© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

# IMPLEMENTATION OF GREEN SUPPLY CHAIN - A COMPARATIVE ANALYSIS BETWEEN SMALL, MEDIUM AND LARGE SCALE CONSTRUCTION INDUSTRIES"

[1]Miss Toke Monika Prabhakar
ME Student, Department of Civil Engineering,D.Y. Patil Institute of Engineering,Ambhi,Talegaon,Pune
[2]Dr. Sumant Kulkarni
Professor,Department of Civil Engineering,D.Y. Patil Institute of Engineering,Ambhi,Talegaon,Pune

ISSN : 2278-6848 03
9 772278 684800
© International Journal for Research Publication and Seminar

**Abstract-**Environmental pollution is the major problem that mankind faces in present state, the major emission of toxic gases is from vehicles and manufacturing industries. The thesis study focuses on three different types of Small Scale Industries (SSI) in India that are bumper manufacturing industry, dyeing industry and food processing industry. The product life cycles of the process for each industry are identified and their final green waste disposal methods are investigated. The significance of GSCM in greening the building sector in addition to the inherent gaps in the literature formed the inspiration of the analysis, in which an extensive, theory enabled GSCM exploration is going to be performed on the construction market addressing the implementation of different eco-friendly practices across all key development (from first advancement of the look to end of recycling) and life demolition, drivers for and obstacles to the implementation of theirs (antecedents) and their various performance implications (outcomes), all with the amount of individual stakeholders, Architects/Consultants, i.e. Developers, Contractors/Subcontractors and also material Suppliers. The study will even check out the impact of (stakeholder) firm size plus ownership, so that any intrinsic differences could be fully understood and also delineated. Furthermore, the analysis is going to try to produce a higher-level abstraction on the GSCM concept in building with the application of established/emerging management theories, based on how and where these theories could, separately and in conjunction, help with providing a much deeper, more and broader simplified conceptualization of GSCM perspectives. Because of the medical idea that good theoretical ideas are essential for managerial and decision-making activities also the development of any area (Paulraj and Chen, 2004)[11], the theoretical underpinnings of this particular research are likely to improve the useful application of GSCM within the building market and in common, along with add significantly towards further theoretical development of the industry.The particular goals of this particular research are therefore as follows: one. Understand the different GSCM elements because of the building segment, specifically eco-friendly practices, drivers for and obstacles to the implementation of theirs, and the impact of it's on the financial and environmental performance (long-term and short-term) of companies across every supply chain stakeholder two. Recognize the crucial inter relationships between these GSCM aspects vital for greening the building market three. Understand the effect of firm size in addition to ownership on the GSCM aspects four. Offer several theoretical perspectives in realising the multifaceted reality of GSCM within the building market. In general, this detailed, theory enabled Resulting insights and GSCM investigation are likely to give policymakers and practitioners with an all-inclusive comprehension of the different circumstances needed for greening the building supply chain and consequently the sector.

**Keywords-**Green Supply Chain, Construction Industries, Environmental Issues

## 1. INTRODUCTION

### 1.1. Criticality of responding to environmental issues

Because of the mankind's quest for industrial modernization and economic growth, the similar problems of resource depletion, climate change, and environmental pollution have grown to be among the best problems of the 21st century (IPCC, 2007). The entire worldwide greenhouse gas (GHG) emissions, the primary driver of climate change, amounted to roughly 52.7 gigatonnes of carbon dioxide equivalent (GtCO2e) in 2014, the best amount reported since the pre-industrial ph levels (UNEP EGR, 2014). Furthermore, the increased the yearly price of GHG emissions during the period 2000 2010 was faster (2.2 %) than during the period 1970 2000 (1.3 %) (UNEP EGR, 2016)[16]. The consequences of these emissions, largely in the type of climate change and rising ocean levels are plainly apparent.

### 1.2. A supply chain strategy to greening or maybe eco-friendly supply chain management Green supply chain management (GSCM)

Perhaps incorporating ecological issues into supply chain management (Srivastava, 2007)[32], has emerged in the recent past as an integrated and systematic method of dealing with the environmental issues of different sectors such as for instance general production, automobile, electrical and electronics (Kant and Malviya, 2015)[25]. This's because professionals and policymakers have begun to understand that the life cycle green impacts of product/project are dispersed across its supply chain development from design to end of life (Hervani et al., 2005; Wu et al., 2011)[16].

### 1.3. Green supply chain management within the building sector

Among the different sectors, the building market continues to be labeled as the only one with the best opportunity to fight climate change and resource depletion (IPCC, 2007; Dommisse and Pinkse, 2009; GhaffarianHoseini et al., 2013)[41].

This's because the building market will be the single biggest contributor, accountable for one third of worldwide co2 emissions, one third of worldwide resource usage, forty % of the world's power usage, forty % of worldwide waste created, along with twenty five % of the world's full water consumption (UNEP SBCI, 2016). With continuously growing urbanization [approximately seventy % of the world 's population is anticipated to exist in areas that are urban by 2050 (UN DESA, 2014)] plus the ensuing increased building activities, green effects could be anticipated to get greater down the road. This's much additional intense in developing countries/emerging economies, pushed by the desire to meet up with the increasing challenges of growing populations and growing middle classes (UNEP SBCI, 2014). Thus, the requirement to combat/curtail the adverse environmental effects or perhaps greening the building market is now important to make certain the survival of the future generations of ours.

### 1.4. Objectives of this particular research

The significance of GSCM in greening the building market in addition to the inherent gaps in the literature formed the inspiration of the analysis, in which an extensive, theory enabled GSCM exploration is going to be performed on the construction market addressing the implementation of different eco-friendly practices across all key development (from first advancement of the look to end of recycling) and life demolition, drivers for and obstacles to the implementation of theirs (antecedents) and their various performance implications (outcomes), all with the amount of individual stakeholders, Architects/Consultants, i.e. Developers, Contractors/Subcontractors and also material Suppliers. The study will even check out the impact of (stakeholder) firm size plus ownership, so that any intrinsic differences could be fully understood and also delineated. Furthermore, the analysis is going to try to produce a higher-level abstraction on the GSCM concept in building with the application of established/emerging management theories, based on how and where these theories could, separately and in conjunction, help with providing a much deeper, more and broader simplified conceptualization of GSCM perspectives. Because of the scientific idea that good theoretical ideas are essential for managerial and decision-making actions and the
Development of every area (Paulraj and Chen, 2004)[9], the theoretical underpinnings of this particular research are likely to improve the useful application of GSCM within the building market and in common, along with add significantly towards further theoretical development of the industry.

The particular goals of this particular research are therefore as follows:
1. Comprehend the different GSCM elements because of the building segment, specifically eco-friendly practices, drivers for and obstacles to the implementation of theirs, and the impact of it's on the financial and environmental performance (long-term and short-term) of companies across every supply chain stakeholder
2. Identify the crucial inter relationships between these GSCM aspects vital for greening the building sector
3. Understand the effect of firm size in addition to ownership on the GSCM aspects
4. Offer several theoretical perspectives in realizing the multifaceted reality of GSCM within the building market.
In general, this detailed, theory enabled Resulting insights and gscm investigation are likely to give policymakers and practitioners with an all-inclusive comprehension of the different circumstances needed for greening the building supply chain and consequently the sector.

## 2. LITERATURE REVIEW

### 2.1.1. Gaps pertaining to green practices

This food section critically examines the gaps pertaining to green practices sub themes, namely, core environmentally friendly methods and facilitating green practices.

#### 2.1.1.1. Gaps pertaining to core green practices

As stated previously, core environmentally friendly practices are activities/initiatives undertaken to minimize the ecological footprint across every one of the unique practical phases of the supply chain, i.e. from design to end of life of the structure.

**Design phase**: It's obvious that just a few scientific studies (Liu et al., 2012; Ng et al., 2012)[21] have examined environmentally friendly design methods, that entail combining ecological factors during design phase, despite being fully necessary of the field, as choices built during this particular phase will likely have a major impact on the life cycle environmental impact of the structure. Additionally, these couple of scientific studies hasn't deemed the person supply chain stakeholders' perspectives. As an outcome, the specifics of the appropriate eco-friendly design contribution of single stakeholders, i.e. Developers, Architects/Consultants, Contractors and also (material) Suppliers is not clear. For instance, in the situation of Suppliers, green product/material look will likely have an immediate effect on the life cycle energy effectiveness of the structure. Nevertheless, there's very little comprehension of the effect, as not one of the pre-existing research seems to have examined the eco-friendly material/product design factors of Suppliers. Similarly, Contractors, primarily based on their onsite project expertise, may bring about green building design by suggesting design characteristics which eat far fewer energy and materials during construction. Once again, there's very little comprehension of the job of Contractors in environmentally friendly construction design. A very clear comprehension of the functions and contributions of specific stakeholders in earth-friendly design is vital for providers and also policymakers seeking to market sector wide energy efficient design practices.

**Purchasing/Procurement phase**: Purchasing/Procurement is an important practice of every building project which contains all the activities regarding acquiring goods, services and also consultancy essential to complete the task objectives (Martins, 2009; Sears et al., 2008)[11]. Green purchasing or perhaps integration of green considerations into buying actions, programs, and policies (Varnas et al., 2009)[13] has, thus, the substantial opportunity in greening the building supply chain. Nevertheless, as observed in Table 2.5, just a small quantity of research has checked out the eco-friendly purchasing aspects (Ofori, 2000; Varnas et al., 2009)[15]. Moreover, these experiments have often disregarded stakeholders' perspectives completely (Ofori, 2000) or even viewed just distinct people like Developers (Varnas et al., 2009) in the investigations of theirs. The green buying practices of many stakeholders are thus not clear. For instance, rather than choosing the lowest bid, that continues to be the standard method of building procurement for several years (Hatmoko, 2008)[18], it's essential to understand' what green/environmental concern is created through the Developer while procuring the services of Architects/Consultants & Contractors'. In the situation of Contractors, this specific understanding is particularly crucial as their green purchasing activities include ecological considerations in equally components purchasing choices and in the number of Subcontractors.

**Transportation phase**: On the list of main shortcomings apparent from the shoes review is the fact that environmentally friendly practices or transportation undertaken to minimize the ecological impact of all transportation related activities seem to be missing entirely. This's shocking since construction projects normally have a considerable amount of transportation activities, and they entail both personnel transportation as well as material transport. Based on Ng et al. (2012)[21], transportation of materials/supplies by itself accounts for about 6 8 % of the co2 emissions in construction jobs.

**Construction/manufacturing phase**: Studies on environmentally friendly building methods, or maybe practices targeted at minimizing the undesirable environmental impact throughout the actual physical building of structures, also have been narrowly scoped with only particular methods like pre fabrication (Jaillon et al., 2009) and onsite waste management (Begum et al., 2007)[25] being studied. Although environmentally friendly building practices are appropriate and then Subcontractors and contractors, the absence of studies in this specific place means that there's minimal knowledge of the different development methods targeted at minimizing the adverse green implications throughout the build phase. This's a key matter, as building stage by itself should bring about much more than twenty % of any building 's lifetime power consumption (Ng et al., 2012)[28].

In the situation of building material Suppliers, the corresponding exercise is "green manufacturing", that requires similar methods at the production sites. Nevertheless, not one of the scientific studies seems to have checked out the eco-friendly manufacturing practices of building material Suppliers. This's an additional main shortcoming because creating material manufacturing itself accounts for ten % of worldwide power consumption (UNEP, 2010).

**Endoflifephase**: End of life environmentally friendly practices are practices undertaken at the conclusion of a building's useful life in order to handle energy efficient demolition activities and also to maximize recyclability and recovery of building materials. Nevertheless, these also, are minimally talked about in the literature despite being recognized to considerably lower the ecological load regarding the building market. As Blengini (2009)[30] describes, they'll decrease the entire life-cycle power of a developing by around thirty %, along with GHG emissions by about eighteen %. Based on Thormark (2002)[3], tail end of daily life control is fully necessary to minimize the embodied energy of building materials. This's because recycling many supplies, like aluminium or steel, can easily confer savings of over 50 % the embodied energy and substantial reductions within the connected GHG emissions (Yan et al., 2010)[8].

To sum up, core environmentally friendly methods, such as the extents of theirs of the implementation at a person stakeholder level, aren't adequately known with the building market. Gaining a comprehensive comprehension of the pertinent core eco-friendly methods for every stakeholder individually is crucial because altogether, they decide the life-cycle environmental impact of a building job and also when aggregated, for the building market like an entire. It likewise seems sensible to learn these practices together/holistically as you will find interactions between them; for instance, eco-friendly design factor in terminology of construction materials/components being utilized can have implications for natural purchasing, environmentally friendly building plus end of life environmentally friendly practices.

**2.1.1.2. Gaps pertaining to facilitating green practices**

As in the past mentioned, facilitating green practices are activities/initiatives undertaken at the intra firm level to create green resources and capabilities. It's once again obvious from that just a small quantity of research has examined facilitating green methods, which far too precise practices such as for instance environmental management methods and ISO 14001 certification (Ofori 2000; Tam and Shen 2002; Creed and Zutshi, 2014)[25]. The spaces in the data are therefore clearly evident. For example, there's very little comprehension of the different environmentally friendly instruction and environmental auditing activities completed by various stakeholders in the building market. A comprehensive comprehension of the nature/details of these methods like as length of the training/auditing activities, coverage of the training/auditing activities (select employees or all employees; all the departments or maybe select departments) and frequency of the training/auditing physical activities will be helpful in realizing the environmental objectives of the field. Still, others such as for instance cross functional integration (or maybe control across various departments and functions) acknowledged to facilitate the realization of going green objectives in some other sectors (Zhu et al., 2012)[29] seem to be lacking in the building literature. Given that building companies are generally characterized by more and more departments and functions, the field is anticipated to gain from coordinated cross practical teams in green related decision making, ideal exchange of green related info, ensuring commitment of departments to a typical

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

eco-friendly goal, mutual assistance, along with constant improvement (Adetunji et al., 2008)[31]. Nevertheless, at present, there's absolutely no knowledge of exactly how this could be attained or maybe the degree to which it's attained in the building market. Likewise, some other related facilitating green methods because of the building market may be lacking in the literature (given the small quantity of studies), and for that reason has to be investigated more.

In a nutshell, for those facilitating green practices, details about the nature of theirs and the extents of theirs of implementation (both known and) that is unknown aren't adequately understood. Given that facilitating practices not just immediately improve environmental performance (Zhu et al., 2012), but also help enhancing the center environmentally friendly practices as well (Sarkis et al., 2011; Zhu et al., 2012)[29], obtaining a comprehensive knowledge of them, and also at a person stakeholder level, is pivotal for the greening the building supply chain as well as the industry.

**2.1.2. Gaps pertaining to green drivers and barriers**

As previously stated, it's crucial for policymakers and practitioners to recognize the' antecedents' or maybe barriers and drivers of center and facilitating green methods, since they could explain elements like the reason some companies are hands-on in applying green methods while others are reactive; and also why some show considerable implementation of environmentally friendly practices while others display limited or maybe no implementation. Like any other sectors, the building market may also take advantage of exploring these barriers and drivers primarily based on the source of theirs of origin (internal or external). While the literature has some info on the dynamics of these external and internal green drivers and barriers , the understanding is far from comprehensive.

**2.1.3. Gaps pertaining to green performance methods widely used and performance advantages from green practices**

Understanding the results or perhaps performance enhancement from environmentally friendly practices (implementation) is crucial as it directly pertains to decision making at all levels: operational, tactical, and strategic. This's particularly crucial for the building segment, because the field is noted for its bad performance and also low profit margins (Agapiou et al., 1998, Ning and Yeo, 2002, Ireland and Cox, 2002)[44].

## 3. RESEARCH METHODOLOGY

### 3.1 INTRODUCTION:

The dynamics of re-search in the nature and previous studies of re-search questions posited in this particular study identified the philosophical stance of this particular thesis. An epistemological placement and a pragmatic approach to research are believed to be in this specific thesis. The reason behind selecting an epistemological job is for the reason that this particular research is trying to lengthen the expertise of GSCM in the building market and generally to curtail the undesirable green implications of the construction market. The pragmatic strategy is selected since it's essential to act quickly as the clock is ticking to fight green problems, and also for which realistic and practical fixes are required to inform train, i.e., the practical application of GSCM in the building market. An extensive knowledge of each practical and theoretical problem in many instances involves integration of both quantitative and qualitative techniques in one analysis

### 3.2 RESEARCH PROCESS:

Material management process begins from the need generated from site then information conveyed to store, department and material are ordered in store and the indent is generated. This research process consists of a series of actions and steps essential to carry out research effectively. The fig 2 shown the well clarifies a research process adopted in this research work

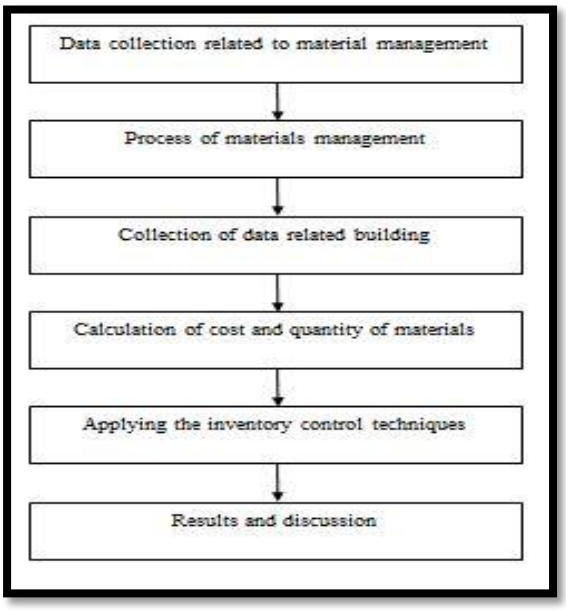



**Fig 3.1 Research process**

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

### 3.3 OBJECTIVES OF RESEARCH:

The purpose of the research is collecting the various material data of the material from our residential construction project site. The main purpose of project is to the existing common practices in construction projects and applies the Green supply chain management (GSCM) technique so as to analyse the effect of material management on our construction site of project.

### 3.4 QUALITATIVE ANALYSIS TECHNIQUES:

Qualitative Analysis techniques are working for the inventory control .Inventory techniques represent the operations aspects of inventory management and help to understand the objective of inventory management and its control many techniques for inventory control are in use and it depends on the policy of the firm, product, the techniques most commonly used are as under.

#### 3.4.1 ABC Analysis:

The ABC analysis is used to identifying material items that has a high impact on overall inventory cost. In this method materials divided into three Groups. A class, B class & C class. A Class materials which require the highest consideration, B Class materials which require medium consideration, and C Class materials which require the least consideration such that the control mechanism be focused on selective class of materials.

The Pareto principle states that 80% of the overall consumption value is based on only 20% of total items. In other words, demand is not evenly distributed between items: top sellers vastly outperform the rest. The ABC approach states that, when reviewing inventory, a company should rate items from A to C, basing its ratings on the following rules:

**Procedure for ABC Analysis:**

- Make the list of all items of inventory.
- Determine the annual volume of usage & money value of each item.
- Multiply each item's annual volume by its rupee value.
- Compute each item's percentage of the total inventory in terms of annual usage in rupees
- "A" Category – 5% to 10% of the items represent 70% to 75% of the money value.
- "B" Category – 15% to 20% of the items represent 15% to 20% of the money.
- "C" Category – The remaining number of the items represent 5% to 10% of the money value.
- The relative position of these items show that items of category A should be under the maximum control, items of category B may not be given that much attention and item C may be under a loose control
    - "A class" inventory will typically contain items that account for 80% of total value, or 20% of total items.
    - "B class" inventory will have around 15% of total value, or 30% of total items.
    - "C class" inventory will account for the remaining 5%, or 50% of total items.

This analysis class the entire range of materials keep in stock in three categories – A,B, and C based upon their annual consumption value known as "annual usage value." Annual usage value for this item is the annual monetary value of consumption, which can be computed by the following relationship:

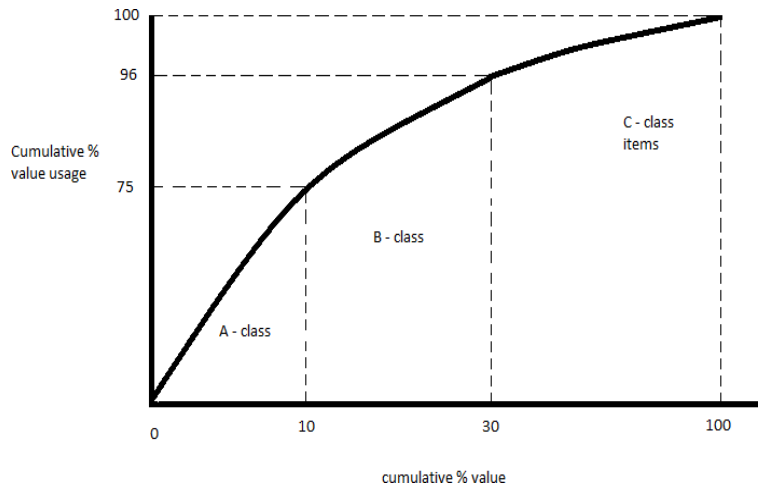
**Annual usage value** = annual consumption in units × unit purchase price

ABC analysis, we arrange the annual usage value of items in the descending order with the maximum usage value at the top. A cumulative graph as shown in Fig. 3 is then obtained this data using

**Conducting ABC Analysis:**

To conduct ABC analysis, following steps is necessary:

1. Make the list of items and evaluation their annual consumption (units).
2. Determine unit value (or cost) of all item.



© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

3. Multiply each annual consumption by its unit value (or cost) to get its annual consumption in rupees (annual usage).

**Advantages of ABC Analysis:**

1. It ensures a closer and a better control over each items , which are having a sizable investment in there.
2. Profitable channel of investment.
3. Reduces inventory-carrying cost.
4. Reduce overall cost and better handling of each items.

**3.5 QUALITATIVE APPROACH METHOD:**

**3.5.1 ECONOMIC ORDER QUANTITY (E-O-Q):**

The meaning of the EOQ is the order of quantity that optimizes the overall cost and cost of ordering. Determining how much to order in a continuous system is the Economic Order Quantity (EOQ) model. The function of the EOQ model is to determine the optimal order size that reduces total inventory costs.

**THE BASIC EOQ MODEL:**

The basic EOQ model is a formula for finding the optimum order size that reduces the sum of carrying costs and cost of the ordering. The model formula is based under a set of simplifying assumptions, as follows:

- Demand is known with certainty and is constant over time.
- No shortages are allowable.
- Lead time for the receipt of orders is constant.

**EOQ: THEORY AND FORMULA**:

The most well-known results in the inventory control area may be the classical Economic Order Quantity (EOQ) formula. This simple rule has had and still enormous no of practical applications. The EOQ is essentially an accounting formula that determines the point at which the combination of cost of order and holding costs as least. The result is the most cost-effective quantity to order.

The basic Economic Order Quantity (EOQ) formula is as follows:

$$\text{EOQ} = \sqrt{\frac{2(\text{Annual usage in units})(\text{Order cost})}{(\text{Annual carring cost per unit})}}$$

**COST COMPONENTS:**

**ANNUAL USAGE AND DEMAND**

Expressed in units this is generally the easiest part of the equation.

**ORDER COST**

This is the sum of the fixed costs that are incurred each time an item is ordered. These costs are not related with the quantity ordered, but mainly with physical activities required to process the order. For purchases items these would comprise the cost to enter the Purchase Order and/or Requisition, any approval steps, the cost to process the receipt, incoming inspection, invoice handling and vendor payment.

**CARRYING COST (INVENTORY HOLDING COSTS)**:

Also called Holding cost, carrying cost is the cost associated with having inventory on hand. It is primarily made up of the costs related with the inventory investment and cost of storage. For the purpose of the EOQ calculation, if the cost does not change based upon the quantity of inventory on hand it should not be included in carrying cost.

BEHAVIOR OF EOQ SYSTEM

1. The amount ordered every time an order is placed is fixed.
2. A function of this type system is the two bin system.
3. As demand of the inventoried item occurs, the inventory level drops.

**3.6 ANALYSIS WORK AND DATA COLLECTION:**

Analysis of work shall be carried out within the scope of the study and between the selected respondents of the material. This data will be divided into respondents and data will be collected through these residential building projects. By these analyses the perceptions of respondents with respect to Material management and reducing the average inventory will be fixed.

**3.7 S-curve analysis:**

S curve analysis is an important project management tool. This analysis is carried for comparison between planned and actual cost for material items. S-curve provides at view of project performance in terms of cost and time. Analysis of S-curves permits project management team to essay identify the project growth, slippage, and potential problems that could adversely impact the project if no corrective action is taken.

They allow the progress of a project to be tracked visually over time, and form a historical record of what has happened to date. It is also a toll to enlighten us with understanding of the project and its progress.

S curve analysis Cost variance is calculated as difference between Budget costs for work performed (BCWP) and Actual cost for work performed (ACWP). Cost performance is calculated as ratio of Budget cost for work performed to Actual cost for work performed.

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

## 4. RESULT AND DISCUSSION

**CASE STUDY 1**

### 4.1 STAKE HOLDER DETAIL

| | |
|---|---|
| **Name of the organization** | SHUBHAM CIVIL POJECTS AND PVT.LIMITED,PUNE |
| **Year of Establishment** | 2015 |
| **Location** | Karve Nagar SM tower near Jigamatachowk Pune. |
| **Structural Engineer** | Mr. Yatish |
| **Project Manager** | Mr Kale |
| **Elevation and Concept** | Mr Pawan Kumar |
| **Architect Engineer** | Mr. Praveen |
| **Name of Contractor** | Mr.Mohan Nirade |
| **Type of Work** | 2 BHK Residential Project |
| **No. of Floors** | G +10 |

### 4.2 LIST OF MATERIAL FOR CALCULATION:

Various lists of materials to carry out qualitative analysis techniques such as ABC (Always Better control) and also uses a qualitative approach EOQ (Economic Order Quantity) for the calculation is as follows,

| Sr No | **Bulk Materials** | **Tiles** |
|---|---|---|
| 1 | Fly ash Cement | Ceramic tiles |
| 2 | River Sand | Vitrified Tiles |
| 3 | Recycle Aggregate | Black granite |
| 4 | Steel | |
| 5 | Binding Wire | |
| 6 | Wood | |
| 7 | Cement | |

**Table 4.2 List of Materials**

### 4.3DATA COLLECTION FOR ALWAYS BETTER CONTROL (ABC) ANALYSIS:

In the Always Better control (ABC) This analysis of various data collection of materials for the project. In these various material data of the image, check the daily reports of material, and lists various amounts of materials for the project. In this table.4.2 show list out the material category and how many items made of materials for our housing projects..

**Table 4.3 Description of Material**

| Sr no. | Items and Description | Total Items |
|---|---|---|
| **1.** | Bulk Material | 7 |
| **2.** | Ceramic Tiles | 3 |
| | **Total items** | **10** |

The numbers shown in Table4.4, which data collection of bulk material for ABC Analysis in our project

| Sr. No | Material Description | Unit | Total Receipt Qt | Rate (INR) |
|---|---|---|---|---|
| **1** | Fly ash Cement | BAG | 19000 | 320 |
| **2** | Fly ash Cement | BAG | 15000 | 225 |
| **3** | TMT Bar 8 mm Dia-Fe 415 | KG | 5000 | 60.00 |
| **4** | TMT Bar 10 mm Dia-Fe 415 | KG | 2000 | 58.30 |

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

| | | | | |
|---|---|---|---|---|
| **5** | TMT Bar 12 mm Dia-Fe 415 | KG | 4522 | 62.22 |
| **6** | TMT Bar 16 mm Dia-Fe 415 | KG | 7254 | 55.25 |
| **7** | TMT Bar 20 mm Dia-Fe 415 | KG | 19025 | 45.55 |
| **8** | River sand | TON | 254714 | 700 |
| **9** | Fine sand | TON | 1900 | 770 |
| **10** | Cement cube | M3 | 450 | 2000 |

**Table 4.4: Bulk Materials for Residential Building**

The number shown in Table .4.5, which data collection of Tiles for ABC Analysis in our Project

**Table 4.5: Tiles for Residential Building**

| Sr. No | Material Description | Unit | Total Receipt Qt | Rate (INR) |
|---|---|---|---|---|
| **1** | Ceramic Tiles | FT2 | 14597 | 230 |
| **2** | Vitrified Tiles | FT2 | 132594 | 350 |
| **3** | Black Granite | FT2 | 1700 | 114 |

## 4.4 DATA ANALYSIS BY ALWAYS BETTER CONTROL (ABC) TECHNIQUE

**Table 4.6: Always Better Control (ABC) Analysis of Bulk material**

| Sr. No | Material Description | Unit | Total Receipt Qty | Rate (INR) | Annual Usage (INR) | Total Annual Usage (%) | Annual Usage Cumulative (%) | Items (%) | Items Cumulative (%) | Rank | Cate gory |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Fly ash Cement | BAG | 2500 | 280 | 6210000 | 14.34 | 14.34 | 7.69 | 7.69 | 2 | A |
| 2 | Cement ppc | BAG | 22200 | 250 | 5550000 | 12.81 | 27.15 | 7.69 | 15.38 | 3 | A |
| 3 | TMT Bar 8 mm Dia-Fe 415 | KG | 10500 | 28.00 | 294000 | 0.67 | 27.82 | 7.69 | 23.07 | 11 | B |
| 4 | TMT Bar 10 mm Dia-Fe 415 | KG | 8400 | 28.30 | 237720 | 0.54 | 28.36 | 7.69 | 30.76 | 12 | B |
| 5 | TMT Bar 12 mm Dia-Fe 415 | KG | 2800 | 29.30 | 82040 | 0.20 | 28.56 | 7.69 | 38.45 | 13 | B |
| 6 | TMT Bar 16 mm Dia-Fe 415 | KG | 10500 | 31.20 | 327600 | 0.75 | 29.31 | 7.69 | 46.14 | 10 | C |
| 7 | TMT Bar 20 mm Dia-Fe 415 | KG | 22400 | 32.00 | 316800 | 1.65 | 30.96 | 7.69 | 53.83 | 9 | C |

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | River sand | TON | 340700 | 900 | 3066300 | 7.08 | 38.04 | 7.69 | 61.52 | 4 | B |
| 9 | Fine sand | TON | 2505.6 | 660 | 1653696 | 3.82 | 41.82 | 7.69 | 69.29 | 7 | B |
| 10 | ement cube | M3 | 598.202 | 3000 | 179406 | 41.44 | 83.03 | 7.69 | 76.90 | 1 | A |
| 11 | inding wire | KG | 23000 | 60 | 1380000 | 3.20 | 86.5 | 7.69 | 84.59 | 8 | C |
| 12 | Wood | KG | 72000 | 42 | 3024000 | 7.00 | 93.5 | 7.69 | 92.28 | 5 | C |
| 13 | Aggregate | TON | 5629.7 | 500 | 281485 | 6.50 | 100 | | 99.97 | 6 | A |
| | | | | | 429030 66 | 100 | | | | | |

The number shown in Table 4.6, which Always Better Control (ABC) Analysis of Summary of Bulk material which number show thatdifferent category, class A, class B, Class C Bulk material total Annual Usage in the residential project.

**Table 4.7: Summary of Bulk Material ABC Analysis**

| Classification | No. of Items | Percentage of Items | Total Annual Usage (Percentage) | Annual Usage (INR) |
|---|---|---|---|---|
| Class A | 4 | 30.76 | 75.08 | 32520910 |
| Class B | 5 | 38.45 | 12.31 | 5333756 |
| Class C | 4 | 30.76 | 12.6 | 5048400 |
| Total | 13 | 100 | 100 | 42903066 |

ABC analysis is a kind of technique, which provides the means for identifying those items that make the largest impact on a company's overall inventory cost performance. Below fig.4.2, the category from the ABC analysis, we can place different controls on items A, B and C to improve the total inventory performance.

**DISCUSSION**

From table 4.7, we can show that the class A items total percentage items 30.76% and total annual usage is 75.08% of the high consumption. The class B items total percentage items 38.45% and total annual usage is 12.31% of the medium consumption. The class C items total percentage items 30.76% and total annual usage is 12.6% of the least control. The number shown in Table 5.11, which Always Better Control (ABC) Analysis of Ceramic/Glazed Tiles in the residential project .

**Table 4.8: Always Better Control (ABC) Analysis of Tiles**

| Sr. No | Material Description | Unit | Total Receipt Qty | Rate (INR) | Annual Usage | Total Annual Usage | Annual Usage | Items | Items | Rank | Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | (INR) | (%) | Cumulative (%) | (%) | Cumulative (%) | | |
| **1** | Ceramic Tiles | FT2 | 16420 | 237 | 3891540 | 6.40 | 6.40 | 33.33 | 33.33 | 2 | **A** |
| **2** | Vitrified Tiles | FT2 | 141700 | 400 | 56680000 | 93.30 | 99.7 | 33.33 | 66.66 | 1 | **A** |
| **3** | Black Granite | FT2 | 1620 | 110 | 178200 | 0.30 | 100 | 33.33 | 99.99 | 3 | **C** |
| | | | | | **60749740** | **100** | | | | | |

**Table 4.9: Summary of Tiles ABC Analysis**

| Classification | No. of Items | Percentage of Items | Total Annual Usage (Percentage) | Annual Usage (INR) |
|---|---|---|---|---|

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

| | | | | |
|---|---|---|---|---|
| Class A | 2 | 66.66 | 99.7 | 60571540 |
| Class B | -- | -- | - | - |
| Class C | 1 | 33.33 | 0.30 | 178200 |
| Total | 3 | 100 | 100 | 60749740 |

**Discussion:** From table 4.9, we can show that the class A items total percentage items 66.66% and total annual usage is 99.70% of the high consumption. The class C items total percentage items 33.33% and total annual usage is 0.30% of the least control.

**4.4 DATA COLLECTION OF ECONOMIC ORDER QUANTITY (EOQ)**

In this Economic Order Quantity (EOQ) Analysis deals with the various material data collection for the current running project In this table 5.23 shows a list out Bulk material and how much Annual Demand per year in material items conducted for residential project.

**4.10 Material Description for Economic Order Quantity (EOQ)**

| Sr. No | Material Description | Unit | Rate(INR) | Annual Demand (Per year} | Annual Order Cost (INR) | Annual Holding Cost | Annual Holding Cost Per Unit (INR) |
|---|---|---|---|---|---|---|---|
| 1. | Fly Ash Cement | BAG | 270 | 6210000 | 130 | 15% | 40.50 |
| 2. | Cement PPC | BAG | 250 | 5550000 | 130 | 15% | 37.50 |
| 3. | TMT Bar 16mm | KG | 31.20 | 327600 | 100 | 15% | 4.68 |
| 4. | River Sand | TON | 750 | 3066300 | 130 | 15% | 135 |
| 5. | Green Cement Block | M3 | 3000 | 17946060 | 60 | 10% | 300 |
| 6. | Recycle Coarse Aggregate | TON | 500 | 2814850 | 120 | 15% | 75 |

**4.5 DATA ANALYSIS BY ECONOMIC ORDER QUANTITY (EOQ) :** The number shown in Table 5.20, which major bulk material data analysis by Economic Order.

**Quantity (EOQ) in the residential project**

**4.12 Total Investment Cost with Use Economic Order Quantity (EOQ)**

| Sr. No | Material Description | Unit | Rate (INR) | Annual Demand (Per year} | Annual Order Cost (INR) | Annual Holding Cost | Annual Holding Cost Per Unit (INR) | EOQ | No of Order | Order Cycle |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Fly Ash Cement | BAG | 270 | 6210000 | 130 | 15% | 40.50 | 122 | 19 | 20 |
| 2. | Cement PPC | BAG | 250 | 5550000 | 130 | 15% | 37.50 | 124 | 18 | 21 |
| 3. | TMT Bar 16mm | KG | 31.20 | 327600 | 100 | 15% | 4.68 | 212 | 5 | 74 |
| 4. | River Sand | TON | 750 | 3066300 | 130 | 15% | 135 | 29 | 12 | 31 |
| 5. | reen Cement Block | M3 | 3000 | 17946060 | 60 | 10% | 300 | 16 | 38 | 10 |
| 6. | Recycle coarse Aggregate | TON | 500 | 2814850 | 120 | 15% | 75 | 43 | 14 | 28 |

| Sr. No | Material Description | Unit | Rate(INR) | Annual Demand (Per year} | EOQ | No of Order | Order Cycle | Total Cost | Total Investment Cost | Total Cost of Material |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Fly | BAG | 270 | 6210000 | 122 | 19 | 20 | 4941 | 329400 | 378810 |

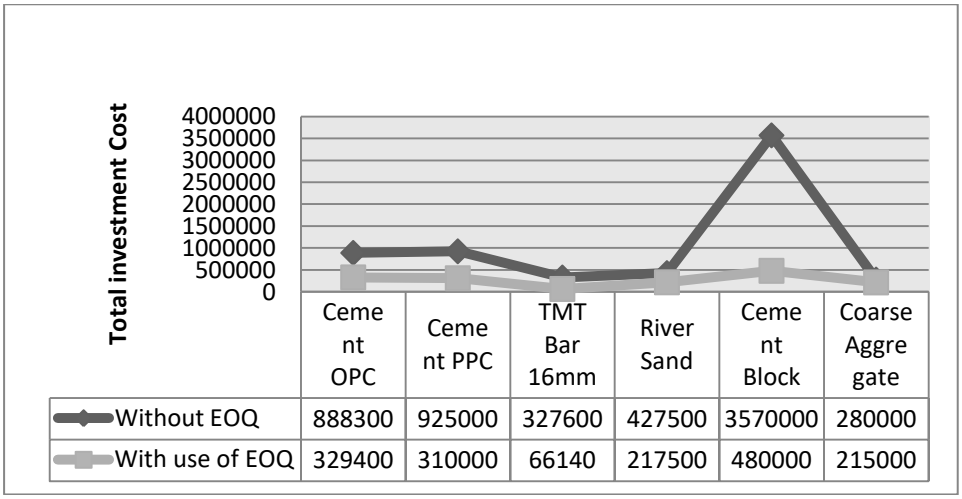
© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cement OPC | | | | | | | | | |
| 2. | Cement PPC | BAG | 250 | 5550000 | 124 | 18 | 21 | 46500 | 310000 | 775000 |
| 3. | TMT Bar 16mm | KG | 31.20 | 327600 | 212 | 5 | 74 | 992.16 | 66140 | 76060 |
| 4. | River Sand | TON | 750 | 3066300 | 29 | 12 | 31 | 3263 | 217500 | 250130 |
| 5. | Green Cement Block | M3 | 3000 | 1794606 | 16 | 38 | 10 | 7200 | 480000 | 558000 |
| 6. | RecycleCoarse Aggregate | TON | 500 | 281485 | 43 | 14 | 28 | 3225 | 215000 | 247250 |
| | | | | | | | **TOTAL** | | **1618040** | **2285250** |

**4.13 Total Investment Cost without Use Economic Order Quantity (EOQ)**

| Sr. No | Material Description | Unit | Rate(INR) | Annual Demand (Per year} | No of Total Order | Demand Per One Order | Order Cycle | Total Cost | Total Investment Cost | Total Cost of Material |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Cement ppc | BAG | 270 | 6210000 | 7 | 329 | 52 | 133225 | 888300 | 1021550 |
| 2. | Cement PPC | BAG | 250 | 5550000 | 6 | 370 | 60 | 13875 | 925000 | 1063750 |
| 3. | TMT Bar 16mm | KG | 31.20 | 327600 | 1 | 1050 | 365 | 4914 | 327600 | 376740 |
| 4. | River Sand | TON | 750 | 3066300 | 6 | 57 | 60 | 6413 | 427500 | 491630 |
| 5. | Cement Block | M3 | 3000 | 1794606 | 5 | 119 | 48 | 53550 | 3570000 | 4105500 |
| 6. | Coarse Aggregate | TON | 500 | 281485 | 10 | 56 | 36 | 4200 | 280000 | 322000 |
| | | | | | | | **TOTAL** | | **6418400** | **7381170** |

**4.5. S-Curve** analysis of the given data S-curve analysis is essential tool in project management, where the comparison between the planned activity and actual activity can be compared, and analysis is made to track down factors affecting the progress and minimize them.[13] In this study we use the planned cost from EOQ analysis and Actual cost for each floor of a G+8 floor is considered for analysis of each inventory, and troubleshoot is done to reduce the cost and time. For this analysis we choose the top 5 inventory item, and rest can be calculated using the same way.




**4.14 Total Investment Cost with Use EOQ Vs. Without Use EOQ Chart IN GSCM**

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

**CASE STUDY 2**
**STAKE HOLDER DETAIL**

| | |
|---|---|
| **Name of the organization** | JADHAV CONSTRUCTION PUNE |
| **Year of Establishment** | 2015 |
| **Location** | Naryangaon. |
| **Structural Engineer** | Mr.Yatish |
| **Project Manager** | Mr.Vicky Patel |
| **Elevation and Concept** | Mr.pawankumar |
| **Architect Engineer** | Mrs. Praveen |
| **Name of Contractor** | Mr. Ajay |
| **Type of Work** | 2 BHK Residential Project |
| **No. of Floors** | G +15 |

**Table 5.29 ABC analysis**

| Sr. No | Material Description | Unit | Total Receipt Qt | Rate (INR) | Annual Usage | Total Annual Usage | Annual Usage | Items | Items | Rank | Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | (INR) | (%) | Cumulative (%) | (%) | Cumulative (%) | | |
| 1 | Cement Acc | Bags | 45820 | 760 | 34823200 | 52.62 | 34.62% | 7.69 | 15.38 | 1 | A |
| 2 | Cement(Acc/ ultratech) | Bags | 20000 | 640 | 12800000 | 14.34 | 14.34% | 7.69 | 34.94 | 2 | A |
| 3 | Cement(Penna) | Bags | 13963 | 660 | 9215580 | 12.81 | 10.25% | 7.69 | 49.28 | 6 | A |
| 4 | STEEL | Tons | 105000 | 124 | 13020000 | 0.67 | 12.35 | 7.69 | 59.53 | 3 | B |
| 5 | LATERITE | Cft | 220300 | 36 | 7930800 | 0.54 | 4.36 | 7.69 | 71.88 | 2 | B |
| 6 | MASONARY | Cft | 4000 | 36 | 1440000 | 0.2 | 3.65 | 7.69 | 76.24 | 8 | B |
| 7 | 4" BRICK MASONARY | Cft | 81730 | 120 | 9807600 | 0.75 | 5.36 | 7.69 | 79.89 | 5 | C |
| 8 | FINE AGGREGATE | Cft | 62475 | 24 | 1499400 | 6.5 | 4.36 | 7.69 | 85.25 | 7 | A |
| 9 | COARSE AGGREGATE | Cft | 120000 | 62 | 7440000 | 11.57 | 1.47 | 7.69 | 89.61 | 4 | A |
| 10 | Paint Brush | No | 20000 | 700 | 14000000 | 0.31% | 4.97% | 7.69 | 91.08 | 10 | B |
| 11 | Rubber Hand Gloves | Pairs | 6000 | 68 | 488000 | 3.06% | 0.64% | 7.69 | 96.05 | 9 | B |
| 12 | PVC Door | No | 500 | 800000 | 121600 | 0.12% | 0.58% | 7.69 | 96.69 | 12 | B |
| 13 | Ear Plug | No | 620 | 310 | 192200 | 0.58% | 0.56% | 7.69 | 97.27 | 11 | B |
| 14 | Electrical Hand Gloves | Pairs | 200 | 424 | 84800 | 0.31% | 0.40% | 7.69 | 97.83 | 16 | C |
| 15 | Safety Belt | No | 1200 | 550 | 660000 | 0.22% | 0.38% | 7.69 | 98.23 | 13 | C |
| 16 | Safety Cone | Pairs | 200 | 396 | 79200 | 0.31% | 0.38% | 7.69 | 98.61 | 18 | C |
| 17 | Nose Mask | No | 2500 | 60 | 150000 | 2.00% | 0.37% | 7.69 | 98.99 | 14 | C |
| 18 | Rubber Mat Blue | mtr | 300 | 240 | 72000 | 0.46% | 0.34% | 7.69 | 99.36 | 17 | C |
| 19 | Saltex Board | SQ | 2554 | 27 | 68958 | 3.90% | 0.33% | 7.69 | 99.7 | 15 | C |

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FT | | | | | | | | | |
| 20 | FUEL & OIL | Ltr | 897 | 68 | 60996 | 1.37% | 0.29% | 7.69 | 99.99 | 19 | C |
| | | | | | 113954 334 | | | | | | |

| Classification | No. of Items | Percentage of Items | Total Annual Usage (Percentage) | Annual Usage (INR) |
|---|---|---|---|---|
| Class A | 5 | 25 | 75.08 | 65778180 |
| Class B | 7 | 35 | 12.31 | 37192600 |
| Class C | 8 | 40 | 12.6 | 10983554 |
| Total | 20 | 100 | 100 | 113954334 |

**Table 5.30 EOQ Analysis**

| SL.NO | NAME OF THE MATERIAL | ANNUAL REQUIREMENT | UNIT | FIXED COST PER ORDER(Rs) | EOQ | NO OF ORDERS | FREQUENCY OF ORDERING(Days) |
|---|---|---|---|---|---|---|---|
| 1 | **Green Cement** | 44253 | Bags | 800 | 224 | 10.57 | 28 |
| 2 | **Cement(Penna)** | 12025 | Bags | 800 | 544 | 24.44 | 12 |
| 3 | **STEEL** | 98521 | Ton's | 10 | 23 | 8.91 | 28 |
| 4 | **LATERITE MASONARY** | 210543 | cft | 400 | 1552 | 13.96 | 19 |
| 5 | **4FLY ASH BRICK** | 80545 | cft | 400 | 743 | 11.15 | 24 |
| 7 | **RECYCLE FINE AGGREGATE** | 61252 | Cft | 250 | 3675 | 17.06 | 18 |
| 8 | **RECYCLE COARSE AGGREGATE** | 115320 | Cft | 250 | 816 | 10.12 | 26 |

**Table 5.31 Material Management Using Green supply Chain**

| Sl.no | Description | Quantity | Unit | Total amount |
|---|---|---|---|---|
| 1 | Green Cement | 45820 | Bags | 34823200 |
| 2 | laterite | 220300 | Cft | 7930800 |
| 3 | Steel | 105000 | Tons | 13020000 |
| 4 | Recycle Coarse aggregate | 120000 | Cft | 7440000 |
| 5 | 4" flyashBrick | 81730 | Cft | 9807600 |
| 6 | Cement Penna | 13963 | Bags | 9215580 |
| 7 | Recycle Fine aggregate | 62475 | Cft | 1499400 |
| | | | **TOTAL** | **83736580** |

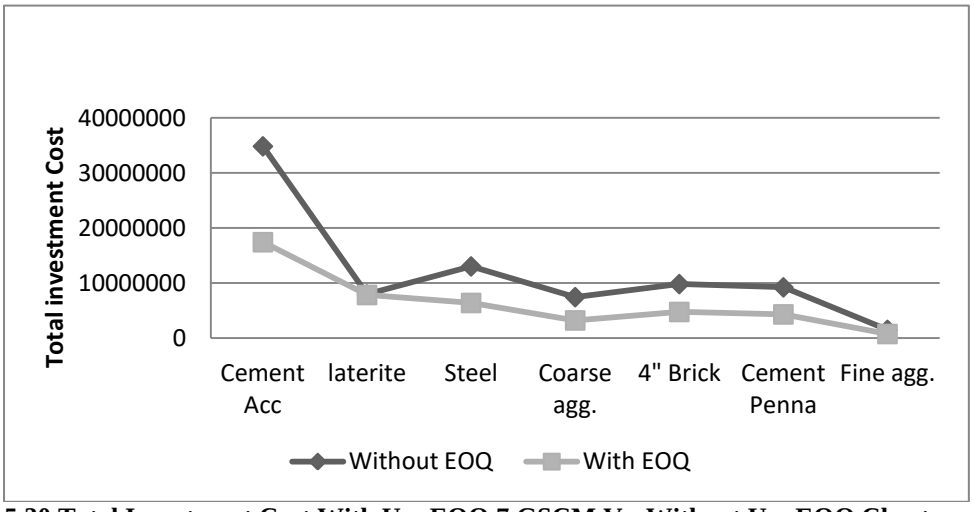
**Table 5.32 Material Managementwithout green supply chain**

| Sl.no | Description | Quantity | Unit | Total amount |
|---|---|---|---|---|
| 1 | Cement Acc | 44253 | Bags | 17411600 |
| 2 | laterite | 210543 | Cft | 7830800 |

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 11 Issue: 03 | July - September 2020
Paper is available at http://www.jrps.in | Email : info@jrps.in

| | | | | |
|---|---|---|---|---|
| 3 | Steel | 98521 | Tons | 6385215 |
| 4 | Coarse aggregate | 115320 | Cft | 3210257 |
| 5 | 4" flyashBrick | 80545 | Cft | 4752900 |
| 6 | Cement Penna | 12025 | Bags | 4307758 |
| 7 | Recycle Fine aggregate | 61252 | Cft | 748500 |
| | | | **TOTAL** | **44647030** |

**5.10. S-Curve Analysis of data** supplied S-curve analysis is an important tool in project management, in which the ratio between the activities planned and actual activity can be compared, and the analysis is made to track the factors that influence the progress and minimize them. In this study we used the planned cost of EOQ analysis and actual costs for each floor of the G + 8 floors are considered for the analysis of each stock, using a green supply chain management and troubleshooting is done to reduce the cost and time. For this analysis we select inventory items on 5, and the remainder can be calculated using the same method.




**5.30 Total Investment Cost With Use EOQ 7 GSCM Vs. Without Use EOQ Chart**

**RESULT AND SUMMARY**

**SUMMARY**

It is concluded that In the material management the main important factors are planning, assessing the requirement, sourcing, purchasing, transporting, storing, and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of material.During the data collection collected data from 22 site but we cannot get the whole data in a single site so data we get converted into 3 cases.

Some data collected manually, some by telephonic and other modesBy applying ABC analysis we can easily classified the material which requires more investment & by using EOQ and using eco-friendly and recycled material we can easily control or reduce the total investment cost of the material. Total investment cost of the material which widely used in in Case study 1 without use of EOQ is Rs. 7381170 & with use of EOQ is Rs. 2285250 also with using of EOQ cost saving in material is 70 %. Total investment cost of the material which widely used in Case study 2 without use of EOQ is Rs. 83736580 & with use of EOQ is Rs. 44647030 also with using of EOQ cost saving in material is 50 %. Total investment cost of the material which widely used in Case study 3 without use of EOQ is Rs. 17128583 & with use of EOQ is Rs. 16577282 also with using of EOQ cost saving in material is 10 %. The concept of environmental sustainability in the construction sector can act in different areas, as waste reduction, carbon emissions reduction, better selection of materials and others. These areas involve several stakeholders during a life cycle of a project, therefore the implementation of a Green Supply Chain Management (GSCM) can help the sustainability aspect of constructions.

**CONCLUSION**

- In this final chapter, first, a brief review of the research background and process carried out is provided. Next, the chapter briefly revisits the findings of this study in relation to the research questions and highlights its contributions to theory and practice. Finally, the limitations of this study along with avenues for future research are discussed. The research aimed to identify several aspects related to GSCM in the construction industry in the India by performing two different methods to different links of the supply chain. However, the aim of the research had to be modified in order to focus only on the contractors' side considering the low response rate obtained on the suppliers' questionnaire. The responses showed that cost and quality of goods are the most important in identifying a critical supplier, followed by other factors resulting from legislation

pressures. Notably, distance was not considered as important regardless of its impacts on the environment. Moreover, large contractors seem to have the financial and market power to implement GSCM. However, in the construction industry GSCM is still reaching a small percentage of the entire population because of the nature of the market.

- One crucial aim of the dissertation was to find out what types of strategies large contractors are requiring from their supply chain. The findings confirmed that process-based strategies are more common than product-based strategies. In the case of product-based only 19% were compulsory, mainly caused by Eco-design and LCA. .
- Confirming the fact that large contractors are trying to support their supply chain on these issues. EMS looked at the most complex strategy of them all was elected by almost all respondents hence confirming its favorable implementation by most large contractors at some point.
- In terms of the drivers for large contractors for implementing GSCM strategies, the results showed that the two most important categories were sustainability and economic motivators. However, legislation as a single driver was the most important for the majority of the companies, confirming that this is a major pressure on GSCM implementation. Unlike some sectors, large contractors do not perceived themselves as major targets for NGOs, so the construction industry is not felt as being under significant pressure.
- In terms of the barriers that large contractors and suppliers are experiencing during the implementation of GSCM, the most significant were lack of resources and short term planning, followed by problems on access to information and expertise, together with lack of government pressure.

## RECOMMENDATIONS FOR FURTHER RESEARCH

It would be worth to exploring in more detail the suppliers, specifically their attitudes and resources to implement GSCM practices, the knowledge and internal capabilities to respond to their customers' pressures, and finally the strategies they are using to overcome the barriers. In terms of the construction supply chain efficiency and environmental performance, it would be interesting in the future to investigate if GSCM in the construction industry is generating benefits to the companies involved. In the end, the main purposes of GSCM are minimising the damage to the environment while generating positive economic impacts in order to achieve sustainable construction. Finally, it was not possible to estimate in this research the percentage of virgin materials compared to the percentage of recycled materials purchased by large contractors, so another issue would be to monitor the evolution of the markets of recyclable materials in the coming years as an interesting indicator for GSCM in the construction industry.

## REFERENCES

1.Abidin, N. Z. (2010). Investigating the awareness and application of sustainable constructionconcept by Malaysian developers. Habitat International, 34(4), 421-426.
2.Adetunji, I. O., Price, A. D., & Fleming, P. R. (2008). Achieving sustainability in the constructionsupply chain. Proceedings of the Institution of Civil Engineers, Engineering Sustainability,161, 161–172.
3.Agapiou, A., Flanagan, R., Norman, G., &Notman, D. (1998). The changing role of buildersmerchants in the construction supply chain. Construction Management & Economics, 16(3),351-361.
4.Baker, S. E., & Edwards, R. (2016). How many qualitative interviews is enough? Expert voices and early career reflections on sampling and cases in qualitative research. 2012. Southampton National Centre for Research Methods.
5.Baojuan, S. H. I. (2008). Green supply chain management and implementing strategy. International
6.Conference on Logistics Engineering and Supply Chain. Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120
7.Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: moving toward new theory. International journal of physical distribution & logistics management, 38(5), 360-387.
8.Chan, K. Y., & Li, X. D. (2001). A study of the implementation of ISO 14001 environmental management systems in Hong Kong. Journal of Environmental Planning and Management, 44(5), 589-601.
9.Checkland, P., &Holwell, S. (1997). Information, systems and information systems: making sense of the field. Wiley.
10.DiMaggio, P., & Powell, W. W. (1983). The iron cage revisited: Collective rationality and institutional isomorphism in organizational fields. American Sociological Review, 48(2), 147-160.
11.DiStefano, C., Zhu, M., &Mindrila, D. (2009). Understanding and using factor scores: Considerations for the applied researcher. Practical Assessment, Research & Evaluation, 14(20), 11.
12.Dowell, G., Hart, S., & Yeung, B. (2000). Do corporate global environmental standards create or destroy market value?. Management science, 46(8), 1059-1074.
13.Eisenhardt, K. M. (1989). Agency theory: An assessment and review. Academy of management review, 14(1), 57-74.
14.EMSF (2004). Report of the Round Table on Fostering CSR among SMEs. European Multistakeholder Forum

15.Faisal, M. N. (2010). Sustainable supply chains: a study of interaction among the enablers. BusinessProcess Management Journal, 16(3), 508-529.
16.FDI (2014). The Foreign Direct Investment Report 2014. Global greenfield investment trends. The Financial Times Limited, London. Retrieved 16, January, 2016, fromhttp://ftbsites.ft.com/forms/fDi/report2014/files/The_fDi_Report_2014.pdf
17.Garver, M. S., &Mentzer, J. T. (1999). Logistics research methods: employing structural equation modeling to test for construct validity. Journal of business logistics, 20(1), 33.
18.Geijer, J., &Sturesson, L. (2013). Standardization of environmental management and sustainability reporting. Lund University Libraries, Student Papers.
19.Gephart, R. (1999). Paradigms and research methods. In Research methods forum, 4(1), p. 11 Hannan, M. T., & Freeman, J. H. (1989). Organizational ecology. Cambridge, MA: Harvard University Press.
20.Harty, C. (2008). Implementing innovation in construction: contexts, relative boundedness and actor-network theory. Construction Management and Economics, 26(10), 1029-1041.
21.IPCC (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,
22.Johnson, R. B., &Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. Educational researcher, 33(7), 14-26.
23.Kerlinger, F. N., & Lee, H. B. (2000). Survey research. Foundations of behavioral research,, 599-619.
24. Khalifa Fund (2016). SME Financing in the United Arab Emirates. Retrieved July 01, 2017, from https://www.khalifafund.ae/SiteAssets/KF/Documents/SME_Financing.pdf
25. Koufteros, X. A., Cheng, T. E., & Lai, K. H. (2007). “Black-box” and “gray-box” supplier integration in product development: Antecedents, consequences and the moderating role of firm size. Journal of Operations Management, 25(4), 847-870.