

A Case Study of Analysis of Factor Affecting Material Management and Inventory Management by RII Method

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Abstract: *This research work is on the analysis of the factors affecting effective material managements in building construction projects. Having the right materials in the right place at the right time is important for effective execution of a building project. This study is carried out to fill the voids created by improper materials management on construction site material constitute over 70% of the project cost and may affect overall projects cost if not managed properly. The study describes the case study of nine different small, large and medium firm in Maharashtra. By studying gathered data factors were found out affecting materials management. It was recommended that organizations should incorporate materials managements in the overall policy of the firm in the order to eliminate some of these problems.*

Materials management is a process for planning, executing and controlling field and office activities in construction. The goal of materials management is to ensure that construction materials are available at their point of use when needed. Poor materials management can result in increased costs during construction.

The material cost is almost 50-60% of most construction projects. A better material management and inventory management contributes to the lesser cost for a project and also sustainable use of available resources in the long run. This project aims to identify the major facts affecting material management in the construction project. The various factor at different stage of material management is identified and put in a form of a questionnaire. The Response to The Questionnaire were Obtained from The Stakeholder Such as Architect, Storekeepers, Material Managers, Quantity Surveyors, Site Engineers, Project Managers, And Project Engineers. The Relative Importance of Each Is Arrived at Based on The Ranked Response Obtained from The Questionnaire Survey by Using RII Method. Among The Factor Identified, The Factor 'Unclear Definition of Roles and Responsibilities' Is Ranked as The Major Factor That Affects Materials Management.

Keywords: Material management, Inventory management, Cost efficient Surveying, Percentile Method, Relative Importance Index Method (RII Method)

I. INTRODUCTION

Construction projects depend upon having the right people with right skills and equipment that are able to deliver the project on time and on budget. Having the right materials, in the right place at the right time equally is important and having the cash flow and capital to procure the labour and materials is also important.

Materials management is the system for planning and controlling to ensure that the right quality and quantity of materials and equipment are specified in a timely manner (Donyari and Flanagan, 2009). Material management is a management system that integrates purchasing, shipping and material control from suppliers. Based on those definitions, generally materials management can be defined as a process of planning, executing, and controlling the right source of materials with the exact quality, at the right time and place suitable for minimum cost construction process. Selection of personnel for marketing, purchasing, inventory control, stores management and materials handling and their training and placement is also to be seen by the materials management department. This indicates that it is very essential to have a materials management department in any organization to support the management in the

production activities. It also helps in the marketing, sales promotion and control of all the types of materials for its quantity, quality and cost. Thus, the objective of this paper is to find out the factors affecting material management on construction site & suggest remedial measures on it. This study describes the general procedure followed by small, medium & large construction firms in Maharashtra, India and factors affecting the material management for all three sizes of construction firms. To overcome these factors some remedial measures were suggested.

Material Management deals with managing of materials along with costs the material can be purchased material which are the raw material for input or semi- final finest product or final product called output.

The main construction materials are:

1. Cement
2. Steel
3. Stones
4. Aggregates
5. Sand
6. Soil
7. Bitumen
8. Sanitary items
9. Electric items
10. Tiles

It is estimated that about 10 to 20% of all materials delivered to the site other end up as waste or illegally removed during the construction phase and proper materials management is imperative for effective construction management inventory management system involves procurement, storage, identification, retrieval, transport and construction methods. This study proposes to apply the Material management and Inventory management technique which includes well documented

procedures to decrease the cost and increase in profit during any construction project Lifecycle. Construction Industry involves multi echelon supply chain. With so many stake holders involved, the inventory management becomes a critical aspect of construction project management. Construction industry faces a lot of problem due to poor inventory management, these projects over run the time and the allocated budget. The term inventory refers to the goods or materials used by a firm for the purpose of production and sale. It also includes the items, which are used as supportive materials to facilitate production. Nearly 60% of money is allotted for the inventory in a project. Inventory constitutes one of the important items of current assets, which permits smooth operation of production and sale process of a firm. Inventory management is that aspect of current assets management, which is concerned with maintaining optimum investment in inventory and applying effective control system so as to minimize the total inventory cost. Materials Management is related to planning, procuring, storing and providing the appropriate material of right quality, right quantity at right place in right time so as to co-ordinate and schedule the production activity in an integrative way for an industrial undertaking. Inventory Management is simply the process by which an organization is supplied with the goods and services that it needs to achieve its objectives of buying, storage and movement of materials. Inventory is seen as incurring costs, or waste, instead of adding and storing value, contrary to traditional accounting. Inventory management is the supervision of non-capitalized assets (inventory) and stock items. A component of supply chain management, inventory management supervises the flow of goods from manufacturers to warehouses and from these facilities to point of sale. A key function of inventory management is to keep a detailed record of each new or returned product as it enters or leaves a warehouse or point of sale.

Construction industry plays a vital role in the socio-economic growth of a country and is an agent for national development. Economically, it generates increase in the nation's gross domestic product (GDP) and contribute significantly to the national wealth and economic prosperity.

Additionally, construction projects also play a significant role in safety, health and environmental aspects of the society by creating physical facilities and social infrastructure.

In Malaysia, the construction industry has been an important and productive sector as it contributes significantly to the economic growth with 3–5 percent of the national economy GDP. In addition, the Tenth Malaysia Plan has recognized that this industry had a great impact on the Malaysian construction sector. Hence, the Ministry of Works had been

allocated with RM138 billion for its physical development projects to be undertaken by construction sector under this plan. This shows that the contribution of this sector is essential to the national economy and has an important role in improving the people's quality of life. However, despite the importance of the construction industry to the nation's socioeconomic growth, this industry faces many challenges and issues related to poor construction project performances. This poor performance has been attributed to the ineffective resources management in the construction projects. As a result, construction projects had suffered with delays, cost overrun, construction wastes, low productivity, compromised quality etc. Prior literature reports that shortage of materials is among the most significant factors that contribute to delays, cost overrun and low productivity. Therefore this again shows that ineffective materials management that causes materials shortage occurs in construction sites affects project performance.

However, literature also reveals that very little re-search has been carried out by academics and practitioners on the problems faced by the local construction industry. This is specifically in terms of local construction materials management effectiveness. Nonetheless topics regarding materials management practices and information and communication technology (ICT) have been researched before. But, there are limited studies that focus on influential factors affecting materials management. As it essential to gain better insights and understanding of the factors influencing

project performance, this study is now being embarked. Therefore, this study aims to identify the influential factors affecting materials management in construction projects and then to highlight the identified influential factors. Briefly, materials management can be defined as a planned process that consist of identifying, purchasing, delivering, handling, allocating of storage and minimizing wastes with the purpose of ensuring the availability of sufficient quantities of material for project need. Materials management in a construction project consists of seven integrated processes and functions. They include project planning, materials take-off, suppliers' enquiry, purchasing, materials control, warehousing, expediting and shipping.

1. In this case we studied the following 20 factors:

1. Delay in project commencement

A project delay is typically an issue that can take companies over budget, cause them to miss deadlines, and sometimes derail projects.

2. Health

An inventory management system is key in health organizations that need to keep track of medical supplies, order and dispense prescriptions, or sell health products to patients. Within large organizations, inventory management strategies help protect your company from both monetary and product losses, by keeping an updated and accurate log of products and supplies.

3. Materials damage on site

A material damage coverage means that, the insured will be covered against the losses or damages or destruction to the property that is insured.

4. Social responsibilities.

Social responsibility is having a sense of duty to society and everything that is a part of it. In other words, "social responsibility" means managers are accountable to society at large, not just their share holders.

5. Manufacturing defects

A well-designed product can still harm consumers. Defects in manufacturing occur when a product is improperly manufactured and departs from its intended design.

6. Design changes by owner

A construction project is particularly prone to a high degree of change for a variety of reasons such as the disruption of monetary, fiscal disorder, lack of time and effective communication, environmental changes and increasing complexity of a project. The changes influence its performance, especially the cost and time.

7. Poor and wrong storage materials

While you will initially save money on the project by opting for low-quality materials, chances are it will cost you more in the long run. These materials may settle, rut, wash out, warp, fade, break, chip, corrode—basically, they will do anything but last.

8. Improper materials

Poor materials management can result in increased costs during construction. Efficient management of materials can result in substantial savings in project costs. If materials are purchased too early, capital may be held up and interest charges incurred on the excess inventory of materials. Materials may deteriorate during storage or get stolen unless special care is taken.

9. Severe weather conditions

Severe weather can take many forms, especially on a construction site where workers are exposed to the elements for long hours. Whether it is a downpour of flooding rains, blistering high winds, heavy snow, hurricanes, stiflingly hot temperatures, or even hurricanes.

10. Existence of unnecessary material on site

Managing your waste will help you limit how much you generate and dispose of, as well as ensure its properly processed once removed from your site. This will help to conserve our planet's natural resources and minimise the energy required to transport and reprocess waste.

11. Improper handling of materials on site

However, improper handling of materials can be hazardous if precautions are not taken. Often, handling heavy and bulky objects results in back and spinal injuries. Workers that lift these objects may suffer from acute and chronic back pains. This is a common factor related to back injuries.

12. Use of incorrect material

If you're a contractor, incorrect quality materials can actually hurt your reputation. If a homeowner or general contractor has nothing but problems with the project you handled, they will tell their friends and family about it. This not only hurts your overall reputation, but it will also lose your business, and that's something you likely can't afford.

13. Improper cutting of materials

Lack of durability, appearance, price, reputation sometimes lead to problems in improper cutting of materials.

14. Contractor's slowness in taking decisions

Inconsistencies in budgets, labour challenges, approvals, subcontractor schedules and compliance, lack of good communication sometimes slow down contractor decision making.

15. Do you used vendor evolution?

Vendor means a person or company that sells services. The vendor process is a series of strategic and tactical activities that companies use to manage and collaborate with vendors.

16. How is the material requirement planned?

Material Requirements Planning (MRP) is a standard supply planning system to help businesses, primarily product-based manufacturers, understand inventory requirements while balancing supply and demand. Businesses use MRP systems, which are subsets of supply chain management systems, to efficiently manage inventory, schedule production and deliver the right product—on time and at optimal cost.

17. Is the quotation comparison done in SAP?

After your quotations are entered, you can compare them to select the best available offer at this moment. We can compare the quotations in transaction code ME49.

18. Lack of materials (due to closure)

Sometimes problems arise due to lack of materials (due to closure) as such disturbances result in high lead time, high production cost, low product reliability, waste of time, materials etc.

19. Poor site layout

Problems caused by poor site layout planning can include: Inappropriate storage which can result in damage to products and materials. Poor siting of plant. Poor siting of welfare facilities. Inadequate space provision. Unsatisfactory access.

20. Price and contract

The construction contract price includes the direct project cost including field supervision expenses plus the markup imposed by contractors for general overhead expenses and profit. The factors influencing a facility price will vary by type of facility and location as well.

OBJECTIVES

The paper focused in the following objectives of the Materials managements and Inventory managements regarding construction industry.

1. To Study Material Management and Inventory Management for Construction Field.
2. To Identify the Factor Affecting Material Management and Inventory Management.
3. To Study Contractors and Engineers Review Based Optimization Towards the Material Management and Inventory Management.
4. To identify the problems faced in Materials Managements.
5. To identifying the critical stages in material management and inventory management.
6. Analyze the inventory management control adopted and the effective utilization of inventory at the construction site.
7. To improve materials handling savings in materials cost , increased production and Large profits.
8. To gather info about materials management procedure of different firms.
9. To study the different materials managements procedure (from collecting data).
10. To find out factor affecting materials management and inventory management for Small, medium and large construction firm.
11. To suggest remedial measures to overcome factors affecting materials management on construction site.
12. To study material management and inventory management for construction fields by survey of construction firm using Relative Importance Index (RII Method).
13. To identify the causes of these materials management problems.
14. Suggest ways of solving materials management problems by construction firms
15. To identify proper ways of managing materials by construction firms on site
16. Development and maintaining good relations and developing potential supplier.

The scope of this project limited to small and medium scale residential projects which are being constructed in the urban areas , where there is a relatively better availability of materials and inventory, when compared to the remote areas.

PROBLEM STATEMENTS

As kini (1999) pointed out that 50-60% of the total construction cost goes to material and equipment. some construction project may experience project cost for material ranged from 30 to 80% of the total construction cost (proverb, et al., 1999) It is therefore vital to control this large portion of tangible cost and every penny save will contributes to the profitability of the projects. Inventory Control and waste control on the site remain a low priority for the majority of the contractor (begum, 2009). When construction site is less concerned on inventory management more materials and labour times are wasted. An estimated about 10-30% of waste disposed of for landfills originate from

construction site (Fish bein, 1998). Many contractors and developers do not take advantages on this saving and look for other meant for getting extra earning and risk to be penalized for using inferior materials or maybe cut corners here and there. This research is to give awareness for builder to look seriously on inventory control management where saving of materials and labour times can impact the profitability of the project. Management of materials have over the years been a great problem to most firms in the construction industry. In construction project operations, there is always a tendency of mismanagement of materials by construction firms. As the size of the contract increases, however so do the scale of activities concerning materials management. During the occurrence of high number of projects, most construction firms focus on getting work done whiles neglecting the management of materials. The negligence of proper materials management contributes to several negative consequences such as, breakages of materials, dissatisfaction by client, and reduction in the productivity of workers, materials wastage, high project cost and delay in the progress of work at hand, which affects the maximization of limited resources. Most construction firms have given little priorities to the setting up of a department which oversee the management of their materials resulting in improper materials management if there is any at all. Mismanagement of materials can be classified as loss since it has adverse effects on construction projects. On the small sites, materials are managed by individuals with little or no knowledge

about the management of materials. It is therefore prudent for construction firms to have a critical look on materials management, since it has a rippling effect on construction projects.

II. MATERIAL MANAGEMENT AND INVENTORY MANAGEMENT

1. Material management:

Material management is a core function of supply chain management, involving the planning and execution of supply chains to meet the material requirements of a company. These requirements include controlling and regulating the flow of material while simultaneously assessing variables like demand, price, availability, quality, and delivery schedules.

1. Types of Material Management:

1. Material Requirements Planning

This important step in material management directly affects profits as the lower the amount of material used, the lower the cost of production and the more profit is delivered. Reducing material overspend has caused some industries to consider 'Just in Time (JIT)' strategies that require very small levels of inventory. However, this still requires careful planning to maintain without impacting production schedules.

2. Purchasing

Purchasing should be done economically and on time to maintain material supplies and increase final profits by lowering expenses.

3. Inventory Control

An inventory can include a range of goods being held including partially finished items, goods ready for sale and those used in production. Many industries try to time purchasing so that materials enter stores just ahead of production, although there is also a need to gauge supplier levels so items can be stocked before they become unavailable. Inventories are required to control the flow of raw materials, purchased goods and finished parts and components.

4. Material Supply Management

Supply chain management can require materials to be distributed to different sites or production centres, each of which needs to be continuously supplied. Lack of stock can lead to financial losses through having to source replacement production materials or having to halt production schedules. Poor storage can also lead to material supply disruptions through damaged or misplaced stock. Material management teams should be able to mitigate against these situations by using alternative supply systems.

Quality Control

Quality control of materials is also important, since good quality materials lead to good quality products. Factors such as durability, dimensional accuracy, dependability, performance, reliability and aesthetic value can all be important quality factors for materials management, depending upon the applications. All five of these types need to work together for the successful management of materials from purchase and supply through to utilization.

The importance of material management as follows:

1. The material cost content of total cost is kept at a reasonable level. Scientific purchasing helps in acquiring materials at reasonable prices. Proper storing of materials also help in reducing their wastages. These factors help in controlling cost content of products.
2. The cost of indirect materials is kept under check. Sometimes cost of indirect materials also increases total cost of production because there is no proper control over such materials.
3. Their equipment is properly utilized because there are no break downs due to late supply of materials.
4. The loss of direct labour is avoided.
5. The wastages of materials at the stage of storage as well as their movement is kept under control.
6. The supply of materials is prompt and late delivery instances are only few.
7. The investments on materials are kept under control as under and over stocking is avoided.
8. Congestion in the stores and at different stages of manufacturing is avoided.

Inventory Management

Inventory management helps companies identify which and how much stock to order at what time. It tracks inventory from purchase to the sale of goods. The practice identifies and responds to trends to ensure there's always enough stock to fulfil customer orders and proper warning of a shortage.

1. Types of Inventory Management

1. Raw materials

Raw materials are any items used to manufacture finished products, or the individual components that go into them. These can be produced or sourced by a business itself or purchased from a supplier.

2. Work-in-progress (WIP) inventory

Work-in-progress (WIP) inventory again refers to retailers that manufacture their own products. These are unfinished items or components currently in-production, but not yet ready for sale.

3. Finished Goods

Finished goods are products that are complete and ready for sale. These may have been manufactured by the business itself, or purchased as a whole, finished product from a supplier.

4. Maintenance, repair & operations (MRO) goods

MRO goods are items used within the manufacture of products, but without directly making up any part of a finished product.

5. Packing materials

Packing materials are anything you use for packing and protecting goods – either while in storage, or during shipping to customers.

The importance of Inventory management as follows:

1. Inventory control paves for competitive ability.
2. Inventory planning improves service level.
3. Inventory planning and management reduces storage cost.
4. High inventory turnover brings revenues.
5. You can utilise warehouse space better.
6. Inventory control makes cost accounting activities easier.
7. Inventory control is consistent with safety and economic advantage.
8. Regular supply at reasonable prices builds customer confidence.
9. Inventory holding results in effective utilisation of human and equipment.
10. Effective inventory control enhances market share.
11. Inventory control improves product quality.
12. Effective inventory control brings the potential saving.
13. Inventory control avoids costly interruptions in operation.
14. Inventory control strategy facilitates purchase economies.

III. LITERATUR REVIEW

Asadi in the paper "Improving materials management on construction projects" have prepared scheme of material management in the industry for building project. The author has conducted survey of industry and determined the format for construction material management and has also discussed the software development for proper management. For this purpose, he conducted industrial expert survey. The data through this survey was collected from project manager, billing engineer and store in charge etc.

Narimah kasim in the paper " ICT implementation for materials management in construction projects: case studies " in this study seeks to identified the implementation of ICT for materials management processes in construction projects.

Microsoft Excel Spread sheet and handheld devices are founded to be the common ICT tools adopted in the materials management processes. This paper concluded the found from interviews towards the ICT implementation of materials management in the construction projects. Construction materials usually constitute a major portion of the total cost in a building construction project. Materials management is made problematic by materials shortages, delays in supply, price fluctuations, damage and wastage, and lack of storage space.

Mr.m. kalilurrahman, mr.s.s. Janagan in the paper " construction waste minimization and reuse management " this study seeks to identified the implementation of Construction industry has been developing rapidly around the world. The development has led to serious problem in generation of construction wastes in many developing countries and expectation of the natural resources to large extend. The construction wastes clustered into physical and non-physical waste and it has greater impact to environment, economy and social of each country. Before it can be managed well, it is important to understand the root cause of the generation. This study has identified significant factors contributing to waste in construction projects. By identifying the significant factors in construction process, construction players are able to notice the best ways to apply new practice for reducing material waste, time delay and cost overrun in any project. Based on the results and findings of this study, the following recommendations are made to reduce the construction waste generation in any construction projects. The aim of this study is to investigate the waste recycling and reuse in the construction industry. It can be concluded that generally the construction personnel are Zero waste of the construction waste.

HEMISHKUMAR PATEL, JAYESHKUMAR PITRODA, PROF. J. J. BHAVSAR in the paper, "A review on material management through inventory management " this study seeks to identified the implementation of Construction industry has been developing rapidly around the world. The development has led to serious problem in generation of construction materials usually constitute a major portion 50-60% of the total cost in a building construction project. Materials management is made problematic by materials shortages, delays in supply, price fluctuations, damage and wastage, and lack of storage space. For this purpose, he published Paper based on the study in order to It is clearly important to manage all materials from the design stage to the construction stage. The waste of materials should also be minimized during construction stage in order to avoid loss of profit. Better coordination among purchase and finance department will help in achieving greater efficiency in Inventory management. Firm, employing proper material management system can have increased their overall efficiency by 35%. Aparna Shruthi E MTEch Fellow, Sastra University, Thanjavur, Tamil Nādu, India. Dr.C.Venkatasubramanian Associate Professor, Civil Engineering Department, Sastra University, Thanjavur, Tamilnadu, in the paper " factors affecting material Management in construction Industry " this study seeks to identify the implementation of Material management function contributes significantly to the success of the project and is crucial to manage all the materials in construction. For a typical construction project, materials constitute over 70% of the project cost and may affect the overall cost if not managed properly. For this purpose, he published Paper based on the study in order to. The research has thoroughly examined all the factors affecting material management in the construction industry. This research identifies the following as major factors for effective management, material requirements planning, proper cash flow control, identifying and selecting suppliers, organizing and scheduling the procurement, skilled negotiation with suppliers, non-delay of payments, skill and experience of material management team, planning delivery of materials to site, proper inspection and documentation of materials and site location and layout.

Idowu Albert, Winston Shakantu, Emmanuel Dele Omopariola & Williams dunu in the paper " Reaction of Poor Materials Management on Project Delay in the Construction Industry " this study seeks to identify the implementation of Construction industry have been developing rapidly around the world. When the problem of delay occurs, the companies stand to lose a large amount of money which can sometimes render the company insolvent. The study aimed to investigate the reaction of poor materials management on project delay with a view to enhancing materials management in the construction industry .The literature and the findings from the study have established that site materials management is poor. The study concludes that poor materials management was found to have a negative reaction on project delay. The study recommends that Construction professionals should be well informed on the reactions of poor materials management on project delay so that it can be minimized site materials management

practices should be promoted by professional bodies in construction, such as the Nigerian Institute of Building (NIOB), the Nigerian Institute of Arc.

René Castillo Rodríguez, José Antonio Domínguez Lepe in the paper "Current situation of construction material management at international Level" The present research aims to provide a broad overview regarding the management of construction materials. As a starting point, the conception of the set of actions that make up the materials management is described and its importance within the construction sector is pointed out; Likewise, new management support technologies such as Radio Frequency Identification (RFID) web-based systems for materials management and data storage applications are described, offering a vision of the advantages and disadvantages involved in implementing these information technologies. For this purpose, he published Paper based on the study in order to construction industry has already consolidated the concept of material management, as well as its implicit processes. This is perceived in the definitions pointed out by different authors in different countries: they all agree with the fact that the main pillars for properly managing materials are: planning, procurement, storage and control.

N.B. Kasim, C.J. Anumba² and A.R.J. Dainty in the paper "Improving materials management practices on fast-track construction projects" key factor adversely affecting project performance is the improper handling and management of materials on site. Materials management is particularly problematic on fast-track projects where design and procurement decisions are made concurrently with construction activities. This paper reports on the early stages of research which is developing a new ICT-based approach to managing materials on fast-track schemes. For this purpose, he published Paper based on the study in order to Paper has presented a brief overview of materials management practices on fast-track construction project. The next stages of this research will examine the extent and nature of automation of the materials management process and will develop new ICT-enabled approaches to improving materials management. Hitects (NIA), and the Nigerian Institute of Quantity Surveyors (NIQS).

Chidiebere Emmanuel Eze^{1*}, Imoleayo Abraham Awodele², Adesoji Anthony Adegboyega³, Onyealilam Peter Onyeagam⁴, Jibrin Ahmed Guto⁵ in the paper Assessment of the Triggers of Inefficient Materials Management Practices by Construction SMEs in Nigeria this studied assessed the factors that trigger inefficient material management practices by construction SMEs in Port Harcourt, Nigeria. The study utilised a quantitative survey method and convenience sampling technique in the distribution of the structured questionnaire used to gather data from project managers, procurement officers and construction professionals working with the construction SMEs. With a 93.33% response rate, the gathered data were analysed using percentage, frequencies and factor analysis with principal component analysis. It was found that the major triggers of inefficient materials management among construction SMEs are; traditional approach and maintenance issues, manufacturer error and poor planning, inventory management issues, poor handling of procurement, materials estimating problems, storage problems and insecurity, and communication issues. It was concluded that the predominance of these triggers in the management of materials among construction SMEs would result in a continued poor performance of construction projects, especially with regards to project time, cost, quality and productivity. The study recommends a move away from the traditional methods of managing materials and the adoption of a technological-based material management system.

Peter Fewings, Christian Henje wele in the Construction Project Management an Integrated Approach in this chapter, the authors consider integration of people with the aim of sustainable wellbeing in the production of built assets that they will call future cities. Future cities aim to counter traditional manifestations of class as linked to power and culture. Future cities involve a collaborative and systemic way of thinking that aims to interconnect physical, social and virtual subsystems so that they operate in a more efficient and sustainable way and improve citizens' quality of life. Wellbeing is a measure of the experience of the user, the community and generations to come. In terms of future generations, wellbeing can be about maintaining the value of materials used in construction by becoming aware of the principles of the circulareconomy.

In the construction of the Andover North Site Redevelopment, the objective of the client.

According to Arnold, J. R. and Chapman (2004), Materials management can define as an organizing function responsible for planning and controlling the materials flow. This means that the materials management is a planned procedure that involves from the initial purchasing, delivery, handling and minimisation of waste of the material with the purpose to ensuring the quality, quantity and time of the requirement should meet accordingly. Material management are the activities involved to plan, control, purchase, expedite, transport, store and issue in order to

achieve an efficient flow of materials and that the required materials are bought in the required quantities, time, quality and at an acceptable price. (Stukhart, 1995).

Gulghane, Prof P. V. Khandv in the Management for Construction Materials and Control of Construction Waste in Construction Industry: A Review The systematic literature review identified that Materials management processes require a transformation to improve the overall in handling of materials for more efficiency and effectiveness on the construction site. This is because poor handling of construction materials affects the overall performance of construction projects in terms of cost, time, quality, and productivity. From the literature review it is understood that this area requires further research to find some feasible solutions to control the total project cost. There is no proper system for procurement of construction materials. This give light to the fact that pre-planning and material procurement are equally important in controlling the total project cost. It reveals that the minimization of materials wastage during the construction phases is important in order to avoid loss of profits. It is observed that considerable research has been conducted to investigate individual construction waste management strategies at a specific stage of a construction project. Currently, the majority of research efforts have been given to the material loss in construction activities rather than the non-value-adding work as an intangible waste. Waste Generation Rate is an effective indicator for measuring construction waste and benchmarking construction waste management performance.

Ar. Gayatri Ashish Patil in the CAUSES OF CONSTRUCTION MATERIAL WASTE”A CASE STUDY OF JALGAON Closer observations of Jalgaon construction industry states that, waste reduction or prevention is not considered as an integral part of the related management systems.

However, it is an explicit fact that, lack of awareness among clients and contractors, lack of proper material utilization, in preparation, handling, storage, untrained staff, lack of skilled labour, improper supervisions, non-existence of proper documentations, reveals this problem pertaining to data regarding Indian Construction Industries, which include causes of waste construction material is not fully appeared in literature, however few references are available as far as the international strategies is concerned in this context.2. Formulation of the six groups namely; 1.Design and contracts 2. Site management 3. Procurement 4. Storage and handling 5. Workers and supervision 6. Other external factors Based on responses received from consultants. these groups overall considered 36 causes of waste of construction material.

DR. Kevin Aku Okorochoa in the FACTORS AFFECTING EFFECTIVE MATERIALS MANAGEMENT IN BUILDING CONSTRUCTION PROJECTS- A CASE STUDY OF SELECTED BUILDING SITES, IN IMO STATE, NIGERIA This research work is on the analysis of factors affecting effective materials management in building construction projects. Having the right materials in the right place at the right time is important for effective execution of a building project. Secondary and primary data collected were subjected to statistical analysis through the use of multiple regressions. Six hypotheses were tested and the results show that significant relationships exist between the factors and effective materials management. It was recommended that organizations should incorporate materials management in the overall policy of the firms in order to eliminate some of these problems.

Zairra Mat Jusoh, Narimah Kasim in the INFLUENTIAL FACTORS AFFECTING MATERIALS MANAGEMENT IN CONSTRUCTION PROJECTS In essence this studied has identified 47 influential factors that affect efficiency of materials management. These factors are then categorised into 8 specific groups according to their respective themes. Initial finding shows that the highest number of influential factors is under ‘management’ group which consists of 15 influential factors. However, further examination will have to be conducted with practitioners to confirm the relevancy of those influential factors and each group in the context of the Malaysian construction projects. All information gained from the practitioners will then be used to develop structural modelling for materials management. Thus, it is hoped that the models will assist the construction industry players especially the contractors to improve materials management efficiency of construction projects in the near future.

IV. METHODOLOGY

Data was collected from previous literature to determine the most influential factors on Material management in the construction industry. Data collection for the project was done through a survey by explorative questionnaire to the respondents involved in daily activities of construction firms in and around Nashik region of India. The questionnaire was designed so that respondents can give the rank to their answers based on the Likert scale. The analysis of these data

was done by a method named relative importance index (RII) method as well as Percentile method with the help of the Microsoft Excel.

The questionnaires had been developed based on the criteria carried from literature reviewing and expert discussion. The questionnaires were then distributed to the respondents in order to get the agreement level for each criterion. Questionnaires were used in this research to gather information. Several steps were taken to complete the questionnaires for this research including finding objectives of the survey, determining sampling group, designing the questionnaire, administering the questionnaire and interpreting the result.

The research was conducted using literature on sustainability research, experts' opinions, questionnaires and a statistical analysis of the survey data. There are a lot of references for the establishment of decision criteria for the evaluation.

1. RII (Relative Importance Index) method:

1. Definition

RII is defined as the percent improvement with respect to the most important predictor. Relative Importance is calculated by dividing each variable importance score by the largest importance score of the variables, then you multiply by 100%.

Advantages of RII

RII analysis allows identifying most of the important criteria based on participants replies & it is also an appropriate tool to priorities indicates rated on Likert type scale.

Uses of RII

RII is commonly used measure of the extent to which the occurrence of an outcome such as Delay in project commencement or health or paper site layout or price & construct etc. The standard RII estimator applies only to linear variation in incidence rates.

The RII is simply a mean score for an item. Scaled to have a value somewhere between 1/A & Where A is the no. of response categories. So, you may also just compute the mean score for each item & that will sort the items from "most" to "least" in exactly the same way and would the values.

To obtain the RII there are several methods of normalization depending on the desired result. We use the following very much.

The RII (Relative Importance Index) method was adopted in this study to determine the relative importance of various factors affecting the quality of the construction works. RII value ranges from 0 to 1. The higher the RII value greater is the impact or frequency of occurrence of the variables. RIIs are calculated for each factor as in equation below

$$RII = \Sigma W / (A * N)$$

Where,

RII = relative importance index;

W = weighting given to by respondents (ranging from 1 to 5);

A = highest weight (i.e., 5 in this case) And N = total number of respondents

Likert scale:

A Likert scale is a unidimensional scale that researchers use to collect respondents' attitudes and opinions. Researchers often use this psychometric scale to understand the views and perspectives towards a brand, product, or target market.

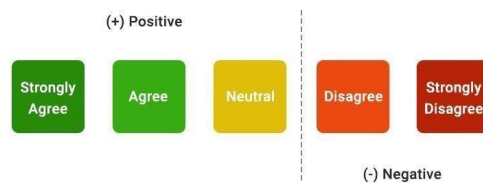


Fig 4.2 : Likert scale

When responding to an item on the Likert Scale, the user responds based explicitly on their agreement or disagreement level. These scales allow determining the level of agreement or disagreement of the respondents. The Likert scale assumes that the strength and intensity of the experience are linear. Therefore, it goes from a complete agreement to a complete disagreement, assuming that attitudes can be measured.

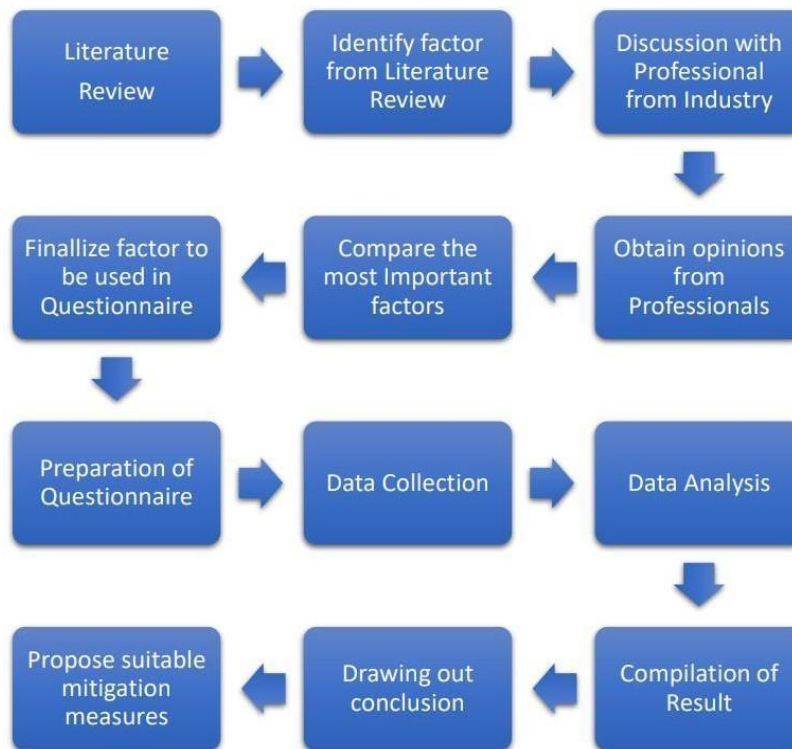
Advantages of Likert scale

- Ease of implementation.
- Quantifiable answer options.
- Analyze the rank of opinions.
- Simple to respond

The Methodology distributed in three stages; this is as follows:

1. DATA COLLECTION
2. DATA ANALYSIS
3. DATA INTERPRENCE

Flow chart 4.1 Research Design



DATA COLLECTION:

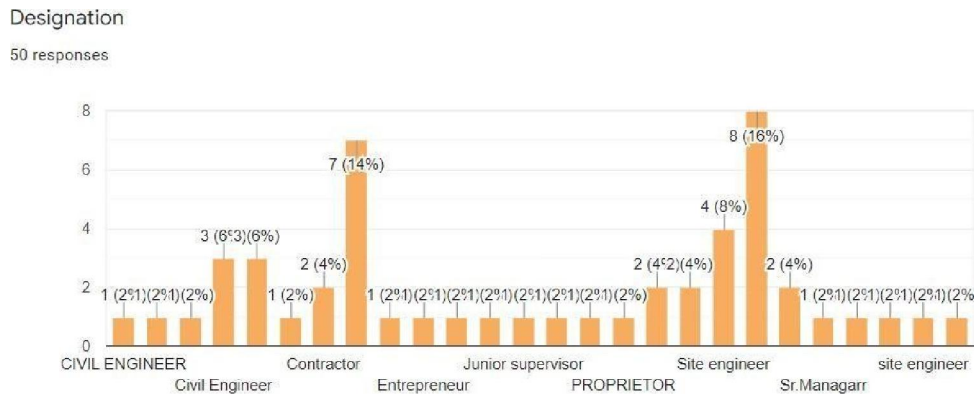
Data was collected through questionnaire survey. It is a data gathering tool with a series of question with provisions for responses either in the form of hierarchical ranking or open-ended opinion. The Questionnaire used in the study had hierarchical ranking as the response option. It is reliable way to get the relative importance of factors. Developing a reliable questionnaire for this project is very important for identifying the correct factors regarding material management. Initially the design of the questionnaire was developed based on the review of the existing literature. In this research, a five-point Likert scale was used as a simple method to identify the factors in construction site.

The questions in the questionnaire survey are provided to identify the factors affecting the material management process. A series of questions pertaining to the identified factors and sub factors were posed to all the personnel in the project such as architects, sponsors, storekeepers, material managers, quantity surveyors, site engineers, project managers, and project engineers.

The Contractors, project engineers, store in-charge & site Supervision of various construction projects were targeted for survey. We distributed over a 50 Questionnaires. A total number of 50 respondents were surveyed. We received responses from a pretty diverse group of professionals i.e. owners, contractors, builders, architects, consultants, etc. The respondents were surveyed. The respondents were a mix of contractors, Project engineers, Site supervisors & store in-chargers. The shortlisted 20 factors were further filtered based on their significance & relevance to the current practices. These factors were explained in detail in the following pages.

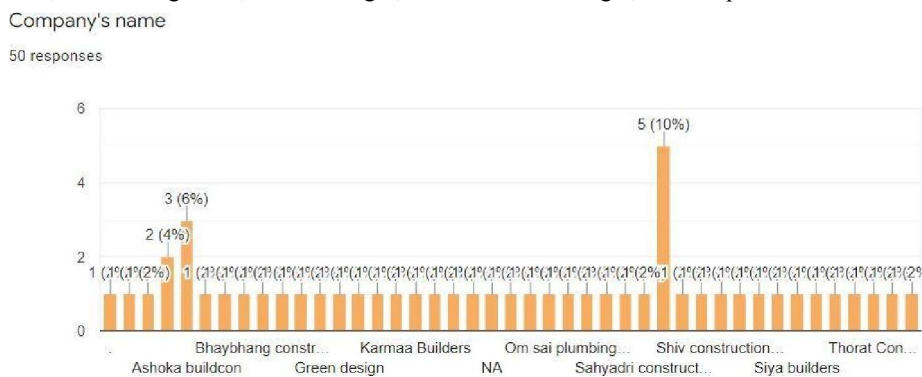
Questionnaire survey has been done data is collected based on the questionnaire provided. Given below is the link of questionnaire survey

The weightage is thus calculated from the responses gathered.



Bar graph No. 4.2: Designation

It is studied through questionnaire survey from 11 Civil Engineers, 12 Contractors, 2 Entrepreneurs, 2 Jr. supervisors, 1 Mistry, 1 Proprietor, 17 Site Engineers, 1 Sr. Manager, 1 Investment manager, 2 Site supervisors.



Bar graph No. 4.3: Company's Name

We surveyed from various firms following are the names of firms/companies. Ashoka buildcon, Karmaa Builders, Om sai Plumbing, Shiv construction, Thorat construction, Jupiter Construction, etc. Total 50 respondents were taken. The questionnaire for the survey was prepared using a Likert's scale. The respondent is required to rate the factors based on its importance in their professional opinion & thus the survey was carried out using Google form. The scale used for rating the factors is as follows :

Table No. 4.4 : Responses of the factors

Responses of the factors	Rating of the factors
Strongly Agree	1
Agree	2
Neutral	3
Disagree	4
Strongly disagree	5

V. DATA ANALYSIS

The data collected was manually analysed by the RII method with the help of which a decimal figure for which factor is obtained which is known as Relative Importance Index. This index is used to rank the factors. Total 20 factors were analyzed using RII method & ranked as shown in Table No. 3. The data included 20 factors to be analyzed. Relative Importance Index (RII) method was used to find strength of index familiarity and frequencies, Ranking was done using the Likert's scale.

The RII (Relative Importance Index) method was adopted in this study to determine the relative importance of various factor affecting the quality of the construction works. RII value ranges from 0 to 1. The higher the RII value greater is the impact or frequency of occurrence of the variables. RIIs are calculated for each factor as in equation below.

$$RII = \frac{\sum W}{A * N}$$

Where,

RII = relative importance index;

W = weighting given to by respondents (ranging from 1 to 5);

A = highest weight (i.e., 5 in this case) And

N = total number of respondents

The RII value, mean RII, and ranking of all groups of a quality factor are shown in table below:

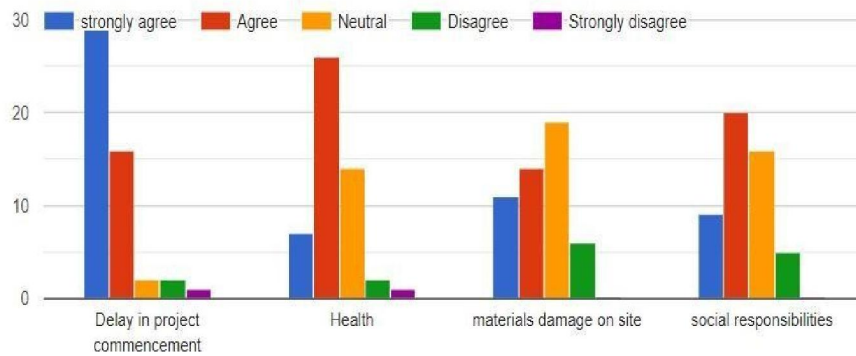
Table No. 5.1: RII of quality factor

Factors critical to quality (Q. No.)	Respondent scores					RII
	1. Strongly agree	2. Agree	3. Neutral	4. Disagree	5. Strongly disagree	
1. Delay in project Commencement	29	16	2	2	1	0.456
2. Health	7	26	14	2	1	0.48
3. Materials damage on site	11	14	19	6	0	0.468
4. Social responsibilities	9	20	16	5	0	0.44
5. Manufacturing defects	12	21	13	3	1	0.44
6. Design changes by owner	15	17	12	5	1	0.424
7. Poor and wrong storage materials	11	27	7	5	0	0.448
8. Improper materials	14	17	12	7	0	0.456
9. Severe weather conditions	9	22	15	4	0	0.496
10. Existence of unnecessary material on site	9	19	11	11	0	0.452
11. Improper handling of materials on site	12	24	7	3	4	0.5
12. Use of incorrect material	8	21	11	8	2	0.48
13. Improper cutting of materials	12	19	8	9	2	0.456
14. Contractor's slowness in taking decisions	8	25	13	3	1	0.492
15. Do you used vendor evolution	7	21	17	2	3	0.436
16. How is the material requirement planned	11	27	5	6	1	0.464
17. Is the quotation comparison done in SAP	6	29	10	3	2	0.48
18. Lack of materials(due to closure)	9	19	17	3	2	0.436
19. Poor site layout	13	23	9	2	2	0.468

20. Price and contract	11	19	14	4	2	0.452
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There are 20 factors to be analysed. Relative Importance Index (RII) method was used to find strength of index familiarity and frequencies, Ranking was done using the Likert's scale. We have done questionnaire survey through Google form following are its results.

Material management issues

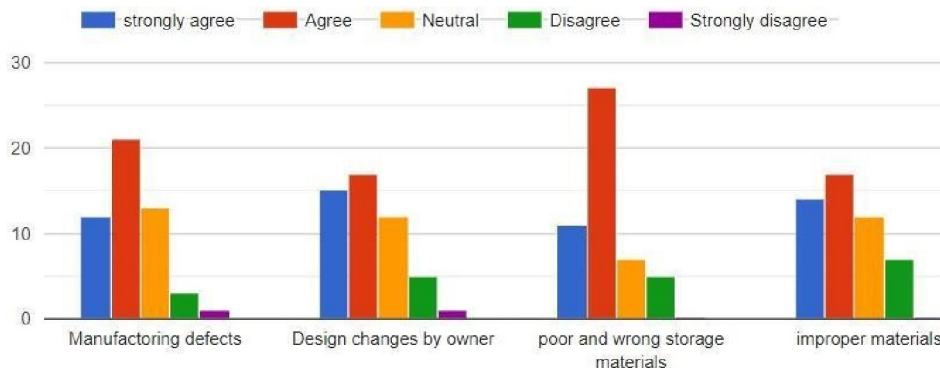


Bar graph No. 5.2: Delay in project commencement, Health, Materials

Damage on site, Social responsibilities.

This graph depicts delay in project commencement, Health, material damage on site, social responsibilities. These are some factors related to delay by the contractor in completion of the project, most affected factor is delay in project commencement

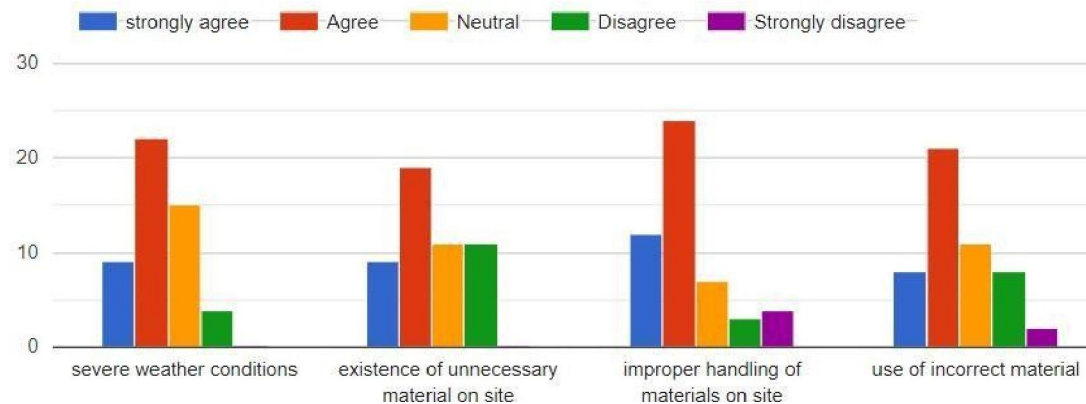
Material management issues



Bar graph No. 5.3: Manufacturing defects, Design changes by owner, Poor and wrong storage materials, Improper materials.

These graph shows the details about manufacturing defects, design changes by owner, poor and wrong storage materials, improper materials, where most people agreed with poor and wrong storage materials.

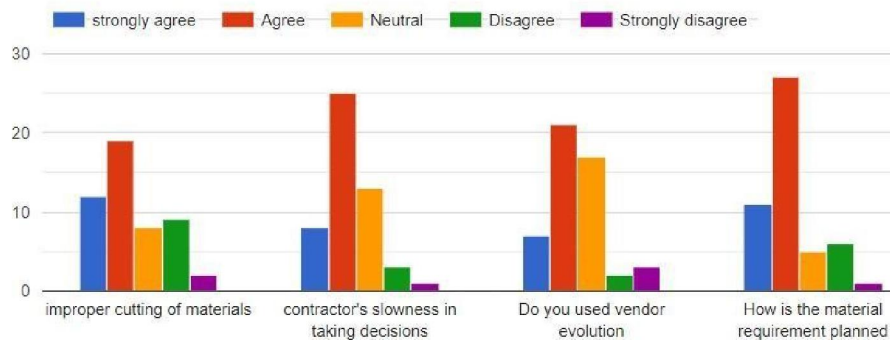
Material management issues



Bar graph No. 5.4 : Severe weather conditions, Existence of unnecessary material onsite, Improper handling of materials on site, Use of incorrect material

These graphs explain severe weather conditions, existence of unnecessary material on site, Improper handling of materials on site, Use of incorrect material where most people agreed for improper handling of materials on site, where most people agreed with improper handling on site.

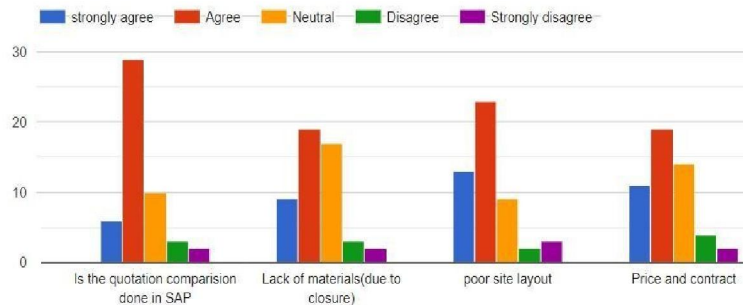
Material management issues



Bar graph No. 5.5 : Improper cutting of materials, Contractor's slowness in taking decisions, Do you used vendor evolution, How is the material requirement planned.

These graph shows the details about Improper cutting of materials, Contractor's slowness in taking decisions, Do you used vendor evolution, How is the material requirement planned, where most people agreed with how is the material requirement planned

Material management issues



Bar graph No. 5.6 : Is the quotation comparison done in SAP, Lack of materials (due to closure), Poor site layout, Price and contract.

These graph shows the details about is the quotation comparison done in SAP, lack of materials (due to closure), poor site layout, price and contract, where most people agreed with is the quotation comparison done in SAP.

VI. DATA INTEREFERENCE

As the mean RIIs and rankings of all groups are depicted in Table No. 6.1, Most important factors critical to the quality of construction works are shown in Table No. 5.1. According to the rankings of the factor groups, the factors of that contribute most in affecting the quality of construction works are discussed in what pursues.

Table No.6.1 : RII and Ranking of quality factor groups

Sr. No.	Most important factors affecting the quality	RII	Rank
1.	Improper handling of materials on site	0.5	1
2.	Severe weather conditions	0.496	2
3.	Contractor's slowness in taking decisions	0.492	3
4.	Use of incorrect material	0.48	4
5.	Is the quotation comparison done in SAP	0.48	5
6.	Health	0.48	6
7.	Poor site layout	0.468	7
8.	Materials damage on site	0.468	8
9.	How is the material requirement planned	0.464	9
10.	Improper materials	0.456	10
11.	Improper cutting of materials	0.456	11
12.	Delay in project commencement	0.456	12
13.	Price and contract	0.452	13
14.	Existence of unnecessary material on site	0.452	14
15.	Poor and wrong storage materials	0.448	15
16.	Social responsibilities	0.44	16
17.	Manufacturing defects	0.44	17
18.	Lack of materials(due to closure)	0.436	18
19.	Do you used vendor evolution	0.436	19
20.	Design changes by owner	0.424	20

Now in this table relative importance index value are given for each statement of factor relative importance index value range between 0 to 1. The highest value will be one for each statement of factor we can see the relative importance index value in improper handling of material on site is having the highest relative importance index value it is 0.5 followed by severe weather condition is 0.496 what is the contractor slowness in taking decision is 0.492 fourth is use of incorrect material is 0.48 fifth is the quotation comparison done in SAP is 0.48 sixth is health it is 0.48 seventh Is poor site layout it is 0.468 eight is material damaged on site it is 0.468 ninth is How is the material requirements planned it is 0.464 ten is the improper material it is 0.456 eleventh is improper cuttingof material is 0.456 twelfth is delay in project commencement is 0.456 13th is price and contract it is 0.452 14th is existence of unnecessary material on site is 0.452 15th is poor and wrong storage material it is 0.448 16th is social responsibilities it is 0.44 17th is manufacturing defect is 0.44 18th is lack of material(due to closure) is 0.436 19th is do you use vendor evaluation it is 0.436 and 20this design changes by owner is 0.424 so using relative important index. You can understand what is important given to each statement of factor this relative important index will be used for Likert scalequestionnaire and we are not comparing between the statement.

We are giving rating for each statement of factor if you want to give comparison between the one statement to other statement of factor then we must use different type of questionnaire which is ranking questionnaire they must ask rank your level of satisfaction toward the following factor at present job now when we give the type of questionnaire what will happen is the respondent will answer rank wise when we taking like a scale were comparing only with one statement of factor we are not comparing between the two statement we are not comparing the improper handling of

material on site to severe weather condition but when we want to comparison between the statement and we must use the Ranking method and to solve the Ranking method then we Henry garret Ranking method/RII method.

VII. CONCLUSION

The Construction industry is considered as an important sector in the world as it develops and achieve the goals of the society. The research has thoroughly examined all the factors affecting material management in the construction industry. A questionnaire-based survey was used to judge the attitude of Contractors, Project Engineers, Store In charge and Site Supervisors towards factors affecting Material Management of construction firms in the Nashik region. 50 questionnaires were distributed as follows:

11 Civil engineers, 12 Contractors, 17 Site Engineers, 2 Entrepreneur, 2 Junior supervisors, 1 Proprietors, 1 Sr. Manager, 1 Investment manager, 1 Mistry and 2 Site Supervisor. 50 questionnaires were returned as 11 Civil engineers, 12 Contractors, 17 Site Engineers, 2 Entrepreneur, 2 Junior supervisors, 1 Proprietors, 1 Sr. Manager, 1 Investment manager, 1 Mistry and 2 Site Supervisor as respondents. The respondents were asked to indicate the level of importance of each of the 20 factors of Material management and Inventory management in the Nashik region as very high, high, mid, little, very little degree affect. Results indicated that the most important factor affecting Material management and Inventory management of construction firms are Improper handling of materials on site, Severe weather conditions, Contractor's slowness in taking decisions, Use of incorrect material, Is the quotation comparison done in SAP, Health, Poor site layout, Materials damage on site, How is the material requirement planned, Improper materials Improper cutting of materials, Delay in project commencement, Price and contract, Existence of unnecessary material on site, Poor and wrong storage materials, Social responsibilities, Manufacturing defects, Lack of materials (due to closure), Do you used vendor evolution, Design changes by owner.

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