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Application of ABC & EOQ Analysis in Construction Resource Scheduling & Inventory Control: A Complete Study

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Abstract: *Efficient resource management is a critical factor in the successful execution of construction projects. This study focuses on the application of ABC Analysis and Economic Order Quantity (EOQ) techniques for improving material planning and inventory control. A residential building project was analyzed using Primavera to develop planned and actual schedules based on real site data. Materials such as cement, steel, bricks, and tiles were evaluated to understand their cost contribution and consumption pattern. ABC analysis was used to classify materials based on their importance, while EOQ was applied to determine the optimal ordering quantity. The results indicate that improper ordering leads to increased holding cost and overall project expense. By integrating scheduling with inventory control techniques, better resource utilization and cost efficiency can be achieved. This study highlights the importance of systematic planning in reducing waste, avoiding delays, and improving project performance..*

Keywords: Construction Project Management, Resource Management, Material Planning, Inventory Control, ABC Analysis, EOQ (Economic Order Quantity), Primavera Scheduling, Cost Optimization**.**

I. INTRODUCTION

Construction projects are highly dependent on effective resource management, which includes materials, labor, equipment, time, and cost. Among these, material management plays a major role as it contributes a significant portion of the total project cost. In many construction projects, improper planning and poor coordination lead to delays, wastage of materials, and increased expenses. The availability of materials at the right time is essential to maintain continuous workflow and avoid interruptions. Therefore, efficient planning and control of resources are necessary to achieve project objectives related to time, cost, and quality.

In recent years, the complexity of construction projects has increased due to rapid urbanization, advanced construction techniques, and higher client expectations. Modern projects involve multiple stakeholders such as contractors, suppliers, consultants, and subcontractors, making coordination more challenging. Any delay in communication or resource supply can directly affect project progress. Traditional methods of resource management are often not sufficient to handle such complexity. Hence, there is a growing need for systematic and analytical approaches to improve project performance.

One of the major challenges observed in construction projects is the lack of proper inventory control and material planning. Overstocking leads to increased holding cost and material damage, while understocking results in delays and disruption of work. To overcome these issues, techniques such as ABC Analysis and Economic Order Quantity (EOQ) can be effectively applied. ABC Analysis helps in classifying materials based on their importance and cost, allowing better focus on critical items. EOQ, on the other hand, determines the optimum order quantity that minimizes total inventory cost.

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In this study, a real residential construction project was analyzed to understand the practical application of these techniques. Project scheduling was carried out using Primavera software, and material data was collected from actual site records. ABC Analysis and EOQ calculations were performed for key construction materials such as cement, steel, bricks, and tiles. The integration of scheduling with inventory control provided better insight into material usage and cost optimization.

The main objective of this study is to demonstrate how systematic application of ABC and EOQ techniques can improve resource planning and project efficiency. The findings highlight that proper material management reduces waste, avoids delays, and ensures smooth execution of construction activities. This study emphasizes the importance of bridging the gap between theoretical methods and their practical implementation at the construction site.

II. METHODOLOGY

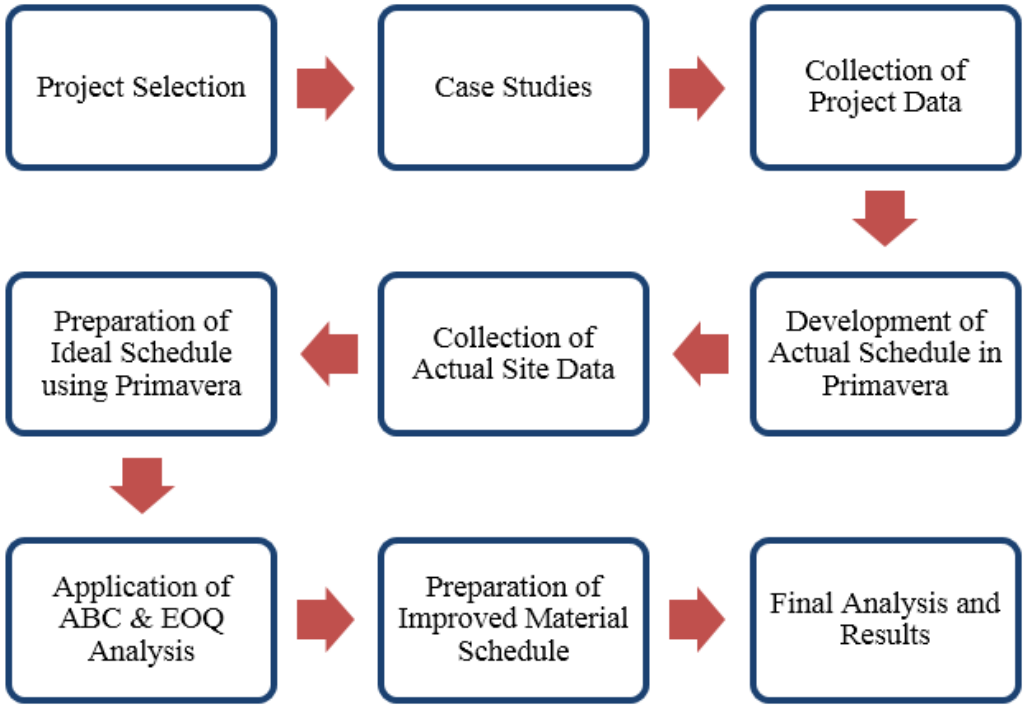

Figure 1 Work Flow Chart

The methodology adopted in this study is based on the analysis of real construction project data and the application of systematic resource management techniques. A residential building project was selected as a case study to understand the practical challenges in construction planning and material management.

Initially, all relevant project data such as Bill of Quantities (BOQ), steel consumption sheets, site records, and project drawings were collected. This data helped in understanding the actual scope of work, material requirements, and execution sequence. Based on the BOQ, an ideal project schedule was prepared using Primavera software, which represents the planned execution of activities under proper management conditions.

Further, actual site data including work progress, quantities executed, and resource utilization were collected from the construction site. This data was used to develop the actual project schedule in Primavera. A comparison between the planned and actual schedules was then carried out to identify deviations in terms of time, cost, and material usage. This comparison helped in understanding the gaps in planning and execution.

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After analyzing the schedule, material quantity analysis was performed to evaluate the consumption of major construction materials such as cement, steel, bricks, and tiles. ABC Analysis was then applied to classify these materials into different categories based on their cost significance and importance. This classification helped in identifying critical materials that require strict control and monitoring.

In addition, Economic Order Quantity (EOQ) analysis was performed to determine the optimal quantity of materials to be ordered. EOQ helps in minimizing the total cost by balancing ordering cost and holding cost. Based on EOQ results, an improved material planning strategy was developed.

Finally, the results of ABC and EOQ analysis were integrated with the project schedule to develop an optimized resource management approach. This methodology helps in improving material availability, reducing wastage, and enhancing overall project efficiency.

Table 1 ABC Analysis Result (Cost Contribution)

Material	Contribution
Steel	41%
Cement	17%
Brick	11%
Tiles	9%
Paint	6%

Table 2 EOQ Analysis Result

Material	EOQ	Orders/Year	Total Cost
Cement	1,317	25	50,000
Steel	29 MT	17	1,72,000
Brick	70,711	14	56,000
Tiles	707	11	55,780

III. RESULT

The analysis of the selected residential construction project provided significant insights into resource utilization and material management practices. The comparison between planned and actual schedules revealed deviations in activity durations, material consumption, and resource allocation, indicating inefficiencies in site-level planning and execution. These deviations were mainly caused by improper coordination, delayed material supply, and lack of systematic inventory control.

The ABC Analysis results showed that a small number of materials contribute to a major portion of the total project cost. Materials such as steel and cement were identified under Category A, contributing approximately 58% of the total cost, while bricks and tiles also formed part of the high-value group. Medium-value materials such as paint and putty were classified under Category B, whereas sand and aggregate were placed under Category C due to their relatively lower cost contribution. This classification highlights the need for strict monitoring and control of high-value materials to optimize project cost.

The EOQ Analysis provided optimal ordering quantities for major construction materials. The calculated EOQ values were 1,317 bags for cement, 29 MT for steel, 70,711 units for bricks, and 707 m² for tiles. Based on these values, the number of orders per year and time intervals were determined, which ensured a balance between ordering cost and holding cost. The total inventory cost was found to be minimized when materials were ordered according to EOQ.

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A comparison between EOQ-based ordering and actual high-quantity ordering practices demonstrated that ordering beyond the optimal quantity leads to a significant increase in holding cost. Although the number of orders decreases, the overall inventory cost increases due to excess storage. For example, in the case of cement and steel, higher order quantities resulted in a noticeable rise in total cost, confirming the effectiveness of EOQ in cost optimization.

It was also found that the gap between planned and actual performance can be reduced by adopting systematic inventory control techniques. Projects that rely on traditional methods often face issues such as delay in material supply and inaccurate estimation. The application of ABC and EOQ helps in minimizing such deviations and improves overall project reliability.

Additionally, the use of Primavera for scheduling provided a clear visualization of resource demand over time. This helped in identifying peak material requirements and planning procurement accordingly. As a result, resource conflicts and idle time were minimized, leading to better productivity at the construction site.

Finally, the results demonstrate that adopting analytical tools in construction management not only improves cost efficiency but also enhances project control and decision-making. The combined use of scheduling, ABC analysis, and EOQ creates a more organized and efficient system for managing construction resources.

IV. CONCLUSION

This study focused on improving construction resource management by applying ABC Analysis and Economic Order Quantity (EOQ) techniques to a residential building project. The analysis of planned and actual schedules revealed that improper material planning and lack of coordination are major causes of delays and cost overruns in construction projects. It was observed that traditional methods of material management are not sufficient to handle the complexity of modern construction activities.

The results of ABC Analysis showed that a small number of materials, such as steel and cement, contribute to a large portion of the total project cost and therefore require strict control and continuous monitoring. EOQ Analysis helped in determining the optimal order quantity for major materials, which minimizes the total inventory cost by balancing ordering and holding costs. The comparison with actual practices clearly demonstrated that ordering quantities beyond EOQ leads to higher total cost due to increased storage and handling expenses.

The integration of material planning with project scheduling using Primavera proved to be effective in improving resource allocation and ensuring timely availability of materials. This approach helped in reducing material wastage, avoiding shortages, and maintaining smooth workflow at the construction site. It also enhanced coordination between different project activities and improved overall productivity.

Overall, the study concludes that the combined application of ABC Analysis and EOQ, along with proper scheduling techniques, provides a systematic and practical solution for effective material management in construction projects. The implementation of these techniques can significantly improve cost efficiency, reduce project delays, and enhance project performance. This study also emphasizes the need to adopt modern analytical approaches in real construction practices to bridge the gap between theoretical knowledge and site-level implementation.

The present study can be further extended by integrating advanced technologies such as Building Information Modeling (BIM) and Internet of Things (IoT) for real-time material tracking and monitoring. Future research can also focus on developing automated systems that link scheduling software with inventory control tools for dynamic material planning. The application of artificial intelligence and machine learning techniques can improve demand prediction and decision-making accuracy. Additionally, similar studies can be carried out on different types of construction projects such as infrastructure and commercial buildings to validate the results. Incorporating sustainability aspects, such as waste reduction and efficient resource utilization, can also enhance the overall effectiveness of construction management practices.

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