An Empirical Study of Inventory Management with reference to Construction Sector

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Abstract:

Inventory management is a critical part of construction Industry. Inventory Management system consist of different tasks like finding suitable materials, procurement process of those materials, transportation. Inventories represent the second largest asset category for construction companies, next to plant and equipment. Inventory would be the number of raw materials, fuel and lubricants, spare parts and semi-processed material to be checked inventories for the smooth running of construction firm. The main objective of our study is to investigate the efficiency and its impact in application of inventory management system in construction projects. Identification of impacts and risk influence of inventory management systems in a construction project. The lack of proper handling and storage of material in construction site has made it difficult to track and locate the material availability and suggestion about inventory management system and its control over efficiency construction projects will be analyzed and the outcome of the effective utilization of inventory at construction site to overcome the difficulties by giving best the possible recommendations. ABC analysis is one of the most conventionally inventory management system suited for construction infrastructure.

Keywords: Construction, Efficiency, Inventory, Management, Material, Organizations, Productivity

Introduction

Inventory management plays an important role in the completion of construction project successfully and on time. The role of inventory is to store the materials on site so that those material can be available in time of their use. Inventory not only holds the material required for construction but also store the finished products, spare parts and tools. It is very common in Indian construction industry that the project suffers from cost overrun and exceeding the deadline. The problems like this could be solved by the proper implementation of the inventory management. Which will increase the productivity on site and the progress of project will be consistent. Inventory management consist of many processes like selecting the materials and their procurement, cost involve in transporting them and storage of materials (Malik & Sharma, 2022).

It deals with the various policies and procedures for procurement of commodities. Since it is bit difficult to imagine a real work situation in which required material will be made available at the point of use instantaneously, maintaining inventories becomes almost necessary. Every organization are in need of inventory for easy running of its activities. It acts as a link between production and distribution process. Thus, it is essential to have proper control and management of inventories. The need of inventory management is to make sure that the availability of materials in appropriate quantity and when required and also to reduce investment in inventories (Thrishna & Harish, 2018).

Inventory management is a challenging problem area in supply chain management. Companies need to have inventories in warehouses in order to fulfil customer demand, meanwhile these inventories have holding costs and this is frozen fund that can be lost. Therefore, the task of inventory management is to find the quantity of inventories that will fulfil the demand, avoiding overstocks.

In construction industry one of the big problems is project delay due to material shortages. To overcome this problem, material should be procured at correct time and dumped at correct place. The basic purpose of inventory holding stocks in a material flow system are to double successful stage of following system is important purpose of inventory. The importance of the project is trying to avoid the over dump and correct procurement of the material for building works at right time. This can be done with the help of inventory management. In this inventory system, the required amount of building material is calculated by detailed study of plan. The whole inventory management chart is classified into different dates for easy work flow. So, the required number of materials for different works is released according to it. It also increases the efficiency of work and it will flow continuously without any barrier.

The supervisor can easily understand the inventory chart, quantity of materials require for the work and purchase of the materials is done according to it. Over dumping of materials occupies more land and amount will be released earlier. With the help of inventory chart the over dumping is avoided. The study focuses on to minimize and control the construction cost of a construction project. To minimize the cost of a project there are different methods such as quality management, time management etc. Inventory management will be very useful in getting the right quality & right quantity of supplies at right time, having good inventory control & adopting sound methods of condemnation & disposal will improve the efficiency of the organization. If managers keep too much inventory on hand, they will waste money on storing it and lose money if inventories are damaged or stolen.

So, the main scope of the project is the control of materials which get deteriorated.ie it avoids the wastage of materials. The study focuses on the assessment of factors influencing inventory management and analysis of inventory control technique on multi-storey buildings.

Literature Review

The review of literature was conducted to understand various aspects of the inventory management system adopted by various organizations. Nozari, et al. (2022) study deals with modeling and solving a multi-stage stochastic inventory management problem for transport companies, including several different transport modes. The results of the problem analysis show that the increase of uncertainty rate in different scenarios due to the increase in the amount of demand from cargo, transmission, and maintenance costs have increased. In return, the total network costs have also increased. Shokouhifar, Sabbaghi, and Pilevari (2021) proposed an inventory management model for age-distinct platelets under uncertainty for blood supply chains. To solve the proposed model, they used the whale optimization algorithm, considering the costs of ordering from blood and lateral transfer centers, transportation, inventory maintenance, shortage, and waste. Orobia, et al. (2020) study was two-fold i.e., to establish the relationship between inventory management, managerial competence and financial performance and to test whether inventory management mediates the relationship between managerial competence and financial performance. The results indicate that inventory management and managerial competence are significantly associated with financial performance of small businesses. Further, inventory management partially mediates the relationship between managerial competence and financial performance. Jebisha (2019) studied the going practices for material management in construction project and inventory control techniques like ABC classification, EOQ analysis and SPSS software. The study found that the supervision was inefficient, poor communication between the team which overall lead to improper and frequent moving of material on construction site. All these lead to cost increased not only in project but also in holding or storing of the inventory materials that all finally delays the completion of the project. Panigrahi, et al. (2019) studied to pick out how different organization use the inventory management techniques to operate their inventory at optimal level. Authors' objective of this study was to find the various advanced inventory management accepted by the manufacturer of steel and to find the link between the efficiency of manufacturing industry and advanced inventory management. The study found from the study that recently services, cost quality, flexibility in performance and innovation have a huge impact to make good inventory management. The factors like reduction of wastage, improvement in

production, minimizing manufacturing downtime, reduce number of scraps and rejects can be solved by the techniques in advanced inventory management.

Sohail and Sheikh (2018) studied the connection between the company's performance and the material management. He studied the case study of small industry who is manufacturing steel. He found that performance of the company based on inventory days and return on Asset analysis. The author gathered data through different interface and through structured and unstructured interviews. He considered the annual reports and magazines articles. He found that the company should order their material regularly instead of ordering in bulk, he also suggested that despite managing inventory well, company should also use the modern technology to get the better hold onto its inventory. Kameshwar and Saravanan (2017) studied about the effective system of inventory management present in the construction industry. The objective of this paper is reducing the total cost of inventory and achieve the optimum quantities of items for the construction at right time. The authors analgised 41 different materials from different work in construction, for example safety helmets, PVC cover block, measure tape, Shovel, mortar and etc. The authors suggested that inventory management team should replenish multi-item jointly to reduce the ordering cost. The authors also suggested 7 points explaining different techniques that can be used and what materials are important, are in continuous use throughout the project. Tundura and Wanyoike (2016) researched about the effect of inventory management strategies. The authors focused on three strategies of inventory control; Computerized inventory accuracy, cycle counting and inventory coding. The objective of this paper to find the effect of computerized inventory management on inventory record accuracy, to find the effect of cycle counting on inventory management. There after the authors mentioned the effects of cycle counting, inventory coding and computerized inventory on inventory record accuracy by using literature reviews. The authors used the Pearson correlation to establish the relation between the three strategies and as a result, authors recommend that cycle counting is a good determinant in accuracy.

Pande and Sabihuddin (2015) studied about the implementation of the inventory management techniques and how it will affect the management of the items on construction site. The authors adopted quantitative and qualitative methodologies. The authors found that by using the EOQ analysis, he managed to solve the issue to stock out of cement bags. He showed the result of S-curve Analysis and identified the problem of variations in planned cost and actual cost of the material like problem with availability of RCC drawings and procurement of materials. Raphella, et al. (2014) studied the process of analyzing the company's current forecasting model and recommending an inventory control model to help them solve their current issue. The study concluded that Inventory problems of too great or too small quantities on hand can cause business failures. If an organization experiences stockout of a critical inventory item, production halts could result. Inventory management indicates the broad frame work of managing inventory. The inventory management technique was more useful in determine the optimum level of inventory and finding answers to problem of safety stock and lead time. Sindhu, et al. (2014) objective of the study was to analyze the inventory management control adopted and the effective utilization of inventory at the construction site. The inventory management risk was being identified in construction industries in India such as lack of storage space, problems with de-centralized processing, inadequate training practices, improper financial support in ordering of materials, difficulty in delivery of long lead materials.

Arunprakash and Nandhini (2013) studied about the material control exercises adopted by different construction companies. Different criteria analyzed include the kind of material stock, maintain stock for equipment spares, maintain stock for materials, stock for sand, brick, aggregate, steel rod, primer, cement, maintaining documents, reorder of stocks and stock management. The study found that 50%-60% companies only focused on important materials like cement and steel. Rest of the materials and their availability on site decreased as they were less important for the companies and required lot of space to hold those materials. Mahapatra, et al. (2012) stated that the involvement of contractor in material management, need for stock management, managing stock in growth of company, importance to stock comparing other works and maintaining safety in storing. Inventory management system is considered to perform a key role in an

organization, which is responsible to complete the company's project in a specific budget within a certain period of time.

Research Objective and Hypotheses

The primary objective of the study is to analyse the inventory management practices of the construction firms and analyse the general details of the respondent firms.

The following research hypotheses are developed in the study:

H1: There is a significant relationship between the sources of raw material with the age, education qualification, experience in construction, category of the construction projects and types of organization.

H2: There is a significant relationship between the method of raw material procurement with the age, education qualification, experience in construction, category of the construction projects and types of organization.

H3: There is a significant relationship between the method of maintaining stores ledger with the age, education qualification, experience in construction, category of the construction projects and types of organization.

Research Methodology

The study uses data from both primary and secondary sources. The secondary data is collected from journals, books, magazines, reports on the construction industry, CREDAI, and other internet sources. The primary data is supplemented with the data collected from secondary sources. For the purpose of the study, registered construction builders in Apartment Builders Association (ABA) and CREDAI, an apex body for private real estate developers of Visakhapatnam constitute the total population. As per the latest records, there are approximately 600 registered construction builders in Visakhapatnam. The study covers 10% of the total number of registered builders, thus, the sample size is 60 builders who are in this business for quite some time and established themselves as reputed builders. To collect the required data a structured questionnaire was designed and approached the construction builders. To analyse the collected data, the statistical techniques such as frequency, percentages and chi-square analysis are used with the help of SPSS software.

General Information of the Respondents

To study analyzes the efficiency of receivables and payables practices in the building construction firms. The general information about the respondents related to age category, education qualification, experience in the construction field, category of construction projects taken up, and working capital mechanism is shown in table-1.

Table-1. General Information about the Respondents (n=60)

Factor	Frequency	Percent
Age		
Below 30 Years	1	2%
31 - 35 Years	3	5%
36 - 40 Years	8	13%
41 - 45 Years	14	23%
45 - 50 Years	18	30%
Above 50 Years	16	27%
Education Qualification		
Graduate	37	62%
Post Graduate	21	35%

Professional	2	3%
Experience in the construction field		
Below 5 Years	15	25%
6 - 10 Years	21	35%
11 -15 Years	13	22%
16 - 20 Years	8	13%
Above 20 Years	3	5%
Category of the Construction Projects		
Residential	39	65%
Commercial	8	13%
Both	13	22%
Type of Organizations		
Sole Proprietorship	24	40
Partnership firm	28	47
Joint Stock Company	5	8
Family Business	3	5

The demographic status 30 per cent of the respondents are in the age group of 45 - 50 years and 27 per cent are above 50 years of age. There are 23 per cent of the respondents in the group of 41 - 45 years, 13 per cent are in the age group of 36 - 40 years, 5 per cent belong to 31 – 35 years of age and only 2 per cent are below 30 years. The educational qualification of the respondents shows that 60 per cent are graduates, 35 per cent are postgraduates, and only 3 per cent are professionals. The experience of the respondents in the construction field reveals that 35 per cent have 6 - 10 years of experience. There are 25 per cent of the respondents having below 5 years of experience, 22 per cent have 11 – 15 years of experience, 13 per cent of the respondents have 16 – 20 years of experience, and only 5 per cent of the respondents have above 20 years of experience in the construction field.

The category of the construction projects taken up by the respondents' shows that, 65 per cent have taken up residential projects, 22 per cent have taken up both residential and commercial projects, and 13 per cent have taken up only commercial projects. With regard to the types of organizations, 47 per cent of the firms are partnership form of organizations, 40 per cent of the firms are sole proprietorship form of organizations, 8 per cent of the firms are joint stock companies and 5 per cent of the firms are family operated businesses.

Statistical Data Analysis

The statistical data analysis related to the opinions of the respondents on the inventory management on the sources of materials available, the procurement of raw materials, and maintenance of stores ledger is shown in table-2.

Table-2. Inventory Management Statistics (n=60)

Sl. No.	Parameter	Frequency	Percent
Sources of Raw material			
1	Local market	17	28%
2	Regional market	22	37%
3	National market	11	18%
4	From other Projects	4	7%
5	Government agencies	6	10%
Raw material procurement			
1	Open market	31	52%
2	Tenders	9	15%
3	Contract suppliers	14	23%
4	Imports	2	3%
5	Government	4	7%
Maintenance of Stores ledger			
1	FIFO	37	62%
2	LIFO	2	3%
3	Averages method	21	35%

The analysis reveals that majority of the firm's source of raw material is regional market with 37 per cent. However, 28 per cent of the firm's source of raw material is local market (28 per cent), national market (18 per cent), government agencies (10 per cent), and from other projects (7 per cent). The statistics on raw material procurement reveals that 52 per cent of the firms procure from open market, 23 percent procure the raw materials from contract suppliers, 15 per cent of the firms procure the raw materials through the tenders, 7 per cent of the firms procure from the government and only 3 per cent of the firms procure raw materials through imports. In the case of maintaining the stores ledger, the majority of the firms representing 62 per cent maintain FIFO method of stores ledger, 35 per cent maintain averages method and only 3 per cent maintain LIFO method of stores ledger.

The study analyses the relationship between the sources of materials available, the method of raw materials procurement and maintenance of stores ledger with the respondents age, education qualification, experience in construction field, category of the construction projects and types of organizations.

Table-3. Sources of Raw Material - ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
Age	Regression	4.659	5	.932	3.192	.008[b]
	Residual	144.192	494	.292		
	Total	148.851	499			
Education Qualification	Regression	4.487	5	.897	2.989	.011[b]
	Residual	148.347	494	.300		
	Total	152.835	499			
Experience in construction field	Regression	3.546	5	.709	2.276	.046[b]
	Residual	153.886	494	.312		
	Total	157.432	499			

Category of construction projects	Regression	3.773	5	.755	2.733	.019[b]
	Residual	136.384	494	.276		
	Total	140.157	499			
Types of organizations	Regression	4.227	5	.845	2.565	.026[b]
	Residual	162.814	494	.330		
	Total	167.041	499			

The ANOVA table-3 show the relationship between the source of raw material with the age of the respondents, education qualification and experience of the respondents in construction field, category of construction projects taken up by the respondents and types of organization. It can be observed that the respondent's age (F=3.192, p=0.008<0.05), education qualification (F=2.959, p=0.011<0.05), experience in construction field (F=2.276, p=0.046<0.05), category of construction projects taken up (F=2.733, p=0.019<0.05) and types of organization (F=2.565, p=0.026<0.05) have a significant relationship with the source of raw material. Thus, the test results reveal that the hypothesis related to the relationship between source of raw material with age, education qualification, experience in construction field, category of construction projects taken up and types of organization is accepted.

Table-4. Raw Materials Procurement - ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
Age	Regression	1.655	5	.331	1.253	.283[b]
	Residual	130.493	494	.264		
	Total	132.148	499			
Education Qualification	Regression	6.362	5	1.272	4.994	.000[b]
	Residual	125.863	494	.255		
	Total	132.224	499			
Experience in construction field	Regression	12.361	5	2.472	6.981	.000[b]
	Residual	174.953	494	.354		
	Total	187.314	499			
Category of construction projects	Regression	9.640	5	1.928	4.355	.001[b]
	Residual	218.708	494	.443		
	Total	228.348	499			
Types of organizations	Regression	7.489	5	1.498	4.065	.001[b]
	Residual	182.004	494	.368		
	Total	189.493	499			

The ANOVA table-4 show the relationship between the raw materials procurement with the age of the respondents, education qualification and experience of the respondents in construction field, category of construction projects taken up by the respondents and types of organization. It can be observed that the respondent's age (F=1.253, p=0.283>0.05) do not show a significant relationship with the raw materials procurement. However, the respondent's education qualification (F=4.994, p=0.000<0.05), experience in

construction field (F=6.981, p=0.000<0.05), category of construction projects taken up (F=4.355, p=0.001<0.05) and types of organization (F=4.065, p=0.001<0.05) have a significant relationship with the raw materials procurement. Thus, the test results reveal that the hypothesis related to the relationship between raw material procurement with education qualification, experience in construction field, category of construction projects taken up and types of organization is accepted except age of the respondents.

Table-5. Maintenance of Stores Ledger - ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
Age	Regression	10.517	5	2.103	5.186	.000[b]
	Residual	200.353	494	.406		
	Total	210.870	499			
Education Qualification	Regression	10.433	5	2.087	6.823	.000[b]
	Residual	151.073	494	.306		
	Total	161.506	499			
Experience in construction field	Regression	6.964	5	1.393	3.601	.003[b]
	Residual	191.065	494	.387		
	Total	198.030	499			
Category of construction projects	Regression	2.750	5	.550	2.097	.064[b]
	Residual	129.552	494	.262		
	Total	132.302	499			
Types of organizations	Regression	3.982	5	.796	3.685	.003[b]
	Residual	106.742	494	.216		
	Total	110.724	499			

The ANOVA table-5 show the relationship between the maintenance of stores ledger with the age of the respondents, education qualification and experience of the respondents in construction field, category of construction projects taken up by the respondents and types of organization. It can be observed that the category of construction projects (F=2.097, p=0.064>0.05) do not show a significant relationship with the maintenance of stores ledger. However, the respondent's age (F=5.186, p=0.000<0.05), education qualification (F=6.823, p=0.000<0.05), experience in construction field (F=3.601, p=0.003<0.05), and types of organization (F=3.685, p=0.003<0.05) have a significant relationship with the maintenance of stores ledger. Thus, the test results reveal that the hypothesis related to the relationship between the maintenance of stores ledger with age, education qualification, experience in construction field and types of organization is accepted except category of construction projects taken up by the respondents.

Conclusion

Inventory management system plays a vital role in activities of an organization involved in construction as well as production and supply of producer. Inventories are maintained for the operational smoothness which they can affect by uncoupling successive stage of production, whereas the monetary value of inventory serves as a guide to indicate the size of the investment made to achieve this operational convenience. It can be observed that the source of raw material for majority of the firm's is regional market, procure the raw materials from open market, and maintain FIFO method of stores ledger. Further, the results reveal that sources of raw material, raw materials procurement, and maintenance of stores ledger have a significant relationship with the respondents age, education qualification, experience in construction field, category of construction of projects taken up and types of organization.

There should be a centralized material management team co-ordination between site and organization. In addition to applying inventory management system for small scale projects proper control, tracking and monitoring of the inventory management system is also required which is responsible to complete the company project in a specified budget within a certain period of time efficiency. The common risks are occurred due to the wastages and stock overflows occurred in the construction sites. The inventory management system is useful for small scale buildings also for controlling wastages and making daily records for the material management in construction projects. It helps to control loss of payments and work delay caused by materials.

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