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Application of Relative Importance Index for Assessment of On-Site Labour Productivity

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Abstract - The productivity in any organization is a key parameter showing the success of the organization. The construction site is a place where a number of factors play crucial role in deciding the labour productivity. The construction activities depend upon the basic factors like manpower, money and machinery. In the present study, the relative importance index (RII) has been used to assess the on-site labour productivity for a residential project. For this purpose, the factors have been divided into different groups like manpower group, communication group, resources group, etc.

Keywords: Labour productivity, resources, relative importance index, and management.

I. INTRODUCTION

Indian construction industry is one of fastest growing sector globally. The construction sector gives second largest employment after agriculture. India shares about 8% of total GDP and also provides employment to around 35 million people directly or indirectly. The construction projects are mostly labour based with basic use of hand tools and equipments in which labour cost consists of about 30% to 50% of total project cost. Labour productivity is one of important factors which affects physical progress of construction project. To perform effective job, construction labour should be familiar with materials, tools and machineries they use. Many researchers have shown that poor construction management practices lead to poor performance, wastage of efforts in different phases of construction projects. Identifying and analyzing the critical factor that influences construction productivity will lead to develop most effective method and strategies to improve the construction productivity in upcoming time. Construction project is said to be successful if it is completed in scheduled duration and estimated cost. Productivity forecasting plays an important role in strategic and operational planning. Site productivity is one of difficult factors for measurement because they can be determined significantly depending upon size of site and place of measurement. Achieving better labour productivity requires detailed studies of the actual labour cost and a number of other factors.

The term "productivity" expresses the relationship between outputs and inputs (Borcherding Liou, 1986).Productivity is generally defined as the average direct labour hours required to install a unit material. It is said that perfect productivity (1.00) can be achieved with a 40-hour work week, with people taking all the holidays and vacation days as planned. In construction, productivity is generally referred to labour productivity. In the construction industry, many external and internal factors are difficult to anticipate and are never constant. These factors lead to a continuous variation in labour productivity. Therefore, it should be ensured that a reduction in productivity does not affect the plan and schedule of the work.

Some important Factors affecting productivity can be enlisted as -

Management system: The decision making on the site is an important part of actual construction work. So, for high productivity proper decisions should be taken.

Lack of measurement: There are many labour factors that affect construction project. For improvement of labour productivity, the activities on site should be measured and record should be kept on regular basis and should always be compared with a standard acceptable benchmark. This will give a proper baseline productivity of previous projects having same conditions.

Motivation and safety: The lack of motivation in workers may lead to take them in anti-work behaviors which cause negligence of their duties, coming late to work, failures to meet deadlines, absentees, frustrations on job site which ultimately affects the labour productivity.

Skills and Ability: The personal attributes of workers contribute more of the factors that directly affect the productivity. The factors are worker skills, experience, training and qualification, physical and mental ability, etc.

External issues: There are some other issues than labour and management that harm the productivity in high manner, such

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as social factor, economic factor, weather conditions, labour unions, legal issues, etc.

Material and tools: Material management is one of the most important factors in construction industry. Productivity can be affected if required materials, tools, or construction equipment for the specific work are not available at the correct location and time. Therefore, site managers must be familiar with the characteristics and working of the major types of equipments most commonly used in construction activities.

Natural factors: Various natural factors affecting labour productivity are weather conditions of the job-site and geographical conditions. Others factors such as fuel, water, and minerals also affect productivity to certain extent. Productivity is found to be highly affected if weather recorded is extreme (too cold, heavy rainfall, too hot).

Political factors: Law and order, stability of government, etc. are essential for high productivity in the construction industry. The government's taxation policies influence willingness to work and expansion of plant.

The objective of present paper is to study about various factors affecting labour productivity in the construction industry.

II. LITERATURE SURVEY

Ameh et al. (2011) established the relationship between time overrun and labour productivity on construction sites. They found the factors that affect productivity in the construction sites were use of wrong construction method, inadequate construction materials and inaccurate drawings/specification. Attar et al. (2012) carried out survey of building projects where an increase in productivity was studied. They identified significant factors affecting labour productivity for small, medium and large companies. The

factors which were highly effective were supervision, material, execution plan, design, equipment factors, etc. Shehata et al. (2012) proposed proper management of resources in construction projects could yield substantial savings in time and cost. Dayakar et al. (2012) concluded important factors affecting labour productivity were quality of site management, material shortage, timely payment of wages, labour experience, misunderstanding between labour and superintendent. Fifty-one factors were considered for study and categorized into four different groups which were work content issues, work environment issues, workforce issues and regulations. Shah Meet et al. (2014) stated that productivity could be an influential factor in minimizing the project losses or increased profits. They suggested top factors which affect productivity based on the survey conducted, were low payment, poor construction methods, use of technology/level of mechanization, delays in material delivery etc. Ghate et al. (2016) observed that measurement of labour productivity was helpful in saving the time of the project as well as cost of project without hampering the quality of work. They used work study and work measurement techniques for data collection of labour and improvement in labour productivity. They concluded that these techniques helped to reduce cost by 20% of labour cost per floor. Mahesh et al. (2017) found prior knowledge of labour productivity during construction could save money and time. Similar studies have been performed by many researchers (Raj (2014), Rao (2015), Dharani K (2015), Kazaz (2015), Kazaz (2016)).

III. METHODOLOGY

For studying the productivity and related problems of labour, the questionnaire forms were prepared and the responses to them were collected. The details about the facilities, wages, working condition, expenses, etc. were included in the questionnaire (Table 1).

 Table 1: The various questionnaires include the following factors

 (Data measurement: 1- Not Applicable, 2-Does not affect, 3-Slightly affects, 4-Directly affects)

Category	Factors affecting labour productivity in building construction	Data measurement			
		1	2	3	4
Manpower	1. Lack of experience				
	2. Disloyalty				
	3. Misunderstanding among labours				
	4. Lack of competition among labour				
	5. Age (More than 50 years)				
	6. Personal problem				
	7. Alcoholic				
	8. Absenteeism				

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	9. Team work		
	10. Job satisfaction		
External	1. Implementation of government laws		
	2. Rework		
	3. Supervision delay		
	4. Inspection delay from authority		
	5. Variation in the drawing		
	6. Complex design provided		
	7. Incomplete drawing		
	8. Payment delays to worker		
	9. Training sessions		
	10. Design changes		
	11. Political effects		
Communication	1. Change order from designer		
	2. Change order from owners		
	3. Dispute with owners		
	4. Dispute with designer		
	5. Misunderstanding with owners and contractors		
	6. Disrespectful treatment		
	7.Consulting with other while making decision		
Resources	1. Lack of required construction material		
	2. Increase in the price of material		
	3. Lack of required tool and other equipment		
	4. Poor site condition		
	5. Difference in site conditions from the plans		
	6. Violation of safety laws		
	7. Insufficient lightning		
	8. Inadequate construction method		
	9. Inadequate transportation facilities for workers		
	10. Material storage location		
	11. Quality of required material		
Miscellaneous	1. Shortage of water and power supply		
	2. Working overtime		
	3. Accident during construction		
	4. Project objective is not well defined		
	5. Festival		
	6. Weather condition (excluding monsoon)		
	7. Labour accommodation		



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IV. ANALYSIS METHOD

The data from survey were analyzed by using Relative importance index (RII) method.

Relative importance index (RII) method

The contribution of each of the factor to overall delays was examined and the ranking of the attributes in term of their critically as perceived by the respondent was determined by use of relative importance index (RII). For the analysis purpose, a rating scale of 1 to 4 was adopted with 1 representing the lowest level of effect and 4 representing the highest level. The RII was evaluated by the following expression

$$RII = \frac{\Sigma W}{A} \times N$$

Where,

W is the weight given to each factor by the respondents ranging from 1 to 4.

A is the highest weight = 4

N is the total number of responses collected for the ordinal scale.

V. CASE STUDY

Construction projects involve huge input of resources which are primarily materials, manpower and machinery. The materials assume maximum importance (nearly 40% to 60%) of the project costs. Manpower and equipment being the other input account to nearly 30% to 40% of the project outlay. This productivity management not only ensures timely completion and cost advantages to the project but also provides comfort to the investors, mitigate risks, and fix liabilities and responsibilities in the construction phase.

In order to study the labour productivity, a Residential construction site at Belapur (City in Navi Mumbai, Maharashtra) was visited. The construction of building was Ground floor + 13 storied. The construction of building was under the Bharati Construction Company. The questionnaire was circulated among the total forty numbers of labours and other employees at the site. Data obtained from questionnaire was further used for analysis of labour productivity.

VI. RESULTS AND CONCLUSIONS

After the interviews of labours and employees conducted at the site, the factors affecting labour productivity based on the group are discussed. Based on the relative importance indices, the ranking for factors was done (Tables 2 through 6).
 Table 2: Manpower group

Factors	RII	Rank
Lack of experience	0.875	1
Age (More than 50 years)	0.861	2
Alcoholic	0.856	3
Misunderstanding among labour	0.838	4
Disloyalty	0.833	5
Team work	0.787	6
Lack of competition among labour	0.773	7
Job satisfaction	0.764	8
Personal problem	0.759	9
Absenteeism	0.699	10

Table 3: External group

Factors	RII	Rank
Incomplete drawing	0.889	1
Payment delay to worker	0.861	2
Variation in the drawing	0.856	3
Complex design provided	0.851	4
Inspection delay by authority	0.847	5
Supervision delay	0.829	6
Training session	0.782	7
Rework	0.778	8
Implementation of government laws	0.773	9
Design changes	0.769	10
Political effect	0.690	11

Table 4: Communication group

Factors	RII	Rank
Dispute with owner	0.870	1
Disrespectful treatment	0.847	2
Misunderstanding with owner and contractor	0.843	3
Change order from designer	0.810	4
Consulting with other while making decision	0.805	5
Change order from design	0.800	6
Dispute with designer	0.611	7

Table 5: Resource group

Factors	RII	Rank
Lack of required construction material	0.986	1
Violation of safety laws	0.963	2
Lack of required tool and material	0.949	3
Material storage location	0.875	4
Inadequate construction method	0.852	5
Poor site condition	0.847	6
Inadequate transportation facilities for workers	0.824	7
Differencing site condition	0.810	8
Insufficient lightening	0.792	9
Quality of required material	0.681	10
Increase in price of material	0.671	11



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Table 6: Miscellaneous group

Factors	RII	Rank
Shortage of water and power supply	0.884	1
Accident during construction	0.866	2
Festival	0.856	3
Weather condition (excluding monsoon)	0.843	4
Labour accommodation	0.787	5
Working overtime	0.782	6
Project objective is not well defined	0.755	7

VII. CONCLUSIONS

From the study conducted for determining the factors affecting the productivity at a residential construction site at Belapur (City in Navi Mumbai, Maharashtra), following conclusions are drawn.

- 1. Project objectives must be well defined.
- 2. Material management method needs to be used to improve management of required material. Proper and high quality of required material be maintained on site. Proper attention should be given to lack of required tools and other equipment.
- 3. It is observed that the productivity decreases with the age of a labour. However, on one hand, older workers are thought to be more reliable and to have better skills, while on the other hand, they have higher health care costs, lower flexibility in accepting new assignments.
- 4. Safety guidelines should be followed for safety of individuals and other members, and should be displayed properly at construction site. It is always advisable to wear personal safety wears when operating in harsh weather conditions.
- 5. Proper and timely payment to workers is found to be motivational to improve the productivity. The working time of workers be followed strictly.
- 6. To improve the productivity, programs like training, apprenticeship should be carried out frequently. Aside from technical skills, these programs also help teach leadership, teamwork, work ethic, and life skills.
- 7. The drawings provided should be lucid and made by using latest technology for correctness. The complex design should be made simple to understand.
- 8. Misunderstanding between owner, contractor and labours costs high to productivity on site. Proper respect should be given to any feedback given by team members.
- 9. Proper labour accommodation facilities should be provided on site or close to the site. Employee Assistance Programs should be conducted in order to deal with the alcoholic problem.

- 10. It must be compulsory to implement concerned government laws. No or minimal political effect improves the productivity.
- 11. Rework at construction site should be avoided by identifying some common reasons of rework.
- 12. For better productivity, a healthy competition among workers is absolutely necessary in the organization.

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