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

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Abstract: ***The aim of this paper is to outline the process for creating activity construction labour productivity models in order to to improve the labour productivity level problems. Through a rigorous site supervision and site training, 38 days data collection was done and different elements of building construction were examined for this purpose. The regression analysis was done and the results are shown below. The findings of this analysis may provide construction organizations with insight into how to prioritize and execute the usage of soft computing technologies inside their operations.***
Keywords: Construction Labour Productivity, Work Sampling, Regression.

I. INTRODUCTION

The construction sector typically measures productivity by human and equipment production. Worker productivity contributes more than other factors. India's construction industry today employs more than 52 million people. Employees' skill levels are below par due to a lack of formal training and education provided by the organization. Individuals may only develop required skills via job experience. Two Indian states namely Gujarat and Maharashtra have the greatest labor productivity and West Bengal and Odisha have the lowest in the country. Numerous factors influence labor productivity in the construction industry. Construction crew productivity varies due to several reasons. These components can be classified into three broad categories: (1) Management factors include project team, management control, equipment, materials, and tools availability, crew composition, job sequence, scheduled overtime, and congestion. (2) Project parameters include requirements, design features, size of crew, repetitive actions, conditions of site, temperature, humidity, & precipitation. (3) Labor variables include rewards, morale, weariness, unionized labor, handicraft quality, absenteeism, and turnover.

These disparities can be explained using models that account for varying levels of productivity in the building sector. Construction planning, estimating, and scheduling all need the usage of these models. The purpose of planning is to maximize labor productivity to lower the labor expenses and minimize project duration. These models must incorporate controllable parameters (for example, worker size or scheduled overtime hours). Productivity models are used in estimating to predict labor costs, scheduling to predict activity durations, and both to estimate labor costs. Although productivity modelling is an important part of construction planning, estimating, and scheduling, the models developed thus far fall short of adequately understanding productivity variations. Most of these models simply took into consideration one variable, neglecting the unpredictability caused by other factors. Furthermore, only a small amount of data was used to develop the models.

II. NEED OF THE STUDY

Construction has traditionally been considered a labor-intensive sector of the economy. This region's production is notable for its massive scale, open job sites, and severe process fragmentation. Customers and decision-makers are concerned about the industry's slow productivity development compared to other industries, including manufacturing. Efforts to identify and prioritize the causes of poor productivity are in process. Efforts to improve productivity can lead to prompt implementation of corrective actions. Project management cannot influence the pricing of other components, such as equipment and materials, which are determined by the market. In construction industry, labor expenditures contribute from 33% to 50% of total project cost. Higher productivity leads to decreased labor expenses. The construction industry's profitability depends on this factor, which may either boost or decrease project profits.

III. OBJECTIVES

1) Review research articles on construction productivity and related issues.
2) Conduct a review and create a statement on issues impacting productivity in the context of the evaluation.

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IV. REVIEW OF LITERATURE

Some theoretical and analytical investigations performed in this field are presented in the literature survey below.

1) Ghalia and Sweis (2010)\ says to overcome information gaps, this study looks at the link between IT adoption and work satisfaction among Jordanian contracting organizations. The IT Barometer and MSQ surveys were utilized to develop the metrics. Fifty questionnaires were sent to explore the relationship between Jordan's contracting firms. We employed multiple regression analysis to collect descriptive data and test hypotheses. Research indicates that investing in technology can enhance employee job satisfaction, both intrinsically and broadly. Increased investment in technology leads to higher employee work satisfaction, based on intrinsic, extrinsic, and overall factors. The research makes an intellectual contribution by developing a conceptual method that may be applied in future investigations. While the study's generalizability is limited, it is applicable to other emerging nations with similar socioeconomic situations as Jordan.
2) Sawhney (2014) said this study identifies industry-specific elements that have contributed to these organizations' status as delayed (low) technology adopters. This study argues that small and medium-sized enterprises (SMEs) in the Indian construction sector should leave the status quo and reap the advantages of other industries to enhance their company and stimulate innovation, especially in the early adopter S curve. This study suggests a scenario thinking approach to identify "deficits" in the industry's ICT adoption. This framework identifies important elements that cause huge impact on the adoption of ICT in the construction sector. There are several situations for ICT acceptance and spreadings. Industry professionals helped build tangible KPIs to ensure relevance and prioritization. This framework provides a future-state ICT vision for SMEs, emphasizing operational and strategic perspectives, as well as long-term organizational goals.
3) Begić, Galić, & Dolaček-Alduk (2022) says this study aims to identify the origins and present levels of digitalization and automation, as well as their interoperability throughout critical life-cycle phases of construction projects. A brief assessment of this literature is given. The study found significant disparities in automation and digitalization levels across construction project stages. The study found low automation and digitalization at the start phase, high automation with little digitalization throughout the design and planning stages, and low automation with increased digitalization during the execution phase. The study discovered that automation and digitalization are closely related to project life-cycle stages and the usage of BIM. The BIM technique is commonly used in the design phase to facilitate the creation of planning-related schedules.
4) Mlybari (2020) illustrates this study developed techniques for estimating labor productivity rates in concrete building activities, using MLPNN, SVM, GRNN, and MART. Several soft computing technologies were evaluated to discover the best effective approach for predicting productivity. Compared to previous productivity studies, the anticipated patterns of various techniques differ. The study discovered that the GRNN model beats other methods for assessing labor productivity for steel fixing, pouring, and finishing concrete. The GRNN model lowered labor productivity by 199.41%, 23.21%, and 53.46%, whereas MLPNN, SVM, and MART models reduced it by 3,311.78%, 681.81%, and 776.68%, respectively. The MART approach outperformed MLPNN, GRNN, and SVM for forecasting labor productivity in formwork assembly, with RMSE increases of 232.93%, 90.89%, and 28.88%, respectively.
5) Momade, Shamsuddin, Hainin, Nashwan, & Umar undertook a data-driven approach was suggested for creating CLP models based on labor variable influences. Random Forest (RF) with Support Vector Machine (SVM), two state-of-the-art classifiers based on machine learning, were used to model CLP. In order to extract all CLP-related factors, a preliminary examination of previous studies was conducted first. Experienced project managers ranked the list of CLP criteria according to their significance from the viewpoint of Malaysian homeowners using a pilot survey. The most important factors were found to be the labor force's age, marital status, nationality, job type, education/training, skills, and lack of work experience. Based on these contributing factors, all construction workers on residential projects in Malaysia supplied information. The acquired information was employed to develop CLP models by means of SVC and RF. Numerous statistical metrics, such as the Peirce skill score, the Heidke skill score, the False Alarm Ratio, and the Probability of Detection (POD), (PSS), were employed to assess the models' performance. The SVM and RF successfully reproduced the CLP. The models' excellent efficacy was demonstrated by the reliability graphs. The models' outstanding effectiveness was shown by the reliability graphs. The results demonstrate that advanced machine learning approaches may be used to achieve high accuracy in CLP prediction.
6) Ahuja, Yang, & Shankar (2009) syas the current study's comprehension of how machine learning techniques may be applied to learn more about construction productivity and eventually raise the bar for construction labor productivity in Malaysia can also be helpful to researchers and industry experts.

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7) Shehata & El-Gohary (2011) says this research takes into consideration the most recent cutting-edge subjects related to this subject. It covers definitions, characteristics, metrics, impacts, and a range of techniques for modelling and measuring the productivity of construction workers. The main conclusion drawn from the literature is that there is no universally accepted definition of productivity. This study suggests methods that should be implemented to maximize construction worker productivity and, as a result, improve project performance. The overall performance of building projects may be improved by implementing the benchmarking approach. It also offers a contemporary concept for calculating productivity loss for assertions pertaining to construction productivity. Two noteworthy case studies from literature are offered to demonstrate construction labor productivity rates, factors influencing construction labor productivity, and recommendations for enhancement.

V. DISCUSSION AND CONCLUSION

1) According to Ghalia and Sweis, making wise investments in the technology sector might lead to increased employee work satisfaction.

2) Mlybari estimated construction labor productivity using a variety of methods, and the GRNN model often provides the best answer for steel fixing. pouring and completing concrete, however SVM and RF were shown to be highly effective in assessing construction labor productivity by Momade, Shamsuddin, Hainin, Nashwan, and Umar.

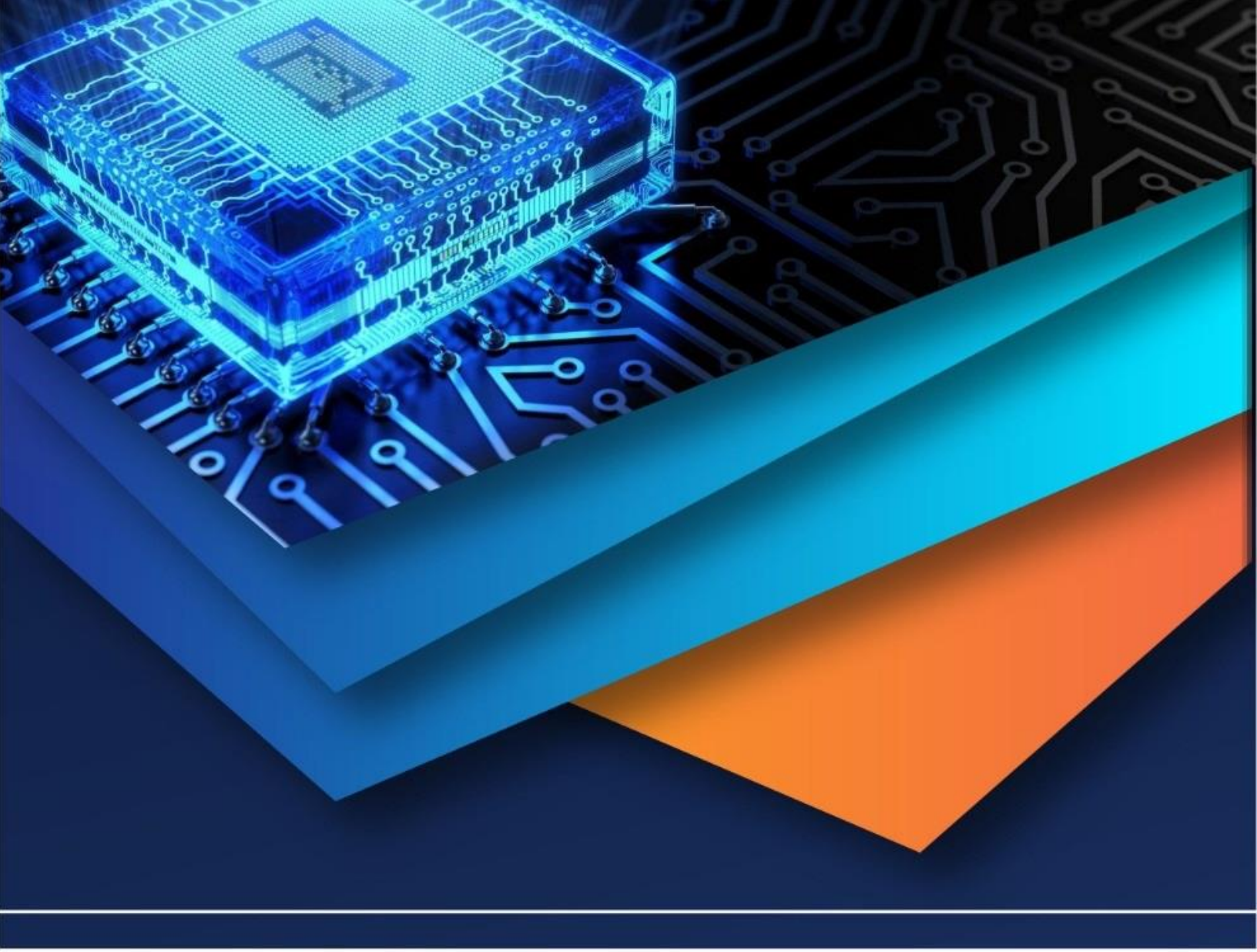
3) According to Sawhney, Mukherjee, Rahimian, and Goulding, the construction industry's inadequate usage of ICT has a detrimental impact on several businesses.

4) While Shehata & El-Gohary claim that there is no universally accepted definition of productivity, Ahuja, Yang, and Shankar examined the use of analysis of quantitative data and questionnaire survey, the extent to which formal project management practices are used, and the significance of ICT in construction presented.

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