

Secondary Data Analysis on Factors Affecting Labour Productivity in Construction

T.G. Shree Raja Gopal*, Dr. K. Murali**

*Student M.E. (CEM, Sri Ramakrishna Institute of Technology, Tamil Nadu, India)

**Professor, Sri Ramakrishna Institute of Technology, Tamil Nadu, India)

Abstract- Productivity has an important role in construction industry. The level of productivity is the result of the driving, induced and restraining factors acting upon the workers. The main objective of the paper is to perform secondary data analysis on the factors affecting labour productivity in construction. The secondary analysis provides a cost effective way of understanding a research and also helpful in designing for primary analysis. Based on study it was observed that the secondary analysis techniques such as constant comparison analysis, classical content analysis and domain analysis identified fifty four factors and were grouped under nine groups namely workforce, management team, psychological, schedule compression, material/equipment, supervision, safety, external and miscellaneous. Secondary analysis is valuable for identifying the critical areas investigated during the primary analysis which will help in improving the productivity of the labour.

Index Terms- Construction, Labour, Productivity, Secondary analysis

I. INTRODUCTION

Productivity is the most significant factor which influences the entire executional efficiency in any firm or organisation. Productivity is defined as the relationship between the output generated by a production or service system and the input provided to create this output regardless of the type of production, economic or political system, the definition of the productivity remains the same (Prokopenko, 1987). Construction industry provides major contribution to economy's gross domestic product and also provides basic physical and organizational structures towards sustainable development. The global construction industry makes up approximately 9% of the world's gross domestic product and accounting to around 7% of the total employment worldwide (Horta et al, 2012). Labour productivity constitutes important part of production input in construction projects, many internal and external factors are varying at immeasurable rate and are difficult to anticipate. It is inevitable to make sure that reduction in productivity does not affect the plan and schedule of work and cause delay in the project. Therefore, identifications of the factors affecting labour productivity is important, since considerable cost can be saved if productivity is improved because the same work can be done with less manpower, thus reducing the overall labour cost (Thomas, 1991). Secondary data analysis methods such as constant comparison analysis for coding of identified factors, classical content analysis to investigate the frequency of repetition of selected factors and domain analysis for grouping of factors are performed. The main objective of this paper is to perform secondary data analysis on factors affecting labour productivity which will be helpful in designing for the subsequent primary research.

II. REVIEW OF LITERATURE

Labour productivity

The United States Department of Commerce defines productivity as "dollars of output per person-hour of labour input" (Adrian, 1987). Handa and Adballa (1989) defined productivity as the ratio of outputs of goods or services to input of basic resources. Finck (1998) defined productivity as the quantity of work produced per man-hour, equipment-hour and crew-hour. Ardit and Mochtar (2000) referred productivity as the ratio between total outputs expressed in Dollars and total inputs expressed in Dollars as well. In 2001, Horner and Duff expressed productivity as "how much is produced per unit input".

Factors affecting labour productivity

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. Thirteen significant factors influencing labour productivity namely Skill of labour, Build ability, Quality of supervision, Method of working, Incentive scheme, Site layout, Complexity of construction information, Crew size and composition, Length of working day, Availability of power tools, Absenteeism, Total number of operations on site and Proportion of work sub contracted were identified. In 1995, Lim and Alum classified various factors impacting the construction productivity in Singapore and shortlisted the following five factors as most significant, Lack of qualified supervision, Shortage of skilled labours, High rate of labour turn over, Labour absenteeism and Communication with foreign 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 following five factors that has major impacts on labour productivity, Material shortage, Weather and site condition, Equipment breakdown, Drawing efficiency/change orders and Lack of proper tools and equipment. Makulsawatudom et al (2004) researched the influence of twenty three factors on the productivity of the construction industry in Thailand and deduced 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, Incompetent supervisors, Lack of skill, Rework, Lack of tools/equipment and Poor construction method, are among the most influential.

Constant comparison method

Strauss (1987) with Corbin (1998) developed a coding paradigm which was a structured theoretical process to follow when working with data during the axial coding step of their constant comparison method. Glaser's and Strauss' (1967) term, "Theoretical sensitivity", original meant a deep well of theories or theoretical knowledge that a sociologist gains over time. Glaser (1978) attempted to explain through the use of theoretical codes how to engage theoretical sensitivity. Kella (2005) suggested that novice attempts during open coding when using when using a constant comparison analysis technique to allow categories to emerge from data resulted in confusion and an overabundance of categories.

Classical content method

In the United States, content analysis was first used as an analytic technique at the beginning of 20th century (Barcus, 1959). Initially researchers used content analysis as either a qualitative or quantitative method in their studies (Berelson, 1952). More recently, the potential of content analysis as a method of qualitative analysis of health researchers has been recognized, leading to increased application and popularity (Nandy and sarvela, 1997). Qualitative content analysis is one of the numerous research methods used to analyse text data. Text data might be in verbal, print or electronic form and might have been obtained from narrative responses, open-ended survey questions, interviews, focus groups, observations or print media such as articles, books or manuals (Konracki and wellman, 2002)

Domain analysis method

Hjorland (1997) was among the first to introduce the concept of domain analysis as the basis for designing and improvements of a system, and for him the main objective of domain analysis is the development of collective information and knowledge structures. The thesaurus is a tool that supports the individual user to get understanding of the structure of the knowledge domain. Thus a domain analysis should cover both the characteristics of the domain and characteristics of the individuals acting in the domain community. Allen (1997) calls it a person-in-situation approach, and in our view a domain analysis should be carried out in that perspective. In 2001, Clements and Northrop studied about domain analysis not carried out properly which ends up in defining either too broad or too restrictive line scope, the major benefits like rescue, cost reduction and improved quality cannot be realised.

III. METHODOLOGY

A detailed review of the literature revealed a number of factors affecting labour productivity in construction. As the initial analysis technique, the constant comparison method is adopted for comparing various factors portrayed in past studies. One way in which data can be constantly compared throughout a study is by means of coding. A literature is with highest number of factors affecting labour productivity chosen as base literature and codes are generated. Further process is performed by comparing newly collected factors with the factors in base literature that was collected in one or more earlier studies. While working through the factors, the number of codes will increase as more factors are identified. If a factor is identified from the data that does not fit the codes that you have already identified, then a new code is created to involve that factor within the analysis. This is a continuous on going procedure, as a result of any new data emerges from the study.

Classical content analysis is a technique for contextualized interpretations of data having an ultimate goal of producing valid and trustworthy inferences. After providing the codes, factors have to be scrutinized for further study. This method enables the researcher to include large amounts of textual information and systematically identify the frequencies of most used keywords.

Domain analysis is the process of analysing related factors available in a domain to find their common and variable parts. Domain analysis produces domain models using methodologies such as domain specific languages, feature tables, facet tables, facet templates, and generic architectures, which describe all of the systems in a domain.

IV. RESULTS AND DISCUSSIONS

Secondary data analysis focuses on determining the nature of the impact of factors causing poor productivity upon construction industry. Currently due to their importance, researchers are focussing on improving the productivity. From the review it is observed that there are many factors are affecting labour productivity in construction and synthesis of various factors has to be performed. Constant comparison analysis adopted to compare the number of factors using the coding techniques and a total of 128 factors affecting labour productivity were explored.

AdanEnshassi et al (2007) classified 45 factors impacting the construction productivity in Gaza strip, selected as base literature and reference codes were generated.

Table 1. Comparison of factors affecting labour productivity using constant comparison analysis

Author and Year	No of factors in the study	No of new codes	No of reference codes
Abdulaziz M. Jarkas et al (2011)	45	23	22
MistrySoham and Bhatt Rajiv (2013)	27	1	26
Brent G. Hicksona and Leighton A. Ellis (2014)	42	2	40
AynurKazaz (2008)	23	23	14
Soekiman et al (2011)	16	8	8
Anu V. Thomas and Sudhakumar J (2014)	43	13	30
Attar et al (2012)	27	4	23
Robles (2014)	35	9	26
Vaishant Gupta and Kansal (2014)	10	0	10

Secondary analysis of the original data is currently being used primarily in the field of construction in which there are large amount of data and cost of data collection is particularly high. The factors arrived from the constant comparison method will undergo further analysis for the purpose of clearly understanding upon the topic by reduction of factors. Based on the frequency of repetition, about 54 factors were arrived by classical content analysis.

Domain analysis is the process of analysing related factors available in a domain to find their common and variable parts. The fifty four factors were selected based on the relative importance of grouping of factors category, which will be very useful to identify the critical factors affecting labour productivity. The grouping of factors affecting labour productivity clearly states that when more number of factors is considered in the study, importance of many significant factors will be ranked below. Grouping makes it easier for identifying the similarities and differences between them.

Many management related concepts are discussed in Thirukural, which are utilized to add value to better knowledge and understanding underlying this topic. The following 9 groups are considered in the study

Workforce group, labour plays an important role to achieve good productivity. Labour related attributes negatively affect labour productivity because speed, agility, quality, strength and efficiency declines over time and reduce productivity (Heizer and Render, 1990). As said in couplet 471 of Thirukural, before implementation of any project one should study the various workforce factors and go through SWOT analysis of the project to know their own human resource strength, strength of the opponent and strength of the assistants who are going to work with them.

***“The force the strife demands, the force he owns, the force of foes,
The force of friends; these should he weigh ere to the war he goes”***

The factors under workforce group, lack of skill and experience of workers, lack of empowerment, high workforce absenteeism, low labour morale, increase of labour age, poor health of workers and poor relation among the workers.

Management team, skills and attitudes of manager have an essential support on productivity. It is only through sound management that optimum utilization of human and technical resources can be achieved. According to couplet 111 of Thirukural, thiruvalluvar wisely advises to king and ministers to asseverate equity for the benefit of the state. Now we can perceive this is one of the most important traits for administrative, project managers, policy makers, researchers and human resource managers. This kural also said that as a man should rehearse this mantra as a code of conduct in every panorama of his life.

***“If justice, failing not, its quality maintain,
Giving to each his due, -'tis man's one highest gain”***

The factors under management group, bad leadership skill, poor site management, inadequate construction method, lack of labour surveillance, poor relation between labour and superintend, lack of periodic meeting with labours.

Psychological factors, refers to intellectual characteristics that affect the attitude, behaviour and function of mind. Factors such as payment delays, low amount of pay and a lack of training sessions can be grouped under this topic (DeCenzo and Holoviak, 1990). According to couplet 470 of Thirukural, compliance to policies is a mutual mandate between the employee and the employer. Therefore it is very important to study the framework which affects the important factors such as educational, social, cultural and ideological movements as well as major swings in the political pendulum.

***“Plan and perform no work that others may despise;
What misbeseems a king the world will not approve as wise”***

The factors beneath psychological group, late payment, little or no welfare, low amount of pay, little or no financial rewards, lack of labour recognition programs, poor condition for campaign and lack of place for eating and relaxation.

Schedule compression, reduction of the overall time frame of the project are often the way to compensate interruptions and to complete the assigned task on schedule. Schedule compression, when linked with overtime, often results in major productivity losses due to shortages of material tools or equipment to support the extra labourers, resulting in difficult for planning and coordinating the task, and unavailability of experienced labours (National Electrical Contractors Association, 1983). According to couplet 391 of thirukural, let a man learn thoroughly whatever he may learn, and let his conduct be worthy of his learning.

***“So learn that you may full and faultless learning gain,
Then in obedience meet to lessons learnt remain”***

Factors under schedule compression are working 7 days per week without taking a holiday, poor work planning, frequency of work overtime, shift work and overcrowding.

Material/Equipment group, productivity can be affected if required materials, tools and equipment for the specified work are not available at the correct location and time. The size of the job site and other material/equipment related factors results in productivity loss (Sanders and Thomas, 1991). According to couplet 483 of thirukural, is there anything difficult for him to do, who acts, with instruments at the right time.

***“Can any work be hard in very fact,
If men use fitting means in timely act”***

Material shortage, low quality of raw materials, unsuitable material storage location, lost time to find materials because of poor arrangement, equipment/tools shortage and poor condition of equipment/tools are the factors under this group.

Supervision group, drawings or specifications are with errors and unclear, productivity is expected to decrease due to lack of supervision as labours in the field are uncertain about what needs to be done. As a result, task may be delayed or have to be completely stopped and postpone it until clear instruction. There is a 30% loss of productivity when work changes are being performed (Thomas et al., 1999). According to couplet 651 of thirukural, the efficacy of support will yield wealth; the efficacy of action will yield all that is desired.

***“The good external help confers is worldly gain;
By action good men every needed gift obtain”***

The factors under supervision group, poor or no supervision method, incompetent supervisors, change order, incomplete/revise drawing, inspection delay, rework and supervision absenteeism.

Safety group, a prime concern in construction industry is safety, since accidents have high impacts on labour productivity. Various types of accident occur at the site, such as an accident causing injuries and even death at more severe cases, resulting in a total work stoppage or even delay for a number of days. According to couplet 491 of thirukural, let not despise, nor undertake any thing, until he has obtained place for besieging him.

***“Begin no work of war, despise no foe,
Till place where you can wholly circumvent you know”***

Ignore safety precautions, accidents, not having safety engineer at site, inadequate lighting, unsafe working conditions, noise, and lack of labour safety are the factors grouped under this group.

External group, influence of certain factors that are not directly related with the job site activities. Law and order, stability of government, etc. are essential for high productivity in the construction industry. The government's taxation policies influence willingness to work (A. Kumar, as cited in Desai, 2004). According to couplet 676 of thirukural, an act is to be performed after considering the exertion required, the obstacles to be encountered, and the great profit to be gained.

***“Accomplishment, the hindrances, large profits won
by effort these compare, - then let the work be done”***

The factors under this group are implementation of government laws, variations in drawings, training sessions and design changes.

In miscellaneous, odd bunch of factors that are unexpected to happen. Adverse weather sometimes stops the work totally (Sanders and Thomas, 1991). According to couplet 672 of Thirukural, in case of an unexpected flood, weather conditions, shortage of water / electricity, continuous work without break etc., the construction activities can be delayed, but the relief works should not be delayed in order to achieve the fixed target.

***"Delay the actions which are not important,
Delay not the actions which are urgent."***

Shortage of water supply, weather conditions, working overtime, project objective is not well defined and shortage of power supply are the factors under this group.

V. CONCLUSION

Construction industries restrain large amount of data on productivity. In prospect of research carried out on productivity for improving it, secondary data analysis are valuable source of information for gaining knowledge and insight into a broad range of issues. Secondary analysis can yield substantial cost and time saving, so they should be considered the starting place for any research and also complements the primary research.

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AUTHORS

First Author – T.G.Shree Raja Gopal, PG Student, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India

Second Author – Dr.K.Murali, Professor, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India

Correspondence Author – Dr.K.Murali, murali.vlb@gmail.com, 9894518182