# Enhancing the Supply Chain Management in Construction using Artificial Intelligence

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**Abstract**

A new wave of digitization is reshaping the construction industry, but it also brings a wealth of new prospects. Building materials manufacturing, planning, design, and construction are all in a supply chain projected to be boosted by artificial intelligence. Along with this, facility management is also expected to benefit from this technology. Choosing the optimal project management solution, particularly for major building projects, is sometimes complicated and fraught with uncertainty. As per the original references, the success and efficiency of project management rely on using three pillars called "Management involvement,""create and streaming systems," and "using the tools."Tools and procedures are directly in the knowledge areas of executives andengineers.On the other hand, the other two pillars rely on the outputs of the tools and procedures indirectly. As a result, tools and methods play a critical part in project management's effective implementation. However, artificial intelligence includes collectingdata, induction, and experiment analysis to comprehend human intelligence modeling and non-numerical methods to solve complicated issues. Hence it can be used as a tool in four major fields: Integration Management, Project Procurement Management, Project Risk Management, and Project Communications Management;they can be used in numerous applications.

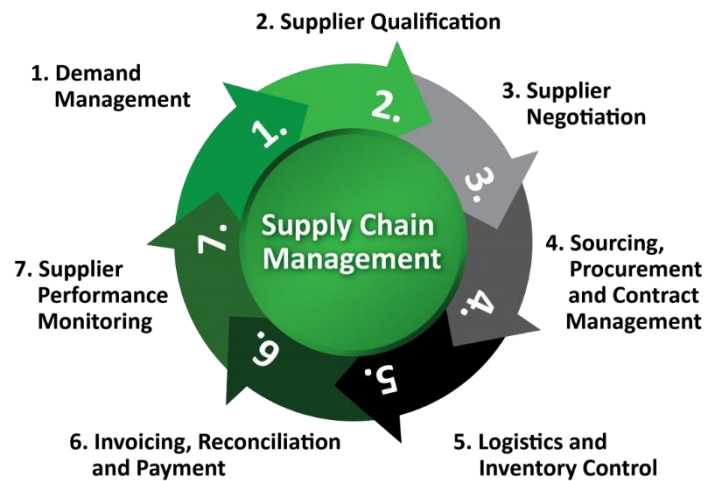**Keywords**: AI in construction Supply chain management, Artificial intelligence.

## 1. Introduction

Procurement is defined as a process of acquiring new resources, materials, and services needed for a company to execute its project. The term is also called the services and materials required for a project from its start till its completion. It also encompasses the supply chain in the material procurement process. Procurement allows obtaining the products required in an organization, while Supply Chain Management is a wide system followed to finalize a product. SCM must only be considered one of the duties a procurement department must deal with.

SCM and procurement will, in the end, assist organizations in maximizing earnings. It is carried out by reducing the cost of balancing, quality of goods from suppliers, supply assurance, and increasing innovation from the supplier. The supply chain network comprises suppliers, manufacturers, providers of logistics, and other

Fig.1 Supply chain management cycle. Source: imgbin.com



professionals involved in delivering a product to a customer. The supply chain comprises the collectors of raw materials, transport and logistic organizations and storage/ware houses, and the functions and tasks which helps in moving a product.

### 2. Literature review

Murat Gunaydın*et al.* (2003) presented a model for estimating the cost of a structural system of reinforced concrete skeleton buildings when it is in the early phase of design using the technology of ANN (Artificial Neural Network). Seyed Hossein et al. (2008) further listed the uses of ANN for forecasting actual project costs as per the Earned Value Management System (EVMS) by randomly selecting the projects as per the standard set of data. In their model, KimaHee et al. (2004) added the Back-Propagation Network along with the GA (Genetic Algorithms) used for estimating the cost. BPN and GA were used for determining the parameters of the BPN and for enhancing the accuracy of cost estimation. In India, the construction industry is the second highest blooming sector after agriculture and is rapidly developing by adapting the latest technologies. Gayatri, Mahajan & Patil (2019) stated that in the construction field using, IoT devices like smart machines, digital sensors, and other devices operated by mobiles are also widely used. Artificial Intelligence, out of all the technologies, provides a novel solution to the issues faced in the construction industry. Mohsen Hatami et al., (2019).

### 3. ARTIFICIAL INTELLIGENCE (AI)

Artificial Intelligence (AI) is a fast-developing technology increasingly becoming a part of our daily lives. Artificial intelligence strives to create a smart system that can learn, plan, reason, comprehend, and process natural language the same way humans can. Most difficulties can be solved with the help of artificial intelligence. AI technology has the potential to solve challenges in the construction sector. AI will play a key role in the future in enhancing quality, productivity, and safety on the construction site. [4]. AI uses the computing capability of computers to simulate human intellect. AI makes use of the concept of ML for storing data, making the system work fast and more efficiently.

### 4. OBJECTIVES OF THE STUDY

i. This research is conducted to get detailed knowledge about the Artificial Intelligence system and its applications in construction projects and management.
ii. The present research would also attempt to study the different AI domains and determine the best area where AI could be applied in SCM of the construction and manufacturing sector.

### 5.    RESEARCH METHODOLOGY

The study was designed to gather input from the industry on artificial intelligence's understanding, application areas, utilization, practicality, and dependability in construction project management. Survey analysis was distributed for collecting respondent responses. Following are the steps followed in carrying out this research:

Step 1: Identify the employees working in construction industries who use AI and the experienced workers in this industry who are willing to use AI in their workflow.

Step 2: To identify the key areas of application in construction project management where AI methods can be used. Through a detailed literature analysis, the major applications were picked which were best suited and most used in the construction industry, specifically in project management. Below given is the list of applications areas extracted from the literature review:

(a)  Scheduling and planning the Projects
(b)  Site Layout
(c)  Managing contracts
(d)  Duration and Cost estimation for Projects
(e)  Managing Logistics
(f)  Accident and Traffic Management
(g)  Forecasting the demand
(h)  Providing Safety
(i)  BIM Integration

Step 3: To identify different technologies or logic that can implement AI. Every researcher uses different AI technology in their studies. Therefore, capturing the technology/logic is vital for conducting a thorough review. According to the literature review, below listed technologies are identified:

(a)  Neural Networks
(b)  Robotics
(c)  Fuzzy logic systems
(d)  Expert systems
(e)  Natural Language processing

| Sr no. | Users | Tool/technique | Activity |
|---|---|---|---|
| 1 | Designers | Autodesk's Generative Design | -To edit<br>-To select<br>-To generate option |
| 2 | Estimators | Combined AI with BIM | Estimations with higher accuracy and rapidly. |
| 3 | SafetyManager | Smart | Visual processing algorithms are riskprevention & monitoring tools. |

| 4 | Project Manager | Drones,Sensors,Cameras,Doxel | -To schedule a project<br>- To measure the amount of material<br>-Job-site activity |
| 5 | Foreman | The 3D model | Detecting defects, inconsistencies or error |

**Table:1** Summary of AI application in the construction industry

In addition to the uses listed above, the following are particular examples of how AI has aided the construction sector.



Fig.2 Survey questionnaire.

Step 4: Survey analysis was carried out to capture the industry's response for identifying findings from the literature review for understanding the part of AI in project management in the construction industry. The survey was given to all the identified respondents. The questionnaire was comprised of three parts:

Part 1: General data of the respondents were asked. Awareness and knowledge of respondents regarding Artificial Intelligence were checked in the first part of this survey form. The required data is:

1. Name of Organisation using AI.

2. Technology/Logic being used with AI.

3. Issues in using AI.

Part 2: Areas of AI application in construction project management for selecting the best possible field in which AI will be the most effective and feasible application based on the knowledge and expertise of the respondents. The results were analyzed on a 3-Point Likert Scale with a least to the most feasible range.

| 1 | 2 | 3 |
|---|---|---|
| Least Feasible | Moderately feasible | Most Feasible |

Fig.3 Three-point ranging survey.

Part 3: Effects of AI in an organization are captured in the third part. To check if AI implementation would bring in some effective changes w.r.t work quality, time, cost, productivity and if it has helped their competitive advantage.
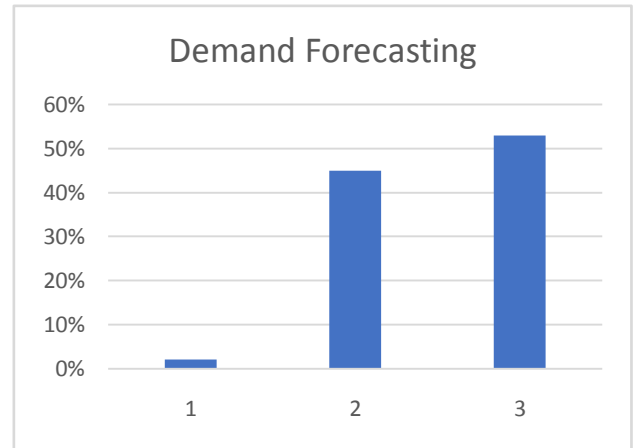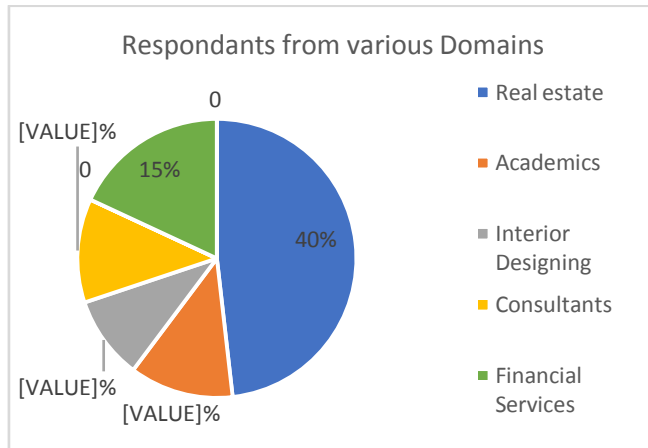
## 6.  Data Analysis and Findings:



Fig.4 Breakup of respondents from various domains.



Fig. 5. Demand forecasting results.

**6.0.1**   The outcomes of AI applications in the Construction supply chain management.
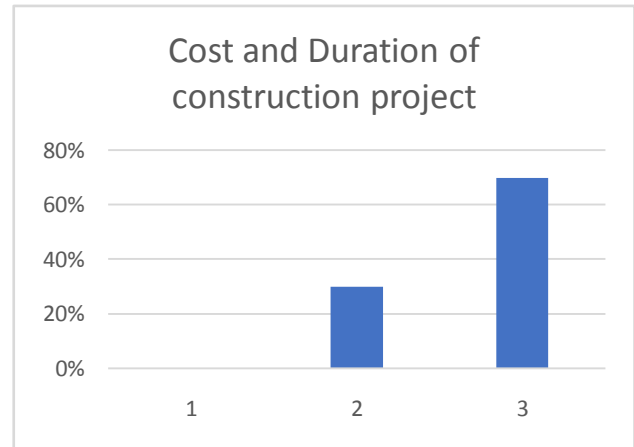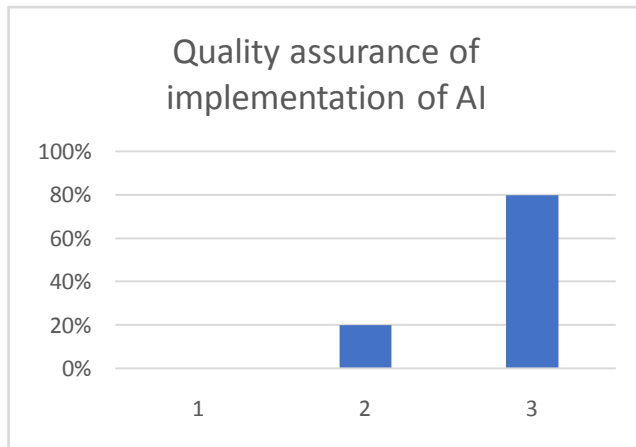




Fig. 6 Quality assurance of implementation of AI.          Fig.
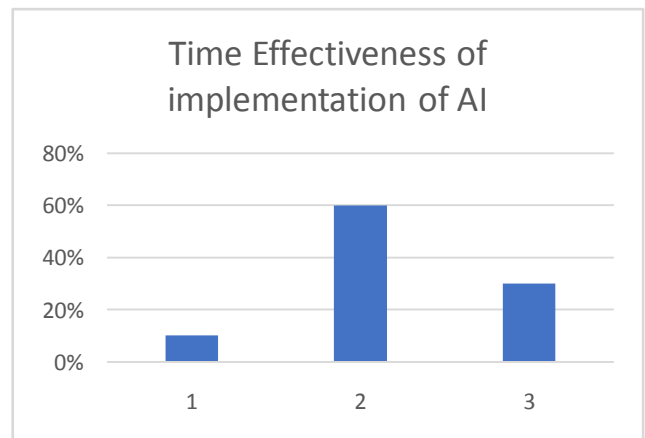5. Cost and Duration of construction project.





Fig. 8. Logistics management results.   Fig. 9. Time effectiveness of implementation of AI.

**6.2 Findings**

- Some major factors in SCM affect the project, like low contractor experience, inaccurate forecast of demand, lack of proper financial stability, improper resource management, and longer lead time. These factors can be minimized or can remove the effects by using AI.
- AI comes with many tools like Neural networks, Machine Learning, genetic algorithms, agent-based systems, expert systems, etc., used in these processes.
- These AI technologies may help improve the SCM process and solve many of the issues in it. And AI has aided them in automating several manual tasks.
- AI has been proposed as a beneficial decision-aid tool for connecting the firm's suppliers, customers, and SC partners by simplifying information flow across multiple business units.

**Conclusion**

Some major factors in SCM affect the project, like low contractor experience, inaccurate forecast of demand, lack of proper financial stability, improper resource management, and longer lead time. AI comes with many tools like Neural networks, Machine Learning, genetic algorithms, agent-based systems, expert systems, etc. These tools can change the entire process of SCM and help solve the many issues that might occur in management. AI technology has also helped to eliminate the efforts of human activities.

**Reference**

[1] Nie-Jia Yau, and Jyh-Bin Yang, "Case-Based Reasoning in Construction Management", Computer-Aided Civil and Infrastructure Engineering, 1998.

[2] RemonFayek Aziz, Sherif Mohamed Hafez, and Yasser Ragab AbuelMagd "Smart optimization for mega construction projects using artificial intelligence", Alexandria Engineering Journal, 2014.

[3] MeghaJaina, and K. K. Pathak, "Applications of Artificial Neural Network in Construction Engineering and Management-A Review", International Journal of Engineering Technology, Management and Applied Sciences, vol. 2, no. 3, 2014.

[4] Gunaydın H. Murat, Zeynep Do S. gan, "A neural network approach for early cost estimation of structural systems of buildings" International Journal of Project Management vol. 22, pp. 595–602, 2004.

[5] Seyed Hossein Iranmanesh, and MansourehZarezadeh, "Application of Artificial Neural Network to Forecast Actual Cost of a Project to Improve Earned Value Management System "World Academy of Science, Engineering and Technology 2008, pp. 210-213.

[6] Mohsen Hatami, Ian Flood, Bryan Franz, Xun Zhang, State-of-the-Art Review on the Applicability of AI Methods to Automated Construction Manufacturing, Computing in Civil Engineering 2019.

[7] Cheung, Sai On, Wong, Peter ShekPui, Fung, Ada S. Y., and Coffey, Vaughan, "Predicting project performance through neural networks." International Journal of Project Management, 24(3), 2006 207-215

[8] Aziz Muysinaliyev, "Supply chain management concepts: literature review", IOSR Journal of Business and Management (IOSRJBM)",2014.

[9] Charles Scott, Roy Westbrook' "New Strategic Tools for Supply Chain Management", 2013

[10] AsseyMbang Janvier-James, "A New Introduction to Supply Chains and Supply Chain Management: Definitions and Theories Perspective",2012