

EVALUATION OF LABOUR PRODUCTIVITY IN CONSTRUCTION FIRMS BY ANALYTICAL HIERARCHY PROCESS

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Abstract - Construction industry is one among the labour concentrated industries where human capital is measured as the greatest benefit of the firm. Companies got to spend so as to certify growth and survival of those assets. In general construction industry frequently experiences complexities in meeting project completion schedule and finance due to non availability of adequate number of skilled labours and staff to hold out the planned work. This kind of complexity can be managed and it efficiently possible to handle such issues with appropriate use of human resource management techniques to avoid shortage of labour.

Human performance could also be termed as accomplishment of certain task according to the prescribed standards of accuracy, completeness, efficiency and quality. This study aims to examine human resource practice followed in construction industry. Identifying the human performance factor and evaluating the construction firms with the assistance of identified human performance factor.

Key Words: Labour Productivity, Experience based Construction firms, human performance factor, Analytical hierarchy process.

1. INTRODUCTION

Construction is one of the country's biggest ventures of the world and has been assuming a critical part in financial improvement, and additionally in lessening unemployment. Profitability is one of the essential viewpoints for the organizations in the development business. Change in the efficiency of the development business is accordingly of basic significance thinking about its huge commitment to the GDP (Gross Domestic Product).

The construction company with the most efficient operations has a greater chance to make more money and deliver faster construction project to the project owner. Improving labor productivity for every project, productivity, cost, quality and time have been the main concern it is called "triple imperative". Performance & productivity improvement are enter center regions in development industry for any country. Indian construction industry frames a necessary piece of economy. The second

biggest industry in India after farming. It represents around 8% of India's GDP. Improving productivity is significant worry for any benefit arranged association. When all is said in done terms productivity is named as ratio between input & output. Hamouda et al.(2015) Construction industries are still facing number of problems regarding the low productivity, poor safety and insufficient quality.(K Dharani, R. Raj 2015) Productivity remains an intriguing subject and a dominant issue within the construction sector, promising cost savings and efficient usage of resources. Productivity is one of the most important issues in both developed and developing countries. So labour productivity shows the economy of a project, having a control over labour productivity and The related factors will increase the overall productivity. Poor productivity of construction labours is one of the main causes of cost overruns and delay in construction projects. The aim of this research is, first, to identify significant factors influencing labour productivity in the construction sector from contractors' viewpoint and, second, to initiate the basis for labour productivity model using the Analytical Hierarchy Process.

2. OBJECIVES OF STUDY

The main Aim of this work is to evaluate the effectiveness of human resource management in the Indian construction industry. The main queries that are addressed and evaluated in this study are:

1. To study and evaluate the factors for human work performance in various construction firms in construction industry using Analytical Hierarchy Process.
2. To determine most crucial factors that affect labour productivity of typical types of building & infrastructure project in India.
3. To suggest the finding for improving Skill trainings, living standards and occupational education labour productivity in construction firms.

3. LITRATURE REVIEW

Mark velasquez, Patrick T. Hester (2013)

Multi-Criteria Decision Making (MCDM) methods have evolved to accommodate various types of applications. Dozens of methods have been developed, with even small variations to existing methods causing the creation of new branches of research. This paper performs a literature review of

Table -1 : Summary of0 MCDM methods

Method	Advantages	Disadvantages	Areas of Application
Multi Attribute Utility Theory (MAUT)	Takes uncertainty into account can incorporate preferences.	Needs a lot of input preferences need to be precise.	Economics, finance, actuarial, water management, energy management, agriculture
Analytic Hierarchy Process(AHP)	Easy to use scalable hierarchy structure can easily adjust to fit many sized problems not data intensive.	Problems due to interdependence between criteria and alternatives can lead to inconsistencies between judgment and ranking criteria rank reversal	Performance-type problems, resource management, corporate policy and strategy, public policy, political strategy, and planning.
Case-Based Reasoning (CBR)	Not data intensive requires little maintenance can improve over time can adapt to changes in environment.	Sensitive to inconsistent data requires many cases.	Businesses, vehicle insurance, medicine, and engineering design.
Data Envelopment Analysis (DEA)	Capable of handling multiple inputs and outputs efficiency can be analyzed and quantified.	Does not deal with imprecise data assumes that all input and output are exactly known.	Does not deal with imprecise data assumes that all input and output are exactly known.
Simple Multi-Attribute Rating Technique (SMART)	Simple allows for any type of weight assignment technique less effort by decision makers.	Procedure may not be convenient considering the framework.	Environmental, construction, transportation and logistics, military, manufacturing and assembly problems.
Simple Additive Weighting (SAW)	Ability to compensate among criteria intuitive to decision makers calculation is simple does not require complex computer programs.	Estimates revealed do not always reflect the real situation result obtained may not be logical.	Water management, business, and financial management.
Technique for Order Preferences by Similarity to Ideal Solutions (TOPSIS)	Has a simple process easy to use and program the number of steps remains the same regardless of the number of attributes.	Its use of Euclidean Distance does not consider the correlation of Attributes difficult to weight and keep consistency of judgment.	Supply chain management and logistic, engineering, manufacturing systems, business and marketing, environmental, human resources, and water resources management.

common Multi-Criteria Decision Making methods, examines the advantages and disadvantages of the identified methods, and explains how their common applications relate to their relative strengths and weaknesses. The analysis of MCDM methods performed in this paper provides a clear guide for how MCDM methods should be used in particular situations.

Mistry Soham, Bhatt Rajiv(April-2013)

A study was completed in south Gujarat area urban communities on civil temporary workers. Add up to 51 criticisms were broke down through the Analytic chain of importance process(AHP) and Relative Importance Index(RII) procedures. Five most crucial factors in descending order from RII Technique are Delay in payments, Skill Of Labour, Clarity Of Technical Specification, Shortage Of Materials, and Motivation of Labour. According to AHP Technique first 5 crucial factors in descending order are High/Low Temperature, Rain, High Wind, Motivation of Labour, and Physical Fatigue. Contractors shall act on these factors to improve labour productivity in construction projects. From the present study, total 27 factors were identified which affects labor productivity in construction projects. 51 feedbacks from various civil contractors were collected to identify critical factors by two techniques : AHP & RII.RII Technique gives first 5 crucial factors as: (1) Payment Delay, (2) Skill Of Labour, (3) Clarity Of Technical Specification, (4) Shortage Of Materials, (5) Motivation Of Labour. AHP Technique gives first 5 crucial factors as: (1) High/Low Temperature, (2) Rain, (3) High Wind, (4) Motivation Of Labour, (5) Physical fatigue. Finding from this study reveals that there is a contradiction in critical factors ranking by two techniques. RII technique gave first rank to delay in payments while AHP technique gave first rank to high/low temperature. Contractors should act on these factors to improve labour productivity which ultimately can help to get higher profits from the projects.

Varun V. Et al. (2014)

This paper inspected the convincing organization of this human financing to improve the proficiency and wealth of affiliation and furthermore to keep up amicability between the experts and organization. The examination perceives the segments that can be used for appraisal of human capital being developed industry and distinctive Multi Criteria Decision Making Techniques used for execution evaluation of Human Resource. Human resource organization is a specialty of pushing the human oblige for achieving the progressive destinations. However improvement industry with its significantly considerable work drive unmistakable evidence of the necessities of the workers and its fulfillment is a dull occupation. The examination gone for recognizing the distinctive components those impacts the bona fide execution of workforce in the advancement business and the diverse systems for examination used for their evaluation. The review suggests that usage of Multi criteria essential authority methodology like Analytical different leveled get ready, Analytical Hierarchy process and TOPSIS methodologies are more dominating in evaluating human execution than traditional techniques like reward

structure, mental systems and 360 appraisal strategies. Since both subjective and quantitative data can be inspected by using the MCDM strategies.

Dharani et al. (2015)

Construction laborers are migratory in nature and therefore geographically searching for employment. Thus their employers keep on changing and it is impossible for both the parties to develop long-term relationships and loyalty to their employers. Productivity is one of the most important issues in both developed and developing countries. The developed countries are aware of the importance of economic growth and social welfare. The developing countries which face unemployment problems, inflation and resource scarcity seek to utilise resources and in such a way as to achieve economic growth and improve citizens lives. The aim of this thesis is to identify factors which are affecting labour productivity and also to study causes i.e. labour problems on site and its effects on the construction projects. Some of the important factors affecting labour productivity are: quality of site management, labour experience, misunderstandings between labour and superintendent etc. The problems faced by the labour on Indian construction sites are dealt with in detail. Problems like non-availability of proper accommodation, basic amenities, low wages, safety related problems etc. dominate on almost all Indian construction sites. The small firms in India are not able to fulfil labours requirements, and that is why labour is not able to raise their productivity. In fact it is found that actual labour productivity ratios are reducing day by day, which in turns harms organization's profitability. In this study we will try to relate the ill effects of falling labour productivity with the productivity of other resources such as material, equipment and capital. This thesis restricts itself to the survey and research in the Indian context. Analysis of obtained data was done using different statistical methods He found most of the construction labour is also engaged in some other profession like farms, factory, domestic servant etc. and hence they do not give full importance to construction work and tend to work informally. Due to this labour cultivates informality, and Informality lowers productivity growth.

Hasan hamouda et al. (2015)

Development area assumes a main part in financial development for nations all around the globe. Since development is a work concentrated industry, profitability is viewed as an essential main thrust for monetary advancement. In the Gaza Strip, the economy is seriously tested by the joined impacts of fast populace development

and the conclusion arrangement forced on the range since 2007. Inferable from this circumstance, development ventures are described by low net revenue, time and cost overwhelm making work efficiency a key segment of organization's prosperity and intensity. Despite the fact that, work efficiency has been subject of concentrate by numerous specialists, a more profound comprehension is as yet required to enhance work profitability. The principle point of this investigation is to distinguish key elements influencing work efficiency in the Gaza Strip. It likewise goes for defining a work efficiency standard model utilizing the Analytical Hierarchy Process (AHP). By checking on the writing and directing profundity interviews with experienced designers, thirty basic variables identified with work efficiency were distinguished and sorted into six gatherings: psychological, experience, supervision and leadership, physical, time and workload, and external factors. Based on the Analytical Hierarchy Process approach, a questionnaire was designed and delivered to sixty contractors to elicit the view on how labour productivity might be affected. A total of 56 feedbacks were analysed through the AHP.

The outcomes demonstrated that Job satisfaction & security, absence of motivating force plot, skill & encounter tranquilize utilize, extra minutes and climate changes significantly affect work efficiency in GS. Likewise, the created AHP demonstrate gives a structure that can help supervisors in assessing different components and subsequently successfully enhance work profitability.

Laura Andrea Gutierrez-Bucheli et. al. (2016)

This paper applies multi-criteria decision methodologies, specifically the Analytic Hierarchy Process (AHP), in the selection of the plot for a real estate project located in Valledupar city, Colombia. To support the study, a literature review comparing single-criterion and multi-criteria problems and also an analysis of the scope of Multi-Criteria Decision Making (MCDM) were performed. Moreover, a review of the state of the art is presented, describing the developments in AHP and its main achievements and contributions. As a result, a hierarchical structure of the main criteria and sub-criteria that managers, managers and real estate developers take into account is realized. These criteria make it possible to evaluate the alternatives present within the existing portfolio and therefore to select the best alternative by applying the AHP, allowing the needs of stakeholders to be met and organizational and project goals to be achieved. The case study shows the benefits of removing decisions based on the intuition and expertise of decision-makers

making subjective assessments, quantifying in the best way the criteria that affect the selection of plots for the realization of a real estate project. In conclusion, the use of AHP as a tool for decision-making triggers better-supported decisions and provides greater transparency in the projects. Furthermore, it provides an increase in decision makers' awareness and reduces uncertainty in the project, generating better results for the managers and real estate developers in construction projects.

Aynur Kazaz et al. (2016)

Identification of 37 factors and categorized under four groups such as organizational, economical, physical, and socio-physiological factors. Analyze the dispersion of the factors within a group and the compactness of each factors group. And the results revealed that organizational factors group has the highest weighted mean and lowest standard deviation values. So, factors under organizational factors group are perceived as equal important by craft workers. And in economical and physical factors were also perceived equal important by craft workers. Only, factors categorized under socio-psychological factors group had different importance degrees according to craft workers evaluation.

Vishal Sherekar, Mahesh Tatikonda(2016)

Identification of the factors affecting on labor productivity of Residential construction projects in the Pune. By reviewing the literature and detailed questionnaire with experienced engineers and skilled labour including meson, painter, steel fitter, plasterer. The questionnaire was circulated 100 persons for collecting their opinion amongst them fifty opinions were taken from small construction projects and fifty opinions are taken from large construction projects. There are thirty five critical factors related to labour productivity were identified and categorized into eight groups: psychological, experience, external, capital, physical, time and workload, supervision and leadership and safety. The analyses of the identified factors are done by multi-criteria decision analysis Analytic Hierarchy Process (AHP) method. The result indicated that the three important factors affecting on labor productivity of small construction projects in Pune are Remuneration, drug use, Ignore Safety Precautions. In large construction projects top three factors are job satisfaction, level of training and work planning scheduling.

Vivek Kumar Patel, Sohith Agrawal, Dr. Mukesh Pandey (2017)

Labour productivity in a construction industry has become most challenging issue in developing as well as developed

country. Labours are the main, unique and precious resources in construction industry due to high migration towards construction. Productivity depends on some factors related to construction which improves or negatively affects the labour productivity. This paper attempts to identify the factors that negatively affects the productivity of labours in construction industries in Gwalior region(India) by conducting a questionnaire survey that relates for these problems encountered at construction sites. Eighty Three (83) questionnaire sets are distributed to the construction sites out of which forty seven(47) were returned (56%). Thirty three (33) factors have taken from the various literature review and categorized into five main group namely- Manpower Group, Financial Group, Material and Equipment Group, Management Group, and External Group in questionnaire survey. The data has been analyzed using AHP and Garrett's Ranking Technique. At the last, most critical factors that are affecting labour productivity are identified. The policy makers, researchers and construction management should focus on these identified factors in order to improve labour productivity.

Maryam Huda et al. (2017)

This paper identifies public and experts perspectives towards large-scale solar PV system using analytic hierarchy process (AHP) method. A three-level hierarchy structure AHP model is developed in order to prioritize the weight of factors influencing the investment and installation of large scale solar PV system. The AHP model engages six main criteria financial, technology, political, social, environmental and safety. This study analyses the AHP results for both Japan and Malaysian context and a comparative analysis is done to observe the public and experts view towards the system. The AHP analysis observed the highest influence for investment and installation of solar PV in Japan with financial (28.7%), safety (19.7%) and political factors (16.3%). Malaysia shows higher concern on safety as the highest influence factor (20.5%), followed by financial and political factors, 18.5% and 18.2% respectively. The assessment performed in this analysis may benefits decision makers in framing long-term policies towards promoting the growth of solar PV and other renewable energy alternatives in general.

Hongmei Li, Fujian Ni (2017)

This paper proposes an Analytic Hierarchical Process (AHP) theory based method to determine the weight of the decision-making influence factors, considering their relative significance and generating an overall ranking for each road section. A case study on the highway network

maintenance priority was conducted to illustrate the proposed procedure. A total of five pavement maintenance decision-making related factors were considered in the study, including pavement performance, pavement structure strength, traffic loads, pavement age and road grade. The weightings of the five factors were quantified through AHP method. Then, the comprehensive ranking index value U_i was determined, which indicated the maintenance priority of a road section in network level decision-making. From the aspect of maintenance cost, the sensitivity analysis results were in accordance with the weightings of different maintenance decision-making factors. The pavement maintenance cost was significantly sensitive to the change of pavement performance. The case study clearly demonstrated the applicability and rationality of the AHP theory based decision-making method and it can be used as a guideline for pavement maintenance agencies. There are also several problems that can be improved for the application of AHP method. The five indices considered in this study are generally the pavement structural, functional and conditional factors. Several other potentially important factors, including pavement structure type, climatic condition, details of the surface materials, could also be included when the data is available.

Revianty nurmeylindari nurhendi et al. (2019)

Productivity in a construction project closely related to the labour. The productivity of construction industry has a significant impact on the cost and profitability. A variety of previous studies on the identification of the factors that affect construction labour productivity (CLP) has been carried out by researchers in many countries. This study aims to critically examine the factors that influence labour productivity and classify these factors into groups of factors based on previous studies. Drewin's Open Conversion System is a theoretical framework used to classify those factors in this study. Based on this theory, there are three key factors, namely input, internal environment and exogenous. The input category consists of labour, finance, material, and equipment. Design, health and works safety, supervision, organization, scheduling, project, leadership and coordination, management, motivation, technology, socio-psychology, communication are the internal environment category. This study aims to critically examine the factors that influence labour productivity and classify these factors into groups of factors based on previous studies in various countries. Based on critical understanding of previous research and by using Drewin's Open Conversion System (DOCS) there are three key factors in order to achieve goals, namely

input factors, internal environment factors and exogenous factors. The input consists of a factor category, namely labour, finance, material and equipment. Internal environment consists of factor categories namely design, health and work safety, supervision, organization, scheduling, project, leadership and coordination, management, motivation, technology, socio-psychology, communication. The exogenous category includes weather, government regulations, site conditions, economic conditions and public. In this critical review, 175 factors have been identified affecting the productivity of construction labour which is classified in the framework of the Dreyfus theory

4. CONCLUSION

In the view of satisfying share of construction industry in the whole economy the stakeholder attention is focused on improved resource utilisation and productivity. Now a days, due to skilled labour problems, market slowdowns and changing business environment, certain problems are necessary to be considered for success of the project. From the review, it was observed that inefficiency of finance and management of construction resources can result in low productivity.

The critical literature review based conclusions are as follows:

- 1) Major factor affecting labour productivity are low payment, poor construction methods, use of technology/level of mechanization, delay in material delivery etc.
- 2) For large companies, equipment factor is highly affecting labour productivity. While in small and medium companies owner/consultant factor need special attention.
- 3) Technology exploration will increase the productivity.
- 4) There are various methods for improvising labour productivity in construction industry but mostly used method is analytical hierarchy process.
- 5) Some construction labours are engaged in some other profession like farms, factory, domestic servant etc. and hence they do not give full importance to construction work and tend to work informally.
- 6) Factors affecting productivity are categorized under four groups such as Organizational, Economical, Physical and Socio-physiological.
- 7) The best inter-relationship can be found out by evaluating them using various multi-criteria decision making processes like analytical hierarchy Process, Analytical Network Process.

REFERENCES

- 1) Mark Velasquez and Patrick T. Hester,(2013) "An Analysis of multi-criteria Decision Making Methods" International Journal of Operations Research Vol. 10, No. 2, 56-66
- 2) Mistry Soham, Bhatt Rajiv (2013), "Critical Factors Affecting Labour Productivity In Construction Projects: Case Study Of South Gujarat Region Of India", International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-4.
- 3) Varun.V, Linu T. Kuriakose, (2014) "Factors and Methods for Performance Evaluation of Human Resource in Construction Industry", International Journal of Scientific Engineering and Research (IJSER), ISSN (Online): 2347-3878, Impact Factor 3.05.
- 4) K. Dharani, R. Rathan Raj (2015) "Study on Labour Productivity Management in Construction Industry,IJSER,vol 6,issue 9,ISSN 2229-5518
- 5) Hasan Hamouda,Nadine Abu-Shaaban,(2015)"Enhancing Laour Productivity within Construction Industry Through Analytical Hierarchy Process, the case of gaza strip,UJM3(8):329-336
- 6) Laura Andrea Gutierrez-Bucheli, Jose Agustina Vallejo-Borda & Jose Luis Ponz Tienda (2016) "Application of the analytic hierarchy process (ahp) in the construction industry: a case study in the selection of the plot for a real estate project.
- 7) Aynur Kazaz, Serdar Ulubeyl, Turgut Acikara, Bayram ER,(2016)"Factors affecting labor productivity: perspectives of craft workers", Creative Construction Conference 2016, CCC 2016, 25-28 June 2016, Procedia Engineering 164, 28-34.
- 8) Vishal Sherekar, Mahesh Tatikonda,(2016) " Impact of Factor Affecting on Labour Productivity in Construction Projects by AHP Method.Vol 6 Issue No. 6 ISSN 2321 3361-2016 IJESC
- 9) Vivek Kumar Patel, Sohit Agrawal, Dr. Mukesh Pandey (2017) "Study of factors affecting labour productivity in construction industry.volume 4 issue 09,JETIR (ISSN-2349-5162)
- 10) Maryam Huda, Keiichi Okajima, Kengo Suzuki,(2017)"Identifying public and experts perspectives towards large-scale solar PV system using analytic hierarchy process", 9th International Conference on Applied Energy, Energy Procedia 142 2554–2560, ICAE2017, 21-24 August.
- 11) Hongmei Li, Fujian Ni, Qiao Dong, Yuqin Zhu,(2017) "Application of analytic hierarchy process in network level pavement maintenance decision-making", International Journal of Pavement Research and Technologyx.

- 12) Revianty nurmeyliandari nurhendi, Muhamad Azry Khoiry, Noraini Hamzah (2019) "Review on factors Influencing Labour Productivity in Construction Project, IJRTEISSN:2277-3878, volume-7, Issue-6S, March 2019