Performance Evaluation of Labor Productivity for High Rise Buildings

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Abstract - Due to a lack of space in developing countries, the development of high rise building in city areas has increased. To save money, high rise buildings in developing countries are constructed using a combination of manpower and equipment. The interaction of people and equipment, particularly in fundamental operations like concreting, reinforcing, formwork, blockwork, and plastering, has an impact on both resources' output. This study will look at the elements that influence human and equipment productivity at the micro level for fundamental construction tasks for high rise building projects. The components have been divided into parts and grouped together. Responses from 104 people involved in the construction of 10 high rise buildings projects in Pune India are analyzed using theoretical methods such as the Relative Importance Index. The factors were ranked in order of RII. According to the findings, human and planning elements are more effective and have a considerable impact on labour and equipment output. This research can be used by contract managers and cost engineers to make allowances when analyzing productivity and calculating costs for high rise buildings projects that utilize a combination of personnel and machinery. This approach may be used by construction employees to assess the of LP using data from survey methods, and it can also help construction personnel make timely decisions on how to improve LP for various activities on high rise building projects. Ultimately contractors and construction managers must be familiar with the methodologies used to examine the performance of construction workers in various trades. To meet the fund predicted for any construction project in general, it is critical to have a good control on the productivity aspects that support the combined production composition, such as worker, equipment, working capital, and so on.

Keywords—-High rise construction, Labour, Productivity, Building, RII, Construction industry

I. INTRODUCTION

In developing countries, the building sector is one of the most important contributions to development, usually second after agriculture. Building construction is the most important industry that has grown importance in recent years among the different construction industries. Construction of high-rise building projects has become necessary in major cities due to space constraints. High rise building construction involves the use of three key resources: personnel, materials, and equipment. High rise building construction requires a lot of personnel and equipment in developing nations. Due of the ample workforce available at a lower cost, complete automation is rarely used. Due to a number of factors, labour and equipment productivity in terms of quantity of work completed in various construction tasks varies greatly.The construction industry (CI) is labour -intensive and largely dependent on labour force efficiency. The most essential factor influencing the performance of any building projects is labour productivity (LP). The performance of the labour force participating in the various jobs in the construction operations is frequently related with LP difficulties. Factors such as time, cost, and quality of building projects have a significant impact on labour performance. A detailed assessment of the elements impacting the LP will allow for effective allocation of limited resources, as well as providing workers with well-supported or developed LP. The assessment of labour concerns on construction sites while taking into account the effect of critical LP elements will help construction engineers, supervisors, and managers make timely actions in building projects. In India many factors are affecting on construction industry but one of the most important is low productivity which can affect the profitability of construction firms. labor

productivity is one of the greatest remarkable aspects which disturbs the physical growth of any building or commercial construction projects. To manage their jobs flexibly all construction labors must be aware with their duties which equipment, machine, and materials they're using. However, many of worker don't care about their performance or productive capacity as long as they get salary on time but some of the labor become unproductive because of money problems such as delay in salary, cut down of extra time payment and gain small salary by overloaded of work. The current research contributes to an understanding of the significance of analyzing LP components using data from questionnaire survey methodologies and assessing task level LP in high rise building projects in India. The study's goal is to determine how heuristic data from questionnaire surveys may be used to identify the critical causes causing LP loss on building sites. A new area of research is parameters affecting human and equipment productivity in high rise structures for essential construction jobs (concreting, reinforcing, formwork, blockwork, and plastering). This study also examines how these characteristics affect productivity when building is done with both labour and machines. Through responses from execution employees in 10 high-rise building projects, this study aims to explore the factors affecting people and equipment productivity in high rise building construction projects, as well as the and relationship between these factors that affect productivity. High rise buildings are considered as constructions that are taller than 23 meters in this research.

A. Review Stage

WHAT IS LABOR PRODUCTITVITY?

Productivity may be expressed in a variety of ways, such as the output to input ratio. Productivity is usually known in the construction business to relate to labour productivity, or the number of units of work put or generated per man-hour. The reciprocal of labour productivity, manhours per unit (unit rate), is also commonly used. Productivity is defined as the ratio of production to all or a portion of the resources required to achieve that output. The output might be either mixed or consistent in nature. Examples of resources include labour, capital, energy, raw materials, and so on.

Labour Productivity= Output/Work Hour

Most employees are less productive as a result of poor work behaviors or attitudes, such as failing to arrive on time and leaving early, which occurs due to a lack of management. Labor is one of the most effective tools of any construction project in general, and project organizations in particular, because the quality of output of the organization is heavily reliant on the high caliber of the labour working there. The

quality of an organization's output may give a significant competitive advantage over their competitors, with both positive and negative labour contributions. To achieve this in today's competitive market, management will need to make certain strategic decisions to increase the performance of its human assets. One of these choices is to design a work system that fits the job to the worker rather than the job to the worker. It requires the scientific application of human data to the design of a workstation, work process, or working environment in order to create a job-friendly setting for individual workers. This is done to increase workers' well-being, safety, and efficiency by adjusting the environment to their specific requirements. It also supports in the smooth flow of labour inside an organization.

B. OBJECTIVES OF STUDY:

1. To Study Factors affecting improving Labor Productivity.

2. To Identify influencing elements on performance evaluation of labor productivity.

3. To assess the impact of affecting elements on labour productivity variation.

4. To suggest recommendation to improve labor productivity for high rise building with workplace that is more worker-friendly and to reduce its variation.

C.PROBLEM STATEMENT:

Previous research tried to find effective strategies for increasing productivity in the high-rise construction industry. Productivity loss is one of the most serious issues in the construction industry. Current building contracts do not accurately identify remuneration for productivity losses caused by field conditions. With the increase in high rise building construction, it is vital to enhance production efficiency through increasing labour efficiency in the construction industry in order to contribute to the advancement of life, the advancement of the national economy, and the improvement of global competitiveness. The economy of country is becoming more complex and dynamic. As a result, economic measurement and analysis, particularly in the area of productivity have been more and more complicated and challenging. Previous studies have found that productivity loss is caused by a variety of factors, including as variations in drawings, longer hours of extra labour, inadequate field management, and unfavorable environmental circumstances. In reality, these factors frequently cause further disturbances to production that are outside a contractor's direct control, resulting in lost output or more labour hours required to complete the task in case of high-rise buildings.

Allowances for factors affecting productivity must be studied and taken into account when budgeting high rise buildings. Contract managers and cost engineers commonly fail to account for these factors because they make no effort to understand and evaluate them. This study will assist them in becoming more aware of the major aspects impacting productivity and in accounting for productivity in high rise construction projects. This will also assist project planning managers in avoiding any productivity losses during project execution by reducing the impact of the factors influencing manpower and equipment productivity (Human factors, Planning factors, System factors, Natural factors, Resource/Equipment aspects) examined in this study.

D.LITERATURE REVIEW:

Amina khavan and Abubakar, (2008), Identified the many types of labour that are used in building projects (skilled, semiskilled, unskilled labours, others.). Low education, low income, family problems, lack of desire, and other variables are all identified as hurdles to labour training and motivation in construction projects. employing a questionnaire survey and a technique of analysis Improvements in labour training performance and human resource motivation.

Olga, (2015), this study showed that the discovered this

paper's limitations Professional training for construction workers, including how to train, the length of training for each worker, and how to improve labour performance in correct demand and supply work. The task of influencing the difficulties of the work was simplified. To hire professionals from the building business.

Sudam chavan et al, (2016), The purpose of this research was to identify factors that impact labour productivity using productivity analysis. Prepare a creative plan to eliminate inefficiencies and increase the building project's efficacy. The study of labour productivity measurement methodologies. The following are some of the most widely utilised techniques: direct observation, time study, activity sampling, Site manager delay surveys, Craftsman questionnaire sampling, group timing technique, and recording methods.

Prachi et al, (2016), The value of productivity measurement was highlighted in this research. The productivity of skilled, semi-skilled, and unskilled labour must be measured and distributed so that labour costs per floor may be reduced. Work study and work measurement are labour data collecting and productivity improvement approaches. It was possible to save 20% on labour costs per floor by employing this strategy.

Williamibbs and Xiaodan, (2017), In this paper they discussed the impacts of weather on productivity ratios were found to be lowered and raised. The effects of temperature and humidity on the production ratio were measured. The impact of average temperature and humidity on production was higher. To summarise, past research on the influence of temperature and humidity on productivity had inconsistent data criteria and hence cannot be directly compared.

Dai et al. (2009), To arrive at this conclusion, the researchers conducted research based on industrial initiatives across the United States. They discovered 83 determinants influencing labour productivity, from which they derived 10 latent components that have a significant impact on labour productivity.

Mistry and Bhatt (2013), a study was conducted to identify crucial factors impacting labour productivity This research involved a survey of civil contractors in the cities of South Gujarat. Five critical criteria were discovered based on an examination of their feedback utilising the AnalyticHierarchy Process (AHP) and Relative Importance Index (RII) methodologies.

Nguyen and Nguyen (2013), have conducted a case study to investigate the link between floor number and labour productivity in multi-story structural work. However, this study only looked at formwork and reinforcing activities. Furthermore, because this study was based on structural work in one apartment building, it cannot be regarded a universal theory for all tall structures.

Adnan enshassi and Sherif, (2007), This study is about major negative aspects that impact productivity, and it was discovered by a questionnaire survey and analysis. Analysis and the relative significance index approach were used to determine the factor. To prioritise the negative variables in order to assess the elements that influence labour productivity. Analyze these aspects and propose suggestions for increasing productivity, taking into account all of the negative elements that have been found.

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Fagbenleolabosipo et al, (2011), Identified the elements that influence labour performance. Lack of training and retraining, unjust salaries, design modifications, and the

hiring of unqualified labour are all contributing reasons. Poor (communication, motivation, and specification) are all elements that have an impact on labour performance, and all of these issues might be improved with appropriate management.

II. DATA COLLECTION

Survey Preparation: -

The survey's main goal is to obtain general information on numerous factors influencing worker productivity in the construction industry.

The survey's goal and methodology are properly described to the respondents. The major concern for a survey is that it should be simple for participants. Logic-based questions are avoided because they may confuse respondents and increase fall rates. A study is conducted to see whether there are any critical problems and if the questions are actually answered.

Questionnaire Design: -

The collecting data method used in this study is a questionnaire survey.

This is the most significant tool for collecting data just because it provides each individual's as well as the project's perspective on each element that impacts labour productivity. A collection of parameters impacting productivity are defined and implemented for questionnaire design on the basis of related studies on labour productivity and direct interviews with experts. 10 residential high rise building construction site is selected for carrying out the investigation on factors influencing LP which are situated in Pune India. The questionnaire is prepared using Microsoft Office software and responses are collected through surveying.

Responses to variables affecting manpower and equipment productivity have been examined differently.

Summary of Responses: Manpower Productivity

Sr.no	Factors	Strongly Agree	Agree	Disagree	Strongly Disagree	Cannot Say
1	Human Factors	24	63	10	4	3
2	Planning Elements	38	41	20	3	2
3	System Aspects	38	45	13	6	2
4	Ergonomic Factors	57	33	13	1	0
5	Resource/Equipment factors	35	50	15	2	2

Summary of Responses: Equipment Productivity

Sr.no	Factors	Strongly Agree	Agree	Disagree	Strongly Disagree	Cannot Say
1	Human Factors	29	47	20	7	1
2	Planning Elements	34	53	15	2	0
3	System Aspects	25	42	27	7	3
4	Ergonomic Factors	53	35	13	2	1
5	Resource/Equipment factors	19	46	30	4	5

III. RESULT ANALYSIS

Relative Importance Index (RII)

The Relative Significance Index (RII) technique is used to rank various aspects and determine the relative importance of various factors impacting labour productivity. The RII value ranges from 0 to 1. In order to provide an overall picture of labour productivity in this study, the RII of each individual element collected by all respondents should be designed to evaluate the general and overall ranking. The following factors were used to determine the RII:

$$RII = \sum_{i=1}^{n} (w_i x_i)/AN$$

W = the weighting value of each indicator, given by the respondent here);

A is the highest weight

N is the total number of respondents

n_i is the total number of responses that are

evaluated with the number i (i=1 to 5/Likert scale)

Rank of Group Factors affecting Manpower Productivity

Group of Factors	Average RII	Rank
Ergonomic Group	0.912	1
Workforce Group	0.889	2
System Group	0.795	3
Resource Group	0.759	4
Planning Group	0.719	5

Rank of Group Factors affecting Equipment Productivity

Group of Factors	Average RII	Rank
Planning Group	0.907	1
Ergonomic Group	0.863	2
Workforce Group	0.841	3
Resource Group	0.790	4
System Group	0.772	5

Bar Chart of RII group (Manpower Productivity)

Bar Chart with RII of Group Factors (Equipment Productivity)
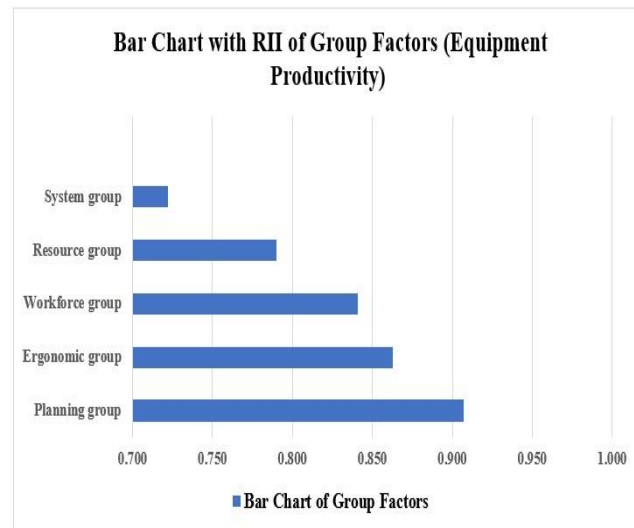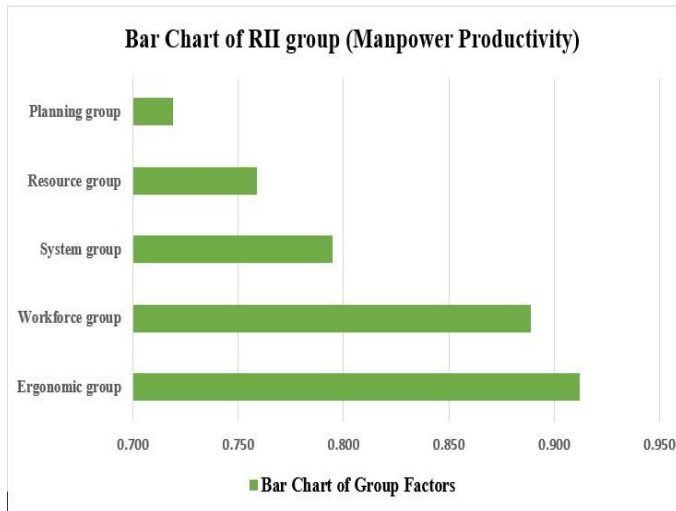
IV. CONCLUSION

There are several factors influencing workforce and equipment productivity in the construction business. Contract managers and cost engineers, on the other hand, must study and identify the most important aspects impacting productivity in order to determine and estimate allowances for labour and equipment productivity

1.According to this research, 26 elements influencing personnel productivity are discovered and classified into five categories: human factors, planning factors, system factors, ergonomic factor and Resource/Equipment factors. Eighteen equipment productivity elements were found and classified into five categories: human factors, planning factors, system factors, ergonomic factors, and resource/equipment factors.

2. RII index for the 26 factors affecting manpower productivity and 18 factors affecting equipment productivity are calculated from the responses received through 104 questionnaires.

3. The formation of group using RII index for manpower productivity has resulted in five sections, for equipment productivity group has resulted in five sections. Ergonomic and workforce factors both is the most influential on manpower productivity, also planning and Ergonomic both factors is the most influential on equipment productivity.

4.The three important factors affecting manpower productivity are:

(i) poor quality management, with Relative importance index of 0.970.

(ii) No job rotation, with Relative importance index of 0.961.

(iii) Repetition of work, with Relative importance index of 0.955.

The three important factors affecting equipment productivity are:

(i) Improper planning of work, with Relative importance index of 0.960.

(ii) Overhead work, with Relative importance index of 0.943.

(iii) Material Shortages, with Relative importance index of 0.882

The RII value describes the relevance of each indicator. According to the respondents, high RII values are similar to more important indicators for sustainable building projects. The RII value ranges from 0 to 1, with 0 not being inclusive. In accordance with Chen et al. (2010), Akadiri (2011) designates the resulting RII significance levels as follows. High (H): $0.8 < RII < 1.0$

High-Medium (H-M): $0.6 < RII < 0.8$

Medium (M): $0.4 < RII < 0.6$

Medium-Low (M-L): $0.2 < RII < 0.4$

Low (L): $0 < RII < 0.2$

All results of this research are satisfied according to the above range given by Akadiri (2011).

5. Contract managers and cost engineers frequently fail to make concessions because they are not able to visualize and prioritize these elements. This research will assist them in becoming aware of the major aspects influencing productivity and in making provisions for productivity in the costing of high-rise construction projects. This will also assist project managers in avoiding any productivity losses during project execution by limiting the influence of the factors affecting productivity examined in this study

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