

ANALYSIS OF CRITICAL FACTORS AFFECTING CONSTRUCTION PRODUCTIVITY

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ABSTRACT

Productivity is one of the critical factors affecting the overall performance of any construction site, large or small. Construction productivity measurement is the analysis into the ratio of total output to the total input of the construction process. Inputs generally refer to labor, equipment and materials cost which are brought into a system. Output is evaluated in terms of total value of the project. The aim of this study is to identify factors that affects construction productivity and to identify the critical factors using Relative Importance Index Method(RII). Identification of factors is done by conducting literature survey and interview session with the site engineers, project engineers and contractors. 85 questionnaire surveys were done. The identified factors is then evaluated using relative importance index method. It helps to achieve a competitive level of quality and cost effectiveness in projects. For future research, the study recommends developing a model for forecasting construction productivity.

Keywords: Critical factors, Literature survey, Questionnaire survey, Relative Importance Index

INTRODUCTION

Productivity is the key components of every company's success and Competency in the market. Construction companies can make advantage over the competitors by improving productivity to build projects at much lower costs; still, most contractors do not systematically address this strategic issue and evaluate its impact on the project's profit. Productivity measurement at construction site level enables companies to monitor their own performance against their site performance.

The fundamental concept of productivity measures is a comparison of the output of a production process, an industry, or an economy with the corresponding factors of production required to generate that output. The output and inputs of production thus constitute the basic components of every productivity measure. Productivity measures are formulated as a ratio of output to one or more of the inputs. Previous studies regarding productivity indicate that a broad range of factors affect productivity. The factors that influence productivity may be separated into three factors: labor-related, material-related, and equipment-related factors.

In order to improve productivity, a study of the factors affecting it whether positively or negatively is necessary. Previous studies regarding productivity indicate that a broad range of factors affect productivity. The factors that influence productivity may be separated into three factors: labor-related, material-related, and equipment-related factors. Making use of these factors

that positively affect productivity and controlling factors that have a negative effect, will ultimately improve the productivity. This study addresses labor, material and equipment related factors.

If only one of the inputs is used in the denominator, then the ratio is a single factor productivity measure. If all of the inputs are used, then the ratio is a total factor productivity measure. The development of both single and total factor productivity indexes requires measures of output and input quantities. Field study has to be done to collect data regarding input and output.

LITERATURE STUDY

Literature survey is an integral part of any project. It has to be conducted to understand various aspects of the project and it will help in the successful completion of the project. In this chapter, the research work carried out in the productivity is considered and reviewed.

Abdulaziz M. Jarkas, and Camille G. Bitar (2012) identified and ranked the relative importance of factors that affected labor productivity on construction sites in Kuwait. To achieve this objective, a representative sample of contractors was invited to participate in a structured questionnaire survey, comprising 45 productivity factors. The clarity of technical specifications factor ranks first among the 45 factors explored, and thus considered the most significant factor affecting construction labor productivity in Kuwait with a relative importance index of 81.67%. The surveyed contractors ranked lack of labor supervision as the most important factor affecting labor productivity in management group.

Khaled, Mahmoud El-Gohary and Remon, Fayek Aziz (2013) identified, investigated, and ranked factors perceived to affect construction labor productivity in the Egyptian construction context with respect to their relative importance. The study was based on a survey designed to gather all necessary information in an effective way. The survey presents 30 productivity factors generated on the basis of related research works on construction productivity. The most important factors identified are Labor experience and skills, Incentive programs, Availability of the material and ease of handling, Leadership and competency of construction management and Competency of labor supervision. .

Gholamreza Heravi and Ehsan Eslamdoost (2015) developed a labor productivity model based on multilayer feed forward neural networks trained with a back propagation algorithm by which complex mapping of factors to labor productivity is performed. This paper focused on the work involved in installing the concrete foundations of gas, steam, and combined cycle power plant construction projects in the developing country of Iran. The results proved a better prediction performance for Bayesian regularization than early stopping. To demonstrate the prediction performance of the presented models, the developed models are implemented at two real power plant construction projects.

Tao Wang et al. (2016) investigated the long- and short-run impacts between material productivity and selected socioeconomic factors, such as energy intensity, economic structure, international trade and resource endowment in the case of China by using the auto-regressive distributed lag model over the period of 1980-2010. The model confirmed the existence of co-integration among the variables both in the long and short run. The results indicated that energy intensity, Trade openness, domestic extraction per capita are the significant factors for material productivity.

Bon-Gang Hwang et al. (2017) identified the critical factors affecting the productivity of green building construction projects. The results indicated that experience of the worker, technology, changes in design, skill of worker, and planning and sequencing of work were the top five most critical factors that affect the productivity of green building construction projects. Comparison was done with traditional projects. . One sample t-test, paired t-test, and Spearman rank correlation are used for comparisons of means amongst the factors between green and traditional projects.

RESEARCH METHODOLOGY

- 1.Literature survey: The identification of research problem and the collection of information required for the progress of work are done through the literature survey.Factors affecting productivity of a construction site is identified.
- 2.Identification of factors:Factors affecting construction productivity is identified.
3. Data Collection : The relevant data to identify critical factors were collected by a structured, closed-ended questionnaire survey.
4. Data Analysis:Relative Importance Index(RII) method is used to rank the factors.
5. Discussion And Conclusion: Based on the analysis of results , conclusion and future study were discussed.

IDENTIFICATION OF FACTORS

The methodology used in this research to determine the factors affecting the construction productivity involves; Literature survey and Preliminary interviews.A number of personal interviews were conducted with engineers who work as a project manager, estimators, planners and site engineers.Relying on personal interviews and the literature review, the researcher was able to classify the factors affecting construction productivity into the labor, material and equipmentrelated factors.

Table1 Labor-related factors

Sl.No	Factors
1	Worker's skill level
2	Labor's Experience
3	Number of labors
4	Labor supervision
5	Weather Condition
6	Working overtime
7	Labor's Age
8	Payment delays
9	Lack of labor safety
10	Working condition

Table 2 Material-related factors

Sl.No	Factors
1	Ease of availability of material
2	Quality checking of material
3	Cost of the material
4	Storage facility
5	Material Requirement Planning
6	Periodic inspection
7	Amount of wastage
8	Weather condition
9	Loading and unloading of materials
10	Delay in supply

Table 3 Equipment-related factors

Sl.No	Factors
1	Specification and standard of equipment
2	Regular maintenance of equipment
3	Fund shortage to procure
4	Working cycle
5	Age of Equipment
6	Handling of Equipment
7	Downtime
8	Site layout
9	Fast and efficient repair of materials
10	Non availability of materials

RANKING OF FACTORS

Five point scale is used to rank the factors. Factors affecting labor, material and Equipment productivity are considered separately. Online and offline survey has been done. Contractors, project managers and site managers were considered for the survey. 85 questionnaire survey has been done. Based on the data from the questionnaire prioritizing of factors is done. Relative Importance Index method was used to rank the factors.

$$\text{Relative Importance Index(\%)} = \frac{5(n5) + 4(n4) + 3(n3) + 2(n2) + n1}{5(n1 + n2 + n3 + n4 + n5)} \times 100 \quad (1)$$

where n1, n2, n3, n4, and n5 = the number of respondents who have selected: 1, for no effect; 2, for little effect; 3, for moderate effect; 4, for strong effect; and 5, for very strong effect, respectively.

Table 4. Relative Importance Indices and Ranks of Labor-Related Factors

SI No	Factor	RII(%)	Rank
1	Worker's skill level	98.2	1
2	Labor's Experience	96.4	2
3	Number of labors	90.1	3
4	Labor supervision	88.9	4
5	Weather Condition	63.7	5
6	Payment delays	62.1	6
7	Labor's Age	60.2	7
8	Working overtime	59.7	8
9	Lack of labor safety	40	9
10	Working condition	32.7	10

Table 5 Relative Importance Indices and Ranks of Material-Related Factors

SI No	Factor	RII(%)	Rank
1	Material Requirement Planning	96.4	1
2	Quality checking of material	95.5	2
3	Periodic inspection	93.1	3
4	Amount of wastage	82.1	4
5	Ease of availability of material	75.2	5
6	Cost of the material	74.4	6
7	Storage facility	71.2	7
8	Delay in supply	41.8	8
9	Loading and unloading of materials	40	9
10	Weather condition	39.2	10

Table 6. Relative Importance Indices and Ranks of Equipment Productivity Factors

SI No	Factor	RII(%)	Rank
1	Regular maintenance of equipment	89.77	1
2	Specification and standard of equipment	84	2
3	Working cycle	83.11	3
4	Fund shortage to procure	82.67	4
5	Handling of equipment	76.88	5
6	Age of Equipment	72.89	6
7	Fast and efficient repair of materials	48.88	7
8	Downtime	48.45	8
9	Site layout	36	9
10	Non availability of materials	35.55	10

RESULT AND DISCUSSION

The table below shows the top 15 critical factors affecting construction productivity, there relative importance index and corresponding ranks. It includes factors related to labor, material and equipment.

Table 7. Relative Importance Indices and Ranks of Factors Affecting Productivity

SI No	Factor	RII(%)	Rank
1	Worker's skill level	98.2	1
2	Labor's Experience	96.4	2
3	Material Requirement Planning	96.4	3
4	Quality checking of material	95.5	4
5	Periodic inspection	93.1	5
6	Number of labors	90.1	6
7	Regular maintenance of equipment	89.77	7
8	Labor supervision	88.9	8
9	Specification and standard of equipment	84	9
10	Working cycle	83.11	10
11	Fund shortage to procure	82.67	11
12	Amount of wastage	82.1	12
13	Handling of equipment	76.88	13
14	Ease of availability of material	75.2	14
15	Cost of the material	74.4	15

CONCLUSIONS

Productivity is one of the most important factors affecting the overall performance of any construction site, large or small. Productivity measurement at construction site level enables companies to monitor their own performance against their site performance. In order to improve productivity, a study of the factors affecting it whether positively or negatively is necessary. In this study, main factors affecting construction productivity mainly labor related, material related and equipment related is identified and ranked. Productivity measurement provides the necessary data to analyze factors for project owners, constructors, and management professionals to control construction progress, estimate the cost of future construction projects, and determine its competitiveness in the global market. Workers' skill level, lack of labor supervision, experience and number of labors are found to be the most influential labor related factors affecting construction productivity. Material requirement planning, quality checking of materials, periodic inspection, amount of wastage, ease of availability of material and cost of the material are found to be the most influential material related factors affecting construction productivity. Regular maintenance of equipment, specification and standard of equipment, working cycle, fund shortage to procure and handling of equipment are found to be the most influential equipment related factors affecting construction productivity. Factors affecting construction productivity. Material requirement planning, quality checking of materials.

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