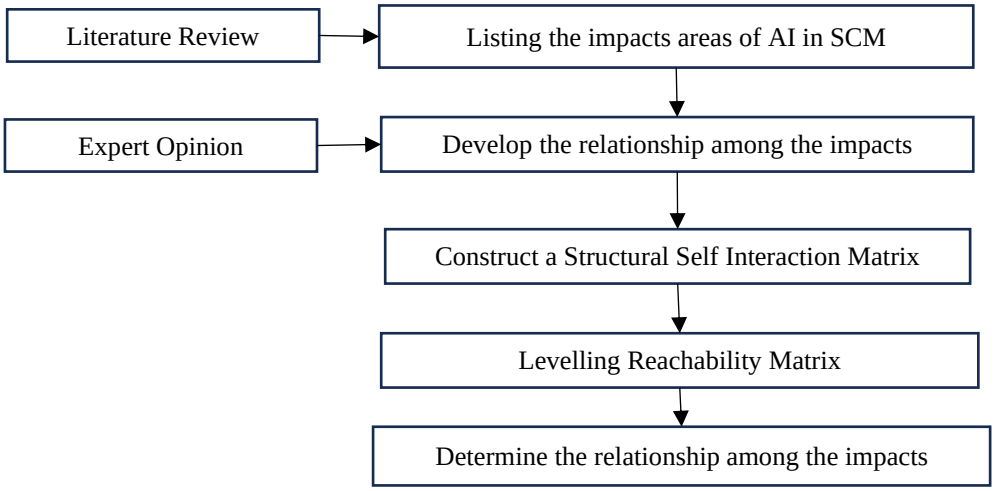


Fig. 1: Steps of Research methodology

From the literature study findings, the authors of this paper have determined the following impacts and their implications for the use of AI in modern SCM. Table 1 displays each of the variables and sources mentioned. The writers suggested essential components for the group discussion based on literature reviews and related research. During the group discussion, industry experts took into account the elements based on Bangladesh's industry scenario, controllability, and their ability to be implemented in the industry. Because industrialization depends on a wide range of factors, industry practices and cultures vary from one place to another. The study's practical scenario is its main emphasis. The study's practical scenario is its main significance. As previously stated, the goal of the research's collaborators was to provide a practical strategy for the near future. Decision-making in this regard really takes Bangladeshis' implementation skills into account.

For variables, a structural self-interaction matrix (SSIM) is created, which shows the pairwise relationships between the variables in the system in question. The direction of the link between the criteria is shown by four symbols.

V: Criteria *I* and *J* will follow from each other.

A: Criteria *I* will follow from Criteria *J*.

X: Criterion *I* will lead to criterion *J*.

O: Criteria *I* and *J* have no connection.

The SSIM is used to build the reachability matrix. It aids in the creation of the "final reachability matrix." One fundamental tenet of ISM is the transitivity of contextual interactions. It asserts that variable A will inevitably be associated to variable *C* if variable *A* is related to *B* and *B* is related to *C*. It was created with Microsoft Excel 2022.

• The value of the *(i, j)* entry in this reachability matrix is 1 and, as a result, the value of the *(j, i)* entry is 0 if the relation of the *(i, j)* item in the SSIM is *V*.

• The value of the *(i, j)* entry in this reachability matrix is 0 and, as a result, the value of the *(j, i)* entry is 1 if the relation of the *(i, j)* item in the SSIM is *A*.

• The *(i, j)* entry in this reachability matrix has a value of 1, and the *(j, i)* entry also has a value of 1, if the relation of the *(i, j)* entry in the SSIM is *X*.

• The value of the *(i, j)* entry in this reachability matrix is zero, and as a result, the value of the *(j, i)* entry is zero, if the relation of the *(i, j)* item in the SSIM is *O*.

There are several layers of classification or partitioning for the reachability set. The reachability set, antecedent set, and intersection set are determined using the reachability matrix. Both the factor itself and the factors it will help attain in GSCM are part of the reachability set. The factor itself is part of the antecedent set, and the factors will drive this. The factors that intersect between the antecedent and reachability sets are included in the intersection set. At the top level, factors with the lowest reachability set are divided. It suggests that no additional variables will result from this factor [41].

4. Result and Discussion

The structural self-interaction matrix is developed from the reports of targeted group discussions and individual surveys of industry specialists. The SSIM matrix is displayed in Table 2.

Table 2: Structural Self-interaction Matrix

	j				
i	1	2	3	4	5
1	*X*	*A*	*V*	*A*	*A*
2		*X*	*V*	*V*	*V*
3			*X*	*A*	*A*
4				*X*	*A*
5					*X*

Five such factors are deemed critical to attaining optimum efficiency and response characteristics in the management of Bangladesh's textile supply chain under AI. Inventory Management: impact 1 is highly significant here as AI is used to dynamically control the stocks and timely replenishment of the same cuts down the expenses while on the other side the order delivery ratio is optimally maintained. Demand Forecasting impact 2 is a way of using data modelling techniques aimed at predicting potential customer demand in a way that makes it possible for manufacturers to alter their production and hold inventory in a way that will make sourcing of materials more efficient, with great value given to resource utilization hence sustainable profitability. Logistics and transportation subfield has 3 benefits for AI: Improved route planning and dynamic scheduling minimize the time and cost of transportation. Supplier Selection: also, the impact 4 is advanced by AI algorithms that seek to evaluate reliability, quality and price of the suppliers so it becomes easy for the companies to source for their supplies in the right manner considering the costs standards as well as the quality.

Table 3: Final Reachability Matrix

	j					
i	1	2	3	4	5	Driving Power
1	1	0	1	0	0	2
2	1	1	1	1	1	5
3	0	0	1	0	0	1
4	1	0	1	1	0	3
5	1	0	1	1	1	4
Dependence	4	1	5	3	2	

Table 4: Summary of Level portion

Impact	Reachability set	Antecedent Set	Intersection Set	Level
1	1,3	1,3	1	II
2	2,5,4,1,3	2,5,4,1,3	2	V
3	3	3	3	I
4	4,1,3	4,1,3	4	III
5	5,4,1,3	5,4,1,3	5	IV

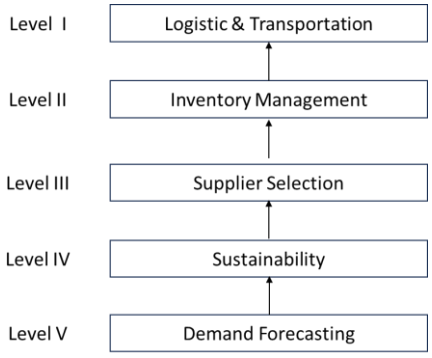


Fig. 2: Classification of impact

Last but not least, Sustainability impact 5 becomes a priority as AI orients the sector to the monitoring and minimization of environmental effects in the supply chain, sourcing, production, and delivery. Altogether, these describe an extensive AI-based strategy for optimizing the performance of the textile chain in Bangladesh. From the original reachability matrix at Table 2, the final reachability matrix in Table 3 is obtained. Table 4 provides a summary of the factors' iterations and level portions. Fig. 2 shows the relational diagraph of the impacts based on the leveling divisions and the reachability matrix.

5. Conclusion

The objective of the study was to show the integration of artificial intelligence in Supply Chain Management in the textile sector of Bangladesh which has been presented in this study. Viewing it through the lens of inventory management, demand forecasting, logistic & transportation, supplier selection and sustainability, it becomes apparent that AI indicates well for efficiency of the administration and financial responsibility, and profitability as well as its environmental management. ISM methodology helped unmask interconnections of these AI-related factors regarding SCM, which provided a conceptual map of how the integration of AI can improve SCM methodologies. The findings explain the fact that AI enhance the sustainability of competitiveness of the Bangladeshi textile sector in the world market. Future works can expound on the development of these new AI technologies and how other issues such as data privacy and multiplex system integration should be tackled in order to enhance further development in SCM. Five components are analyzed for the study utilizing a relevant literature review, though this is not an exhaustive analysis. It is predicated on qualitative information from professionals in the field. However, opinions may be evaluated differently by different experts, industries, and nations. The study may have biases because it is dependent on the knowledge management of experts. Ongoing research in this area is necessary to determine how the variables interact in various contexts across various sectors.

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