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A Critical Review on Factors Influencing Labour Productivity in Construction

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Abstract: *Worldwide labour productivity is at the forefront of concern facing professionals in the construction industry. Productivity helps construction industries to be competitive, to achieve the goals and to meet stakeholder's expectation. The main objective of the paper is to critically review the factors affecting labour productivity, grouping of factors and methods to evaluate it. The study on productivity of labour is important in developing country like India, where most of the building construction is in manual basis. Based on review it was observed that supervision, skill of labour, tools and equipment, absenteeism and financial constraints were the most significant factors affecting labour productivity, however in case of grouping of factors it was noted that human group, management group, material and tool group, environmental group and technological group are relatively important groups. In case of analysis of labour productivity, factor analysis plays a vital role in identifying the independent and group factors which can be used to improve the factors affecting.*
Keywords: *Construction, Labour, Manpower, Machine, Material, Productivity*

I. Introduction

Productivity is one of the most important factors which affect the overall performance of any organization, either large or small. The construction sector has strategic role in developed and developing countries, employing more than 7% of European work force, the sector is the largest industrial employer in continent (Rateb et al 2009 and Proverbs et al 1999). The construction industry in India contributes to over 5% of Nations gross domestic product and employs over 30 million people (Planning Commission 2008). According to Make in India project it was estimated that the construction industry contribute more than 10% of India's gross domestic product. In most countries, labour cost comprises 30-50 percent of total project cost (Shashank et al 2015, McTague and Jergeas 2002) and the reduction of these costs can be carried out by effective utilization of manpower in construction industry. Construction productivity and labour productivity are two important words that determine the profit and loss of construction business. Labour productivity is a sub domain of the overall construction productivity at the same time construction productivity is highly dependent on labour productivity (Prakash Rao et al 2015). There are number of factors that directly affect the productivity of labour, thus it is important for any organization to study and identify those factors at micro level to improve the labour productivity. The main objective of the paper is to critically review the factors affecting labour productivity and methods to evaluate labour productivity.

II. Review Of Literature

2.1 Definitions

The origin of the term productivity can be traced back to 1766 when it was first mentioned in article by Quesnay (Vaggi 1987, Abdulaziz and Camille 2012). In 1883, Littre defined productivity as the faculty to produce (Jarkas 2005). 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). Two measures of productivity namely total factor productivity (TFP) and partial factor productivity (PFP) are commonly used in construction industry (Vaishant and Kansal 2014). The first measure of productivity total factor productivity is defined as the ratio of total output to total input. Total factor productivity is expressed as shown in the equation (1).

$$\textbf{TFP} = \frac{\text{Total output}}{\sum(\text{Labor}+\text{Material}+\text{Equipment}+\text{Energy}+\text{Capital})} \quad \ldots\ldots\ldots 1$$

The second measure partial factor productivity it is defined as the ratio of the output to a single or selected set of input. Equation (2), (3), (4) gives partial factor productivity for selected set of inputs.

$$\textbf{Labour productivity} = \frac{\text{Output quality}}{\text{Labor hours}} \quad \textbf{\ldots\ldots\ldots 2}$$

Capital productivity = $\frac{\text{Output quality}}{\text{Capital input}}$**…….3**

Equipment productivity = $\frac{\text{Output quality}}{\text{Equipment hours}}$**…….4**

2.2 Factors Affecting LabourProductivity

Construction labour productivity has been the subject of numerous research studies. Horner et al (1989) investigated the factors affecting productivity and improving productivity in construction in UK through a questionnaire survey to a wide range of British constructors. The 13 significant factors which influence labour productivity were; 1. Skill of labour, 2. Build ability, 3. Quality of supervision, 4. Method of working, 5. Incentive scheme, 6. Site layout, 7. Complexity of construction information, 8. Crew size and composition, 9. Length of working day, 10. Availability of power tools, 11. Absenteeism, 12. Total number of operations on site and 13. Proportion of work sub contracted.

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.

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.

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. In another study by Attar et al on various factors affecting labour productivity and methods to improve it at Sangli, Kolhapur and Pune district concludes with the same parameters given by Soekiman et al (2011) as most significant factors affecting labour productivity.

Vaishant and Kansal (2014), based on relative importance index identified the top ten following factors affecting labour productivity in Chambal region, India were: (1) Classification in technical specification, (2) Labour supervision, (3) Method of construction, (4) Delay in payment, (5) Labour fatigue, (6) Lack of construction managers leadership, (7) Extents of variations/change order during execution, (8) Late arrival, early quit and frequent unscheduled break, (9) Labour skill and (10) Availability of experienced labours.

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

2.3 Grouping of the Factors Affecting Labour Productivity

Talhouni (1990) classified four categories responsible for affecting productivity on construction sites: (1) Management, (2) Site, (3) Design, (4) Weather, whereas Herbsman and Ellis (1990) reported two-group main divisions of influencing factors: (1) Technological and (2) Administrative.

Enshassi et al (2007), surveyed 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) sorted productivity factors into four major 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), selected 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.

2.4 Analysis of Labour Productivity

Unanticipated conditions on a construction project leads to significant loss of productivity. A model for analyzing the complex cause and effect relationships were needed to measure the loss of productivity. Daniel et al (1994), suggested the action-response model. The action response model provides a new approach to evaluate specific occurrences of loss of productivity. The cause of loss of productivity was identified through this model by addressing six issues such as, importance of focusing on crew in any discussion of productivity, extent to which productivity loss at crew level may be removed, relationships that exists in productivity, contractor's active role in influencing productivity, awareness of contractor on need for management decisions and constraints resulting from external conditions. The action-response model provides a frame work for evaluating the cause of productivity loss on individual projects.

Improved measured mile analysis technique for quantifying lost labour productivity suggested by William and Liu (2005), a widely accepted way to quantify losses in the measured mile approach. This approach compares periods of a project that have been impacted by the change to those that have not been impacted.

Measured mile concept allows specific impacts to be isolated while accounting for other inefficiencies inherent in the work being performed. It was noted that the measured mile method is the best choice for productivity loss calculation because it calculates base line productivity and disruption effects in a much more objective manner. Rateb et al (2009), studied the variability of labour productivity in masonry construction through measured mile model (ie., base line productivity) and quantified comparable measures of productivity. Randolph (2010), used measured mile approach in quantification of losses of labour efficiencies. It was observed that the measured mile is not a rigorous procedure, but rather a concept. Therefore, each analyst is left to develop procedures as required, which will lead procedure that undermine the validity of analysis.

Shashank et al (2014), analyzed the key factor affecting the variation of labour productivity in India. A total of 34 factors, grouped into 8 groups according to their characteristics, namely: Manpower, Managerial, Environmental, Safety, Material/Equipment, Schedule, Motivation and Quality. The result of reliability analysis and factor analysis showed that three independent factors and one independent group were reflected due to low corrected item based on total coefficient and loading score. Multiple regression analysis showed that six groups, namely: Motivational group, Manpower group, Material/Equipment group, Safety group, Managerial group and Quality group had a positive impact on labour productivity variations.

III. Summary

Construction sector mainly concentrate on 3-M principle for a substantial yield in terms of time and cost. The 3-M concept includes manpower, machine and material. In recent years many researches concentrate on improving the labour productivity witnessed the importance of labour productivity. From the review it was observed that the ordinal measurement scale 1 to 5 was used to determine the effect level and relative importance index for all factors were calculated. Few researches calculated relative importance index at 1 to 4 ordinal measurement scale. The factors affecting labour productivity in various countries presented in the review were ranked based on the relative importance index. The major five factors that affect the labour productivity were; supervision, skill of labour, absenteeism, tools and equipment and financial constraints. These are the most significant factors that are accounted in US, India, Singapore, Indonesia, Thailand, Turkey and Iran. Few factors relating to construction methods, site condition, change of order and communication also contribute to low productivity. Communication plays a vital role in India and in some parts of the European nation due to the migration of labours. Other factors such as weather and complexity of construction also contribute to low productivity in countries like Iran and UK.

The review on grouping of the factors affecting labour productivity clearly states that when more number of factors are considered in the study the importance of many significant factors were ranked below. Therefore grouping makes it easier for one to identify the similarities and differences between them. From the review it was noted that in earlier studies there were only two main groups influencing productivity namely technological group and administrative group later due to the evolving nature and characteristics of factors affecting productivity, the number of groups increased in order to identify the significant factor relating to manpower, leadership, motivational, material/tool, supervision, project, safety, quality and external factors. Based on the relative ranking it was observed that human group and management group have high impact on

affecting labour productivity in major countries like UK, India and Spain. In India and Gaza the group such as project, technology, motivational, quality and safety have adverse impact on labour productivity. Due to the grouping of factors, the relative importance on most significant factors in eachgroup can be individually analyzed and overall ranking of groups through relative importance index can be determined.

The prediction models are very important to identify the problems and suggest a suitable solution for improving the productivity. From the review it was observed that the three important methods used to develop a model were action response model, measured mile concept and factor analysis. The action response model is a plot of productivity overtime for analyzing the complex cause and effect relationship that may lead to loss of productivity in construction. The model graphically depicts how variety of factors may interact to cause a loss of productivity, how the crew is influenced by these factors and how management of crew can mitigate, eliminate and initiate any particular loss of productivity. The action response model provides a framework for evaluating the cause of productivity loss on individual projects. The measured mile technique is used to quantify the losses in measured mile approach. The measured mile concept involves comparison of actual labour performance between two periods. Measured mile is the best choice for productivity loss calculation because it calculates baseline productivity and disruption effects in objective manner. However the measured mile concept may be unsuitable for unique and complex work or where work disruption are so pervasive that no measured mile period exists. An important point to remember is that loss of efficiency can be subjective and experts need time to develop a report. Factor analysis is a multivariate statistical technique that can be utilized to examine the underlying patterns or relationships for large number of variables and summarize information in smaller set of factors or component for prediction purpose. Principal component analysis is the most frequently employed factor analytic approach. By carrying out the factor analysis one can judge the independent factors and group factors which show a high correlation with each other and least correlation can be rejected.

IV. Conclusion

The construction sector has strategic role in all developed and developing countries. In the view of the substantial share of construction sector in the whole economy, the stakeholder attention is focused on improved resource utilization and productivity. From the review it was observed that, inefficient management of construction resources can result in low productivity. Proper management of resources in construction project can yield substantial saving in cost and time.

References

[1]. Rateb J. Sweis, Ghaled J. Sweis, Ayman A. Abu Hammad and Malek Abu Rumman,, Modelling the Variability of Labour Productivity in Masonry Construction. Jordan Journal of Civil Engineering,3(2), 2009,197-212

[2]. Proverbs, D.G., Holt, G.D. and Olomolaiye, P.O.,The Management of Labour on High Rise Construction Projects: An International Investigation. International Journal of Project Management, 17, 1999, 195-204.

[3]. Planning Commission, Government of India. , Eleventh Five Year Plan (2007–2012). Planning Commission, Government of India, 3, 2008.

[4]. Shashank K, Dr. Sutapa Hazra, Kabindra Nath Pal, Analysis of Key Factors Affecting the Variations of Labour Productivity in Construction Projects. International Journal of Emerging Technology and Advanced Engineering, 4(5), 2014, 152-160.

[5]. McTague, B., and Jergeas, G., Productivity Improvement on Alberta Major Construction Projects, Construction Productivity Improvement Report / Project evaluation tool, Alberta economic development, Alberta, Canada, 2002.

[6]. B. Prakash Rao, AmbikaSreenivasan, Prasad Babu NV, Labour Productivity-Analysis and Ranking. International Research Journal of Engineering and Technology, 2(3), 2015, 151-155.

[7]. Vaggi, G., The economics of France Quesnay, Duke University Press, Durham, NC, 1987.

[8]. Abdulaziz M. Jarkas, P. Eng and Camille G. Bitar, Factors Affecting Construction Labour Productivity in Kuwait., Journal of Construction Engineering and Management, 138(7),2011 ,811-820.

[9]. Sumanth, D. J., Productivity engineering and management, McGraw-Hill, New York, 1984.

[10]. Vaishant Gupta, R. Kansal, Improvement of Construction Labour Productivity in Chambal Region. International Journal of Research in Engineering and Technology, 3(10), 2014, 34-37.

[11]. Horner, R. M. W., Talhouni, B. T and Thomas H. R., Preliminary Results of Major Labour Productivity Monitoring Program. Proc.of the 3rd Yugoslavian Symposium on Construction Management, Cavtat, 1989, 18-28.

[12]. E C Lim and Jahidul Alum, Construction Productivity: Issues Encountered by Contractors in Singapore. International Journal of Project Management, 13(1), 1995, 51-58.

[13]. A.Soekiman, K.S.Pribadi, B.W.Soemardi, R.D.Wirahadikusumah, Factors Relating to Labour Productivity Affecting the Project Schedule Performance in Indonesia. Procedia Engineering, 14, 2011, 865-873.

[14]. A.A. Attar, A.K. Gupta, D.B. Desai, A Study of Various Factors Affecting Labour Productivity and Methods to Improve It. Proceedings of International Conference on Emerging Trends in Engineering, ISSN 2278-1684, 11-14..

[15]. Aynur Kazaz, Ekrem Manisali, Serdar Ulubeyli, Effect of Basic Motivational Factors on Construction Workforce Productivity in Turkey, Journal of Construction Engineering and Management, 14(2), 2008, 95-106.

[16]. Makulsawatudom, A., Emsley, M.and Sinthawanarong, K., Critical Factors Influencing Construction Productivity in Thailand. J. King Mongkut's Institute of Technology North Bangkok, 14(3), 2004, 1–6.

[17]. Zakari, M., Olomolaiye, P. O., Holt, G. D., and Harris, F. C., A Survey of Constraints on Iranian Construction Operatives Productivity. Constr. Manage. Economics, 14(5), 1996, 417–426.

[18]. Talhouni, B. T, Measurement and Analysis of Construction Labour Productivity. Doctrol diss., Univ. of Dundee, UK, 1999.

[19]. Adan Enshassi, Sherif Mohammed, ZiadAbu Mustafa and Peter Eduard Mayer, Factors Affecting Labour Productivity in Building Projects in the Gaza Strip. Journal of Civil Engineering and Management, 8(4), 2007, 245-254.

[20]. Brent G. Hickson and Leighton A. Ellis, Factors Affecting Construction Labour Productivity in Trinidad and Tobago. The Journal of the Association of Professional Engineers of Trinidad and Tobago, 2(1), 2014, 4-11.
[21]. Alinaitwe, H. M., Mwakali, J. A., and Hanson, B., Factors Affecting the Productivity of Building Craftsmen—Studies of Uganda. J. Civil Eng. Manage, 13(3), 2007, 169–176.
[22]. G. Robels, Labour Productivity in the Construction Industry-Factors Influencing the Spanish Construction Labour Productivity. International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering, 8(10), 2014, 1021-1030.
[23]. David W. Halligan, Action Response Model and Loss Productivity in Construction, Journal of Construction Engineering and Management, 120(1), 1994, 47-64
[24]. William Ibbs and Min Liu, Improved Measured Mile Analysis Technique. Journal of Construction Engineering and Management, 131(12), 2005, 1249-1256.
[25]. H. Randolph Thomas, Quantification of Losses of Labour Efficiencies: Innovations in and Improvement to the Measured Mile, Journal of Legal Affairs and Disputes Resolution in Engineering and Construction, 2(2), 2010, 106-112.