

# A Review Paper on Prediction of Construction Productivity Using Artificial Neural Network Model

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**Abstract:** *The construction industry's productivity is generally based on three factors: labour characteristics, control systems, and external issues. Various academics have identified a number of elements that influence building productivity. Understanding the level of productivity makes it considerably more important to improve modern techniques in order to boost construction productivity. This report presents a thorough review of the research on productivity in the construction industry. The paper provides a review of different methods that can be used to measure production productivity, as well as factors affecting and theories on improving construction productivity, such as labour factor, control elements, and outside factors. The paper also critiques various improvements that can be made to improve construction productivity. According to opinions, there are numerous different strategies and strategies for increasing construction productivity, but they differ from web to web. On the subject of viewpoints, it has long been stated that there are numerous alternative tactics and strategies for increasing construction productivity, but they differ from web-based strategies.*

**Keywords:** Construction productivity, ANN, Construction management, Labour and Equipment productivity

## 1.Introduction

The Indian manufacturing industry is one of the world's fastest growing sectors. After agriculture, the construction industry employs the second-largest number of people. India accounts for around 8% of global GDP and employs approximately 35 million people directly or indirectly (Yogendra kumar et al, 2013). Unskilled labour is one of the most significant concerns in the manufacturing industry, as it results in productivity loss and has an impact on cost overruns and daily schedules. One of the most important factors influencing the physical growth of a construction project is labour productivity. Construction workers must be familiar with the materials, tools, and machinery they utilise in order to do their jobs effectively. Many studies have shown that poor construction control procedures result in poor overall performance and waste of resources at various phases of the construction process. Researchers sought to overcome some of the hurdles by involving themselves in the creative process, but numerous issues remain.

In strategic and operational planning, productivity forecasting is critical. For a variety of complex scenarios, quantitative forecasting is employed in the decision-making process (Mohamed and srinavin, 2005). Prior studies carried out in the determination of manufacturing quotes suggest that avenue creation production prices are prompted by a wide range of factors which include weather, area, soil characteristic, fabric transport, crew size, and many others. The range and complexity of these elements might create problems in figuring out an inexpensive manufacturing charge. Therefore there is a want to investigate what elements are significantly affecting the production prices of sports with the aid of

how a lot. The majority of research on simulating construction productivity has mostly concentrated on modelling and has neglected to look into the impact of subjective variables on the construction system's productivity. Because of the precise nature of manufacturing projects and the instability of construction procedures, a new age of trends is required that incorporates ancient realities.

**Sasan Golnaraghi (2005).** The facts used inside the present take a look at changed into organized using facts processing strategies and turned into in the end used inside the development of a predictive version for exertions productivity making use of radial foundation feature neural network. The version specializes in labor productiveness in a formwork installation the use of information collected from two high-rise homes within the downtown place of Montreal, Canada. The predictive capability of the evolved version is then in comparison with other strategies which include adaptive neuro-fuzzy inference machine, synthetic neural network, radial basis function (RBF), and generalized regression neural network. The outcomes show that LU-RBF predicts productivity more appropriately and for this reason may be utilized members of mission groups to validate the predicted productiveness based on available information

**Yasser Elfahham (2019).** The projected productivity was modelled in this study using environmental and operational variables. Various ANN techniques, including the Adaptive Neuro-Fuzzy Inference System (ANFIS), General Regression Neural Network (GRNN), Back propagation Neural Network (BNN), and Radial Base Function Neural Network (RBFNN) were employed to assess their respective findings. BNN surpasses other

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methodologies for simulating construction labour productivity, according to the findings.

**Faiq Mohammed Sarhan AL-Zwainy (2018).** This paper recognition on make the funding economically feasible, the productiveness machine have to be incorporated into the general database and data machine of the development company. Using the synthetic neural network (ANN) technique and the transfer function of the hyperbolic tan function, the proposed engineering method was used to model production hard work productivity of two creation crafts, carpentry and solving reinforcing metallic bars of various types of concrete foundations (tanh). The outcomes revealed a good convergence with reasonable generalisation capabilities, as well as more accurate and believable results when compared to not only the traditional methodology, but also the most widely used approaches in the literature. This research adds to the body of knowledge in development engineering and management by providing insight into the usage of unique ANN activation and switch capabilities, as well as a wide range of influencing elements, to benchmark the contractor's construction hard labour productivity. It supports the two most fundamental foundations of sustainable development: economic and social measurement.

**Sana Muqeem (2019).** The construction productivity is the focus of this paper. Anecdotal evidence suggests that people's attitudes toward increased productivity are naturally tied to many various hidden elements, not just money benefits. Some building production jobs in Melbourne are compared to one another in order to determine the factors that influence productivity. The factors a impacting on workers' productiveness through the usage of a based questionnaire survey approach. Analytical hierarchy system indicates that the biggest affects on productiveness are making plans and programming. The final results of this examine need to help control selections and advise viable upgrades to set up the best management methods for most effective use of labour resources in creation initiatives.

**Emad Elwakil (2016).** The goal of this research is to develop an estimation model for creation hard labour productivity that provides consistent manufacturing rates while also taking into account the influences of the elements through the use of Artificial Neural Networks (ANN). On assignment websites from different parts of Malaysia, labour output rates for beam concreting were measured. Weather, availability of fabric and equipment, area of mission, web site situations, and a wide variety of workers are the most common factors influencing labour productivity identified in the literature. These factors are recorded on a severity scale of 1 to a few on the web sites simultaneously at some stage in the records collection of production prices. The severity indices (S. I) of the recorded influencing elements have been determined, with fabric and system availability ranking top, followed by people, website online conditions, and weather. Severity indexes (S. I) of the recorded influencing elements have been calculated, availability of fabric and system has been ranked as first while variety of people, website online

conditions, weather and region of assignment are ranked as second, 1/3, fourth and 5th. and assigned region are ranked second, third, fourth, and fifth, respectively. Finally, the records were used to improve an estimation version using ANN. The Mean Square Error (MSE) determined from the expected prices and the results show that the model has accurately forecasted the costs with a reasonable range of errors and can be used in the manufacturing industry.

**Baba Shehu Waziri (2009).** The research discovered that ANNs are effective in Prediction of price, risk appraisal, scheduling and optimization and decision-making. It was discovered that ANN was used to address problems that were difficult to solve using statistical mathematical and traditional methods. The use of ANNs in conjunction with other soft computing strategies such as Genetic Algorithms, has also been investigated, with promising outcomes when compared to traditional ANNs. The examination reveals ANN's complete reputation in creation engineering and control for use in various locations for advanced accuracy and reliable predictions.

**Bhavik K. Kashiyani (2017).** The fundamental intention of this Paper is to perceive important issue which affects creation hard work productiveness and to use them for developing a predictive model. This paper provides the factors which affect the hard work productivity for the residential and business buildings within Surat metropolis, Gujarat. By literature assessment total 47 factors have been finalized that influences the labor productivity in the scope of work and distributed in eight principal classes as: Management, Supervision, Safety program and motivation, Technical excellence and placement layout, Proper making plans and schedule, Labor competence, Effective conversation and language know-how, and External condition. The evaluation to find out the maximum influencing factors has been executed the usage of the Mean Variance Method through the SPSS device. After finding top eleven factors, an ANN models is evolved by means of the use of MATLAB software to expect labor productivity. Amongst diverse trials, we observed that eighty 5%-15% FFDTD is the nice model for the prediction. At ultimate, we took four case studies for validation of ANN Model on ongoing projects in Surat which has proven the exceptional effects in predicting the productiveness.

**Faiq Mohammed Sarhan AL-Zwainy (2016).** In this paper, Multi-layer perceptron trainings using the back-propagation set of rules neural community is formulated and represented for estimation of the productiveness of creation tasks. Data acquisition used in the examine are for residential, industrial and academic tasks from exceptional component from Iraq. It is utilized in education the model and evaluating its overall performance. Age, enjoyment, quantity of assist hard work, height of the floor, length of the marbles tiles, safety situations, fitness reputation for the painting group, climate conditions, website online situation, among the ten influencing factors used in the ANN model for productivity forecasting. For the prediction of marble finishing work productivity for flooring, one model was

created. It discovered that ANNs have the ability to predict productivity for completing tasks with a high degree of accuracy, with a coefficient of correlation (R) 89.55%, an average accuracy percent of 90.9%.

**Tarek Zayed (2020).** Poor productivity of the construction labour force is commonly blamed for time and cost overruns in creation operations. Despite the fact that there have been several studies on productivity aspects in other foreign locales, there have been little studies on productivity issues in Iraq. In the Iraqi province of Karbala, a brainstorming session and an online interview survey were conducted to determine the productivity of bricklayers and the factors that affect their production. Age, experience, are among the thirteen influencing factors used in the synthetic neural community (ANN) model for productivity forecasting. For the productivity of bricklayer labours, one ANN prediction version was created. It was discovered that the expected productivity is quite comparable to the actual productivity, with a high degree of accuracy in the coefficient of correlation (86.28 percent) and suggest rectangular errors of a few percent (1.32 percent) after having a look around the neighbourhood. By combining the influence of specified elements, the evolved ANN model may be used to accurately estimate bricklayer manufacturing expenses for any creating construction issue.

**Modestus O. Okwu, et. Al (2010).** Managing a dual source multi-destination inventory machine is far more difficult than managing a single supply multi-destination inventory machine. Direct engagement with strategic and operational team members on the paint manufacturing business enterprise, as well as interaction with clients at destination points, helped to realise data sourcing. Information on product demand and unit price of product distribution was gathered, with 74 percent of the data being used for education and 26 percent for verification and validation. The MSE and R-price of the records-set of 15 samples, 74% of which were chosen for training, 26% for validation, and 4% for trying out. Using the ANN technique, approximately 17% of cutting-edge operational fees were avoided. The limitations of the Rule of Thumb and Classical approaches in product distribution have been demonstrated in this study.

**Farid Mirahadi, Tarek Zayed et. Al (2015).** Fuzzy models and Artificial Neural Network (ANN) architectures are two soft-computing areas that have greatly aided researchers in making decisions under uncertainty. They began to use advanced light computing techniques to forecast manufacturing productivity based on a variety of qualitative and quantitative criteria. It specialises in climate, personnel, and production ventures. Finally, a technique known as Approach of Hybrid was used to simultaneously version datasets including both fuzzy numbers and crisp values. In this study, the proposed system's parameters are optimised using a (GA) to excellent-track the system for the greatest possible level of accuracy that may be used for productivity estimation. Using a hybrid modelling technique based on the application of the alpha-reduce method, the proposed

model can also manage a mixture of crisp and fuzzy input variables. The advanced version allows academics and practitioners to use past information to the productivity of construction operations with greater precision standard methods can provide.

**Faiq Mohammed Sarhan Al-Zwainy et. Al (2016).** In terms measuring labour productivity, a systematic method falls short. Despite the obstacles, this definition is used to assess the overall productiveness of an Constrcuton industry. Overall productiveness is important applications of strategies in the creation productiveness field ((ANN), and assist vector device approaches (SVM)). The majority of previous study has focused on understanding the factors that influence development productivity in order to better manage and increase development productivity and to establish a mathematical model for estimating construction productivity. These artificial intelligence tactics both mimic the human ability to learn from a variety of sources and to respond quickly to new situations or to offer new solutions using analogy-based picks. The expected outcomes of this study provide a useful tool for estimate engineers who are in charge of forecasting.

**Gafel Kareem Aswed (2016).** This research looked at how people perceive productivity and the factors that influence bricklayer productivity. The NeuroSolution device conducted a sensitivity analysis to determine the impact of each input parameter on the output variable in order to determine the significance of input parameters on version output. The relationship weights of the neural community are obtained using the FORMULA WAND programme in Excel or VBA from the NeuroSolutions software. The lump sum wage pricing strategy and the choice of gypsum mortar have also been discovered to be highly connected with bricklayer production quotes on websites. The Mean Square error of ANN model, which is a measure of the model's overall performance in predicting bricklayer production quotes, has been determined. After examining the network, it was observed that the expected productivity was nearly identical to the productivity estimation was remarkable degree of accuracy of the coefficient of correlation R (86.28) percent and suggest rectangular blunders of 1.32 percent.

**Saurav Dixit (2018).** The construction industry suffered a variety of issues, including low productivity boom quotes and diminishing growth, which have been discussed by a number of researchers for many years. This paper is an expanded version of the previous one, and the statistical analysis used in it is as follows: The Kaiser–Meyer–Olkin table was created to assess the applicability of element evaluation, and a regression model was presented using the SPSS 23 software programme based on the idea of effects. Changes in scope, revisions in drawings, and response to alternate orders have the greatest impact on development productivity, according to the regression model's results. Rework, as well as training, has a moderate impact on construction productivity.

According to the conclusions of the dependability analysis, all of the elements have a price larger than zero. The study's findings conclude that the most significant

three qualities grouped in linear regression analysis exchange in scope, modification in designs, and response to alternate orders have the biggest impact on construction productivity.

**Santhosh Loganathan (2015).** Recent research on Lean Construction shows that labour productivity has sizable correlation with paintings flow reliability and project overall performance. Lack of education and incorrect businesses of the migrant staff has resulted in unproductive and unpredictable work surroundings. The task accommodates of buildings and a convention centre. Building-1 and a pair of are six-storeyed and four-storeyed constructing. Masonry production pastime of the mission contains of 230 mm and one hundred fifteen mm brickwork wall production. Actual manufacturing statistics for masonry construction activity were accrued and analyzed. Results of the analysis imply that 20% to 40% manufacturing variant between unique creation crews concerned. The paper offers the factors which motive manufacturing version between different production crews and presents how Lean Construction principles can higher cope with the problem. They declare that adopting Lean Construction concepts, LPS as co-planning tool can reduce paintings waft variation, and that reducing paintings flow variation can help to improve labor productivity.

**Mojtaba Maghrebi, Ali Shamsoddini (2015).** The goal of this work is to forecast the concrete pouring production charge by considering both production and delivery characteristics and employing a more comprehensive solid studying method. Unlike similar techniques, this study takes into account not only the online parameters of the creation website, but also the supply chain parameters. The works that have focused on the productivity of concrete pouring in RMC have been summarised. The suggested statistics set and outcomes are compared to Adaboost, ANN-Gaussian, and ANN-Sigmoid. When compared to other approaches, MLF-R has a better overall performance when it comes to obtain (RMSE). Furthermore, in several trials, the RMSEs produced from MLF-R predictions showed the least desired deviation, indicating that the consistency of this procedure when compared to other commonly utilised processes. The MATLAB R12 interface was chosen to implement the proposed approach. In a similar study of concrete pouring productivity prediction, the RMSE from the quality example is 3.28, while MLF-R receives 2.92. The data set includes approximately 2, 600 deliveries to 507 different locations over the course of a month in the metropolitan area.

**Seungwoo Han (2010).** The earthmoving activity was selected as the development hobby for the study's target operation. However, in terms of software, these strategies that rely on a single estimation tool have a number of drawbacks. The common comparison rates of styles I, II, and III were 99.06 percent, 91.23 percent, and 90.89 percent, respectively, according to a comparative examination conducted with the aid of fitted prediction model A. In contrast to the results obtained using fitted predictive model A, the common assessment prices of

fitted predictive version B were 103.06 percent, 98.8 percent, and 99.28 percent, respectively, for versions I, II, and III. These findings revealed that predictive version B was better matched to real-world data than model A. The implementation of prediction model B, on the other hand, is complex since walking the MATLAB programme requires specific skills. The implementation of predicting version A has gotten a lot easier than that of version B, for the reason that consumer can acquire predictive results by merely inputting the information for every component or explanatory variable.

**Faiq Mohammed Sarhan Al-Zwainy, Ali Abed-Alla Eiada, et al. (2016).** In terms of assessing and measuring labour productivity, a systematic method is limited. Furthermore, the most important techniques ((MLR), (ANN), and (SVM)) in the creation productivity field. The majority of previous research has been focused on determining the elements that influence construction productivity in order to better manage construction productivity. These artificial intelligence tactics either use analogy-based choices to offer new responses or replicate the human potential to learn from prior experience and use quick answers to new situations. The findings of this study provide a beneficial tool for estimate engineers who are in charge of forecasting creation productivity in their early planning process.

**Gafel Kareem Aswed (2016)** Though good sized studies exists on productivity elements in different international locations, little or no research have addressed productivity troubles in Iraq. It was found that the are expecting productivity about the same as the actual productivity with an excellent diploma of accuracy of the coefficient of correlation  $R=86.28\%$  and mean rectangular mistakes (MSE) of 1.32% after checking out the community. Saurav Dixit (2018) The creation sector faced plenty of issues, including low rates of productivity growth and diminishing growth, which have been studied by several researchers for years. This paper is an expanded version of the preceding one, with the following statistical analysis: The Kaiser–Meyer–Olkin (KMO's) table was arranged to assess the applicability of thing analysis, and a regression model was presented based on the outcomes generated using the SPSS 23 software package. According to the results of the dependability study, all of the elements have a cost greater than zero. The study's findings conclude that the most vast three attributes categorised in linear regression analysis trade in scope, with 67 being judged accurate., revision in drawings, and response to exchange orders having most effect over the development productiveness.

**Santhosh Loganathan, and Satyanarayana Kalidindi (2015).** Recent studies on Lean Construction display that exertions productivity has enormous correlation with paintings go with the flow reliability and venture performance. Lack of training and wrong businesses of the migrant personnel has resulted in unproductive and unpredictable work environment. The task incorporates of homes and a conference centre. Building-1 and a pair of are six-storeyed and 4-storeyed constructing. Masonry production interest of the assignment comprises of 230

mm and a hundred and fifteen mm brickwork wall construction. Actual manufacturing information for masonry creation activity had been amassed and analyzed. Results of the analysis imply that 20% to 40% manufacturing variation among distinctive creation crews concerned. The paper presents the factors which purpose manufacturing variation among special construction crews and provides how Lean Construction principles can better address the difficulty. They declare that adopting Lean Construction ideas, LPS as co-making plans tool can lessen paintings waft variant, and that reducing work waft variant can help to enhance hard work productivity.

**Mojtaba Maghrebi, Ali Shamsoddini. (2015).** The purpose of this project is to forecast the concrete pouring manufacturing fee by taking into account all production and delivery elements and employing a more thorough studying strategy. Unlike other approaches, these studies takes into account not just the optimum construction website criteria, but also supply chain parameters. The papers that have been in particular targeted on productiveness of concrete pouring in RMC are summarised. The works that have focused on the productivity of concrete pouring in RMC have been summarised. Machine learner fusion regression (MLF-R) is used to forecast concrete pouring responsibilities manufacture costs. MLF-R is employed with 2, 600 deliveries to 507 exclusive locations on a discipline database. The proposed data collection and effects are compared to Adaboost, ANN-Gaussian, and ANN-Sigmoid. R2 (Second) (ANN-Gaussian). In compared to other approaches, MLF-R has a better performance in obtaining the least root suggest square error (RMSE). Furthermore, the RMSEs produced from MLF-R forecasts in a few trials showed the least general deviation, indicating that this strategy is the most consistent among comparable methods. For implementing the proposed technique, the MATLAB R12 interface was chosen. In analogous investigations of concrete pouring productivity prediction, the RMSE from the first-class scenario is 3.28, and the RMSE derived using MLF-R is two Ninety two. The records set covers one month of deliveries across the metropolitan place and includes over 2, 600 deliveries to 507 distinctive places.

**Seungwoo Han et. al (2010).** The aim operation on this study was an earthmoving operation, which was chosen as the construction interest. In terms of utility, however, techniques that rely on a single estimation device face a variety of challenges. Model A, which combines multiple regression (MR) technique and a simulation, is a preferred estimating approach based on statistical notions, while Model B, which combines simulation and an artificial neural network (ANN) method, is an excellent tool for prediction in engineering. In this study, quantitative reliability comparisons between actual and anticipated productivity records were made using the presented models. These comparisons indicated the predictability of the outcomes and the effectiveness of each version's implementation. The fundamental characteristics and technical comparisons of each method, simulation-based MR or ANN methodologies, are discussed in this study. Researchers might use the information to develop or

broaden a fresh new predictive model. The typical assessment charges of models I, II, and III, respectively, were 99.06 percent, 91.23 percent, and ninety.89 percent, according to a comparative study produced by equipped predictive version A. In comparison to the effects acquired by equipped predictive version A, the common assessment charges of outfitted predictive version B were 103.06 percent, 98.8 percent, and 99.28 percent, respectively, for versions I, II, and III. These findings revealed that predictive version B was better suited for real-world statistics than version A. The user can obtain prediction effects by just inputting the facts for each issue or explanatory variable, making the implementation of predictive version A unexpectedly easier than that of model B.

**Dayanand, T & Sundarrajan, Shanmugapriya. (2016).** Various models were developed for the estimation of hard work productiveness but they do not provide reliable and accurate consequences, due to loss of legitimate and reliable information on manufacturing charges. Currently, manufacturing costs statistics is taken from the ancient file, private evaluations and judgments. Therefore, the goal of this observe is to develop an estimation version for construction exertions productiveness that offers dependable production rates that still takes under consideration of the elements influencing productivity by way of using Artificial Neural Network (ANN). The effect of various factors on creation productivity can be quantified with the aid of productiveness fashions. Modeling of production labour productiveness could be challenging when results of a couple of factors are considered concurrently. In this observe the multiple elements affecting the productiveness are used as an input for developing productiveness model the use of Artificial Neural Network (ANN) approach. Finally, a new statistics set is used in ANN to increase an estimation version. The Predicted Rate from the model is compared with Actual rate and difference is observed. From the distinction Mean Squared Error (MSE) is determined. These models play an essential role in production estimating, Scheduling, and making plans selections.

**Farid Mirahadi, Tarek Zayed (2015).** ANN systems are well-known smooth-computing areas that have greatly aided researchers in making decisions under uncertainty. It focuses on creation's weather, team, and mission. The following version, dubbed Modified NNDFR, is the product of trial-and-error and comparisons of different forecasting fashions' performance. The training dataset (90 percent-117 points) is separated into three subsets: schooling (70 percent), validation (15 percent), and checking out (15 percent) (15 percent). The current research presented a hybrid wise model to improve productivity estimation accuracy in construction operations. A modified form of a (NNDFR) shape was developed for this purpose. The NNDFR structure is first altered in this study by substituting the FCM for the K-Means algorithm. The model parameters that define the layout of the model were then optimised using GA. The improved version allows researchers to use historical data to forecast the productivity of manufacturing operations with greater accuracy than older methods.

**Identified Research gaps:**

1. Construction productivity centered most effective on labour component affecting the use of case take a look at.
2. Predictions of equipment productiveness studies paper are comparatively less out of 90% of research paper.
3. To higher know-how of the elements affecting on-website online productiveness in construction projects.
4. Performance difference of MLP fashions on schooling dataset is not enormous which fails to give higher end result than NN.
5. Cost and device productivity the use of ANN model are very less. So a long way, there is no systematic method to show production productiveness complicated.

**2. Conclusion**

An extensive reviews of literature survey deals with application of ANNs in construction activities related to prediction of costs, risk and safety, tender bids, as well as labour and equipment productivity. The results demonstrate that ANNs were particularly useful in efficiently decoding insufficient input statistics. According to the findings, ANNs were incredibly helpful in correctly analyzing insufficient input data. The majority of the researchers used a feed forward returned propagation kind of network; however, if a single ANN structure was found to be insufficient, hybrid modelling in conjunction with different device mastering tools like genetic programming and help vector machines proved to be very beneficial. It became evident, however, that the accuracy of the data and the modeler's experience are critical in achieving desirable outcomes. The preceding sections defined ANN applications in construction management and organised them into broad categories. ANNs are based entirely on the input-output statistics in which the model can be trained and can always be trained. The preceding sections defined ANN applications in construction management and organised them into broad categories. ANNs are entirely reliant on input-output statistics, and the model may be trained and updated at any time to get better results by presenting additional training cases. As a result, ANN has numerous advantages that make it an efficient instrument for resolving a variety of difficulties in the field of production management. It can be experimentation with community architectures, teaching algorithms, and hybrid methods that could lead to improved version performance. It will be easier to extend the usage of ANN in field of construction management if there is a common benchmark for measuring the accuracy level of construction proposals. Large-scale efforts in the future to release capability know-how within the community system can also help to increase construction productivity in construction management.

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