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IMPROVING LABOUR PRODUCTIVITY IN CONSTRUCTION INDUSTRIES

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ABSTRACT –

One of the most investigated topics and a popular buzzword nowadays is construction productivity. Labor costs are considered a true indicator of the operation's economic success because they typically account for 30 to 50% of the project's total cost in most nations. The construction business has numerous obstacles, but inadequate productivity is among the most significant. The writer argues that low productivity is one of the most significant issues affecting Kerala's building sector. Construction costs are continuously rising, project completion times are significantly lengthening, and the majority of projects are significantly exceeding their budgets, even with all the technological advancements, an abundance of construction materials and tools, and financial resources available to local contractors. Therefore, identifying and ranking the elements that influence labor productivity on construction sites is the aim of this study. A statistically representative sample of contractors was asked to take part in a structured questionnaire survey that included 30 productivity factors, divided into five main categories: (1) manpower; (2) external; (3) communication; (4) resources; and (5) miscellaneous. This was done in order to accomplish this goal. The primary goal of this study is to examine how the construction industry views the numerous elements that impact labor productivity, analyze those factors, and recommend suitable actions that may be implemented to increase labor productivity. Additional goals of this research include: thoroughly examines and measures earlier research in order to determine the main elements influencing labor productivity, determine the relationship between the elements, compare and evaluate the factors, and rank the elements according to their level of importance. .

Keywords – Labour productivity, Efficiency, Management
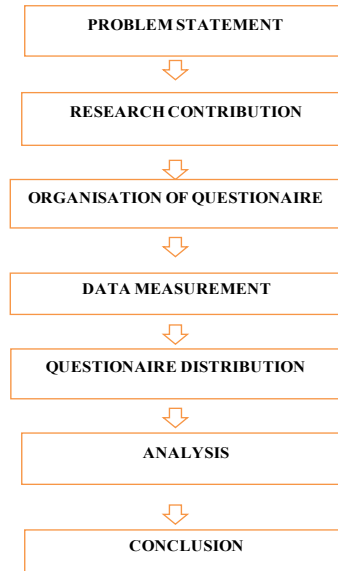

Introduction

One of the most investigated topics and a popular buzzword nowadays is construction productivity. Labor costs are considered a true indicator of the operation's economic success because they typically account for 30 to 50% of the project's total cost in most nations. The construction business has numerous obstacles, but inadequate productivity is among the most significant. The writers argue that low productivity is one of the most significant issues affecting Kerala's building sector. Construction costs are continuously rising, project completion times are significantly lengthening, and the majority of projects are significantly exceeding their budgets, even with all the technological advancements, an abundance of construction materials and tools, and financial resources available to local contractors. Therefore, identifying and ranking the elements that influence labor productivity on construction sites is the aim of this study. A statistically representative sample of contractors was asked to take part in a structured questionnaire survey that included 30 productivity criteria categorized into the following five main groups in order to accomplish this goal: (1) personnel; (2) outside; (3) correspondence; (4) assets; and (5) other. The ten factors listed below are thought to have the most impacts on labor productivity out of all those examined: (1) Technical specifications' clarity; (2) the degree of variation or change orders during execution; (3) the degree of coordination among design disciplines; (4) the absence of labor supervision; (5) the percentage of work that was subcontracted; (6) the complexity of the design; (7) the absence of an incentive program; (8) the lack of leadership from the construction manager; and (9) the engineer's thorough inspection.

Objective

The primary goal of this study is to examine how the construction industry views the numerous elements that impact labor productivity, analyze those factors, and recommend suitable actions that may be implemented to increase labor productivity. Additional goals of this research include: thoroughly examines and measures earlier research in order to determine the main elements influencing labor productivity, determine the relationship between the elements, compare and evaluate the factors, and rank the elements according to their level of importance.

METHODOLOGY

The process of gathering various data by asking individuals questions is known as survey research. Two fundamental techniques were available for the data gathering process in this study: questionnaires and in-person interviews. The most appropriate and successful data-collection method for the study was a questionnaire. The questionnaire's description as a self-administered tool with web-design questions was deemed adequate. Comparatively speaking, a field survey questionnaire saves the researcher time and money while allowing respondents to complete it whenever it is most convenient for them. In contrast to online surveys, this method typically has a greater response rate. Information was gathered from literature reviews of books, journals, articles, seminars, conferences, and websites that highlight the labor productivity of building construction. Workers from several trades involved in the construction project were given a survey.

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LITERATURE REVIREW SUMMARY

. 1. The average number of direct labor hours needed to install one unit of material, under ideal conditions, is the conventional definition of productivity. That is, the amount of time needed to finish a task flawlessly from start to finish.

2. Productivity is defined as the precise relationship between a task's input and output. The degree of output relative to input efforts is what counts.

3. The cost of labor divided by the outcome of the activity that labor has undergone is how productivity is measured.

4. Productivity is the quantity of service we receive as a result of the labor that is really put into completing a certain task.

5. The desire or readiness to generate a particular output is the simplest way to define productivity, and it entirely depends on the worker's mindset.

6. In relation to its degree of output, productivity is a relative element of output.

7. Depending on the nation, productivity is measured in terms of currency and might be described as the amount of money spent on a particular activity. Dollar for the USA, for instance.

8. Productivity, which is defined as the cost of labor per hour, is proven to be a significant factor.

9. By using equipment instead of people, productivity can be raised. Money will be saved, results will be fast, and satisfaction will be high.

10. Since employees' time is not all the same, productivity is addressed. Just 40% of workers are very productive, 55% are unproductive, and 5% of working hours are spent on personal activities. Therefore, it is not feasible to achieve 100% productivity.

ANALYSIS AND RESULTS

Following completion of the questionnaire, each item may be examined independently, or in certain situations, the replies to all of the items may be added together to produce a score for the entire set of items. There is a lot of dispute in the literature over whether individual Likert items should be regarded as ordered-categorical data or as interval-level data, and there are strong opinions about which approaches are best (Wikipedia 2016). In many ways, the reason for this discrepancy stems from how Likert items are seen as being ordinal data. There are two main things to think about. Likert scales are arbitrary, at start. Neither measure theory nor scale (from which a distance metric can be calculated) provide an objective numerical basis for the value assigned to a Likert item. The researcher creating the survey simply decides the value to be assigned to each Likert item based on a desired level of information. Nonetheless, progressive positive integer values are typically assigned to Likert items by convention. Additionally, the scale's progressive nature means that each subsequent Likert item is seen as representing a "better" response than the one before it. The second, and perhaps more crucial, question is whether the "distance"—which is generally inferred—between each subsequent item category is equal. For instance, the four-point Likert scale above suggests that the "distance" between categories 1 and 2 is equivalent to that between categories 3 and 4. An equally spaced presentation by

the researcher is crucial for excellent research practices; else, the analysis may be biased. Since only one category can be rated below average, it is improbable that all of the categories in this four-point Likert scale—"Poor," "Average," "Good," and "Very Good"—will be equally spaced. One could argue that this would skew any finding in favor of a favorable conclusion. However, the respondent may not interpret the researcher's presentation of what they believe to be equidistant categories as such. Three primary forms of analysis are used in this study: (1) the Pearson's product moment correlation approach; (2) the one-way anova test; and (3) the center tendency dispersion test, also known as mean value analysis. We can start by talking about Pearson's test, also known as Pearson's product moment correlation analysis.

A. PEARSON'S CORRELATION TEST

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:

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

where $\mathrm{cov}(x, y)$ is the sample covariance of x and y; $\mathrm{var}(x)$ is the sample variance of x; and $\mathrm{var}(y)$ is the sample variance of y.

B. THE ONE-WAY ANOVA TEST

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.The main assumption in this test is; the *independent variable* should consist of *two or more categorical*, *independent groups*. Typically, a one-way ANOVA is used when you have *three or more* categorical, independent groups, but it can be used for just two groups. One-Way ANOVA is a parametric test.The null and alternative hypotheses of one-way ANOVA can be expressed as:

H_0: $\mu_1 = \mu_2 = \mu_3 = ... = \mu_k$ ("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 ith group ($i = 1$, 2,..., k)Another important assumption was*dependent variable* should be *approximately normally distributed for each category of the independent variable*,the one-way ANOVA only requiring *approximately* normal data because it is quite "robust" to violations of normality, meaning that assumption can be a little violated and still provide valid results.

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

C. RANKING OF VARIABLES

The ranking of variables done in this analysis is based on the following factors (1) 'The valid data analysis', (2) 'The missing value analysis' and (3) 'The centre tendency and the Dispersion tests'. The valid data analysis is nothing but the checking of measurement data should be valid or not, using SPSS software. The missing value analysis is a type of analysis which is done in SPSS for find the missing value in the collected data. 'The Centre Tendency and Dispersion tests' are done the basis on the Mean value, Standard Deviation, Count and the Percentage.

1. Measurement Requirements for Central Tendency and Dispersion.
The choice of descriptive measures depends entirely on the level of measurement for a particularvariable, and the levels of measurement are:
- Nominal measurement: merely a set of mutually exclusive and exhaustive categories.
- Ordinal measurement: as in nominal, but with the addition of an underlying dimension whichallows comparative statements about a larger or smaller quantity of the property being measured.
- Interval measurement: as in ordinal, with the addition of equal sized value intervalsseparatingeach of the value classes. Values are continuous, i.e. fractional values of intervals are meaningful.

2. RANKING OF VARIABLES.
The results obtained from the ranking of variables were further divided into 3 main categories such as (1) The overall factors in the ascending order based on their mean values (2) The factors directly affects the labour productivity and (3) The factors that less affects the labour productivity. The 5 sub categories based on their groups and they are given (1) Manpower (2) External (3) Communication (4) Resources and (5) Miscellaneous factors.

3. Overall factors affecting labour productivity.
The result in Table 1 shows overall ranking of 30 factors that negatively affect labor productivity, identified in this study.

Table 1: Overall Ranking of Factors Affecting Labour Productivity

SL.NO.	FACTORS	#RANK	RANK VALUE
1	Absenteeism	1	3.91
2	Alcoholism	2	3.91
3	Disloyalty	3	3.91
4	Lack of experience	4	3.88
5	Violation of safety laws	5	3.83
6	Accidents	6	3.78
7	Lack Of Materials	7	3.58
8	Shortage of water and power supply	8	3.52
9	Payment Delays	9	3.28
10	Increase The Price Of Materials	10	3.25
11	Dispute With Owner	11	3.22
12	Weather conditions	12	3.21
13	Dispute With Designer	13	3.16
14	Inspection Delays	14	3.05
15	Poor site conditions	15	3.05
16	Supervision Delays	16	3.05
17	Insufficient lighting	17	3.02
18	Material storage location	18	3.02
19	Lack of required tools	19	3.00
20	Inadequate transportation facilities	20	2.95
21	Change Orders From The Owners	21	2.93
22	Implementation of Govt.Laws	22	2.92
23	Change Orders From Designers	23	2.92
24	Design Changes	24	2.92
25	Personal problems	25	2.70
26	Rework	26	2.65
27	Age	27	2.43
28	Overtime	28	2.21
29	Training Sessions	29	2.05
30	Project objective not well defined	30	1.40

4. The factors directly affect the labour productivity.

The result in Table 2 show the factors directly affect the labour productivityidentified in this study. The ranking value greater than or equal to 3 (in the interval of 1 to 4) is the criteria for measuring the factors, which have directly, affect the labour productivity.This means the following factors negatively affect the labour productivity more than 75 percentage.

Table 2: Factors directly affects the labour productivity

SL.NO.	FACTORS	#RANK	RANK VALUE
1	Absenteeism	1	3.91
2	Alcoholism	2	3.91
3	Disloyalty	3	3.91
4	Lack of experience	4	3.88
5	Violation of safety laws	5	3.83
6	Accidents	6	3.78
7	Lack Of Materials	7	3.58
8	Shortage of water and power supply	8	3.52
9	Payment Delays	9	3.28
10	Increase The Price Of Materials	10	3.25
11	Dispute With Owner	11	3.22
12	Weather conditions	12	3.21
13	Dispute With Designer	13	3.16
14	Inspection Delays	14	3.05
15	Poor site conditions	15	3.05
16	Supervision Delays	16	3.05
17	Insufficient lighting	17	3.02
18	Material storage location	18	3.02

| 19 | Lack of required tools | 19 | 3.00 |

5. The factors less affects the labour productivity.

The result in table 3 shows the factors less affects the labour productivity, identified in this study. The ranking value below 3 (in the interval of 1 to 4) is the criteria for measuring the factors, which have less, affect the labour productivity. This means the following factors negatively affect the labour productivity less than 75 percentage.

Table 3: Factors less affects the labour productivity

SL.NO	FACTORS	RANK	RANK VALUE
1	Project objective not well defined	1	1.40
2	Training Sessions	2	2.05
3	Overtime	3	2.21
4	Age	4	2.43
5	Rework	5	2.65
6	Personal problems	6	2.70
7	Design Changes	7	2.92
8	Change Orders From Designers	8	2.92
9	Implementation of Govt.Laws	9	2.92
10	Change Orders From The Owners	10	2.93
11	Inadequate transportation facilities	11	2.95

6. Manpower Factors Affecting Labor Productivity

Table 4 shows the ranking of the various factors for the manpower group. Disloyalty, Absenteeism, Alcoholism are ranked first in the manpower group, with a mean value of 3.91.

Table 4: Manpower Factors affects labour productivity.

SL.NO.	MANPOWER	#RANK	RANK VALUE
1	Absenteeism	1	3.91
2	Alcoholism	2	3.91
3	Disloyalty	3	3.91
4	Lack of experience	4	3.88
5	Personal problems	5	2.70
6	Age	6	2.43

Labour absenteeism was ranked 1st in the manpower group, with a mean value of 3.91, and in 1st among all 30 factors that affect labour productivity.Alcoholism ranked 2nd in the manpower group, with a mean value of 3.91, and 2nd among all 30 factors that affect labor productivity. Consuming alcohol at the construction site may lead to various negative effects on other labourers who are working. Alcohol consumption may lead to rework, misplacing the job work, and accidents, thus completely or partially stopping the construction work and affecting labour productivity.
Labour disloyalty had a great effect on labor productivity and ranked in the 3rd position for the manpower group, with a mean value of 3.91, and 3rd among all 30 factors in terms of negatively affecting labour productivity.

7. External factors affecting labour productivity

Table 5 illustrate the ranking of factors for the external group. Payment delays were ranked 1st in the external group, with a mean value of 3.28, and 13th among all 30 factors that negatively affect labor productivity.

Table 5: External Factors affects labour productivity.

S.NO	EXTERNAL	#RANK	RANK VALUE
1	Payment Delays	1	3.28
2	Inspection Delays	2	3.05
3	Supervision Delays	3	3.05
4	Design Changes	4	2.92

5	Implementation of Govt.Laws	5	2.92
6	Rework	6	2.65
7	Training Sessions	7	2.05

8. Communication factors affecting labour productivity.

Table 6 show the ranking of the factors for the communication group. 'Dispute with owner' was ranked 1st in the communication group with a mean value of 3.22, and 20th among all 30 factors affecting labor productivity.

Table 6 Communication Factors affects labour productivity.

S.NO.	COMMUNICATION FACTORS	RANK	RANK VALUE
1	Dispute with owner	1	3.22
	Dispute with designer	2	3.16
3	Change orders from the owners	3	2.93
4	Change orders from designers	4	2.92

9. Resource factors affecting labour productivity.

Table 7 show the ranking for factors of the resource group. Violation of safety laws was ranked first in the resource group, with a mean value of 3.83, and was fifth among all 30 factors affecting labour productivity.

Table 7: Resource Factors affects labour productivity.

S.NO	RESOURCES	RANK	RANK VALUE
1	Violation of safety laws	1	3.83
2	Increase The Price Of Materials	2	3.25
3	Poor site conditions	3	3.05
4	Material storage location	4	3.02
5	Insufficient lighting	5	3.02
6	Lack of required tools	6	3.00
7	Inadequate transportation facilities	7	2.95

10. Miscellaneous factors affecting labour productivity.

Table 8 show the ranking for factors of the miscellaneous group. 'Accidents' was ranked first in the resource group, with a mean value of 3.78, and was sixth among all 30 factors affecting labour productivity.

Table 8: Miscellaneous Factors affects labour productivity.

S.NO.	MISCELLANEOUS	RANK	RANK VALUE
1	Accidents	1	3.78
2	Shortage of water and power supply	2	3.52
3	Weather conditions	3	3.21
4	Overtime	4	2.21
5	Project objective not well defined	5	1.40

CONCLUSION

A.   GENERAL CONCLUSIONS

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, Gundecha*et.al* (2012). This research is intended to identify the causes of probable factors affecting labour productivity in building construction. This study investigates all possible factors through a structured questionnaire administered all over kerala. The survey results are subjected to analysis, and the ranking of factors is calculated.Based on the correlation between the variables, many variables are positively correlated; some of them are negatively correlated; some variables have no significant relation and the data used in the study is from small companies executing small building projects.The basic ideas of the research are to study various factors affecting labour productivity on construction.

B.   RECOMMENDATIONS

Construction tasks are expensive and frequently cause in arguments and claims, which generally affects progress of construction projects. The environment of construction organizations should be suitable to implement projects with successful completion, Adrian *et. al*(1990). In the construction industry, it is necessary to find the weaknesses of particular task in order to solve and overcome them. Mentioned below are the recommendations which were found to be important factors for improving labor productivity in the construction industry.

- Absenteeism at work site can be reduced with inclusion of appropriate paid time off and vacations to all employees.
- Strict drug and alcohol tests should be implemented in working hours at sites.
- Recruiting manager and project managers should recruit appropriate candidate to particular task. Friendly relations should be maintained with labours and made aware of their importance to the organization, Adrian *et. al*(1990).
- A detail schedule of material supply schedule for each project should be provided by the contractors. It should contain the time required to supply materials and the availability of the local market to furnish the required materials in time. Extra attention is required on quality of construction materials and tools used in their projects because using suitable materials and tools reduces both the time taken tofinish the work and wastage of materials. Using suitable materials and tools also has a positive effect on the task and thus, better labor productivity can be achieved.
- Arbitration provided for disputes between the owners and builders.
- Organizations should make sure there is enough lighting present at the construction sites which can indirectly reduce the number of accidents. Continuous safety training and meetings should be arranged to achieve better performance in labor productivity.
- Purchased material should be stored at appropriate location and should be easily accessible and close to constructed buildings to avoid wasting labor time for multiple-handling materials.
- To achieve desired results, time required to implementing change orders and to make corrections in drawings and specifications should be estimated and scheduled without affecting the project-time completion. Regular meetings should be arranged with the project authorities.
- Various external and natural factor risk should be considered in the budget estimation to minimize delays due to closures and material shortages. There should be suitable emergency budget to cover cost of increased material. Haris*et. al*(1998).
- Incomplete drawings should be avoided and care should be taken to avoid confusion among the various construction agencies.
- Change orders and design error should be avoided as much as possible. These factors can be costly and time consuming if the work has been done. Work sequences can also be affected due to rework.

C.   FUTURE RESEARCH

The distribution of the questionnaire and its study are limited with in Kerala and the data used in this study is from small companies executing small building projects. Future study could be done in other parts of the Country and could emphasize specific types of building construction, including commercial, education, government buildings, skyscrapers, etc. There is a need to study the productivity levels in other types of projects. Only a few studies are conducted in this area using SPSS and the output of the project is valuable for researchers as well as companies in this field. A study similar to the present research is needed for transportation projects to find factors that affect the productivity of highway construction, which will help departments of transportation to minimize unnecessary cost and project-schedule delays.

DECLARATION OF CONFLICT INTEREST
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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