OPTIMAL RESOURCES UTILIZATION IN CONSTRUCTION INDUSTRY

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ABSTRACT

Objectives: The main objective of the study is to discover the nature and degree of wastage, and to find out the various causes of wastage. To quantify the effects of wastage and to propose a technique for maximum utilization of resources. Resource planning and management is the most important factor for profitability and competitiveness in today’s Indian construction industry. Construction projects are a bit typical to achieve due to time limitations and predetermined objective.

Methods: selection of the project, Identification of nature & extent of wastage, quantifying the effects of wastage, Finding out various causes of wastage, Finding out the variation between perceived & driven, Establishing waste control indices, Design control measures.

Findings: Without leveling the resources which are scheduled and procured, not any activity can be performed according to fixed time program. Different types of resources are affecting the project time and cost like material, money, machinery, space etc. In addition to this some degree of waste of material, manpower and equipment is inevitable in the construction process. The main goal of this study is to control the construction resources wastage within prescribed limit for achieving the planned profitability level and productivity of construction industry.

Applications: Study also highlights the failure of quality due to waste in construction process and therefore, it is desired to quantify wastage and analyze its effect with a view to promote economy in construction.

Key words: Resource Planning, Management, Resource wastage, Construction, Profitability.


1. INTRODUCTION
The involvement of construction to the GDP at issue value in 2006-07 was Rs.1, 96,555/- crore, recording an increase of 10.7% from the year 2010. The significance of construction activity in housing, infrastructure and other accomplishments of buildings will be appreciated from the actual fact that the element of construction includes nearly 60%-80% of the project value of infrastructure comes like housing,
roads, etc. The employment elasticity of construction with regard to rate of employment and gross domestic product in construction is determined to be high. In year 2009-2010 asset potential of the construction business is calculable at Rs.380, 000 crores the share in the GDP works out be 12% in terms of employment generation delivers 14% of employable subject. The manufacturing product (Construction material, equipment’s and labor) accounts an approximate nearly 8.6% of GDP together with the gross share. It is consequently established that construction, as a financial entity has an impact on the economy of the country and gross domestic product. Construction activity plays a vital role in sustaining the economy.

Construction projects involves a number of inter-related and inter-dependent activities. Present days, due to fast changing environments impose number of legal, financial, logistic, ethical and environmental constraints. They interact economically, socially and technically within the organization and systems. These projects employ huge resources, but they will raise difficulties, risks and uncertainties. These explore series of problems concerning resources alike ‘where they are going to arise from’, ‘how far they are required’, ‘where they should be housed’, ‘when they should be inducted at site’, ‘when to mobilize’ and ‘how to optimize their utilization’. Due to the nature of resource-driven in construction management, the management of resources is really a difficult task. The project manager should develop an action plan for controlling and directing resources of machines, workers and materials intimately and coordinated manner in order to deliver a project within the frame of limited time and funding.

2. RESOURCES MANAGEMENT

A resource is an individual that funds the execution of activities of a project such as manpower, material, money, equipment, space or time.

2.1. Significance of Resources in construction projects

The important issue in successful application of a construction project not solely depends within the amount and value of the work, but also depends on assets availability. All the activities which are concerned in the construction project needs specific amount of resources. Every activity of a project is allotted with a specific resource and it should be completed among the time limitation, otherwise it may impact overall period of the project. The cost and time are directly dependent on the resources availability. The time which is needed might be determined by distributing the output related to the resources used on the activity into the outlined amount of the work for the activity. The best combination of resources for performing an activity in construction is predicated on ability of contractor’s to spot the interdependencies of various resources.

2.2. Construction Resources and Cost

Construction resources and its cost awareness is one of the major aspects in taking resource optimization process various components/resources and their percentage weightage is shown in following [Table 1]. [Figure 1].

<table>
<thead>
<tr>
<th>Table 1 Entire Project Cost Break-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Labor</td>
</tr>
<tr>
<td>Equipment</td>
</tr>
<tr>
<td>Profit</td>
</tr>
<tr>
<td>Indirect Cost</td>
</tr>
<tr>
<td>Over Head</td>
</tr>
</tbody>
</table>
2.3. Labor Resources and Cost
Labor being consisting of about 15 to 20 percentage of total construction cost its analysis and productivity check must be done which is as shown in [Figure 2], [Figure 3], [Figure 4], [Figure 5], and the workers scenario of Indian construction industry was [Table 2].
2.4. Material Resource and Cost

Materials use and reuse, recycling and reduction initiates in the development phases of any project. It begins with the designer, continues over the engineer, the estimator, the purchaser, the project manager and lastly to the contractors. Materials budget control and profitability initiates with a plan. But carefully inspected operational techniques and construction practices, a plan can be developed and executed to save important costs in materials.
2.5. Cost due to waste
The cost of waste is quite merely the price of obtaining it to a low land and selling it. The price of waste very is: Original material cost + Delivery price + Management cost+ handling charge+ Tipping fee+ Cleanup price + water transportation cost = Over-all cost of waste in construction.

3. METHODOLOGY
The methodology followed for the work is represented in [Figure 6]

![Figure 6 Methodology followed](image)

4. PROJECT ATTRIBUTES
Attributes of the Project presents the details of a residential project in terms of cost variances and wastages in each attribute.
Type Of Project : Construction of Residential building
Built up area : 100000 sq.ft
Number of storey’s : Ground + Nine Floors
4.1. Project Management
Project Scheduling was done by using MS Project Software.

4.2. Material Management
Materials were procured centrally for the whole of the project. Proper Inventory control was done and ABC analysis of material management was used in order to have minimum inventory level.

4.3. Wastage Analysis
Based on the estimated inputs and actual inputs data, variance analysis was carried out. The wastage which was perceived and the actual wastage as per the analysis tabulated below in the tables [Table 3], [Table 4].

It can be seen that the derived wastage is much less compared to the perceived wastage. This could be a result of better project management as the project has sufficient staff to supervise different construction activities.

Table 3 Estimated vs. Actual Consumption of materials and their variances

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Component</th>
<th>Estimated Consumption</th>
<th>Actual Consumption</th>
<th>% variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>STRUCTURE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Reinforced Steel</td>
<td>3690 MT</td>
<td>3892 MT</td>
<td>5.47</td>
</tr>
<tr>
<td>2</td>
<td>Brick work</td>
<td>4600 cu.m</td>
<td>4807 cu.m</td>
<td>4.5</td>
</tr>
<tr>
<td>3</td>
<td>M20 Concrete</td>
<td>32525 cu.m</td>
<td>33161.25 cu.m</td>
<td>1.95</td>
</tr>
<tr>
<td>a)Cement</td>
<td>28065 bags</td>
<td>29000 bags</td>
<td></td>
<td>3.33</td>
</tr>
<tr>
<td>b)aggregate (20mm)</td>
<td>4971.5 cu.m</td>
<td>5120.645 cu.m</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>c)aggregate (10mm)</td>
<td>20270 cu.m</td>
<td>20949.5 cu.m</td>
<td></td>
<td>3.35</td>
</tr>
<tr>
<td>d)Sand</td>
<td>15280 cu.m</td>
<td>15662 cu.m</td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>4</td>
<td>Shuttering</td>
<td>248450 sq.ft</td>
<td>261140.75 sq.ft</td>
<td>5.10</td>
</tr>
<tr>
<td>B</td>
<td>FINISHINGS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Internal Plaster</td>
<td>125000 sq.ft</td>
<td>138750 sq.ft</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>External Plaster</td>
<td>19000 sq.ft</td>
<td>20710 sq.ft</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 4 Perceived wastage and the Actual wastage

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PRECEIVED WASTAGE</th>
<th>DERIVED WASTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>5</td>
<td>3.33</td>
</tr>
<tr>
<td>Reinforced Steel</td>
<td>10</td>
<td>5.47</td>
</tr>
<tr>
<td>Sand</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>Shuttering</td>
<td>10</td>
<td>5.5</td>
</tr>
<tr>
<td>Bricks</td>
<td>10</td>
<td>4.5</td>
</tr>
</tbody>
</table>
Optimal Resources utilization In Construction Industry

4.4. Wastage Cost Impact
The wastage in construction materials adds directly to the project cost considering the present day price of construction materials, the additional cost due to wastage can be estimated as shown in [Table 5]

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Material</th>
<th>Wastage</th>
<th>Cost Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cement</td>
<td>935 bags</td>
<td>935 bags X Rs.290 = Rs.271150</td>
</tr>
<tr>
<td>2</td>
<td>Reinforcement</td>
<td>202 MT</td>
<td>202MT X Rs.40000 = Rs.808000</td>
</tr>
</tbody>
</table>

The above cost is just for the main contributor wastage i.e. Rs.8351150/-

4.5. Waste Control Indices
Waste Control Indices (WCI) for material can be developed as under the actual consumption of cement for the project is 29000 bags whereas the estimated consumption is 28065 bags.

\[
WCI (Cement) = \frac{Actual Consumption}{Estimated Consumption} = \frac{29000}{28065} = 1.033
\]

This shows that WCI for cement for this project is 1.0333. The percent variance (wastage) of cement for this project can be directly deducted from the figure of 1.0333 by multiplying this figure by 100 & then subtracting 100 from it which was as follows

\[
1.0333 \times 100 = 103.33
\]

\[
103.33 - 100 = 3.33
\]

This implies that “3.33” is the percentage wastage variance of the cement

5. CONCLUSIONS
- It was identified that the causes of wastage can be categorized in two aspects: construction methods and construction management. Under these two categories these were the common issues like excess preparation of motor, use of dry cement, high silt content in sand not removed, improper cutting and utilization of steel, changes in design, specification and materials, poor workmanship.
- The results of this analysis illustrate the practices which was using in construction projects can be adopted by lean principles for minimum utilization of resources by reducing the waste in the construction industry.

6. RECOMMENDATIONS
The study brought out clearly that the use of machinery in construction produced the least wastage. Project manager should properly select and plan the machinery and labor in order to eliminate the maximum wastage and maximum utilization of resources. In addition to this, a new concept which is called as Lean construction practices may be implemented in the construction industry rather than traditional management. Workshops should be conducted for better understanding between Lean construction and Traditional management. Also, managers should promote the lean construction into the people of the firm which can bring an affordable savings to the firm. Managers and companies should change with time and new technologies. This can be done by bringing change in culture of the organization by adopting the lean principles mandatory, by enhancing new techniques and policies for waste minimization, and by partnering with sub-contractors and suppliers to ensure that they follow Lean Construction methods.
REFERENCES