Predicting Construction labour Productivity Using Optimal Artificial Neural Network, Multiple Linear Regression Models: Comparative Study

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This Thesis was submitted in Partial Fulfilment of the Requirements for the Master's Degree in Engineering Project Management

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May, 2018

AUTHORIZATION FORM

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DETECTION

I would like to dedicate this research to my beloved father Mohammad Al-A'amar and my beloved mother Nayfeh Al-Akhras, who have been my source of strength and inspiration throughout my life. For they have given me all kind of support, guidance, encouragement and love. Without their continuous prayers, this work would not have been possible. Thank you for giving me a chance to prove and improve myself in each step of my life, without forget my dear brothers, Dr. Bashar and Engineer Amer, Ahmed, Abdulelah and my two pearls sister Rasha and Shatha .

Without any doubt, a special dedication to that pure spirit that will not surprise me and that taught me the true meaning of love of God and how to endure the difficulties of life and work hard to achieve the goals and here I mean my sister Amal Al-A'amar.

Hamzeh Mohammad Al-A'amar.

ACKNOWLEDGEMENT

First of all, I am grateful and thankful to Almighty God for all the blessings in my life and for giving me the power, courage and determination in each step of my life to continue achieving my goals.

I would like to express my great appreciation to my supervisors, Dr. Faiq Sarhan Al zwainy, for his patient guidance, enthusiastic, encouragement and useful evaluations of this work. It is really a great pride to be one of him students and to have the opportunity to be under him supervision.

I would like to thank the head of my work, Eng. Mohamed Hamdan, for the moral support and encouragement he has given me. He is truly an example to the leader, who is always interested in team spirit and going up to the summits.

I thank my family and everyone who supported me and I thank all my friends, especially Eng. Hamzeh Al-Safadi, who has always been the best friend, good brother and good opinionator.

Thank you,

Hamzeh Mohammad Al-A'amar.

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LIST OF ABBREVIATION

AI	Artificial Intelligence
ANN	Artificial Neural Network
APE	Absolute Percentage Error
APV	Aldada Private Villa
b_j	Bias or Threshold for Node j
CAGR	Compound Annual Growth Rate
CP	Construction Productivity
d_k	Desired Output of Neuron K
DEMATEL	Decision Making Trial &Evaluation Laboratory
EP	Execution Position
EYN	Experience Year Number
FFNN	Feed Forward Neural Network
FI	Frequency Index
F( )	Transfer or Activation Function
F`	Derivatives of Activation Function
GDP	Gross Domestic Product
I_j	Activation Level of Node j
II	Importance Index
LOGSIG	Log-Sigmoid Transfer Function
MACE	Mongolian Association of Civil Engineer
MAPE	Mean Absolute Percentage Error
MLR	Multiple Linear Regression
MP	Material Position
NN	Neural Network
NSL	Number of Support Labor
PE	Processing Element
R	Correlation Coefficient
R^2	Coefficient of Determination

RBNN	Radial Basis Neural Network
RII	Relative Importance Index
SC	Site Condition
SD	System Dynamic
SI	Severity Index
SPSS	Statistical Package Society Science
SPV	Sinokrot Private Villa
SR	Social Relationship
SSE	Sum Square Error
SVM	Support Vector Machine
SZ	Stone Size
TANSIG	Hyperbolic Tangent Transfer Function
TRB	Tebyeh Residential Building
W_{ij}	Connection Weight between Node i and j
$W_{jk}(n)$	Weight Correction
$W_{jk}(n-1)$	Previous Weight Correction
X_i	Inputs
Y_j	Output of Node j
η	Learning Rate
α	Momentum Term
δ	Backpropagation Error

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ABSTRACT

Construction productivity can be considered as an element in project management; therefore, predicting the rate of construction productivity for labor was an important task. However, the development of the technology tools will enable the planner to best understand the process of estimation and predicting in different stages of construction projects.

The main aim of this research is to develop a novel mathematical model using Multiple Linear Regression (MLR) and Artificial Neural Network (ANN) to predict the construction productivity rates because mathematical models and mathematical equations used for finishing stone activity are characterized by uncertainty and lack validity and verification, and traditional methods fail to calculate the construction productivity due to their slowness and lack of accuracy.

Data was collected from three residential building projects in the Hashemite Kingdom of Jordan in the capital city of Amman from July 2017 to December 2017. The first project was Tebyeh Residential Building (TRB); the second project was Sinokrot Private Villa (SPV); and the third project was Aldada Private Villa (APV). The results demonstrated that (MLR) is a more powerful technique than (ANN) for construction productivity of finishing stone activity depending on validity through Mean Absolute Percentage Error (MAPE%)

and Average Accuracy (AA%), which were equal to 18.615% and 81.3846% respectively; ANN technique (MAPE%) was equal to 27.06 % and (AA%) was equal to 72.94%. This result can be expressed when using multiple linear regression techniques instead of artificial neural networks in estimating and predicting construction productivity when the data of the variables are homogeneous; otherwise, use of artificial neural networks technique is preferable.