

A STUDY ON THE FACTORS AFFECTING ONSITE LABOUR PRODUCTIVITY IN RESIDENTIAL CONSTRUCTION IN CHENNAI

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Abstract - Construction industry faces many problems associated with labour productivity. The aim of this study is to identify the key factors that affect labour productivity in residential projects. 30 factors under 5 groups were identified based on the past studies. A questionnaire survey was conducted among owners, site supervisors and labours of residential projects in and around Chennai. The total number of respondents was 60. The factors were ranked based on the severity index. Spearman's rank correlation method was used to test the agreements among the respondents in ranking of factors. Absenteeism of workers, lack of coordination and lack of experienced labours were identified as the top 3 factors that affects labour productivity with severity index values 0.507, 0.469 and 0.465. The spearman's value between owner and supervisor was 0.49. Between supervisor and labour it was 0.581 and 0.512 in case of labour and owner. The strength of agreement was moderate in all the three cases.

Keywords: *Labour Productivity, Severity Index, Spearman's Rank Correlation, Questionnaire Survey.*

I. INTRODUCTION

The infrastructure development plays a very important role in the economic growth of a country. As a result of the expansion of construction activities, lots of job opportunities are created for skilled, semi-skilled, and unskilled labours. A

construction project can be said as successful only if it attains its goals in terms of cost, time, quality and safety. This can be made possible only when the planned levels of productivity can be obtained [1]. On the other hand, the construction industry faces various levels of problems that directly or indirectly influences on the growth of the project. The various factors are cost overrun, material management, labour productivity, safety and risk strategies. The success of a company and competitiveness in the market depends upon its productivity [2]. Productivity is the one of the most important factor which affects the overall performance of any type of construction industry.

Today, one of the biggest challenges placed in front of any organization is to improve their productivity, by way of conversion of resources into marketable products effectively and efficiently [3]. In any construction labour constitutes the largest unit of human resource. The efficiency of a construction project can be improved by identifying the various critical factors that affects the labour productivity and to formulate various mitigation strategies to overcome these factors.

Definition of Productivity

According to Attar el. (2012), productivity is the ratio of output to all resources used to produce that output. Resources comprises of labour, capital, energy, raw materials, etc.

Sumanth (1984) defined productivity as the effective utilization of resources (inputs) in producing goods or services (output). In construction industry productivity can be measured in two ways (Jarkas and Bitar, 2012).

Total Factor Productivity (TFP)

It is the ratio of total output to the total input (labour, materials, equipment, energy and capital).

$$TFP = \frac{\text{total output}}{\text{total input}}$$

Partial Factor Productivity (PFP)

It is the ratio of the outputs to a single input. Labour productivity in construction industry is commonly measured by PFP.

The output is measured in terms of quantities installed. The labour input refers to the number of working hours.

$$\text{Labour Productivity} = \frac{\text{Output}}{\text{Labour Hours}}$$

Objective of the Study

The objective of the study is as follows

- i. To study and discuss the effect of various factors on labour productivity in residential construction.
- ii. To analyze and calculate the Relative Important Index (RII), Frequency Index (FI) and Severity Index (SI) of those factors affecting labour productivity.
- iii. To test the agreement among the respondents in ranking of factors using Spearman Rank Correlation.

II. FACTORS AFFECTING LABOUR PRODUCTIVITY

From the past studies, 30 factors which affect the

labour productivity were identified and these factors were grouped into 5 categories namely

- i. Management related factors
- ii. Technological related factors
- iii. Human / labour related factors
- iv. Material / equipment related factors
- v. Other factors

A total of 11 constraints have been identified under management related factors. In technological related factors 7 constraints, human / labour related factors 5 constraints, material/equipment related factors 4 constraints and in other factors 3 constraints have been identified.

TABLE I
FACTORS AFFECTING LABOUR PRODUCTIVITY

S.No	Group	Factors Affecting Labour
1	Management related factors	Lack of labour supervision
2		Lack of coordination
3		Lack of training offered to
4		Unrealistic scheduling and expectation of labour
5		Lack of construction
6		Accidents as a result of
7		Lack of incentive scheme
8		Delay in inspection
9		Late payment of salaries
10		Financial difficulties of the
11		Lack of periodic meeting
12	Technological related factors	Rework due to labour
13		Rework due to bad
14		Construction methods
15		Clarity of technical
16		Frequent revision in design
17		Poor site conditions
18		Crew size inefficiency
19	Human / labour related factors	Absenteeism of workers
20		Lack of labour skills
21		Lack of experienced labour
22		Working overtime
23		Labour strikes
24	Material / equipment related factors	Shortage of materials
25		Lack of proper tools and
26		Delay in supply of
27		Usage of poor quality

28	Other factors	Rain
29		High / low Temperature
30		High wind

III. RESEARCH METHOD

The study was performed by conducting a questionnaire survey. The Questionnaire consists of two sections. In Section I details of the respondents like name, age, sex, designation, experience, company address and ongoing project were present. In Section II the respondents were asked to rate the effect of the 30 factors. The effect of factors on labour productivity was measured using a 5-point scale. The frequency of occurrence of the factors in their ongoing projects is measured on a 3-point scale. The sample population targeted includes owners, site engineers / supervisors and labours of residential construction projects in and around Chennai. The total number of respondents for this study was 60. Table 2 shows the number of respondents based on their designation.

TABLE 2
SAMPLE POPULATION

Designation	Number of respondents
Owners	10
Site supervisor / engineer	21
Labours	29
Total	60

Relative importance index is calculated using the following formula. A five point Likert scale is used in identifying the importance index.

$$RII = \frac{(5n_1 + 4n_2 + 3n_3 + 2n_4 + n_5)}{5(n_1 + n_2 + n_3 + n_4 + n_5)}$$

where,

n_1 = No. of persons who chose “extremely significant effect”

n_2 = No. of persons who chose “very significant effect”

n_3 = No. of persons who chose “significant effect”

n_4 = No. of persons who chose “slight effect”

n_5 = No. of persons who chose “no effect”

Frequency index is calculated based on the frequency of occurrence of the factor in ongoing project. It is calculated as follows.

$$FI = \frac{(3N_1 + 2N_2 + N_3)}{3(N_1 + N_2 + N_3)}$$

where,

N_1 = No. of respondents indicating frequency as “high”

N_2 = No. of respondents indicating frequency as “medium”

N_3 = No. of respondents indicating frequency as “low”

Severity index was used for ranking of factors and it is given by the following formula

$$SI = RII \times FI$$

Spearman's rank correlation method was used for testing the agreement among the respondents in ranking of factors. The formula used to calculate Spearman's Rank is shown below.

$$\rho = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

where,

ρ = Spearman's rank correlation coefficient

n = number of factors

d = difference between ranks of two variables

IV. RESULTS AND DISCUSSIONS

The ranking of factors were done by using the SI values obtained. The results of various groups are discussed as below.

Management Related Factors

Lack of coordination ranks first in management related factors with SI value of 0.469 and second among all 30 factors. Coordination between the members is very important in the proper completion of the project. Without proper coordination it is difficult to attain the intended goal of the project. Lack of labour supervision ranks the second having SI value of 0.357 and holds 12th position in overall ranking. It is then followed by Lack of training offered by operatives. Better training must be provided to the labour before starting any job which is unfamiliar for the labour. Accidents may arise due to improper safety precautions available in the site. Accidents will lead to the delay in the progress of work and also to the loss of life of the worker. Accidents as a result of poor safety ranks 4th in this group having SI value of 0.352. Providing proper incentives to workers will motivate them and make them work hard which increases the productivity. With 0.35 as SI value, Lack of incentive scheme ranks 5th in this category which affects the labour productivity. It holds 17th position in overall ranking. Financial difficulties of the owner hold the 11th position in this category with SI value 0.225.

Technological Related Factors

In technological related factors, crew size inefficiency ranks first with a SI of 0.454. Any project must contain the required number of persons to do the job. Insufficient labours will

result in delay of work and increase project time and cost. Crew size inefficiency holds 6th position in overall ranking. Rework due to labour mistake ranks 2nd in technological related factors and 7th in overall ranking with severity index of 0.446.

Human / Labour Related Factors

Absenteeism of workers rank 1st in both human related factors and overall ranking with a SI of 0.507. If the workers get absent to the work often there will be delay in the work which affects productivity. The second and the third place are the Lack of experienced labours and Lack of labour skills with SI values 0.465 and 0.456. These factors hold 3rd and 4th position in overall ranking.

Material / Equipment Related Factors

These are the factors which relates to the materials and equipments which are used in the construction project. Delay in supply of materials by the suppliers ranks first in this group. Any delay in the material supply will leads to increase in project duration and the cost of the project. Severity Index of this factor is 0.457 and this ranks 5th in overall ranking. Shortage of materials ranks 2nd with SI of 0.402 and Lack of proper tools / equipment ranks 3rd having SI value of 0.354. The above two factors hold 9th and 14th position in overall ranking.

Other Factors

These are the factors which depend on the weather conditions available in that area. Change in temperature, heavy wind and rain are those factors which affects the progress of work in the area. Rain with a SI value of 0.321 ranks first in this category and 23rd in overall ranking. It is followed by high/low temperature and high wind with SI values 0.18 and 0.177. These factors are placed in the 29th and 30th position of overall ranking.

Spearman's Rank Correlation

From the ranking of factors by owners, supervisors and labours spearman's ranking correlation value was found. This is found in order to test the strength of agreement between the respondents. The strength of spearman's values obtained is moderate in all the three cases i.e. there exists a moderate association of ranks between the respondents.

V. CONCLUSION

Construction productivity has a great impact on the economics of the construction industry. Proper study on the various factors affecting labour productivity during a construction can lead to saving of money and time. This research was performed to identify the various factors that affect labour productivity in residential building construction by using a questionnaire survey. From the survey results obtained the ranking of factors is calculated using severity index. A total of 60 respondents from residential construction comprising of owners, site supervisors and labours were involved in the study. Among the 30 factors explored, absenteeism of workers was identified as the most critical factor impacting labour productivity. Lack of coordination between the persons, lack of well experienced labours, lack of labour skills, delayed supply of materials by the suppliers and insufficient crew size were the other major factors identified in the survey. The spearman's value between owner and supervisor was 0.49. Between supervisor and labour it was 0.581 and 0.512 in case of labour and owner. The strength of agreement was moderate in all the three cases.

TABLE 3
OVERALL AND INDIVIDUAL RANKING OF FACTORS

S. N o	Factors	Overall	Owner	Supervisor	Labour
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1	Lack of labour supervision	1 2	15	23	6
2	Lack of coordination	2	1	8	2
3	Lack of training offered to operatives	1 5	19	22	8
4	Unrealistic scheduling and expectation of labour performance	2 5	16	20	26
5	Lack of construction managers leadership	1 8	11	25	15
7	Lack of incentive scheme	1 7	21	13	17
8	Delay in inspection	2 4	12	26	21
9	Late payment of salaries and wages	1 9	25	14	19
10	Financial difficulties of the owner	2 8	28	27	27
11	Lack of periodic meeting with labours	2 1	13	21	18
12	Rework due to labour mistakes	7	2	6	7
13	Rework due to bad supervision	1 3	4	24	14
14	Construction methods	2 2	23	11	23
15	Clarity of technical specifications	2 6	14	17	28
16	Frequent revision in design / drawings	11	7	16	20
17	Poor site conditions	8	9	12	4
18	Crew size inefficiency	6	10	7	3
19	Absenteeism of workers	1	8	1	1

20	Lack of labour skills	4	5	3	11
21	Lack of experienced labour	3	3	4	5
22	Working overtime	10	20	15	10
23	Labour strikes	27	27	28	24
24	Shortage of materials	9	24	5	9
25	Lack of proper tools and equipment	14	18	9	22
26	Delay in supply of materials by suppliers	5	6	2	13
27	Usage of poor quality materials.	20	26	18	16
28	Rain	23	17	10	25
29	High / low Temperature	29	30	29	29
30	High wind	30	29	30	30

TABLE 4
RESULTS OF SPEARMAN'S CORRELATION

S.No	Respondents	Spearman's Value (ρ)	Strength of Agreement
1	Owners – Site supervisors	0.490	Moderate
2	Site supervisors – Labours	0.581	Moderate
3	Owners – Labours	0.512	Moderate

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