Analysis of Construction Productivity by using Soft Computing Tools - A Review

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Abstract— **Application of soft computing tools has had an impact on industries, economies, ways of life, and even culture during the past several years. Numerous scholars have looked at the connection between information technology and productivity as productivity has gained much attention as a crucial economic indicator. Although one of the biggest sectors, construction productivity's relationship with information technology is rarely studied. The main goal of this research is to ascertain the relationship between information technology use and construction productivity, in particular, the use of information technology to automate and integrate project work tasks. The first step will be to examine the connection between use of soft computing tools in construction productivity on a global scale. The results of this investigation may give construction companies some insight into how to prioritize and implement use of soft computing tools in their operations.**

Index Terms—**Construction, Productivity, Soft computing tools, Relationship, Automation and Integration, Labour productivity**

I. INTRODUCTION

Productivity in the construction industry is generally measured by manpower and equipment output. However, compared to the other, worker productivity makes a bigger contribution. In India, the construction industry employs close to 52 million people at the moment. Because the firm did not give those employees any formal training or education, their skill level is not up to par. As a result, individuals can only acquire the necessary abilities through work experience. In India, states like Odisha and West Bengal have the lowest labour productivity, whereas Maharashtra and Gujarat have the highest. Variations in labour productivity in the construction industry are caused by a number of factors.

Variations in construction workforce productivity are caused by a number of factors. These elements can be divided into three categories in general: (1) Management-related elements such as the project team, management control, techniques, equipment, materials, and tools availability, crew makeup, work sequence, scheduled overtime, and congestion (2) project-related variables such as requirements, design elements, crew size, repetition, site conditions, temperature, humidity, and precipitation; and (3) labor-related variables such as rewards, morale, fatigue, unionised labour, handicraft quality, absenteeism, and turnover.

Models that account for different levels of productivity in the construction industry explain these discrepancies. Construction planning, estimating, and scheduling all need the use of these models. The goal of planning is to maximise labour productivity in order to reduce labour costs and shorten project duration. Controllable factors (such as crew size or scheduled overtime) must be included in these models. Productivity models are used in estimation to anticipate labour costs, in scheduling to foresee activity durations, and in both cases, productivity models are utilised to estimate labour costs. Although productivity modelling is a critical component of construction planning, estimating, and scheduling, the models created thus far fall short of fully describing the variances in productivity. Most of these models only took into account one element while ignoring the variability brought on by other aspects. Additionally, only a small amount of data was used to create the models.

II. PROBLEM STATEMENT

Construction has long been thought of as a labor-intensive sector of the economy. This region's production is characterised by its huge scale, open job sites, and significant process fragmentation. Customers and decision-makers are quite concerned about the industry's performance because of its

comparatively sluggish productivity growth when compared to other industries, such as the manufacturing sector. At the same time, efforts to pinpoint the causes of low productivity—particularly to separate the important ones—have never stopped.
If efforts are made to boost productivity performance in the appropriate way, then remedial action will be implemented quickly. The pricing of other components (such as equipment and material) is established by the market, hence they are not subject to project management's control. About 33% to 50% of the total project cost is thought to be the labour expense in the construction business. Productivity improvements have a direct correlation to lower labour costs. It is crucial to the profitability of the construction business since it has the potential to either increase or decrease a project's profit.

III. OBJECTIVES

The objectives of this paper are as below.
1. To study various research papers with regard to Construction Productivity and the factors concerning it.
2. To make a review and establish a statement discussing the factors affecting productivity in context with the review.

IV. LITERATURE REVIEW

1) (Ghalia & Sweis, 2010)

This study looks at the connection between IT adoption and work satisfaction from the standpoint of Jordanian contracting organizations in an effort to close these knowledge gaps. IT Barometer and MSQ surveys were used to create the measures. To learn more about this connection between Jordan's various contracting businesses, 50 questionnaires were issued. Multiple regression analysis was used to gather descriptive data and test hypotheses. The findings show that increasing technology spending would more likely improve employee work satisfaction from both an intrinsic and a broad standpoint. The findings show that, from an intrinsic, extrinsic, and overall standpoint, greater investment in technology would rather boost employee work satisfaction. The research's intellectual contribution is in the creation of a conceptual technique that may be used in other, future studies. Although the generalizability of this study may not be very great, it holds true for other developing nations that are comparable to Jordan in terms of their socioeconomic conditions.

2) (Sawhney, Mukherjee, Rahimian, & Goulding, 2014)

This study provides a timeline of linked industry-specific variables that have either directly or indirectly led to these firms' standing as delayed (low) technology adopters. In order to improve the current business and foster new innovation opportunities (particularly in the early adopter S curve), this paper contends that SMEs in the Indian construction industry must abandon the status quo and realise the benefits realised in other industries. This research proposes a methodology that exposes the causal "deficits" connected to the industry's poor ICT penetration using a scenario thinking technique. This framework also highlights the major factors, particularly the interaction of major critical factors, that affect and influence the use of ICT in the construction industry. For the uptake, adoption, and spread of ICT, a number of distinct scenarios are imagined. To embed relevance and set priorities against concrete metrics, they were created with the assistance of industry experts. This framework offers a future state ICT vision for SMEs, one that lays a clear emphasis on their operational and strategic viewpoints as well as their long-term company goals.

3) (Begić, Galić, & Dolaček-Alduk, 2022)

The goal of this study is to determine the origins and current degrees of digitalization and automation, as well as their interoperability, among the key life-cycle stages of building projects. To that end, a state-of-the-art literature review is offered. According to the findings, there are undoubtedly considerable differences in the levels of automation and digitalization throughout the various stages of a building project's life cycle. A low degree of automation and digitalization was observed for the initiation phase, a high level of automation with little to no digitalization for the design and planning phases, and a low level of automation with more automation for the execution phases. The examination of the levels of automation and digitalization for each phase revealed that they are primarily associated across project life-cycle stages via the utilisation of BIM. The design phase, which comes after, usually favours and follows the BIM approach since it makes it easier to create schedules that include planning-related elements.

4) (Mlybari, 2020)

In this study, techniques for estimating the labour productivity rates of concrete building activities were developed, including the multilayer perceptron neural network (MLPNN), support vector machine (SVM), general regression neural network (GRNN), and multiple additive regression trees (MART). The most effective methodology for calculating predicted productivity was determined by examining the outcomes of several soft computing strategies. The various approaches' predicted tendencies are contrasted with those discovered in earlier productivity studies. The findings demonstrate that the GRNN model beats the alternative methods for estimating labour productivity for steel fixing and pouring and finishing concrete. The root mean square error (RMSE) for the labour productivity of fastening steel was reduced by 199.41%, 23.21%, and 53.46% using the GRNN model, and by 3,311.78%, 681.81%, and 776.68% using the MLPNN, SVM, and MART models, respectively. The MART technique was shown to be the most effective for forecasting labour productivity for formwork assembly, offering improvements in the RMSE of 232.93%, 90.89%, and 28.88% over MLPNN, GRNN, and SVM, respectively.

5) (Momade, Shamsuddin, Hainin, Nashwan, & Umar)

In this research, a data-driven methodology for building Construction Labour Productivity (CLP) models from influencing labour variables is proposed. Support Vector Machine (SVM) and Random Forest (RF), two cutting-edge machine learning-based classifiers, were utilised to simulate CLP. To begin with, a preliminary analysis of prior research was done to extract all CLP-related parameters. Through a pilot poll, seasoned project managers evaluated the list of CLP criteria in order of their importance from the perspective of Malaysian homeowners. The labour force's lack of work experience, job type, education/training, nationality, skills, age, and marital status were shown to be the most significant contributors. All construction employees in Malaysian residential projects provided information based on these contributing variables. The gathered information was utilised to create CLP models using SVM and RF. Several statistical indicators, including the Probability of Detection (POD), the Heidke Skill Score (HSS), the False Alarm Ratio (FAR), and the Peirce skill score (PSS), were used to evaluate the performance of the models. The CLP was accurately mimicked by the SVM and RF. The reliability graphs demonstrated the models' excellent efficacy. The outcomes show that great accuracy in CLP prediction may be attained using cutting-edge machine learning techniques. Researchers and industry professionals can also benefit from the current study's understanding of how machine learning techniques can be used to learn more about construction productivity and ultimately raise the bar for construction labour productivity in Malaysia.

6) (Ahuja, Yang, & Shankar, 2009)

The research conducted to examine these elements and problems in the context of the Indian construction sector is discussed in this article as one part of that research. Through the use of quantitative data analysis and a questionnaire survey, the degree of the use of formal Project Management methods, ICT adoption for these processes, and variables such as perception-based factors impacting ICT adoption were investigated. Identification of issues that call for action at the three study levels is one of the outcomes of data analysis. The findings can be generalised to other nations with necessary care, especially those with big populations or building industries that, in terms of operating procedures, are comparable to those in India.

7) (Shehata & El-Gohary, 2011)

The most recent cutting-edge topics pertaining to this subject are taken into account in this study. It discusses definitions, features, measures, influences, various measurement methods, and modelling methodologies related to construction labour productivity. The key finding from the literature is that productivity does not have a common definition. This research offers recommendations for the necessary actions needed to raise construction labour productivity and, as a result, boost project performance. By putting the benchmarking principle into practice, building projects' overall performance may be enhanced. Additionally, it provides a current notion of measuring productivity loss for claims relating to construction productivity. To illustrate construction labour productivity rates, variables impacting construction labour productivity, and suggestions for improvement, two significant case studies from the literature are provided.

V. DISCUSSION AND CONCLUSION

1) Ghalia & Sweis suggests that Employee work satisfaction can be achieved using a good investment in technology sector.
2) Mlybari utilized various techniques to estimate construction labour producitivity and GRNN model tends to give the best solution for steel fixing. pouring and finishing concrete whereas Momade, Shamsuddin, Hainin, Nashwan, & Umar suggested that SVM and RF gave excellent efficacy in evaluating Construction labour productivity
3) Sawhney, Mukherjee, Rahimian, & Goulding describes the negative effect on industries due to poor use of ICT in Construction sector.
4) Ahuja, Yang, & Shankar investigated the use of quantitative data analysis and a questionnaire survey, the degree of the use of formal Project Management methods, ICT involvement in Construction and sets a model for other countries, whereas Shehata & El-Gohary states that productivity does not have a common definition.

REFERENCE

[1] Information Technologies applications for Construction. In Life Cycle Document Management System For Construction (pp. 37-46).

[2] Ahuja, V., Yang, J., & Shankar, R. (2009). Study of ICT adoption for building project management in the Indian construction industry. Automation in Construction , 18, 415-423.

[3] Bartake, M., Patil, Y. S., & Swamy, R. M. (2019). Study of Barriers in Implementing ICT in Indian Construction Industry. International Journal of Research and Scientific Innovation (IJRSI) , 6 (11), 149-152.

[4] Begić, H., Galić, M., & Dolaček-Alduk, Z. (2022). Digitalization and Automation In Construction Project's Life-Cycle: A Review. Journal of Information Technology in Construction , 27, 441-460.

[5] Cherian, T. M., & Kumaran, L. A. (2016). E-Business in Construction Industry: Opportunities and Challenges. Indian Journal of Science and Technology , 9 (32), 1-6.

[6] Gaith, F. H., Ismail, A., & R., K. A. (2012). Application and efficacy of information technology in construction industry. Scientific Research and Essays , 7 (38), 3223-3242.

[7] Ghalia, A., & Sweis, R. J. (2010). The relationship between information technology adoption and job satisfaction in contracting companies in Jordan. Journal of Information Technology in Construction , 15, 44-63.

[8] Kasim, N. B., & Soon, P. A. (2011). The Awareness Of ICT Implementation For Materials Management In Construction Projects. International Journal of Computer and Communication Technology , 2 (3), 158-168.

[9] Kasim, N. (2011). ICT Implementation for Materials Management in Construction Projects: Case Studies. KICEM Journal of Construction Engineering and Project Management , 1 (1), 31-36.

[10] Mlybari, E. A. (2020). Application Of Soft Computing Techniques To Predict Construction Labour Productivity In Saudi Arabia. International Journal Of Geomate , 19 (71), 203-210.

[11] Momade, M. H., Shamsuddin, S., Hainin, M. R., Nashwan, M. S., & Umar, A. T. (n.d.). Modelling labour productivity using SVM and RF: a comparative study on classifiers performance. International Journal of Construction Management .

[12] Sawhney, A., Mukherjee, K. K., Rahimian, P. F., & Goulding, S. J. (2014). Scenarioe thinking approach for leveraging ICT to support SMEs in the Indian construction industry. Procedia Engineering , 85, 446-453.

[13] Shehata, M. E., & El-Gohary, K. M. (2011). Towards improving construction labor productivity and projects' performance. Alexandria Engineering Journal , 50, 321-330.

[14] Sonmez, R. (1996). Construction labor productivity modeling with neural networks and regression analysis. Retrospective Theses and Dissertations, Iowa State University, Ames.

[15] Sreelakshmi, S., Kantilal, B. S., Roshan, M., & Gopinath, S. (2017). Study On The Barriers To

The Implementation Of Building Information Modeling. International Journal of Civil Engineering and Technology (IJCIET) , 8 (5), 42-50.

[16] Taher, G. (2021). Industrial Revolution 4.0 in the Construction Industry: Challenges and Opportunities. Management Studies and Economic Systems (MSES) , 6 (3/4), 109-127.