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Factors Affecting Labour Productivity in Construction Industries

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Abstract*: The most challenging issue in Construction industry is to improving the production efficiency. India is a growing economy. It is estimated to be the third largest economy by 2050. Infrastructure growth is a stepping stone of a stable and productive society, it presents unique challenges but also brings opportunities for private and public sectors in the field of construction. Development will lead to massive construction and there will be a positive growth in industries related to construction. Reports also suggest that the upward trend has been witnessed by these sectors. The aim of this paper is to identify factors affecting labour productivity in building construction projects. A literature review and factors recommended by experts are considered to categorize the factors and analyzed. This study reports the results of a questionnaire survey of project managers, site engineers, supervisors and craftsmen, in India, to identify the factors influencing construction labour productivity.*

1. Introduction

Construction productivity has become such a buzz word and one of the most frequently researched topics. In most countries, labour cost comprises 30 to 50% of the overall project's cost, and thus is regarded as a true reflection of the economic success of the operation. There are many challenges facing the construction industry but one of the most important is low productivity. There are many challenges facing the construction industry in Kerala, but one of the most important, the writers debate, is low productivity. Despite all the technological advancements, abundance of construction materials, tools, and financial means available to local contractors, construction costs are constantly on the rise, completion durations of projects are substantially increasing, and most projects are significantly overrunning their budgets. The objective of this research, therefore, is to identify and rank the relative importance of factors perceived to affect labour productivity on construction sites. To achieve this objective, a statistically representative sample of contractors was invited to participate in a structured questionnaire survey, comprising 30 productivity factors, classified under the following four primary groups: (1) management; (2) technological; (3) human/labour; and (4) external. Among the factors explored, the subsequent 10 are discerned to be the most significant in their effects on labour productivity: (1) clarity of technical specifications; (2) the extent of variation/change orders during execution; (3) coordination level among design disciplines; (4) lack of labour supervision; (5) proportion of work subcontracted; (6) design complexity level; (7) lack of incentive scheme; (8) lack of construction manager's leadership; (9) stringent inspection by the engineer; and (10) delay in responding to requests for information.

2. Research Methodology

Survey research is defined as collection of different data by asking people questions. The data collection process used in this research had the option of two basic methods: questionnaires and personal interviews. A questionnaire was preferred as the best effective and suitable data-collection technique for the study. It was concluded that the questionnaire was described as a self-administered tool with web-design questions, an appropriate response. A questionnaire in a web-survey format comparatively requires less duration and saves cost for the researcher while permits respondents to response the questionnaire at their personal ease. However, for this approach the reply rate is usually lower as compared to face-to-face interviews. Data was collected from literature reviews from books, journals, articles, seminar conferences, and websites which emphasize building construction's labour productivity. A survey was given to employees from different trades involved with the construction project.

3. Planning

For the research study, direct interview as well as email technology was used to send the survey questionnaire. Collecting general information on various factors affecting labour productivity in building construction all over Kerala was the basic

aim of the survey. The purpose and approach used in the survey was fully explained to the respondents. Guidelines were provided to the respondents to ensure that the procedure was followed properly to reduce errors. During the survey period, some oversights were provided to help ensure the process was going smoothly and consistently. The data were stored in order to maintain confidentiality, and the output was received, which included raw data sheets, summary sheets, and computer databases. Results included the overall statistics as well as individual statistics.

4. Background in Labour Productivity

Productivity is generally defined as the average direct labour hours required to install a unit of material. It is said that perfect productivity (1.0) can be achieved with a 40-hour work week, with people taking all the holidays and vacation days as planned all of the engineering drawings would be 100% complete there would be no delays of any kind during construction; everyone would work safely; everything would fit perfectly the first time; the weather would be 70^0 F; and there would be no litigation at the end of the project (Rowlinson and Proctor, 1999). The term "productivity" expresses the relationship between outputs and inputs (Borcherding and Liou, 2006). Output and input differ from one industry to another. Also, the productivity definition varies when applied to different areas of the same industry. Labour is one of the basic requirements in the construction industry. Labour productivity usually relates manpower in terms of labour cost to the quantity of outputs produced (Borcherding and Liou, 2002). In other words, the definition of labour productivity is the amount of goods and services produced by a productive factor (manpower) in the unit of time (Drewin, 2008). In 1883, Littre defined productivity as the "faculty to produce," that is, the desire to produce (Jarkas, 2010). In 1950, the Organization for European Economic Cooperation (OEEC) introduced the definition of productivity as a quotient obtained by dividing the output by one of the production factors (Sumanth, 2012). Depending on measurement objectives and the availability of data, several productivity definitions are encountered. The U.S. Department of Commerce defined productivity as "dollars of output per person-hour of labor input" (Adrian, 2007).Construction requires extensive manual labour. Human performance and productivity are reliant on one another. Therefore, the most commonly used measure of productivity is the constant contract dollars of new construction work per work hour (Hendrickson 1998). A study by Teicholtz (2004) revealed that over 40 years (1964-2003) the construction industry lags compared to all other non-farm industries in developing and applying labour saving techniques and substituting equipment for labour. Figure 1 depicts construction labour productivity changes as opposed to all non-farm industries from 1964-2003.

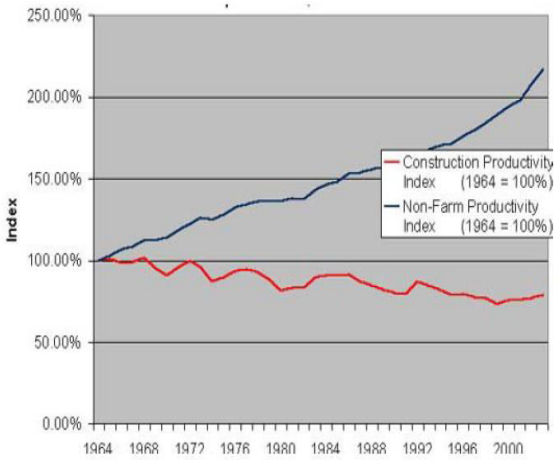

Fig.1 represents construction labour productivity changes as opposed to all non-farm industries from 1964-2003.

A study by Hendrickson (1998) addressed the time utilization of the average construction worker. Only 40% of a workers time is considered to be productive, with 55 % unproductive time, and 5 % personal time. Figure 2 shows a breakdown of the average workers time utilization.

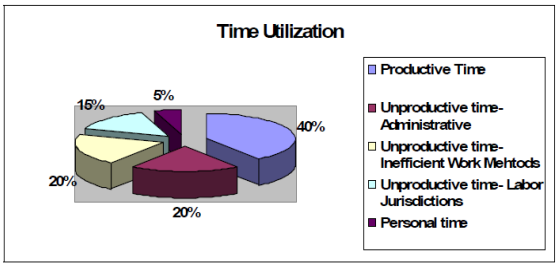

Fig.2 shows a breakdown of the average workers time utilization.

5. Problem Statement

In the construction industry productivity loss is one of the greatest and severe problems. Present construction contracts lack enough to classify recompense for productivity loss due to field factors (Construction Industry Institute [CII], 2000; National Electrical Contractors Association [NECA], 1999). Of various project-costs components such as labours materials and equipment's, labour component is considered the most risk. Whereas others components (equipment and material) are determined by the market price and price and are, consequently, beyond the influence of project management. Labour

cost in construction industry is estimated to be about 33%- 50% of the entire project cost. Because labour is more variable and unpredictable than other project-cost components, it becomes necessary to understand the effects of different factors on labour productivity. An increase in productivity can reduce the labour cost in a direct proportion. It can either benefit or reduce a project's profit, making it of vital interest to the construction industry for its success. Previous researches confirm that productivity loss results from various factors, which includes but not limited to various variation in drawings, long hours of extra work, poor field management, and extreme climatic conditions. In fact, these factors typically produce extra disturbances that affect productivity and are beyond the direct control of a contractor, resulting in productivity loss or extra work hours necessary to accomplish the task.

5.1. Importance of the Research

The study investigates important factors affecting labour productivity in building construction. Understanding these factors is helpful for the construction professionals who work on the initial phases of construction planning in order to efficiently deliver the project plan. The main goal of the research study is to provide essential information about factors affecting labour productivity to the project management teams who enable the project's success. Generally, the factors which affect construction productivity are a lack of required materials, disputes between the major parties, weather, and changes during the construction, accidents, and others. For building construction, extra care must be taken when developing the project time schedule, which is possible only with prior knowledge of factor causes. The research study aims to provide knowledge of building construction-related factors that affect the project's success.

5.2. Organization of the Questionnaire

One of the biggest concern of the research study was about number of responses with complete information. Recognition of respondents about the benefits and uses of this research study was also of great concern. Following criteria was used to begin the questionnaire design process:

Questionnaire:

- Exactness
- Applicable
- Completeness
- Understanding

Response Rate:

- Duration
- Ease of Completion

5.3. Questionnaire Distributions

The target groups in this study were professionals from the construction industry. A list of 100 building-construction organizations was obtained from the Lensfed (Licensed Engineers Federation). The sample size can be calculated with the following equation for a 94% confidence level (Al-Shahri, M et al., 2001; Israel, 2003; Moore et al., 2003):

$$\mathbf{n = n'/ [1+(n'/N)]}$$

Where, n= Total number of population

N = Sample size from a finite population

n' = Sample size from an infinite population = S^2/V

S^2= the variance of the population elements and

V = a standard error of the sampling population. (Usually, S= 0.5, and V = 0.06.)

$n'=S^2/V^2= (0.5)^2/(0.06)^2= 69.44$ For N=100

$n = 69.44/ [1+ (69.44 / 100)] = 41$

To obtain 94% of confidence level, it was calculated to send the questionnaire to 41 organizations to accomplish a 94%.

6. Analysis Method

The first method for the analysis is The Pearson product-moment correlation coefficient (Pearson's correlation, for short) is a measure of the strength and direction of association that exists between two variables measured on at least an interval scale. Many basic analysis projects involving data exploration, descriptive statistics and simple inferential statistics can be successfully completed using a spreadsheet package such as Microsoft Excel. SPSS comes into its own for more advanced projects, especially those requiring statistical routines not available in standard spreadsheet packages and those involving multivariate analysis. Project involves either of the latter, consider using SPSS (or a similar package) for data analysis. SPSS can be used to calculate Pearson's r, using the Bivariate correlation command. SPSS will also report tests of statistical significance. We will show this applied to measure and test the correlation between satisfaction and commitment in the customer satisfaction.sav dataset. The routine is similar for the other tests.

The sample correlation coefficient between two variables *x* and *y* is denoted *r* or r_{xy}, and can be computed as:

$$\gamma_{xy} = \frac{\operatorname{cov}(x, y)}{\sqrt{\operatorname{var}(x)}\sqrt{\operatorname{var}(y)}}$$

where cov(x, y) is the sample covariance of x and y; var(x) is the sample variance of x; and var(y) is the sample variance of y.

Correlations

		Alcoholism	Absenteeism
Alcoholism	Pearson Correlation	1	.843**
	Sig. (2-tailed)		.000
	N	80	80
Absenteeism	Pearson Correlation	.843**	1
	Sig. (2-tailed)	.000	
	N	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

Fig.3 shows correlation between 2 variables.

The way analysis is The One-Way ANOVA ("analysis of variance") compares the means of two or more independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different. One-Way ANOVA is a parametric test.
The null and alternative hypotheses of one-way ANOVA can be expressed as:

H_0: $\mu_1 = \mu_2 = \mu_3 = \ldots = \mu_k$ ("all k population population means are equal")
H_1: At least one μ_i different ("at least one of the k population means is not equal to the others")
Where,

μ_i is the population mean of the i^{th} group (i = 1, 2,..., k)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
lackofexperience	Between Groups	1.616	1	1.616	19.778	.000
	Within Groups	6.372	78	.082		
	Total	7.988	79			
Age	Between Groups	2.427	1	2.427	10.969	.001
	Within Groups	17.260	78	.221		
	Total	19.688	79			
Personalproblems	Between Groups	.002	1	.002	.007	.932
	Within Groups	16.798	78	.215		
	Total	16.800	79			

Fig.4 shows Example for One-way ANOVA test done in spss.

7. Conclusion

In today's world, the construction industry is rated as one of the key industry. It helps in developing and achieving the goal of society. Study and knowledge of construction productivity are very important because they cause losses to the governing agencies and also influence the economics of the construction industry. Prior knowledge of labour productivity during construction can save money and time. Investments for these projects are very high and because of the complexity in construction, various factors can highly affect overall productivity, thus the project can end up adding even more time and money in order to be completed. This research is intended to identify the correlation between the variables and also the comparison between the factors of the labour productivity in construction with their significance. This study investigates all possible factors through a structured questionnaire administered all over kerala. The basic ideas of the research is to study various factors affecting labour productivity on construction.

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