Ain Shams University
Faculty of Engineering
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Productivity of Reinforcement work labors in Residential buildings in Egypt

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STATEMENT

This Thesis is submitted to Faculty of Engineering, Ain Shams University, Cairo-Egypt, in Partial fulfillment of the requirements for the Degree of Master of Science in Structural Engineering.

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ABSTRACT

Production rates are considered an essential aspect of the construction industry because it is the indicators of the productivity efficiency of construction sector. Hence, the efficient management, which considers labors as the most important factor, leads to higher productivity and achieves the goal with lower cost, time, and high quality. However, there is a gap in identifying factors affecting rebar workers. Therefore, this study tries to bridge this gap by developing a neural network model for estimating rebar labor's production rates. Thus, a questionnaire has been distributed to a group of consultants and contractors and statistical software program (IBM SPSS) has been used to statistically analyze the collected data. Mainly, to show the effect of different analytical methods on the ranking of the outputs. The first method depends on applying project management professional (PMP) matrix method, while the second method depends on the probability and the impact to validate the results of the first method. The results indicate that "project type" is the most important factor affecting labor productivity. Also, the application of factors has led to a model that can be used in estimating rebar's labor production rate. Reliable values have been successfully predicted by Artificial Neural Network (ANN). Additionally, the research presents a software program, which is used to measure production rate (Output) based on the data provided in the form of factors affecting the rebar labor (Input). This helps to measure productivity growth in a low-cost residential building in a later work. Moreover, it supports fundamentals building by predicting productivity of rebar labor, to establish a database for executed projects in the future to develop productivity estimation process.

Keyword: Artificial Neural Network (ANN); Influencing factors; Production Rate; Rebar workers; Regression; Relative Importance Index

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ABBREVIATIONS

(AI): Artificial intelligence

(ANN): Artificial neural networks

(B. F. Skinner): Positive Reinforcement Skinner Theory

(CII): Construction Industry Institute

(CPIM): Cost and Productivity Indicator Model

(F.I.): Frequency Index

(GFF): Generalized Feed Forward

(H0): Null Hypothesis

(H1): Research Hypothesis

(IMPI): Importance Index

(L-C-Theory): Learning Curve Theory

(LPV): labors productivity variation

(LWSM): Labor Working Status Monitoring

(M&E Services): mechanical and electrical Services

(MLP): Multilayer perceptron

(MSE): Mean Square Error

(P.R): Production Rate

(PFP): Partial factor productivity

(PMP): Project Management Professional

(QEPSD): Quantitative Engineering Project Scope Definition

(RFI): Ranking factor Impact

(RII): Relative Importance Index

(S.I.): Severity Index

(TLS): Technical and Logistics Solutions

(TPF): Total factor productivity

(PIIS): Process Improvement Initiatives

(PLP): Project level Productivity

(%): Percentage

CHAPTER (1)
INTRODUCTION

1.1 OVERVIEW: -

Numerous studies on labor productivity in the construction industry have been conducted in the past. A series of these studies were designed to calculate the effect of factors affecting productivity. But the others were studied to make standard calculations for the impact of these factors on estimation process for productivity on the construction project, during the planning and the scheduling phases. Previous studies, there is the great difficulty in estimating the impact of these factors. At the present, there are many internationally accepted standards that are used to measure the lack of labor productivity in the construction industry. This lack of methods of measuring this impact is due to the need to strengthen assessments that can measure the factors affecting productivity in the construction sector. This is presented to be the subject of this research.

To achieve a good productivity, it is necessary to achieve detailed labor productivity and the actual cost of labor. Because many factors have different variables that affected productivity levels. For a project, productivity, cost, quality and time are the most important criteria affecting the efficiency of any project. In order to achieve better productivity in any construction site, the project management must include several requirements such as: the skills of learning and training, method of work, personal health, motivational factors, type of tools, machinery and equipment required, the materials required on site, personal skills, the amount of work, the quality of work, work location, type of work, and supervisory staff.

1.2 CONSTRUCTION PRODUCTIVITY: -

The construction sector is one of the most extensive industry, that affected the economy of any nation. In addition, productivity is one of the most important influential factors that contribute significantly to the economy of any country. Therefore, it is essential to identify the factors that directly affect the

construction sector. Accordingly, actions should be taken to improve these factors to achieve low cost, less time, and high quality. Therefore, various studies have shed the light on the development of the production rate to ensure cost reduction in construction projects. Mainly because labor's productivity is considered as one of the most critical factors that affect the physical progress of any construction project.

The estimate of labor productivity in the construction sector must be well documented with the influence of many factors such as: structural planning, scheduling and estimation phases. The planning and scheduling phases are important steps to reach to maximize productivity, predict the activity duration, and achieve to the lowest cost of working in a shorter duration of the project. But the estimation phase is used to predict labor costs. If the estimate is too low, the company may lose funds during the project implementation. On the other hand, if the estimate is high, the company may lose the contract because of the excessive price.

Recently, the prediction of labor productivity using artificial intelligence has become an emerging area for many researches. Artificial intelligence (AI) such as artificial neural networks (ANN) is a promising tool to achieve better estimates using historical data. Many researchers discussed the potential applications of neural networks in construction industry in recent years **(Salem, 2006)**.

1.3 ANN MODELING: -

To achieve the desired productivity in any building project in general, it was important to have good control over factors that affect productivity and contribute to production rate such as labor, material, and equipment. To achieve the goal effectively it was important to determine the relationship between productions rates (output) and related productivity factors (input).

The current traditional activities for estimating, measuring and improving productivity depended on several factors that used in predicting production rates, which include personal arbitration by the estimator, on-site productivity