Construction Labour Productivity - A Review

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***Abstract*—Labour productivity, in the construction industry is one of the most important aspect which contributes significantly in nation's revenue as a whole. Current scenario shows that labour productivity in the construction industry is decreasing on a constant basis. The paper investigates on different factors affecting construction labour productivity by referring research papers from various countries all over the world. Cronbach's Alpha and Relative Importance Index were mostly used for statistical analysis of those factors which were identified by the researchers. The research paper includes the top 10 factors which were published by various research articles from statistical analysis. These top 10 factors were mainly responsible for declination of construction labour productivity. The construction companies/organizations/industries shall consider these factors for effective planning and scheduling of activities of the project which would be beneficial for them to reduce their time of construction and also save economic losses.**

Keywords—Construction Labour Productivity, Cost, Relative Importance Index, Statistical Analysis, Factors

I. INTRODUCTION

In most countries, construction industries are greatly concerned about a low level of productivity. Poor productivity of craftsman is one of the most critical problem that in construction industries. The performance of labour is affected by many factors and is usually linked to the performance of time, cost and quality. Every project has some difficulty in construction like materials, money, tools and local contractor's construction cost. Looking to the current scenario of continuous downfall of construction labour productivity, it is highly necessary to identify the factors which affect it and then work out the critical ones out of the available factors.

Productivity is the ratio of production output to what is required to produce it. In other words, it is a measure of the rate at which work is performed. It is also defined as measured as a total output per unit of a total input. Meanwhile identification and evaluating factors affecting labour productivity have been done in the last decade, however a deeper understanding is still needed to improve the labour productivity. Construction is a key sector of the national economy for countries all around the world, as traditionally it took up a big portion in nation's total employment and its significant contribution to a nation's revenue as a whole. However, today construction industries are still facing numbers of problems regarding the low productivity, poor safety and insufficient quality. As we know, labour productivity is directly linked to improved standards of living in the form of higher consumption as an economy's labour productivity.

In today's time there is a huge need for research in the construction labour productivity in the Indian construction industry particularly where the labour productivity can be increased on significant basis and hence there is a need to identify factors which are responsible for such changes to happen which is the primitive step in enhancing the efficiency of labour productivity. Concerning to those factors which are influential, the management can thereby take action to improvise on that issue. Various studies can be found in other countries as for how to identify the factors that are influencing the construction labour productivity but not in accordance to the Indian context. Researchers generally conclude the major factors influencing productivity are different for every other country, its geographic location and the type of project as well.

The labour productivity factors that are identified by various researchers in their countries may not be applicable in India due to the difference in political, economic and social environment in India. Hence there is need to identify factors affecting labour productivity which are applicable for Indian construction industries and in order to achieve this, a questionnaire survey has to be conducted in consideration to the reviews of project managers, supervisors, site engineers and the craftsmen workers who work on the construction sites. The fundamental behind procuring these responses from all the

project participants is to know about the various though processes of the participants in regards to the factors affecting the labour productivity.

II. LITERATURE REVIEW

There has been a lot of research done about construction labour productivity in the recent decades which were done so as to find out the factors which are affecting the productivity of the construction sector. The following are 28 literature reviews done for this research.

An investigation was carried out in 1985 in which study was carried out to improve labour productivity by comparing the survey done in the year 1979 and 1983 in US [1]. Based on his studies factor affecting labour productivity are 1. Planning and scheduling of work,2. Labour-management relations, 3. Site supervision and 4. Engineering design. After 2 years, in 1987 an investigation was done for identifying factors which were impacting the labour productivity in Nigeria and it was concluded that the output quantities which were found were studied properly with the help of time study techniques and the results that were found should be applied to various construction firms so as to take the most productive methodology without any additional physical problems [2]. In 1995 variety of factors that were impacting the labour productivity in Singapore were identified and then they were narrowed down to only the most significant ones which were 1. lack of qualified supervisors, 2. shortage of skill labour, 3. high rate of labour turnover, 4. labour absenteeism and 5. communication with foreign labour [3]. These factors were in regards to a survey conducted in Iran. A similar survey was done a year later in Iran itself [4]. Relative Importance Index (RII) technique was used to identify problems and prioritizing them for detailed analysis and discussion. After doing the analysis it was found that the construction operates and poor management skills are the factors which are significantly impacting the Iranian construction sites. In the year 1997, a study found that the factors which were affecting the productivity of the craftsmen in Indonesia were 1. lack of materials, 2. rework, 3. absenteeism of labour and 4. lack of equipment and were regarded as the most critical factors [5].

About 6 years later i.e. in 2003, a pilot study was done to find the relationship between the performance at a job site and the level of construction productivity [6]. In the next year in Thailand, the influence of 23 factors on the productivity of the construction industry was found and it was stated that 1. lack of tools and accessories, 2. labour absenteeism, 3. poor communication, 4. instruction time, 5. poor site layout, 6. inspection delay and 7. rework are the most significant factors among the 23 chosen factors [7]. In the same way a year later, a survey considering about 50 productivity factors on the Malaysian residential projects was conducted and it was identified that there are 5 major factors which govern the productivity [8]. A different study was conducted in the USA in the year 2007 to find the factors which were affecting the construction productivity [9]. In the same year, a similar study was done but the respondents were required to to rate the factor affecting labour productivity with respect to cost, time and quality. In this lack of material was ranked high considering loss of time but it was not on top 10 factors considering cost, time and quality [10]. A survey was performed so as to measure the impact of 83 factors which were affecting the productivity from the 18 focused group discussion with the labours and their supervisors on the sites throughout the country. In the same year, another survey on the factors that were affecting the productivity of labours for building projects by considering 45 factors in the Gaza strips was conducted. The factors were segregated into 10 groups viz. 1. supervision, 2. materials/tools, 3. leadership, 4. manpower project external motivation, 5. quality time and 6. safety [11]. In consideration to several other group bifurcations done by researchers all over the world, minute aspects were taken into consideration and were argued over the terminologies used by others which led to a higher level of generalizing in a patterned way and also for subgrouping within the nomenclatures.

Five years later in 2012, an increase in productivity in a building project in Sangli, Kolhapur and Pune districts were found [12]. Data of survey was collected from project manager and experienced engineer of the building project. In this report factor affecting labour productivity were identified separately for small, medium and large companies. In the same year, a structural questionnaire survey which comprised of 45 productivity factors was prepared in Kuwait [13]. Contractors were invited to participate in that survey. The results obtained was used in industry practitioners and provided guidance to construction manager to efficiently utilize their time and labour force. In the same year, 45 factors were first identified as the factor impacting construction labour productivity in India [14]. By factor analysis, critical factor was identified are as follows: 1. Lack of commitment, 2. Inefficient site management, 3. Poor site coordination, 4. Improper planning and 5. Lack of clarity in project scope. In the following year identification of critical factors which were affecting the labour productivity were found as an objective of the project [15]. A survey was carried out in cities of Gujrat region on the civil contractors. By using RII and the Analytical Hierarchy Process (AHP) analysis of 51 feedbacks were computed. In order to improve the labour productivity it was proposed that the contractors should act on the factors accordingly. In the same year, a study was aimed so as to find out the factors that were affecting labour productivity in Saudi Arabia in the public construction projects in regards to a contractor's perspective [16]. For that, 41 contractors who were working in the public construction filled a structural questionnaire survey and then as per the conducted survey the factors were ranked according to their impacts. 32 of the factors were selected, out of which the top 10 factors were identified which affected the labour productivity negatively in road constructions.

TABLE I. OCCURANCE OF FACTORS IN EACH REFERENCE

Occurrence of factors in each reference		
Sr. No.	***Factors***	***References***
1	Site layout	[4, 7, 8, 9, 12, 15, 22, 23, 24]
2	Site location	[4, 8, 12, 16, 24, 28]
3	Low quality of material	[9, 11, 16, 27]
4	Method of working	[10, 11, 20, 22, 26, 28]
5	Project type	[11, 23, 26, 27]
6	Type of structure	[22, 26]
7	Equipment required for work in project	[6, 8, 9, 10, 12, 17, 20, 25, 26, 27]
8	Interruption of work	[8, 22, 26]
9	Ease of processing and preparation of material of work	[26]
10	Labour low wage	[11, 16, 19, 21, 23]
11	Financial condition of	[8, 12, 14, 16, 28]

Occurrence of factors in each reference		
Sr. No.	*Factors*	*References*
	contractor	
12	Labour supervision	[3, 5, 12, 16, 21, 22]
13	Lack of construction manager leadership	[15, 20, 22]
14	Misuse of time schedule	[11, 15, 16, 22, 25, 26]
15	Frequent change of order	[4, 6, 8, 10, 19, 21, 28]
16	Poor site management	[7, 12, 16, 23, 24]
17	Slow response consultant staff	[21, 23, 24]
18	Misunderstanding among labour	[8, 16, 23]
19	Difficulty in recruitment of supervisors and workers	[3]
20	Poor instructions	[8, 11, 15]
21	Service provided to labour	[8, 26]
22	Crew size and composition	[4, 9, 15, 28]
23	Unsuitability of storage location	[9, 11, 12, 22]
24	Shortage of experience labour	[6, 11, 12, 13, 15, 17, 20, 23, 25, 27]
25	Motivation of labour	[13, 15, 22]
26	Service provided to labour	[3]
27	Alcoholism	[3, 12]
28	Personal problem	[11, 16, 23]
29	Labour's education level	[22, 23, 26]
30	Leadership and efficiency in site management	[8, 22, 26]
31	Public holiday	[8, 11]
32	Rain	[3, 4, 7, 11, 13, 15, 21, 23, 24, 27, 28]
33	High wind	[8]
34	Area of project location	[26, 28]
35	Availability of labour in market and competition between them	[26]
36	Health risk (Unfavorable condition)	[3, 10, 23, 25]
37	Noise	[11]
38	Working at high altitude	[3, 28]
39	Unemployment of safety officer on the construction site	[8, 15]
40	Violation of safety precaution	[9, 11, 22, 23]
41	Insufficient lightening	[8, 9, 13, 23]

Manpower is a factor that has been a stronghold to the construction sector since most of the work is labour dependent. In 2014, identification was done of the 10 factors which were significantly affecting the labour productivity in a negative way [17]. These factors were chosen in order to develop a model that established an interpretive relationship amongst these factors. Total Interpretive Structural Modelling (TISM) was implemented so as to identify and summarize relationship among the factors which affected the labour productivity. Similar study was done in Egypt to find most impacting factor influencing construction labour productivity [18]. The factors were categorized into three groups: 1. Human/labour, 2. Industrial, 3. management. In the same year, Thomas et al [19] reported the results of a questionnaire of site engineer, project managers, craftsman and supervisor in State of Kerala. A year after i.e. in 2015 study was done which mainly focused on the labour productivity affecting road projects in Iran [20]. The data were collected from CEOs from road construction companies and factors affecting most was identified. Similarly, in same year, Abdulaziz prepared a questionnaire survey consists of 37 factors, which were divided into following groups:1. Management, 2. Technological, 3. Labour and 4. External [21]. In the next year i.e. in 2016, factor affecting labour productivity were identified around Mumbai sector [22]. These factors were analyzed using RII. Total of 24 factor affecting labour productivity were used. Saving of time and cost was analyzed for G 19 floor building. Then in the same year survey which had 50 questionnaires was conducted in Zimbabwe [23]. Empirical determination of factors affecting construction labour productivity was done. Questionnaire comprised of structured and unstructured question which were used in data collection. In 2016, a research was also conducted and identification as well as ranking of the factors was done that were affecting the productivity in Jordan [24]. In order to achieve it, data was collected by means of a structural questionnaire survey. The survey form consisted 37 factors which were identified on the basis of literature review. Based on it, the research recommended important factors which were essential for the organizations which were planning for an enhancement in the labour productivity workforce. In the same year, factor was identified for improving productivity in construction in Jordon [25]. A questionnaire survey containing 27 question was prepared and responses were statistically analyzed using RII for each factor. In the following year, in Yemen, an aim was set to find and rank the factors which were affecting the construction labour productivity [26]. 52 factors were included in the questionnaire which were further divided into 4 groups viz. 1. human/labour, 2. technical and technological, 4. management and 5. external. RII method was used to rank these factors. In the same year it was found that poor costing and scheduling performance of the projects in construction were the two major challenges that were hindering the performance of construction projects in Cambodia [27]. Identifying various attributes which delayed construction projects was the main objective of the research. 10 factors which were the major frontline players were recommended to put efforts on in order to know the relation between their magnitude of impact so as to find the delays and minimize them which were resulting to slowing down of the construction projects in the Cambodia. A year later in 2018, Artificial Neural Network (ANN) was used as a measure to find the most influential factor that affected the labour productivity in India [28]. The research was emphasized on concreting activities that were carried on field like installation of reinforcement, formwork installation and placement of concrete and some other industry concerning activities as well. 23 factors were considered and grouped them into 4 categories viz. 1. management, 2. human/labour, 3. technical/construction method/technological and 5. external/on-site job conditions.

III. LABOUR PRODUCTIVITY

Labour is most important part of the construction industry as productivity of a particular work in construction are related to each other. In India, construction is the second largest economic activity after agriculture. Productivity improvement is the key area in the construction industry for any country.

Labour Productivity is generally defined as the ratio of unit output (work placed) per given unit input (per man hour) [11, 12]. An inverse of this is also used by [12], i.e.

$$Productivity = Input / Output \quad (1)$$

On the other hand, Jarkas and Bitar [13] classified two measure of productivity:

(1) Total factor productivity, in this all output and input are considered

(2) partial factor productivity, where output and single or selected input is considered.

Input and output are affected by different cost over time, so it is difficult to define productivity [27].

There is other various definition related to labour productivity given by [22], they are as follows:

Total factor productivity (Economic model):

$$TFP = Total\ Output / (Labour + Material + Equipment + Capital) \quad (2)$$

Project Specific Model:

$$Productivity = Output / (Material + Labour + Equipment) \quad (3)$$

Activity Oriented Model:

$$Labour\ Productivity = Output / (Work\ hour\ (or)\ Labour\ Cost) \quad (4)$$

IV. RELATIVE IMPORTANCE INDEX (RII)

RII is used to determine the relative importance of the various factors that cause delay. The same method is going to be adopted in this research within various groups i.e. contractor, project engineer and site supervisor. A five point scale ranged from 1 (very little degree effect) to 5 (very high degree effect) is adopted and transformed to relative importance index for each factor. RII was used in the following references [3], [8], [11], [13-16], [18, 19], [21-27].

$$RII = ((5n_5 + 4n_4 + 3n_3 + 2n_2 + n_1) / (5 \times (n_5 + n_4 + n_3 + n_2 + n_1))) \times 100 \quad (5)$$

where, n_1 = Number of respondents who answer no relevance, n_2 = Number of respondents who answer little relevance, n_3 = Number of respondents who answer moderate relevance, n_4 = Number of respondents who answer strong relevance, n_5 = Number of respondents who answer very strong relevance.

V. STATISTICAL ANALYSIS

The statistical analysis has been divided into two parts as to check the significance (Z-test) and consistency (Cronbach's Alpha test) of the data which are described as follows **:**

A. Z-test

The term Z-test in statics refers to the hypothesis test in which it is measured how many standard deviations above or below the mean a row data is. A Z-test score is also known as the standard score and 99.9% of the value fall in the range of -3 standard deviations (extreme left of the normal distribution curve) up to +3 standard deviations (extreme right of the normal distribution curve). The formula for the Z-test statistics of value is calculated by deducting population mean from the X-value and then the result is divided by the population standard deviation. [11], [13], [15], [21], [26] are the researchers who used Z-test.

Here each observation is denoted by x_i and total number of observations in the population is denoted by N.

Population Mean:

$$\mu = \sum (x_i / N) \quad (6)$$

Population Standard Deviation:

$$\sigma = \sum ((x_i - \mu^2) / N) \quad (7)$$

B. Cronbach's Alpha test

If some measures of scores are unreliable, it is difficult for researchers to know whether they have results meriting further inquiry. Frequent lack of understanding of the role of reliability plays in experiments and therefore frequently omit a reliability estimate from the calculations. Reliability of coefficients describe the consistency, correlation of a set of scores and poor reliability inherently weakens effect sizes. The use of Cronback's Alpha was done by [14], [20, 21], [28-30] in their research.

Coefficient Alpha (α) is the average of all the possible split-half coefficients for a given test.

$$\alpha = ((K / (K-1)) \times (1 - (\sum (\sigma_k)^2 / (\sigma_{Total})^2))) \quad (8)$$

Where, k = Number of items, $(\sigma_k)^2$ = Sum of individual item score variance, $(\sigma_{Total})^2$ = Total test score variance.

VI. FACTOR IDENTIFICATION

The factors affecting labour productivity in the construction field are identified with the help of literature review. But it was found that some factors were repetitive such as site layout, site location, misuse of time schedule, equipment required for work in the project, shortage of experience labour and rain. In order to reduce delays due to site layout factor we have to check the architectural drawings 2 days prior to the commencement of work and also site layout has to be verified beforehand. Availability of equipment is also one of the repeated factors hence if there are no equipment available at the time of construction, the work gets stopped despite having labourers. Such factors should be collectively targeted at the initial stage of the project itself so as to start the work on time. Rain factor should be kept in mind before the arrival of monsoon season and for that the external work could be assessed ahead of the monsoon season whereas when there is rain, we can switch to internal work such that the total duration of the project is not compromised.

Hence it is important to schedule our project while taking every repeating factor into consideration because the labourers cannot perform a particular task in the same way as it was done earlier. Every time there are different consequences due to differences in the situation as per the demands of the site.

Proper monitoring of money and time is also a key factor for the successful completion of the project.

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REFERENCES

[1] A. David, "Construction Productivity Improvement," Journal of Construction Engineering and Management, vol. 111, no. 1, p. 19528, 1985.

[2] P. O. Olomolaiye, K. A. Wahab and A. D. F. Price, "Problems Influencing Craftsmen's Productivity in Nigeria," Building and Environment, vol. 22, no. 4, pp. 317-323, 1987.

[3] E. C. Lim and A. Jahidul, "Construction Productivity : Issues Encountered by Contractors in Singapore," International Journal of Project Management, vol. 13, no. 1, pp. 51-58, 1995.

[4] Z. Mahmood, O. O. Paul, D. H. Gary and C. H. Frank, "A Survey of Constraints on Iranian Construction Operatives Productivity," Construction Management and Economics, vol. 14, no. 5, pp. 417-426, 1996.

[5] F. K. Peter, O. O. Paul, D. H. Gary and C. H. Frank, "Factors Influencing Craftsmen's Productivity in Indonesia," Internal Journal of Project Management, vol. 15, no. 1, pp. 21-30, 1997.

[6] L. Markus, R. Janaka and J. George, Construction Productivity Management: A Study of Human, Management and External Issues, Alberta: American society of Civil Engineer, 2003.

[7] M. Arun, E. Margaret and S. Kuldej, "Critical Factors Influencing Construction Productivity in Thailand," The Journal of KMITNB, vol. 14, no. 3, 2004.

[8] K. M.R. Abdul, W. Lee, M. Jaafar, S. Sapuan and A. Ali, "Factors Affecting Construction Laabour Productivity for Malaysian Residential Projects," Structural Survey, vol. 23, no. 1, pp. 42-54, 2005.

[9] D. Jiukun, M. G. Paul and F. M. William, "Analysis of Craft Workers and Foremen's Perceptions of the Factors Affecting Construction Labour Productivity," Construction Management and Economics, vol. 25, no. 11, pp. 1139-1152, 2007.

[10] M. A. Henry, A. M. Jackson and H. Bengt, "Factor affecting the productivity of building craftsman - Studies of Uganda," Journal of Civil Engineering and Management, vol. 13, no. 3, pp. 169-176, 2007.

[11] E. Adnan, M. Sherif, A. M. Ziad and E. M. Peter, "Factors Affecting Labor Productivity in Building Projects in the Gaza Strip," Journal of Civil Engineering and Management, vol. 13, no. 4, pp. 245-254, 2007.

[12] Mr, A. G. Prof. and D. D. Prof., "A Study of Various Factors Affecting Labour Productivity and Methods to Improve it," Journal of Mechaniacal and Civil Engineering, pp. 11-14, 2012.

[13] M. J. Abdulaziz and G. B. Camille, "Factors Affecting Construction Labor Productivity in Kuwait," Journal of Construction Engineering and Management, vol. 138, no. 7, pp. 811-820, 2012.

[14] D. Hemanta, S. Anil, I. K.C. and R. Sameer, "Analysing factors affecting delays in Indian construction projects," Internation Journal of Project Management, vol. 30, no. 4, pp. 479-489, 2012.

[15] S. Mistry and R. Bhatt, "Critical Factors Affecting Labour Productivity in Construction Projects : Case Study of South Gujarat Region of India," International Journal of Engineering and Advanced Technology (IJEAT), vol. 2, no. 4, pp. 583-591, 2013.

[16] M. Ibrahim, A. Al-Ghonamy and M. Aichouni, "Major Factors Influencing Employee Productivity in the KSA Public Construction Projects," International Journal of Civil & Environmental Engineering IJCEE-IJENS, vol. 14, no. 1, 2013.

[17] Botre, S. Sayali and Rohan, "Applying Total Interpretive Structural Modeling to Study Factors Affecting Construction Labor Productivity," Australasian Journal of Construction Economics and Building, vol. 14, no. 1, pp. 20-31, 2014.

[18] M. Khaled and F. A. Remon, "Factor Influencing Construction Labor Productivity in Egypt," Journal of Management in Engineering, vol. 30, no. 1, pp. 1943-5479, 2014.

[19] V. T. Anu and S. J., "Factor Influencing Construction Labour Productivity: An Indian Case Study," Journal of Construction in Developing Countries, vol. 19, no. 1, pp. 53-68, 2014.

[20] G. Parviz and R. H. Mohammead, "A Survey of the factor affecting the productivity of construction projects in Iran," TECHNOLOGICAL AND ECONOMIC DEVELOPMENT OF ECONOMY, vol. 18, no. 1, pp. 99-116, 2012.

[21] M. J. Abdulaziz, "Factor influencing labour productivity in Bahrain's construction industry," International Journal of Construction Management, vol. 15, no. 1, pp. 94-108, 2015.

[22] R. G. Prachi, B. M. Ashok and R. M. Pravin, "Importance of Measurement of Labour Productivity in Construction," International Jouranl of Research in Engineering and Technology, vol. 5, no. 7, pp. 413-417, 2016.

[23] N. Thabani and G. B. Wellington, "An Empirical Investigation of Factors Affecting Construction sector Labour Productivity in Zimbabwe," International Journal of Business and Management Invention, vol. 5, no. 8, pp. 68-79, 2016.

[24] Bekr and G. A. Dr., "Study of Significant Factors Affecting Labor Productivity at Construction Sites in Jordan : Site Survey," Journal of Engineering Technology (JET), vol. 4, no. 1, pp. 92-97, 2016.

[25] A. H. Mohammed, A. H. Montaser and J. S. Ghaleb, "Factors affecting construction labour productivity: a case study of jordon," International Journal of Construction Management, vol. 16, no. 2, pp. 138-149, 2016.

[26] A. Wael, A. A.-S. Abubaker and S. Basel, "Factors Affectin Construction Labour Productivity in Yemen," International Journal of Contruction Management, 2017.

[27] D. Serdar, O. Maksat and I. Syuhaida, "Causes of Delay in Residential Construction Projects in Cambodia," Civil & Environmental Engineering, vol. 4, pp. 1-12, 2017.

[28] J. M. Mistry and K. J. Geetha, "Implementation of Artificial Neural Network for Recognition of Factors Influencing Labor Production Rates for Concreting Activities," IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), vol. 15, no. 5, pp. 07-14, 2018.

[29] L. W. Katherine, "An Introduction too Cronbach's Alpha : It's the GLM (Again) !," in Researchgate, Texas, 2013.

[30] T. Mohsen and D. Reg, "Making sense of Cronbach's alpha," International Journal of Medical Education, vol. 2, pp. 53-55, 2011.