

# Using Artificial Intelligence and computation Enhanced apply in neural network

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The present study focuses on the optimization techniques to minimize time and cost in prefabricated constructions. Artificial Neural Networks (ANNs) are used for optimization, due to their ability to resolve qualitative and quantitative problems encountered in the construction industry. In an ANN, the input layer, hidden layer, and output layer are performed based on the weight of the hidden layer. The layers are optimized by using various optimization techniques. In the construction management, ANN covers an extensive part of the problems such as cost estimation, decision making, predicting the percentage of markup, and production rate in the construction industry. The fundamental benefit of prefabricated methodology is the quick completion of the process. The other genuine advantage of the prefabrication process is its inbuilt flexible nature. The success of any construction firm depends on the projects completed within a stipulated time frame and at the agreed cost. The construction industry is comprises of prefabrication manufacturing companies, logistics parties, on-site construction fields, and so on.

**Keywords:** Artificial Intelligence; Enhanced sensor; project management; neural network

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## 1. Introduction

The economy of a nation is constrained by a few variables, viz., populace size, modern exercises, horticulture, approaches of its administration, culture of individuals, instructive framework, foundation offices, and so on During the time spent fulfilling the essential requirements, for example, food, haven and garments, individuals connect with themselves in different exercises, for example, horticulture, lodging and material enterprises. Every one of the above businesses is upheld by different enterprises. For instance, a material industry is upheld by machine device, agribusiness and compound enterprises. Significant part of the result of every one of the ventures is devoured by people in general and a segment of it is taken care of as crude materials or gear to different businesses. Far beyond these mechanical exercises, schooling and preparing of required labor for these businesses are taken consideration

by instructive establishments. Notwithstanding these exercises, there are many assistance associations, viz., wellbeing, transportation, postal, lawful, protection, banking, and so forth, for obliging the necessities of the general public [1].

The approaches and the rules of both the focal and state governments encourage the combination, coordination and control of the multitude of exercises of the country with the target of expanding the development of the country. Subsequently, plainly every element of the country is compelled to have a serious part to amplify its profitability for its endurance. A development project is time bound and utilizes colossal assets of men, material and apparatus. The cash included is from millions to billions. Specialized advancement has incredibly impacted the development business. Elevated structures, modern plants, and infrastructural offices have been created in a multidimensional aspect. The

development being both homegrown and worldwide, the development business is a significant supporter of the advancement of a country. This industry produces more work than a large portion of the other modern areas [2].

From the past two decades, Indian construction companies have been undergoing an intense dynamic change, due to political and economic influences on the construction market, such as privatization of state-owned companies, opening of Indian market, aggressive post-disaster reconstruction activities, intense construction of motorways, and so on. These turbulent changes have influenced the construction companies in different ways. Many Indian companies, that were dominant earlier, has disappeared from the market and some companies have transformed their management and construction processes to prefabricated structure technology.

Prefabricated construction is defined as the exercise of making construction components in a manufacturing factory, transferring completed or semi-completed components to the construction site, and finally assembling these components into a building. The prefabrication procedure includes both the production and the transportation of pre-cast components to the erection site [3].

In general, prefabrication technology has been used in many countries and regions where a definite amount of building components is manufactured in a controlled environment, moved to the construction site, and put together into a building. The prefabricated housing units have been improved to an extent that they cannot be differentiated from the conventional buildings even by those who reside in them. Prefabricated structures may be needed in difficult weather conditions to increase the speed of the construction and also to minimize the wastage of the construction material by using mass production under control over material. This requirement has also been extended for constructing large span beams and bridge decks with quicker time by reducing formworks, shuttering material and labor cost in the construction sites [4].

Structure should comprise small numbers of component types such as beams, columns, panels, roof slab etc., and connection should be few and simple. Components are able to be used, to perform some functions like load bearing and space enclosing. The weight of the components should be less and as a result, erection will be easier and safer which may help to reduce the construction site accidents. The components should be suitable for mechanized production or, at any rate; the production should have high degree of mechanization. The structure must be designed based on the structural features such as span, crane loads and lighting etc [5].

Cautious treatment of pre-assembled segments, for example, solid boards or steel and glass boards is fundamental. Consideration must be paid to the erosion obstruction of the joining of pre-assembled segments to maintain a strategic distance from disappointment of the joint. Transportation cost might be higher for voluminous pre-assembled areas than for the materials of which they are made, and henceforth, they should frequently be pressed all the more effectively. Huge pre-assembled areas require substantial cranes, accuracy estimation and dealing with to put in position. The pre-assembled concrete and pre-assembled steel areas are the most broadly utilized type of construction in the development of building structures where a specific part or structure is rehashed ordinarily. Pre-assembling steel segments decrease nearby reducing and welding expenses just as the related perils. Additionally, pouring solid areas in a manufacturing plant brings the benefits of lessening the waste and it likewise assists with reusing the formwork. The solid can be blended on the spot without being shipped and siphoned wet on a blocked building site. Since the need for shuttering and scaffoldings has been greatly reduced by using self-supporting ready-made components and reduction in cost of shuttering and scaffoldings is achieved effectively [6].

Construction strategies are utilized in the development of loft squares, and mass lodging advancement projects with continued lodging units. The methods are likewise utilized in office squares, distribution centers and industrial facility structures. Pre-assembled steel and glass areas are generally utilized for the outsides of huge structures. This offers critical points of interest regarding less development time, wellbeing, ecological effect, constructability and savvy for the project workers. Moreover, radio pinnacles for cell phones and different administrations regularly comprise of various pre-assembled segments. Prefabrication can also help in minimizing the traffic congestion arising during bridge construction in densely populated area because the shuttering and scaffoldings space is ultimately reduced. As a result, traffic congestion is avoided in the bridge construction area [7].

Prefabrication allows an earlier return of the capital investment by reducing the construction project completion time comparing to the traditional approach. Likewise, strength and good quality of components of prefabricated units are manufactured with effective technical control by considering several factors such as storage, grading of materials, proportion, mixing, curing, accurate dimensioning of members and proper positioning of reinforcement etc. Due to high quality control, higher working stresses of concrete can be manufactured and it results in saving of

concrete. Reduction in dimension leads to the reduction of overall weight of the structure [8].

Prefabricated structural component manufacturing or production in factory can procure independent of weather conditions [9]. Consequently, time spent in awful climate or risky climate at the building site is limited. In this manner, spotless and dry site offers improved working condition for works. Accordingly, construction should be possible effectively where gifted works are all the more promptly accessible and besides, expenses of work, power, materials, space and overheads are lower than the ordinary structure development [? ]. This research organized as in section 2 literature review described, In section 3 research methodology described, In section 4 Results and discussion analysed, and final conclusion and future work described in section 5.

## 2. Literature review

Literature review in respect of time and cost management of construction projects has been done extensively and the same is discussed in this section.

In [? ] author have recommended that the ANN and relapse models are utilized to anticipate the vertical twisting of High-Density Poly-Ethylene (HDPE), little width adaptable lines covered in fortified channels. It is exposed to rehashed loadings to mimic the substantial vehicle loads. The trial information from tests show that the Vertical Diametric Strain (VDS) of line implanted in strengthened sand relies upon the overall thickness of sand, number of fortified layers, and the tallness of inserted pipe altogether.

In [10] author have created and tried the TCM III calculation (where TCM represents the Time Coupling Method) by joining the Theory Of Constraints (TOC), Critical Chain Method (CCM), and Critical Path Method (CPM) in the investigation of connections between the all out span of activities and the expense caused on such ventures. This calculation has demonstrated to be helpful for limiting the work cost, and for assessing the absolute expansion in the undertaking acknowledgment cost.

In [11] author have outlined the concurrent impacts of human elements, street, vehicle, climate conditions, and traffic highlights including traffic volume and stream speed on the accident seriousness in metropolitan interstates through various models. Notwithstanding the huge advances in the security of roadways, a great deal of accidents with high severities actually happen in the expressways.

In [12] author have contributed the "cost modeling" research field, from the project management and facility management perspectives, by developing an effective ANN cost prediction model in predicting buildings' future Oper-

ation Maintenance (OM) cost during the project planning phase.

In [13] author have proposed that the optimization of construction time and cost is connected to the cost of events and the cost of complete project realization. All the activities such as duration, direct and indirect cost, project realization time, and relationship among the activities are taken into consideration. For solving this nonlinear problem, the PSO method is applied. With the help of suitable software along with the scope of a MATLAB programming system, enhanced methods are developed for optimization of time and cost.

In [14] author dissected concerning time and cost included interstate street development project utilizing ANN. The necessary information were gathered from the effectively finished two interstate street projects and the models were prepared, tried, and approved utilizing MATLAB R2013a Software.

In [15] author have introduced a moderately new administration model for the ideal plan and activity of water system water siphoning frameworks. The model utilizes the recently presented molecule swarm streamlining calculation. Numerically, it is an ideal plan and activity of siphoning stations territory huge scope nonlinear programming issue, as a result of the size of the issue as far as the number and nonlinearity of the choice factors and limitations.

In [16] author have proposed another improved rendition of Particle Swarm Optimization (PSO). A significant adjustment has been made by adding probabilistic capacities into PSO, and it is named as probabilistic PSO (PPSO). The variety in the speed of particles in PSO comprises its internet searcher, and gives two periods of improvement measures, for example, investigation and misuse.

In [17] author have proposed the use of Ant Colony Optimization (ACO) calculation for the plan of a water supply pipeline framework. Water Conveyance Systems (WCSs) are expensive foundations as far as materials, development, upkeep, and energy necessities. Much consideration has been given to the use of improvement strategies to limit the expense related with such frameworks.

In [18] author have suggested another Continuous Ant Colony Optimization (CACO) calculation for ideal repository activity. The examination has likewise proposed an elitist methodology for CACO calculation where best arrangement of every cycle straightforwardly replicated to the following emphasis to improve the presentation of the technique.

In [19] author expressed that, through an assortment of agreeable specialists called ants, the close to ideal answer

for the multi-supply activity issue might be accomplished successfully by utilizing Ant Colony Optimization Algorithms (ACOAs). The issue was drawn nearer by thinking about a limited working skyline, by grouping the potential deliveries from the reservoir(s) in the foreordained stretches, and extending the issue on a diagram.

In [20] author have talked about the use of two calculations, Heuristic Big Bang-Big Crunch (HBB-BC) and a Heuristic Particle Swarm Ant Colony Optimization (HP-SACO), to discrete enhancement of strengthened cement planar edges subject to blends of gravity and horizontal burdens dependent on ACI 318-08 code.

In [21] author built up a Direct Index Coding (DIC) for discrete estimating advancement of designs. The GA administrators, specific and received for this sort of encoded chromosomes, are contrasted and those of customary GAs. The notable 10-bar support model from examines is treated here as an examination benchmark, and the extraordinary computational productivity and the solidness of the proposed technique are outlined.

In [22] author have offered an orderly path for finding an ideal number and area of actuators following up on the construction. A significant factor in the plan and usage of primary control procedures is the number and position of actuators. By utilizing the ideally found actuators, the adequacy of the control framework can be expanded.

In [23] author have proposed a nonexclusive model, which coordinates hereditary calculations with fake neural organizations, for demonstrating designing execution estimation, to improve mechanical development projects. Modern development projects have been encountering significant issues, for example, cost invade and plan delay. While looking for the reasons for the issues, individuals have come to understand the effects of designing exercises on a fruitful venture execution.

In [24] author have introduced a structure for online master and choice emotionally supportive network to evaluate the danger level of causative variables of time and cost invade on venture accomplishment all through the lifecycle of development measure. It will be incorporated with the task timetable to gauge the results of these variables and figure the deficiency of time and cost, if the danger factors are not controlled.

In [25] author have built up a device to assess the possibility cost of a street upkeep contract by utilizing a numerical model. By and large, a possibility cost is given in a task to cover the change orders that might be created in an undertaking during the development stage, because of different reasons, for example, unanticipated conditions, plan mistakes, and extension changes.

In [26] author have proposed a novel arrangement framework coordinating multitude and meta-heuristic insight, i.e., a shrewd firefly calculation, with a least squares uphold vector machine. Benchmark capacities were utilized to approve the exhibition enhancement of the brilliant firefly calculation.

In [30] author have discovered that five most huge elements causing time and cost overwhelms in Indian development are material market rate, contract alteration, significant degree of value prerequisite, project area, relies upon the fresher's to bear the entire obligation regarding time invades and high transportation cost, change in material particular, acceleration of material cost, regular breakdown of development plants and hardware, and modify for cost overwhelms.

### 3. Research methodology

The profitability of any association can be improved through a few examination considers. Each exploration study is a coordinated arrangement of exercises to examine and build up a model or strategy/procedure to dissect the aftereffects of a sensible issue upheld by the writing and information and with the end goal that their destinations are improved. Further, suggestions/impedances are made for usage.

#### 3.1. 3.1 Key information

For this research study, the data collection may be refined with the contents of small and medium residential, commercial and institutional building projects on prefabricated structure. So as to get a more accurate picture of the perceptions of the low cost housing sector in prefabricated construction industry, the small and moderate low cost housing sector individuals only participated in the survey.

Similarly, concentrates in this model have refined the substance by not using diverse model boundaries, for example, extraordinary number and gathering of variables impacting profitability other than the level of construction content utilized. Additionally, this investigation couldn't be performed for various explicit sorts of development projects, for example, street and railroad development projects, utility ventures, expressways, viaducts and other pre-assembled development projects, and so on This investigation has received quantitative method of examination and information assortment has been helped out through organized poll study among the professionals, for example, customer, advisors and workers for hire who are associated with taking care of pre-assembled development projects.

These respondents have working experience of over 10 years in the field of development. As far as scholastic ca-

capacity, the vast majority of the respondents for example 85% have least of structural science certificate. The examination demonstrates that the respondents have practiced high dynamic forces in their associations, because of their impressive experience and information.

The assembled information are then examined and noticed all the structures researched in this examination. It is discovered that 24 structures have been built essentially utilizing a blend of construction with integral on location development; seven structures are developed utilizing ordinary development techniques with a little extent of prefab casings and parts and just five structures are completely particular with reciprocal on location development.

The extent of prefab substance for a structure has been figured by assessing the expense of prefab parts as a level of the complete last undertaking cost. The natural expense detailing structure received for the situation study projects has given helpful information to calculation. The computed values of percentage of prefabrication content for different projects are calculated by using the following Table 1.

### 3.2. Artificial intelligent

The Artificial Neural Network (ANN) is a productive data preparing framework which takes after the attributes of a natural neural organization. ANNs have enormous number of profoundly interconnected handling components called hubs or units or neurons, which typically work in equal and are designed in standard models. Every neuron is associated with the other by an association connect. Every association interface is related with loads which contain data about the information signal. This data is utilized by the neuron net to take care of a specific issue.

An ANN's aggregate conduct is described by its capacity to learn, review and sum up the preparation examples or information like that of a human cerebrum. They have the ability to display the organizations of unique neurons as found in the mind. In this manner, the ANN handling components are called neurons or artificial neurons. Figure 1 shows the mathematical model representation of the artificial neuron.

Neural organizations, with their wonderful capacity to get importance from confounded or loose information, could be utilized to remove designs and identify patterns that are too mind boggling to possibly be seen by people or other PC procedures. A prepared neural organization can respond as a specialist in a specific classification of data and it examinations the information. This master could be utilized to give projections in new circumstances of interest and to find solutions for the inquiry raised. Different focal points of working with an ANN incorporate, versatile

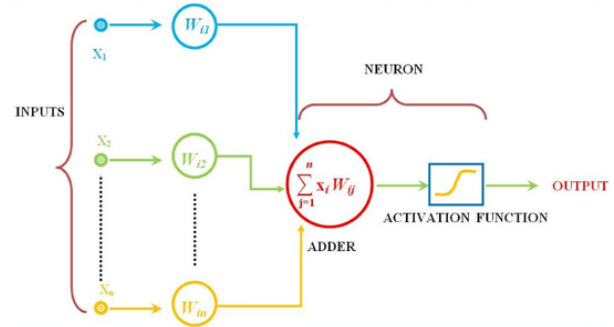


Fig. 1. Mathematical model of artificial neuron.

learning, self-association, constant activity and adaptation to internal failure through excess data coding.

### 3.3. Weight

The ANNs are presented as figuring frameworks which are comprised of number of straightforward, and exceptionally interconnected preparing components called neurons. The organizations are addressed by connective loads between the neurons. These loads are the boundaries that characterize the nonlinear capacity performed by the neural organization. As a rule, the weight addresses the strength of associating the info and the yield neurons. A positive weight compares to an excitatory neural connection, and a negative weight relates to an inhibitory neurotransmitter. The actuation work is applied over it to compute the yield.

The loads contain data about the information signal. This data is utilized by the net to take care of an issue. The weight can be addressed regarding grid. The weight lattice can likewise be called association framework. On the off chance that the weight lattice contains all the versatile components of an ANN, at that point the arrangement of all conceivable data handling designs for the ANNs. The ANNs can be acknowledged by finding a proper lattice. Consequently, the loads encode long haul memory and the actuation conditions of neurons encode transient memory in a neural organization.

### 3.4. Training

The Artificial Neural Networks, similar to individuals, learn as a visual cue. An ANN is designed for explicit application, for example, design acknowledgment or information arrangement through learning or preparing measure. Learning or preparing is a cycle by methods for which, a neural organization adjusts to an upgrade by making appropriate boundary changes, bringing about the creation of wanted reaction. Comprehensively, there are two sorts of learning in ANNs and they are boundary learning and

**Table 1.** The percentage of prefabrication content.

Project	Prefabricated components cost (INR)	Total project cost (INR)	Percentage of prefabrication content (%)
1	225000	750000	30%
2	256500	675000	38%
3	400050	889000	45%
4	395000	790000	50%
5	670280	1289000	52%
6	775475	1550950	50%
7	965709	1755835	55%

construction learning.

Boundary learning refreshes the interfacing loads in a neural net. Design learning centers around the adjustment in the organization construction and it incorporates the quantity of handling components just as their association types. The boundary learning is utilized in this examination study, since it refreshes the associating loads in a neural net. Aside from these two classifications of learning, the learning or preparing of an ANN can for the most part be ordered into three classifications, for example, directed, unaided and support learning.

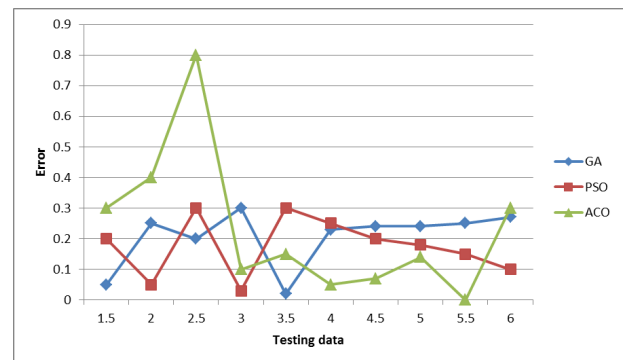
Regulated learning has been utilized in this examination study, since all these constant occasions include directed learning strategy. Here, the learning or preparing is performed with the assistance of an instructor or client. For the regulated learning in ANNs, each information vector requires a relating objective vector, which addresses the ideal yield. The info vector alongside the objective vector is called preparing pair. The organization here is educated absolutely about what ought to be transmitted as yield.

#### 4. Results and discussion

Lately, the ANN has achieved a lot of thought on account of its ability to address both the quantitative and subjective issues experienced in the development business. This work has been proposed to anticipate the Cost Performance (CP) and Time Performance (TP) of the construction interaction in the development project by using the ANN. Here, various rates of construction substance are included the development, and assessed span, genuine length, assessed cost and real expense are utilized as the contributions to the ANN cycle.

The ANN structure is used for preparing with the known information and this interaction is the fundamental stage in the expectation cycle. The better worth got in the ANN structure streamlines the heaviness of the construction. Ideal load of the design is accomplished by utilizing different advancement strategies. On the off chance that the accomplished outcomes are not up to the degree of expected, at that point the preparation cycle is reshaped

to adjust the construction to the fitting level to foresee the yield. When the achieved blunder esteems between the yield of the real qualities and the anticipated qualities are intently equivalent to nothing, at that point the planned model is used for foreseeing the obscure qualities in the information and for enhancing the time and cost of the interaction. The consequences of the proposed work are accomplished utilizing the working foundation of MATLAB 2014a, with the framework arrangement i5 processors with 4GB RAM and the assessment is finished utilizing ANN measure. Along these lines, the Graphical User Interface (GUI) is made by utilizing the previously mentioned framework design to achieve the aftereffects of the proposed ANN model.

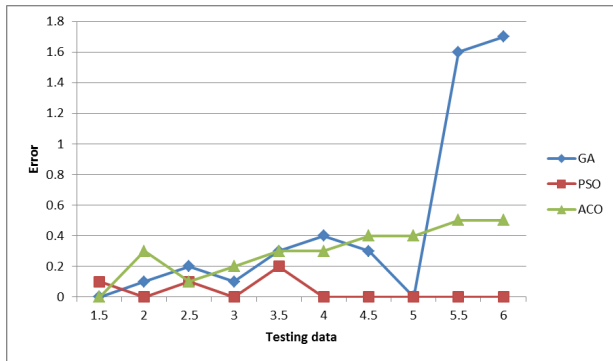


**Fig. 2.** Error graph for time performance with different algorithms of same source data.

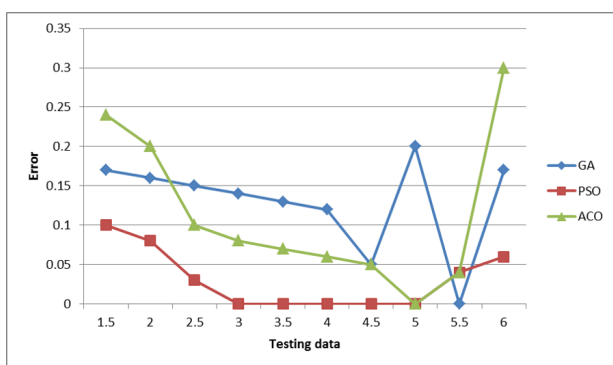
Figure 2 shows an error graph for the time performance of the prefabrication technology process by using different algorithms. Minimum error value of the proposed method with the initial data is compared with the ACO.

Figure 3 shows the error graph for cost performance for different optimization techniques. In this testing error graph also, the minimum error value of the cost performance is attained in the PSO process for the different testing input data values.

Figures 4 show the error graphs for time and cost performances with different Algorithms. During the testing process and the validation process, the best optimum solution



**Fig. 3.** Error graph for cost performance with different algorithms of same source data.



**Fig. 4.** Error graph for time performance with different algorithms of external data source.

is obtained from the PSO algorithm. Thus, the proposed model is validated.

## 5. Conclusion and future work

For being successful in managing a construction project, familiarity with its particular challenges and specifications is essential. An ANN model is used for shaping and implementing the business strategies of the construction companies. The main aim of the research has been accomplished by proposing an optimum time and cost estimation model for precast technology by GUI. The requirements to be met during this procedure have also been defined. As the optimization of time and cost is necessary, it could minimize both the time and the total cost of the project and the optimizations of time and cost are achieved. For future research study, this model may be refined with the contents for mass projects by consulting with professionals working on prefabricated structure. Since, the model has been developed based on the perceptions of the small and moderate low cost housing sectors, only limited individuals have participated in the survey.

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