AN ANALYTICAL APPROACH FOR EVALUATION OF RESOURCES MANAGEMENT IN CONSTRUCTION INDUSTRY: A MODEL STUDY

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ABSTRACT

Resource Management plays crucial role in construction projects cost, schedule etc. either it increases the cost of the projects or decrease the cost of the projects it depends on how effectively or efficiently utilizes the resources in construction projects. Small or big construction company resources management is main part to considered for profits of a company. The construction projects has a lot set of constraints and objectives. Construction activity has an important role to play in the development of any nation. To execute a project, management of resources become an important factor. Even though there are lot of methods and techniques available for resources management it does not provide ideal resources management methods and techniques. So issues involved in methods or techniques or process is considered for analysis and evaluation. Construction projects faces different problems such as duration, cost, quality and safety. Construction sector run’s effectively by employees such as contractors, sub-contractors, project managers, Architects, Consultants, Owners and others. Other than that Resources management is one of the key element in construction project success. In this paper I am going to find issues in resources management in construction projects and collect the opinions of construction managers, site engineers, supervisors and students. The opinions from the questionnaire survey is analyzed by AHP model and develop the importance of each alternatives derived from the issues. This will help the employees of construction projects to find solution for the issues and will help in reducing the construction projects costs and time. The findings revealed that Cost is majorly considered by the employees in construction projects, Time is secondary thing that is important in construction projects and finally Quality is less preferred in the construction projects.
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by the employees in all three resources Human resources, Material resources and Land resources.

Key words: Resources management, construction project management, Material resources, Human resources, Land resources, AHP Model


1. INTRODUCTION

The construction sector is an important driver of the Indian economy but it is also extremely resource intensive. Resources management is a part of project management. India will be the third largest construction sector in World by 2018 according to (Global Construction Perspectives and Oxford Economics, 2015). It currently contributes about 7% to India’s GDP (2014). Project is a temporary and it has a defined start and end time and an defined scope and resources. Project management knowledge on the following areas as follows scope, Integration, cost, procurement, time, communications, quality, human resources, risk management and stakeholder management. Project management process falls into five groups as follows: initiating, planning, executing, monitoring and controlling, closing. Resources are the means of production to complete a project. These resource can include tangible resources and intangible resources. Tangible resources are physical resources such as land, machinery, equipment, furniture, inventory, stock and cash. These assets are important to a company. Tangible resources may have risk of damage from naturally occurring incidents or thefts. Intangible resources are non physical such as trademarks, patents, franchises, copyrights and goodwill. Resources management is the utilizing of resources available near and around locations in efficient and effective manner to improve the profits of a company. Resources management can include ideas such as making sure one has enough physical resources for one’s business, but not an overabundance so that products won’t get used or making sure that people are assigned to tasks that will keep them busy and not have too much downtime.

The types of resources are as follows:

- Material
- Machinery
- Manpower
- Money
- Time

The above mentioned resources are considered as main resources. Other resources are as follows Contractual resources, information resources, space and facilities, water resources and land resources. The challenging construction environment are making companies to take a closer look at their operations. Companies looking for more ideal methods and techniques to complete projects in less time and make profits out of it and maintain their methods and techniques error free than other companies. To have a good project management in construction the one of a must criterion is the resources management to achieve the efficient and effective utilization of materials, manpower, Land resources and method. Materials are the physical resources which provide physical shape to the designed project. Materials holds
75% project cost out of total project cost. Material handling including inventory, procurement, fabrication, storage and field servicing requires specific attention to reduce cost. Manpower including selection of skilled and unskilled labor and giving right work to right labor to reduce time and waste of materials. Land resources includes storage facilities and construction of projects utilizing land resources effectively. For those who are responsible for control of cost for constructed facilities, materials management, improvement of labor productivity would be their major and persistent concern.

2. OBJECTIVES OF THE STUDY
1. To identify the issues involved in resources management in the construction projects and data collection through questionnaire survey from different construction companies.
2. Data analysis with a technique or software and recommend solutions for the issues involved in resources management in construction projects.

3. METHODOLOGY
The first phase of research is literature review. To obtain the information and knowledge about the resources management in construction projects is to collection of different journals on resources management and sub disciplines such as materials, human resources, land etc. The research is done based on the past researches and case studies conducted by previous researchers. In this phase the researches findings of problems in resources management in construction projects helps to know the past and present issues of the resources management in construction projects. The research work carried out by reading conference papers, books, project papers and mostly of journals. These helps in analyzing the issues and a procedure to find solution to that issue. It gives an idea using different techniques to analyze the issues and recommend a solution to those issues.

3.1 Data Collection
Data collection for the resources management was done using qualitative research of existing journals as stated in the objectives. Data collection will also gathered from the officials of the construction projects such as Engineers, Contractors, Project managers as suggestions given by the researchers in their research papers. The pilot survey was conducted to identify and ensure the effectiveness of the questionnaire survey.

In the literature review the research was focused on:
- The problems regarding the management of resources in construction companies that is responsible for the loss of profits to the construction companies.
- The methods/model used to analyze the issues and to recommend the best alternatives for the construction companies.

The aim of the data collection is to gather information regarding resources management in construction projects. The aim of the data collection is to gather information related to the topic resources management and about the resources utilizing in the construction projects. The data collection was done in three ways as following:
- Questionnaire survey
- Journal Papers
- Literature survey

Questionnaire Survey

http://www.iaeme.com/IJCIET/index.asp 132

editor@iaeme.com
This is the main aspect in research where the valuable information is gathered from the officials of construction projects. The opinions of the people are honest while responding to the questionnaire survey regarding to the controversial issues in fact that their responses are anonymous. The questionnaire survey was distributed to the officials of some construction projects in Vijayawada. The questionnaire survey will includes some set of questions in three sections such as materials, human resources and land resources. In this section the respondents were asked about their background. The questions that had been asked were:

- Number of projects involved in;
- Years of experience in construction projects;

3.2. Data Analysis

**Analytical Hierarchy Model (AHP)**

It is a multi criteria decision making technique used to take decisions on complex problems in which many variables or criteria are involved in the resources management issues. The observation and collection of data regarding resources management is done on some of construction companies. The AHP Model was applied to the opinions of the officials of construction projects. Every problem has different criteria’s and each criteria has different alternatives. This method is used to find the best alternative that will be implemented to resolve the issues of the resources management in construction projects. The alternatives were analyzed by the AHP Model under goes five steps to find the best alternatives.

AHP Model calculation for problems in construction projects

- Firstly the problem is decomposed in to Goal, criteria, sub criteria and alternatives in the form of questionnaire survey.
- Then the pairwise comparison’s was done to the criteria’s and alternatives and we find the importance in tends to extremely strong to equal. In this the officials of the construction projects gives their opinions for our questions.
- Then I made in to pairwise comparisons for alternatives and find the importance that which alternative weighs more.

AHP is an two stage process:

- Decomposing the complexity
- Synthesizing the relations

There are five basic elements involved in AHP Method they are

- Hierarchy construction
- Pair wise comparisons
- Relative Weight calculation
- Aggregation of Relative Weights
- Consistency Ratio

\[
CI = \frac{\lambda_{max} - n}{n - 1}
\]

\[
CR = \frac{CI}{RI}
\]

Where as CR = Consistency Ratio
4. RESULTS AND DISCUSSIONS

The questionnaire which was prepared on three resources such as Human resources, Material resources and Land resources responses had been taken from the different level of employees in different construction companies was taken. Out of 73 responses I requested I got 42 responses from the respondents. Only respondents with minimum qualification as diploma were approached for answering the questionnaire survey. This was done to have quality of the opinion gathered in the survey. The result of Human resources, Material resources and Land resources with respect to cost, time and quality as below:

![Hierarchy Tree](image)

**Figure 1** Hierarchy Tree

<table>
<thead>
<tr>
<th>Table 1 Ranking of criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Human Resources</td>
</tr>
<tr>
<td>Material Resources</td>
</tr>
<tr>
<td>Land Resources</td>
</tr>
</tbody>
</table>

**Ranking of priorities**

To find the ranking of priorities, namely the Eigen vector X:

- Normalize the column entries by dividing each entry by the sum of the column.
- Take the overall row averages.

\[
A = \begin{pmatrix}
1 & 0.5 & 3 \\
2 & 1 & 4 \\
0.33 & 0.25 & 1
\end{pmatrix}
\]

Sum 3.33 1.75 8.00
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Normalized column sums

\[
\begin{pmatrix}
0.30 & 0.28 & 0.37 \\
0.60 & 0.57 & 0.51 \\
0.10 & 0.15 & 0.12
\end{pmatrix}
\]

Row Averages

\[
X = \begin{pmatrix}
0.32 \\
0.56 \\
0.12
\end{pmatrix}
\]

Criteria weights

Human Resources = 0.32
Material Resources = 0.56
Land Resources = 0.12

Calculation of Consistency Ratio:
To calculate \( \lambda_{\text{max}} \) so as to lead to the consistency index and the Consistency Ratio.

\[
A \times X = \begin{pmatrix}
1 & 0.5 & 3 \\
2 & 1 & 4 \\
0.33 & 0.25 & 1
\end{pmatrix} \times \begin{pmatrix}
0.32 \\
0.56 \\
0.12
\end{pmatrix} = \begin{pmatrix}
0.98 \\
1.68 \\
0.36
\end{pmatrix} = \lambda_{\text{max}} \begin{pmatrix}
0.32 \\
0.56 \\
0.12
\end{pmatrix}
\]

\( \lambda_{\text{max}} = 3.04 \), By averaging of \( Ax \) and \( X \)

\( CI = (3.04 - 3)/(3-1) = 0.02 \), n=3, R.I. = 0.52 (from Table)

C.R. = 0.02/0.52 = 0.04

C.R. \( \leq 0.1 \) it indicates consistency for decision.

Hence we can move further to do AHP Analysis.

Ranking Alternatives

<table>
<thead>
<tr>
<th>Human Resources</th>
<th>Cost</th>
<th>Time</th>
<th>Quality</th>
<th>Priority Vector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>1</td>
<td>¼</td>
<td>4</td>
<td>0.27</td>
</tr>
<tr>
<td>Time</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>0.63</td>
</tr>
<tr>
<td>Quality</td>
<td>¼</td>
<td>¼</td>
<td>1</td>
<td>0.10</td>
</tr>
</tbody>
</table>

The priority vector is obtained by doing Normalization as done above.

<table>
<thead>
<tr>
<th>Material Resources</th>
<th>Cost</th>
<th>Time</th>
<th>Quality</th>
<th>Priority Vector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>0.58</td>
</tr>
<tr>
<td>Time</td>
<td>½</td>
<td>1</td>
<td>3</td>
<td>0.31</td>
</tr>
<tr>
<td>Quality</td>
<td>1/5</td>
<td>1/3</td>
<td>1</td>
<td>0.11</td>
</tr>
</tbody>
</table>

The priority vector is obtained by doing Normalization as done above.
The priority vector is obtained by doing Normalization as done above.

### Ranking of Alternatives

<table>
<thead>
<tr>
<th>Criteria</th>
<th>HR</th>
<th>MR</th>
<th>LR</th>
<th>Priority Vector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>0.27</td>
<td>0.58</td>
<td>0.64</td>
<td>0.32</td>
</tr>
<tr>
<td>Time</td>
<td>0.63</td>
<td>0.31</td>
<td>0.25</td>
<td>X 0.56</td>
</tr>
<tr>
<td>Quality</td>
<td>0.10</td>
<td>0.11</td>
<td>0.11</td>
<td>0.12</td>
</tr>
</tbody>
</table>

As the analysis is done based on the questionnaire survey, the respondents mainly concentrated on the cost of the human resources, material resources and land resources. The next priority they are giving to the time of work like materials arrival etc., and the least preference is given to the quality as quality is very much important in construction projects. From this analysis the recommendations are quality is one of the main factor in constructions. As it is taken lightly it is recommended that to consider quality with respect to other factors.

Respondents had the awareness about the resources management in construction projects. It concluded that the resources are utilizing based on cost of the items. These resembles that if cost of the items is less, they are preferring to buy and utilize resources in construction projects. If the cost of the items are less then the quality of the items will be relatively low. Due to the low quality many of the structures not performing well and resembles to loss of property and life.

- It is recommended that while buying and utilizing resources they have to have quality check list prepared by the Government to the respected country.
- Following the guidelines provided by the PMBOK.
- Avoiding the low cost items which are available in cheap that diverts decision to purchase good quality items and it influence decision making for utilizing resources.
- Performing Quality tests for every incoming material.
- It is observed that unskilled labors are recruiting due some unknown influences, HR need to sincerely recruit the persons based on the talents.
- Cost of the labor influences the recruitment of skilled labor that leads the fall behind schedules and decreasing in the quality of the work.
- Selection of land with respect to cost will leads to selection of low quality area that leads to inhabitable zone constructions.

There are many improvements required in many aspects need to be considered in order to ensure the effectiveness. The respondents opinions will helps in ranking the most common issues pertaining resources management specifically manpower/labor, material, land resources in the construction projects. This rank can help in future construction project expected issues that might be faced during construction work. They can avoid these issues and look for alternatives. Given that feedbacks of the survey came from the construction employees all members are aware of issues and still they give importance to the cost of the project as they
are not considering quality as an important factor due to the present competitive situation in the construction industry.

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