

A Deep Study on Construction Waste management using Machine Learning

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Abstract - Due to exponential growth in population and human greed the construction works are going on like never before. The process of construction of the building is vast and requires a tremendous amount of the materials in abundance. The most problematic process of construction is an efficient windup of the whole premises after finishing the work. But most of the time this is never going to happen because of piling up of construction wastes like cement, steel, bricks, sand, stone and etc. in very sick manner. This eventually creates the problems for the peoples staying nearby the location. This not only creates the problems in people's life it also becomes the burden on the site owner's fat pocket. So, this paper studies the all past works to reveal a new method to handle construction waste management using Linear regression model and Machine learning models.

Key Words: Regression Analysis, Linear Regression, Machine Learning, waste management Analysis.

1. INTRODUCTION

Construction is one of the most important aspects of modern human life. Early humans dwelled in caves, this would provide them the shelter from the rain, cold, heat, etc. These were the earliest forms of shelters when the species graduated from hunter and gatherers and into farming and producing our own food. This meant living close to the farm was more viable. This is the reason humans started making houses that can be utilized to provide shelter and safeguard them from the elements.

The constructions that were built in the early ages of human evolution were mostly made out of mud and rocks, which was easily available and could be readily transformed into an enclosure. As the human race progressed, the buildings got more and more advanced. Earlier the construction was limited to creating a roof. Then, humans started constructing houses on top of each other. As there were advancements made in material strength more and more buildings with more and more floors started being constructed and led to the development of skyscrapers. These buildings require extensive engineering efforts to be able to be constructed. A lot of materials reused in the construction that would guarantee the resilience and the

safety of the structure as it would be housing a lot of people and their safety is a very big concern. A large amount of materials also increases the number of waste products that are generated as a result of construction.

Construction creates a large amount of debris and waste. The waste generated can be of different materials, leftover bars, cement, and concrete, also large amounts of dirt and other hazardous chemicals required in the construction. This is usually not paid much attention to as the main focus is to complete the work on time. This creates a hazardous environment to work for the workers as well as increase the amount of waste in the city. The rising amount of waste is one of the biggest concerns as it is harming the aesthetic of the city, as well as the construction waste, which consists of a lot of hazards such as steel plates, rods, glass pieces that can greatly injure a person.

Construction waste also reduces the efficiency of the work being done, as having waste lying around would cause injuries to the workers and also cause a hindrance in their work. The amount of waste generated could also be linked to poor planning and execution. All of these issues cause a lot of concern as waste on our planet is degrading our environment at a faster pace. The waste is also dangerous for the animals living close to the area, as this would become a breeding ground for various deadly contagious diseases. Therefore, it is imperative to reduce the generation and management of waste at an elementary level to overcome such grievous circumstances.

Machine Learning can come to the rescue in such situations. Machine learning can help the builders get an estimation of the amount of waste that is being generated. Machine learning is used in various different applications to provide an insight into the process by analyzing the data that is being produced. Machine learning can utilize past data and generate an accurate prediction of future events based on this analysis. Therefore, machine learning can predict the amount of waste generated through construction activity. This insight can be used to reduce such waste and also design ways to manage the waste in such a case where Construction Waste is unavoidable, to ensure the safety of the people and the construction workers at the same time.

In this paper, section 2 refers to literature survey and section 3 concludes the paper

2. LITERATURE SURVEY

This section of the literature survey ultimately discloses some facts based on attentive study of many authors work as follows.

P. Karningsih [1] explains that most of the major problems faced by a project or a construction are improper quality, budget overruns and frequent deadline delays. This is highly inefficient for a construction and creates a lot of waste in the process, therefore, lean construction approach is proposed to eliminate such concerns from construction processes. The authors have extensively tested this methodology to ascertain that the most amount of waste is created due to correction and waiting. This approach can also minimize the wastage that is created due to the above-mentioned sources. The major drawback in this approach is that it has not been tested extensively to assess its performance.

M. Bajjou elaborates on the various techniques that are used for managing construction projects traditionally and has come to a conclusion that those conventional techniques are not highly efficient and usually produce a lot of wastage. This is undesirable and could lead to a lot of difficulties that are experienced by the construction workers and the people living nearby. Therefore, to eliminate this effect, the authors in this paper propose a Lean Construction approach to the construction paradigm to significantly reduce the wastage produced [2]. The major gap in this research is that the proposed methodology has only been tested in Morocco.

M. Covaciu explains that the demolition and construction projects are very large generators of garbage and waste products. This is a growing problem as houses are being constantly built all over the world to accommodate the rising populations. The authors in this paper have attempted to reduce this production with the help of recycling the waste materials for various different purposes in construction [3]. The authors have utilized a high frequency electromagnetic field for determining the waste and its properties to effectively recycle the waste. The drawback in this paper is that this technique can reduce a small amount of waste by recycling.

A. Sambhanthan introduces the different types of waste that is generated in a software company and the various different techniques to reduce this waste. The authors in this paper have analyzed the different types of waste generated with the help of a Nvivo qualitative analysis tool. This tool then identifies the most types of waste being generated. This data is used by the authors to design a system to reduce this generation of waste and efficient reuse and recycling of the waste products [4]. A major drawback in this technique is

that the authors have only surveyed software companies for this paper.

M. Masduzzaman addresses the issues and the significant increase in the amount of electronic and electrical waste. Due to the fact electronic waste can contaminate the environment and can be highly hazardous for the humans and animals around the contamination, the rising electronic waste must be controlled. Therefore, the authors decide to tackle this problem by utilizing the electrical wastes for construction as an aggregate in concrete [5]. The authors suggest that the usage of electronic waste being used as an aggregate would significantly reduce the waste production. The major drawback in this approach is that the authors have not tested these techniques for the various performance parameters.

A. Adedeji [6] states that there has been an increased amount of waste being produced, which has very detrimental effects on the environment and the people living close by. The authors surveyed construction sites and that has resulted in a lot of revelations about the waste generated on the construction sites. The construction sites have a large amount of waste that is generated due to the fact that the construction work isn't planned efficiently. Therefore, to eliminate these concerns, the authors have developed a builder's estimation application which helps the builders plan their construction with minimum wastage.

V. Belpoliti reviews the largescale construction and the rapid development in the UAE in the past years. The rapid urbanization and development have led to a significant increase in the amount of waste in the form of construction waste that is generated from various different construction sites. This is highly problematic as the country hosts a lot of tourists and the waste can be the source of a lot of diseases and is not aesthetically pleasing sight to look at [7]. Therefore, the authors have concluded that there is a need to develop sustainable construction waste management techniques to help ameliorate these effects.

O. Savoshinsky explains that the task of fire management is highly critical and the municipal corporation is responsible for maintaining the safety in their areas and reduce damage done through fires. A lot of waste is also a major cause of fire as different materials used in construction can mix together to turn into a deadly toxin that is flammable. Therefore, management of waste is highly critical for the purpose of increasing the safety in the transportation of waste across the city [8]. The major drawback in this technique is that the waste management only utilizes the GPS for management and does nothing to reduce the waste generation.

M. Akram elaborates on the apparent economic growth that has been the driving force behind the rapid urbanization in the city of Dubai. The city has witnessed a record expansion and construction in the recent years that has led

to a marked increase in the production of construction waste by product. This waste is highly dangerous and must be reduced to lower its impact on the environment [9]. Therefore, the authors in this paper have proposed a system to systematically reuse and recycle waste products generated due to construction and thereby reducing consumption. The major drawback in this technique is that it has only been developed for the city of Dubai.

M. Vostrikov surveys the various different means of waste management and reduction that are being used across the world to eliminate the risk and the negative impact of waste on our planet. The authors have reviewed various different machinery that is responsible for effectively getting rid of the waste. The machines incinerate the waste without much harm done to the environment and the by products formed are reused and recycled again to reduce consumption. Construction waste is highly dangerous and must be handled with care to ensure no mishaps can occur due to injury. [10]

I. Petriwi presents a unique approach towards the management and reduction of construction waste. Construction waste is a really big problem and it is getting highly problematic to process and manage construction waste efficiently [11]. Due to the threat of climate change and global warming, it is imperative to find a solution to this looming problem. Therefore, the authors have presented an innovative solution in the form of waste management contractor, which plans and executes the construction with the minimum amount of waste being generated and managing the waste that is generated effectively.

T. Ali explains that there has been a steady increase in the amount of construction waste being generated everyday as the outcome of increased urbanization which is due to the large number of people. This has led to poor waste management in the area of demolition and construction. Therefore, to reduce the harmful effects of the significant increase in the waste, the authors have proposed a methodology for the construction waste management through the application of Artificial Intelligence [12]. The waste management technique focuses on the economical reduction of waste which is one of the drawbacks in this methodology.

Q. Wang states that there has been a marked increase in the amount of waste being generated every day. This is not a good practice as it poses a significant health risk for individuals working on the site as well as animals. The environment too takes the brunt of the waste generated and accelerates climate change and global warming. Therefore, the authors have reviewed the various different behaviors associated with the reduction of the waste and generated an evolutionary game model of the enterprises [13]. The authors devise a plan to penalize the waste generating enterprises for not utilizing efficient waste management

techniques. The logistical hurdles in the determination of misconduct are on the of drawbacks in this paper.

S. Ghanimeh elaborates on the paradigm of demolition and construction waste management as it is on the rise in the recent years, has led to a significant degradation in the environment. The growing threat of global warming and climate change, the issue of waste management has become a big concern. Therefore, to reduce the impact of the demolition and construction waste, the authors have assessed and quantified the areas in Lebanon [14]. This information is then utilized to model management strategies to effectively manage the waste. The major drawback in this approach is that the modelling has not been applied successfully in construction.

3. PROPOSED MODEL

By analyzing all the facts through the above section, this research article comes to a conclusion of implementing a system for construction waste management using the following block diagram as depicted in fig. 1.

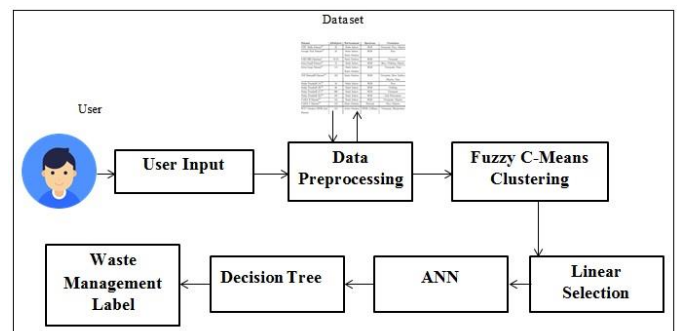


Figure 1: Block Diagram

The algorithm we are using are:

1. Fuzzy C-Means Clustering –

In FCM clustering, each datapoints can belong to more than one cluster. FCM algorithm involves assigning datapoints to clusters such that:

- a. Items in the same cluster are as similar as possible.
- b. While, items in the different cluster are as dissimilar as possible

2. Artificial Neural Network –

ANN is an Information Processing Technique, works like the way human brain processes the given information includes a large number of connected nodes or processing units that work together to process given information.

3. Decision Tree –

Decision tree helps us to create training model using by training data, decision tree algorithm is used to predict the value of the target variable or class by learning simple decision rules concluded from prior data or training data.

The components given in the figure above are described below in brief.

Step 1: User Input and Dataset Preprocessing – The user will provide the system some input parameters regarding the construction. This step also takes the synthetic dataset as the input and preprocesses the dataset to condition the data before performing any operations on it.

Step 2: Fuzzy C-Means Clustering – In this step, the preprocessed dataset is utilized for the purpose of clustering through the use of the Fuzzy approach.

Step 3: Linear Selection – The linear selection technique is deployed for the selection of the clusters on the basis of the user input provided in step 1.

Step 4: Artificial Neural Network – In this step, the obtained and selected clusters are sent to this module that performs the various processes related to the Artificial Neural Network.

Step 5: Decision Tree – In this step, the decision tree takes the output from the ANN module as the input and deploys the if-then rules to achieve the effective classification of the outcomes.

4. CONCLUSION

This paper basically concentrates on studying all the past works which were written on the construction waste management. The concept of construction waste management requires very broad and in-depth analysis of the construction industry. Here all the required scenarios need to analyze related to the construction right from the raw materials to labour cost. This paper works to reveal a new idea of managing the construction waste using the machine learning algorithms like Artificial Neural network, linear regression and Random forest classification algorithm to achieve better accuracy in construction waste management.

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