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A Study Of Various Constraints On Labour Productivity

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Abstract

Productivity plays an important role in the construction industry. The on time completion and project cost is greatly influenced by the labour productivity than anyother factor. To keep the project in track, it is necessary to identify the various constraints of labour productivity and need to find measures to control these factors. In this study various factors affecting labour productivity in the construction scenario of Kerala, India is identified and they are ranked according to their relative importance. A questionnaire survey consisting of 38 various factors and their analysis is done for this. The main factor identified is the unavailability of construction materials which is a major issue in Kerala recently.

Keywords- *Construction, Labour productivity, Questionnaire survey, Relative important index, Reliability analysis*

1. Introduction

Construction is a labour intensive industry and studies (Yates and Guhathakurta 1993; McTague and Jergeas 2002) shows that labour costs comprises of around 30-50% of total project's costs.So productivity is one of the most important factor that affect overall performance of any small or medium or large construction industry. Poor productivity of construction workers is one of the main causes of cost and time overruns in construction projects.There are numerous factors affecting productivity and so without pointing out those factors and finding solutions for those factors, it is difficult to achieve an improvement in productivity in construction sector. Eventhough a lot of investigations were done by different researchers, they have not agreed on a universal set of factors with significant influence on productivity. Many factors typically produce extra disturbances that affect productivity and are beyond the direct control of a contractor. This will result in productivity loss or extra work hours necessary to accomplish the task. This research, therefore, aims to identify the factors which negatively affect productivity in the construction scenario of Kerala.

2. Labour productivity

The construction industry has found it difficult to develop a universally accepted definition of productivity. It can be defined as a relation between inputs and outputs. These inputs can be measured in monetary terms which include materials, tools and equipment and labour costs. Outputs can be measured as volume of concrete placed, area of formwork, volume of masonry work done etc. At the project site, contractors are often interested in labor productivity. Overall, productivity could be defined as the ratio of outputs to inputs

Productivity = Outputs / Inputs

But output values in construction industry is heterogeneous in nature and it can be measured in m^3, m^2, m, kg etc. When the measurement is done through numerical values like wages or price, as it varies in the industry depending on many facotrs, the productivity cannot be measured in standardized form. So it's better to include time in these measurements and productivity can be measured as

Labour productivity= output quantity/work hours

Olomolaiye *et al* (1998) stated that factors affecting construction productivity are not constant. It may vary from country to country and from project to project, depending on circumstances. To improve productivity it is necessary to make use of factors which positively affect productivity and it is required to eliminate or control the factors that have a negative effect on productivity.

3. Research method

This research is based on a questionnaire survey conducted to gather all factors which affect labour productivity in construction sector. The instrument used to collect data for the study is a structured questionnaire in which data were collected from the previous researches and after conducting a pilot survey, 38 factors are finally selected and grouped into 6 groups according to their characteristics, namely: management factors, workforce characteristics factors, environmental factors, material/equipment factors,

schedule and motivational factors. A total of 52 questionnaires were distributed and collected after face to face interview from the construction firms across Kerala.The respondents are people who work as: general manager, project manager, site engineer, supervisor etc. In this study a 5 point Likert scale is used to determine the effect level in this study. Respondents were asked to rank factors affecting productivity according to the degree of importance (1 =strongly agree; 2 = agree; 3 = neither agree nor disagree; 4 = disagree; 5 = strongly disagree).

All the collected information from the survey were checked and verified for their correctness. These data were analysed to obtain variance and statistical descriptive analysis. The software SPSS 12.0. is used to carryout multiple comparison tests.

3.1.Cronbach's alpha:

Cronbach's alpha is generally used as a measure of the reliability of a set of questions in a survey. This is because it combines the split-half method and item-total correlation and thus calculates the mean value of the reliability which can be obtained by the split-half method for all the data of the concept.

In generally, the value of Cronbach's alpha for acceptable reliability is 0.7. Also any variables which the Item-total correlation are smaller than 0.3 will be deleted.

3.2. Relative Importance Index:

The relative importance index method help to determine the relative importance of the various factors affecting labour productivity and to rank them according to their importance. The 5 point likert scale ranged from 1 (strongly agree) to 5 (strongly disagree) was adopted and transformed to relative importance indices (RII) for each factor as follows:

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

Where, W is the weighting given to each factor by the respondents (ranges from 1 to 5), A is the highest weight (5 in this case), and N the total number of respondents. The RII value ranges from 0 to 1 (0 not inclusive), higher the value of RII (here the original values are subtracted from 1 to get final values as the likert scale used is inverse model), more important is the effect of factors on labour productivity.

The RII is used to rank the different factors. Each individual factors RII perceived are used to assess the general and overall rankings in order to give an overall picture of the factors affecting labour productivity. The same procedure was adopted for ranking the effects. The indices (RII) are then used to determine the rank of each item (effect).

3.3. Factor analysis:

Factor analysis is a statistical approach that can be used to analyze large number of interrelated variables and to categorize these variables using their common aspects. Factor analysis is a type of a data reduction tool and it removes redundancy or duplication from a set of correlated variables. Varimax criterion finds the rotated loadings that maximize the variance of the squared loadings for each factor; the goal is to make some of these loadings as large as possible, and the rest as small as possible in absolute value.

4. Results

4.1. Reliability analysis

The cronbach's alpha value obtained is 0.945 which is greater than minimum required value of 0.7. Mean obtained is 82.08 and standard deviation is 20.45. This values shows that all the factors are reliable and no need to exclude any of them. No substantial increases in alpha for any of the factors could have been achieved by eliminating any item.

Table 1. Reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.945	.947	38

4.2. Relative Important Index

Table 2. Table showing factors arranged in descending order of relative importance index and their cronbach's alpha values

Sl.No	Constraints of Labor Productivity in Building Construction	RII	Corrected item-total correlation	Cronbach's Alpha if item deleted
1	Lack of materials due to unavailability of materials	0.655	0.508	0.944
2	No specific planning and scheduling of work	0.658	0.606	0.943
3	Lack of supervision	0.654	0.646	0.943
4	Poor health condition of workers	0.642	0.388	0.944
5	Absenteeism of workers	0.631	0.567	0.943
6	Lack of teamwork	0.627	0.505	0.944
7	Lack of experience/skill	0.619	0.409	0.944
8	Rework	0.615	0.573	0.943
9	Attitude of workers	0.615	0.477	0.944
10	Bad workmanship of preceding work	0.615	0.566	0.943
11	Delay in payment	0.608	0.495	0.944
12	Poor communication between engineer	0.604	0.777	0.941
13	Delay in inspection	0.600	0.572	0.943
14	Lack of space	0.600	0.564	0.943
15	Delay in giving instructions	0.596	0.670	0.942
16	Insufficient number of tools used	0.596	0.646	0.943
17	Lack of materials due to financial difficulties	0.592	0.456	0.944
18	Crew composition	0.592	0.614	0.943
19	Bad weather	0.592	0.618	0.943
20	Poor condition of tools used	0.592	0.682	0.942
21	Lack of training	0.588	0.697	0.942
22	Lack/insufficient number of equipment	0.588	0.645	0.943
23	Change orders during execution	0.585	0.364	0.944
24	Poor quality of materials used	0.581	0.471	0.944
25	Low rate for work	0.577	0.622	0.943
26	Accidents	0.573	0.584	0.943
27	Difficulty level of work	0.558	0.667	0.942
28	Incomplete drawings	0.550	0.453	0.945
29	Lack of incentive scheme	0.550	0.623	0.943
30	Inadequate lighting	0.527	0.683	0.942
31	Overtime work	0.519	0.506	0.944
32	Difficulty in providing/getting accommodation for workers	0.500	0.573	0.942
33	Lack of advanced construction methods and techniques	0.496	0.384	0.945
34	Age of workers	0.481	0.425	0.944
35	Working 7 days a week without taking holiday	0.473	0.381	0.945
36	Distance of working site and material storage	0.423	0.590	0.943
37	Increase in height of structure	0.415	0.339	0.945
38	Noise	0.285	0.460	0.944

4.3. Factor analysis

Table 3. KMO and Bartlett's test results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.699
Bartlett's Test of Sphericity	Approx. Chi-Square	1428.587
	Df	703
	Sig.	.000

As shown in Table 3, the KMO value (0.699) is greater than 0.5, which means the data is likely to factor well and in Bartlett's test the significant value is lower than 0.05, which indicates that the correlation matrix is different from an identity matrix and the correlation between variables are all zero. As result, both acceptances for diagnostic tests confirm that the data are suitable for factor analysis.

The eigen value is an index that represents the explanatory power of the corresponding component, and it is usually extracted from the number of the components that have a value of 1 or more. In Table 4, there are ten components for which initial eigen values are greater than one and ten components were extracted during analysis. These ten components can explain 76.880% of the information contained in the original factors.

Table 4. Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.287	34.966	34.966	13.287	34.966	34.966	6.020	15.842	15.842
2	3.460	9.105	44.071	3.460	9.105	44.071	5.411	14.240	30.081
3	2.376	6.254	50.324	2.376	6.254	50.324	2.878	7.573	37.655
4	2.127	5.598	55.923	2.127	5.598	55.923	2.682	7.058	44.713
5	1.767	4.650	60.573	1.767	4.650	60.573	2.235	5.881	50.594
6	1.407	3.702	64.275	1.407	3.702	64.275	2.232	5.873	56.467
7	1.357	3.572	67.847	1.357	3.572	67.847	2.133	5.614	62.081
8	1.192	3.137	70.984	1.192	3.137	70.984	2.106	5.542	67.624
9	1.169	3.077	74.060	1.169	3.077	74.060	2.011	5.292	72.915
10	1.071	2.819	76.880	1.071	2.819	76.880	1.506	3.964	76.880
11	.922	2.426	79.305						
12	.766	2.017	81.322						
13	.745	1.960	83.283						
14	.706	1.858	85.140						
15	.622	1.638	86.778						

16	.595	1.566	88.344							
17	.532	1.401	89.745							
18	.432	1.138	90.883							
19	.424	1.117	92.000							
20	.357	.941	92.940							
21	.349	.919	93.860							
22	.296	.778	94.638							
23	.281	.738	95.376							
24	.256	.673	96.050							
25	.233	.613	96.663							
26	.206	.542	97.205							
27	.199	.523	97.728							
28	.176	.464	98.192							
29	.133	.349	98.541							
30	.117	.308	98.848							
31	.103	.271	99.119							
32	.091	.241	99.360							
33	.071	.186	99.546							
34	.049	.130	99.676							
35	.043	.113	99.789							
36	.031	.083	99.871							
37	.026	.069	99.941							
38	.022	.059	100.000							

Extraction Method: Principal Component Analysis.

To classify the components, an orthogonal factor rotation analysis was conducted and the rotated component matrix was analyzed, as shown in Table 5.

Table 5. Factor analysis result

	Component									
	1	2	3	4	5	6	7	8	9	10
Incomplete drawings	.742									
Lack of materials due to financial difficulties	.737									

No specific planning and scheduling of work	.733									
Lack/insufficient number of equipment	.721									
Lack of materials due to unavailability of materials	.681									
Poor condition of tools used	.678									
Delay in inspection	.616									
Lack of teamwork	.590									
Absenteeism of workers	.537									
Insufficient number of tools used		.797								
Inadequate lighting		.721								
Lack of training		.686								
Low rate for work		.682								
Delay in giving instructions		.644								
Crew composition		.639								
Lack of supervision		.610								
Poor communication between engineer/supervisor and workers		.505								
Lack of incentive scheme		.438								
Age of workers			.786							
Increase in height of structure			.733							
Working 7 days a week without taking holiday				.800						
Difficulty in providing/getting accommodation for workers				.614						
Distance of working site and material storage				.607						
Delay in payment				.481						
Rework					.755					
Change orders during execution					.607					
Poor health condition of workers						.736				
Attitude of workers						.600				
Lack of advanced construction methods and techniques							.827			
Noise							.566			
Bad weather							.415			
Overtime work								.799		
Accidents								.625		
Lack of experience/skill									.315	
Bad workmanship of preceding work									.574	
Lack of space									.569	
Difficulty level of work									.502	
Poor quality of materials used										.587

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 29 iterations.

5. Discussions

The relative important index values shows the ranking of various factors according to their importance. The major 10 factors which affect labour productivity is as follows.

1. Lack of materials due to unavailability of materials
2. No specific planning and scheduling of work
3. Lack of supervision
4. Poor health condition of workers
5. Absenteeism of workers
6. Lack of teamwork
7. Lack of experience/skill
8. Rework
9. Attitude of workers
10. Bad workmanship of preceding work

In Kerala unavailability of materials is a major issue due to various environmental rules related to stone crushing and sand mining. Also strikes related to these causing shortage of materials.

Absence of specific planning and scheduling is other issue. As there is no clear instruction to labours about the quantity of daily works to be completed, productivity rates are very low.

Lack of supervision is another major factor which arises due to the insufficient number of supervisors. Health condition of workers is also affecting their productivity. In Kerala, treatment sector is expensive and the other state workers refrain from taking proper treatment. This causes high rate of absenteeism also.

Lack of teamwork is another factor. Quarrels between local labours and other state labours are common. Most labours are unskilled labours and even after training they are not upto the level of a good skilled labour. This reduces the productivity rate. Attitude of workers is also contributing to loss of productivity.

Rework is another issue which causes loss in productivity. Bad workmanship of the preceding work causes more time to correct that. This happens due to the unskilled labours.

6. Conclusion

The unavailability of materials is a major issue and to solve this actions should be taken by the Government authorities. Research activities are required to find the alternative materials to replace existing scarce materials. It is recommended to use project scheduling techniques (such as Microsoft Project, Primavera etc) in projects to optimise the times of related activities, so as to ensure that works allow continuous task performance, which will cause reduction in idleness of the labour force to a minimum. It is important for each contracting company to adopt motivational or personnel management measures to boost workers' morale. Workers should be given good training to improve their skills and should be taught new improved ways of performing tasks.

Contracting companies have to conduct productivity studies at the activity/ operation level, such as studying factors affecting labour productivity and labour productivity measurement.

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