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Research Article**ANALYSIS OF FACTORS AFFECTING LABOUR PRODUCTIVITY IN CONSTRUCTION****Shree Raja Gopal T G^{1*} and Murali K²**^{1,2}Sri Ramakrishna Institute of Technology, Tamil Nadu, India

ARTICLE INFO**Article History:**Received 11th March, 2016Received in revised form 14th April, 2016Accepted 18th May, 2016Published online 28th June, 2016**Key Words:**Construction, Factors, Improvement,
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ABSTRACT

Worldwide construction industry faces challenges regard to problems associated with productivity and the problem are usually linked with performance of the labour. Productivity assists the construction industries to be competitive, to achieve the objectives and to meet the stakeholder's expectation. The aim of this paper is to identify and rank the relative importance of factors recognized to affect the labour productivity on construction sites. To achieve this objective, various professionals such as Project Manager, Site Engineer, Architect and other who work on the different level, were invited to participate in the online survey. In questionnaire, factors were divided into 9 groups such as (1) workforce; (2) management team; (3) psychological; (4) schedule compression; (5) material/equipment; (6) supervision; (7) safety; (8) miscellaneous; (9) external. After the analysis of questionnaire, top ten factors which affect labour productivity in construction are: (1) Lack of skill and experience of the workers; (2) Late payment; (3) Poor health of the workers; (4) Low amount of pay; (5) Lack of empowerment; (6) Poor work planning; (7) Design changes; (8) Lack of labour safety; (9) Poor condition of equipment/tools; (10) Ignore safety precautions. The results obtained can be used by the professionals for improving the labour productivity in construction projects.

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INTRODUCTION

Construction is a labour intensive industry and productivity of the labour is one of the most significant factors which affect the overall performance of any organisation, since labour cost comprises 30-50% of the overall project's cost (Yates and Guhathakurta 1993; McTague and Jergeas 2002). The output of the construction sector constitutes one half of the gross capital and 3 to 8% of the Gross Domestic Product (GDP) in most countries (Arditi and Machtar 2000). The construction industry in India contributes to over 5% of the Nation's Gross Domestic Product and employs over 30 million people (Planning Commission 2008). Labour productivity constitutes major part of production input in construction projects, many factors are varying at immeasurable rate and are difficult to foresee. It is inevitable to make sure that reduction in productivity does not affect the scheduled work and cause delay in the project. Thus, identification of the factors affecting labour productivity at micro level is important, since considerable cost can be reduced if productivity is improved because the similar work can be done with less manpower, thus reducing the overall labour cost (Thomas 1991). The main objective of this paper is to identify and rank the relative importance of factors recognized to affect the labour productivity on construction sites.

REVIEW OF LITERATURE**Definition**

In 1950, the organization for European Economic Co-operation (OEEC) introduced a formal definition of productivity as quotient obtained by dividing output by one of the production factors (Sumanth 1984). The United States Department of Commerce defines productivity as "dollars of output per person-hour of labour input" (Adrian, 1987). Handa and Adbalia (1989) defined productivity as the ratio of outputs of goods or services to input of basic resources. Ardit and Mochtar (2000) referred productivity as the ratio between total outputs expressed in Dollars and total inputs expressed in Dollars as well. In 1883, Litte defined productivity as the faculty to produce (Jarkas 2005).

Factors affecting labour productivity

Lim and Alum (1995) classified various factors impacting the construction productivity in Singapore and shortlisted the following as most significant: (1) Lack of qualified supervision; (2) Shortage of skilled labours; (3) High rate of labour turn over; (4) Labour absenteeism and (5) Communication with foreign labours.

In a survey geared towards identifying the constraints on Iranian construction productivity, Zakari *et al* (1996), using the

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relative index ranking technique, ranked the five following factors as major impacts: (1) Material shortage, (2) Weather and site condition, (3) Equipment breakdown, (4) Drawing efficiency/change orders and (5) Lack of proper tools and equipment.

Makulsawatudom et al (2004) researched the influence of 23 factors on the productivity of the construction industry in Thailand and deducted that lack of material, incomplete drawings, incompetent supervisors, lack of tools and equipment, labour absenteeism, poor communication, instruction time, poor site layout, inspection delay and rework, are the most critical.

Alinaitwe et al (2007) studied the impacts on the productivity of craftsman in Uganda and concluded that, (1) Incompetent supervisors, (2) Lack of skill, (3) Rework, (4) Lack of tools/equipment and (5) Poor construction method, are among the most influential.

AynurKazaz et al (2008), moreover surveyed 82 firms on factors affecting labour productivity in Turkey and identified the following nine factors as most important to labour efficiency: (1) Quality of site management; (2) Material management; (3) Amount and on payment; (4) Planning; (5) Supervision; (6) Site layout; (7) Work discipline; (8) Occupational education and training; (9) Working at similar activities, based on relative importance index method.

Soekiman et al (2011) explored various factors affecting labour productivity in Indonesia and shortlisted the following as most significant: Lag of materials, Delay in arrival of material, Unclear instruction to labour, Labour strikes, Financial difficulties, Higher absenteeism of labour, No supervision method, Supervisors absenteeism, Lag of equipment and design change.

Grouping of factors affecting labour productivity

Herbsman and Ellis (1990) reported two-group main divisions of influencing factors: (1) Technological and (2) Administrative.

Talhouni (1990) grouped four categories responsible for affecting productivity on construction sites: (1) Management; (2) Site; (3) Design; (4) Weather.

Enshassi et al (2007), carried out a survey consisting of 45 factors affecting labour productivity in building projects in gaze strip and distributed such factors under the following ten major groups: (1) Manpower, (2) Leadership, (3) Motivational, (4) Time, (5) Material/Tools, (6) Supervision, (7) Project, (8) Safety, (9) Quality, (10) External.

Brent and Ellis (2014) classified productivity factors into four main groups: (1) Management, (2) Human/Labour, (3) Technological and (4) External. Nearly 24 factors were accounted in management factors, the most significant factors based on relative importance index were lack of labour supervision, unrealistic scheduling and expectation of labour performance, lack leadership, payment delay and communication. Human and labour factors include, shortage of experienced labour, skill of labour, motivation of labour and physical fatigue. 12 factors were included in technological group and ranked on RII, the five most significant factors were; delay in responding to request for information, rework, extent

of variation/change order during execution, clarity of technical specification and co-ordination level among design disciplines. Rain and high temperature were grouped under external factors.

Robles et al (2014) grouped a set of 35 factors to identify factors affecting labour productivity in Spain with respect to their relative importance. Factor explored were grouped in five different categories according to the nature of each factor namely, (1) Project, (2) Human, (3) Management, (4) Material and tools, (5) Environmental. Based on RII the five categories were ranked as: (1) Material and tools;(2) Management;(3) Human;(4) Project;(5) Environmental.

Shree raja gopal and murali (2015), carried out a critical review on 54 factors affecting labour productivity in construction and grouped them under following groups namely: (1) Workforce group, (2) Management team, (3) Psychological group, (4) Material/ Equipment group, (5) Supervision group, (6) Schedule compression, (7) Safety, (8) Miscellaneous, (9) External.

METHODOLOGY

Online survey was carried out among the various construction professionals such as Project Manager, Project Engineer, Assistant Project Manager, Assistant Project Engineer, Site Engineer, Architect and other who work on project from management level to operational level. The questionnaire consists of three parts. First part consists of the general information of the company. Second part consists with set of questions targeting the factors affecting labour productivity in the nine different groups that is the (1) workforce group; (2) management team; (3) psychological group; (4) schedule compression group; (5) material/equipment group; (6) supervision group; (7) safety group; (8) miscellaneous group; (9) external group. Third part consists of the respondent's information. The responses collected were based on the understanding, knowledge and experience of the respondents and not related to any particular construction project. Table 1 shows the list of factors considered for the study.

Data Analysis

On completion of the online survey, 108 professionals from the various construction industries have responded. Some researchers, i.e. (**Assaf et al 1995, Faridi and Sayegh 2006, kumaraswamy 1998**) are of the opinion that mean and standard deviation of individual factor is not a suitable measure to assess global ranking as they do not reflect any relationship between them. So the technique used for analysing data was the relative importance index (RII). The analysis involves the computation of weighted average or representative rating point for the collective rating made for each variable in the subset (**Durdyev and Mbachu 2011**).Table 1 represent the scale used for representation of effect of different factors on labour productivity used in the questionnaire

In order to facilitate the study, after a number of literature reviews and personal interviews with field professionals, a plan was formulated for collecting field information and creating an evaluation process and numerical values. Relative Importance Index (R.I.I) method used for analysis of the survey results.

Table 1 List of factors considered for the study

S. No.	Factor	Group
1	Lack of skill and experience of the workers	Workforce factor
2	Lack of empowerment (training and resourcing)	
3	High workforce absenteeism	
4	Low labour morale/ commitments	
5	Increase of labour age	
6	Poor health of the workers	
7	Poor relations among the workers	
8	Bad leadership skill	
9	Poor site management	
10	Inadequate construction method	
11	Lack of labour surveillance	Management team
12	Poor relation between labour and superintendent	
13	Lack of periodic meeting with labours	
14	Late payment	
15	Little or no welfare	
16	Low amount of pay	Psychological
17	Little or no financial rewards	
18	Lack of labour recognition programs	
19	Poor condition for campaign	
20	Lack of place for eating and relaxation	Schedule compression
21	Working 7 days per week without taking a holiday	
22	Poor work planning	
23	Frequency of work overtime	
24	Shift work	
25	Overcrowding	
26	Material shortage	
27	Low quality of raw materials	
28	Unsuitable material storage location	
29	Lost time to find materials because of poor arrangement	
30	Equipment/tools shortage	Material/ Equipment
31	Poor condition of equipment/tools	
32	Poor or no supervision method	
33	Incompetent supervisors	
34	Change order	
35	Incomplete/review drawing	
36	Inspection delay	
37	Rework	
38	Supervision absenteeism	
39	Ignore safety precautions	
40	Accidents	Supervision
41	Not having safety engineer at site	
42	Inadequate lighting	
43	Unsafe working conditions	
44	Noise	
45	Lack of labour safety	External
46	Implementation of government laws	
47	Variations in drawings	
48	Training sessions	
49	Design changes	Miscellaneous
50	Shortage of water supply	
51	Weather conditions	
52	Working overtime	
53	Project objective is not well defined	
54	Shortage of power supply	

Table 2 Scale used for representation of effect

Types of effect	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
Scale factors	5 n5	4 n4	3 n3	2 n2	1 n1

$$R.I.I = \frac{5(n5) + 4(n4) + 3(n3) + 2(n2) + 1(n1)}{5(n1+n2+n3+n4+n5)} * 100$$

Where

n5= number of respondents who selected for strongly agree

n4= number of respondents who selected for agree

n3= number of respondents who selected for disagree
 n2= number of respondents who selected for strongly disagree
 n1= number of respondents who selected for don't know

RESULT AND DISCUSSION

Based on the Relative Importance Index (R.I.I) top ten factors affecting labour productivity in construction are presented in table 2

Table 3 Top 10 factors affecting labour productivity

Rank	Factor	R.I.I	Related group
1	Lack of skill and experience of the workers	86.48	Workforce group
2	Late payment	86.41	Psychological group
3	Poor health of the workers	85.98	Workforce group
4	Low amount of pay	85.79	Psychological group
5	Lack of empowerment	84.67	Workforce group
6	Poor work planning	83.77	Schedule compression
7	Design changes	83.55	External group
8	Lack of labour safety	83.20	Safety group
9	Poor condition of equipment/tools	83.01	Material/ equipment group
10	Ignore safety precautions	82.96	Safety group

The lack of skill and experience of the worker factor ranked 1st among the 54 factors, having a R.I.I 86.48%. So it is the most important factor affecting the labour productivity construction. Lack of skill and experience of the worker became a cause disturbance in the work progress. Specialization and expert in work define a worker to be skilled. Increasing demand of skilled labour due to the use of technology at construction sites such as computerized machines and plant will increase labour productivity.

Late payment factor ranked 2nd among all 54 factors with R.I.I of 86.41%. Without smooth financial flow we can't imagine good performance of the project. A time to time payment will motivate the labour and improve productivity.

Poor health of the worker factor ranked 3rd with 85.98% R.I.I. The exhaustion of the worker is due to long working hours. Poor health decreases the concentration on work, which directly reduces the productivity.

Low amount of pay factor ranked 4th. With proper and suitable amount of pay psychologically motivates the worker. A monetary pay further promotes the objective of operatives and creates a high level of motivation and satisfaction among them, as a result higher efficiency can be achieved.

Lack of empowerment factor with 84.67% R.I.I ranked 5th. Empowerment is the act of identifying the task on which a labour is trusted to act independently versus those tasks the labour must get approval before proceeding. Empowering labours requires a great deal of trust by the Project Manager.

Poor work planning factor ranked 6th with 83.77% R.I.I. Poor work planning may lead to lack of business support, poor estimates, poor scope control. Before actual work of project begins, spend time to define project objectives, scope, assumptions, risk, budget, timeline and overall approach.

Design changes factor ranked 7th. Recognized significant impact of this factor on labour productivity are, insufficient duration imposed upon designers to develop and review design alternatives. Finalization of design should be made to avoid these constraints.

Poor condition of equipment/tools ranked 9th with 83.01 R.I.I. The continuous fetching can waste labour energy and may cause physical fatigue to the workers, which could otherwise be productively used in the other activity under progress.

Lack of labour safety factor and ignore safety precautions factor ranked 8th and 10th with R.I.I of 83.20 and 82.96. Lack of labour safety negatively impact the productivity of labour and performance of the project. By providing aids and following safer construction practices improves the productivity.

CONCLUSION

Fundamental knowledge about the labour productivity during the execution of the construction project can yield substantial saving in time and money. Investments and risks involved in construction industry are very high due to the complexity and long duration of the projects. Major drawbacks of the construction industry are cost and time overrun. The basic reason for these drawbacks is low labour productivity. Currently all the possible factors which may affect labour productivity in construction are identified. Ranking of factors is done using the Relative Importance Index method. Proper management of factors affecting labour productivity in construction can improve the productivity.

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