

# “Artificial Intelligence in Building Construction”

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**ABSTRACT:** Artificial intelligence is the ability of computer systems to perform tasks which otherwise need human brain. Those tasks include visual perception, decision-making, speech recognition and translation between languages. Large amount computing resources is required to traditionally design and optimize complex civil structure in traditional method. This can be effectively eased by using intelligent systems. Safety can be defined as absence of danger or eliminating the situations that could be fatal. As construction industries working environment is very complex and thousands of workers are being injured or killed in accidents every year, so safety needed to be taken into consideration. There is a high need of monitoring the workers and warn the construction workers at the site. The process of safety should start from planning stage itself.

## I. INTRODUCTION

Workplace safety and technology are thoroughly intertwined. From Excel spreadsheets to full-blown EHS software, most EHS professionals now use technology to save time AND effort while ensuring workplace safety. However, a new form of technology has entered the world of EHS. Today, Artificial Intelligence (AI) is undeniably a big part of our lives. Whether it is the virtual assistant on your phone, or the smart speaker in your home, AI has been increasingly normalized in past years. Applications of AI in Workplace Safety Thanks to computing power, a full office working day in 1970 can now be completed in 1.5 hours. Amazing, right? In fact, in 1930 the economist John Maynard Keynes predicted that automation and technology advancements would eventually leave us with a 15-hour work week. We're not quite at that stage yet. However, the value AI brings to each industry is enormous. Here are some of its applications in workplace health and safety. One major benefit of AI is its inability to get stressed, tired or unwell. In other words, AI

safety can scale down human factors in the workplace. Human factors play a huge role in workplace safety, with fatigue and stress readily contributing to accidents. PPE detection: In 2018, AI-SAFE (Automated Intelligent System for Assuring Safe Working Environments) launched which cleverly detects if employees are wearing the correct PPE for each working area. Normally, PPE checks are conducted by a staff member, with potential for human error. Drones for difficult tasks: Another application of AI is to undertake dangerous tasks, so humans don't have to. Although strictly speaking drones themselves are not AI, they are quickly incorporating it. This allows them to make decisions and operate autonomously. For example, drone use is rising in the construction industry. In fact, between 2017 and 2018, the number of drones deployed to construction sites grew by 239%. Furthermore, one survey found over 50% of construction sites using drones reported an improvement in safety. Construction site drones can gather and analyze data otherwise overlooked by humans. For example, one Dallas construction site has used drones to inspect roofs since 2014.

The construction management is a critical part in the project because it contains the knowledge of controlling the cost, scheduling & resources. A construction contract is unit price, lump sum or cost plus; the construction cost is important factor in all projects. At the same time duration of completion of project is also important. Nowadays major construction projects are behind the schedule. The major factors that impact cost of construction are material, labour, equipment, overhead and profit. There are some traditional methods for effective project management including either Critical path Method (CPM) or the Program Evaluation and Review Technique (PERT) combined with trial and error procedure. Some software's are used for effective scheduling of projects in

construction management. It is difficult to attained Project objectives unless proper monitoring methodology is implemented. Employing effective planning in terms of scheduling, budgeting, safety & quality at the early stages of project is very important since it allows control over the process from its commencement phase to its completion phase, minimizes delays and cost over-run & assists in achieving the project objectives efficiently.

The reduction in cost is achieved through effective utilization of locally available material and techniques. The material and techniques should be durable, economical, accepted by users and not requiring costly maintained. Economy is also achieved by finishing and implementing low cost housing technology in phase. Low cost housing can be considered affordable for low and moderate income earner if household can acquires a housing unit for an amount up to 30% of its household income.

Construction play an important role in developing the infrastructure of the country. But the problem faced by the industry is the construction material waste. Construction activities generate more waste materials compared to other industries. All the materials used in the construction activities gets wasted, which in turn increases the cost of the project, reduces the profitability and gives a negative impact to the environment. Building material waste is difficult to be recycled. Also there is no sufficient space for the disposal of waste in cities. Generally the materials that gets wasted include concrete, timer, mortar, steel, bricks ,glass, paints, pvc pipes, electrical fixtures, steel formwork etc...among these materials the materials which gets least wasted but affects the profitability and are paints, pvc pipes, glass, electrical fixtures and tiles. These materials as they are least wasted are not given importance in reducing the waste generated. But these materials cannot be easily disposed as they are not bio-degradable and are sure to cause negative impact to the environment.

## II. LITERATURE REVIEW

1. Hong ling Guo et al. (2018) studied the real time unsafe behavior of the workers at the site. For the same he studied the dynamics motion of the workers. The study is done with the help of video clips from the site. The video clips are being cut into small clips and then the dynamic motion of each worker is being compared with

the predefined unsafe parameters.

2. For recently Pornima M. Kashid & Manisha Jamgade in April 2019 Studying on Time Optimization of Construction projects. Time management is that the vital techniques to confirm the completion of projects within stipulated time. Without a proper time management, many problems will occur such as an extension of time in the construction project.

3. In recent July 2018 Glykeria P. Kalfakakou and Evaggelia A. Antoniou study on Content and Applications of Artificial Intelligence for Cost Management in Civil Engineering. It is clear that, Project Cost Management is an extremely complex and very difficult process. It is a fact that the financial control of construction projects is an integral part of effective project management. The subject has benefited from a number of advances in theory and techniques that have resulted from research.

4. Eadie R (2013), Stowe et al (2014) BIM can enable site safety management system in construction industry. BIM when combined with RFID can help in finding the blind spots while using multiple cranes. The use of BIM with cloud computing techniques has been suggested for maintaining construction health and safety purpose.

## III. SCOPE OF THE PROJECT

1) Artificial intelligence has made an impact in almost every industrial sector, and civil engineering is now joining the bandwagon as well. According to a report by McKinsey, the civil construction sector has a net worth of more than \$10 trillion a year, and while it has one of the largest consumer bases, until recently, the industry had been relatively under digitized. This is because civil engineering is one of the few fields in which basic practices of bricklaying and pouring concrete have remained the same over the century.

2) However, the construction sector is set to undergo yet another industrial revolution, one powered by technology, particularly artificial intelligence. When one mentions artificial intelligence in civil engineering, a picture of robots driving trucks and laying bricks comes to mind. On the contrary, these techniques have more sophisticated applications in construction management, design optimization, risk control, and quality control.

3) Therefore, it would make sense for civil engineers to enroll in artificial intelligence courses, as it would provide significant value-

adds to their career. Not only is AI making construction operations more manageable, but it is also set to make the construction business more lucrative. In the same report, McKinsey states that construction companies that have been incorporating AI techniques are 50% more likely to generate profits than those who don't. AI has a whole gamut of operations in civil engineering that would enhance the processes and transform the way builders and engineers work.

4) This research focuses only on activities carried out in the phases of the project development process that precedes construction and is limited to qualitative assessment.

5) Reduces the cost of the project.

6) Increases the overall quality of the project.

## METHODOLOGY

### 4.1 DATA COLLECTION :

#### 4.1.1 Reduce Construction Risk With Artificial Intelligence And Machine Learning :

Technology's impact on the construction industry cannot be overstated. The industry has seen significant advancements impacting areas such as bidding/estimating, contract and insurance review and compliance, scheduling, safety and overall project and document management. The advent of smart phones, tablets and wearables has brought this technology out to those in the field, and allows data collection directly from their location, further increasing the value delivered. Continued advancements in artificial intelligence and machine learning and the application of these principles to the construction industry are becoming recognized for -

## IV. CASE STUDY

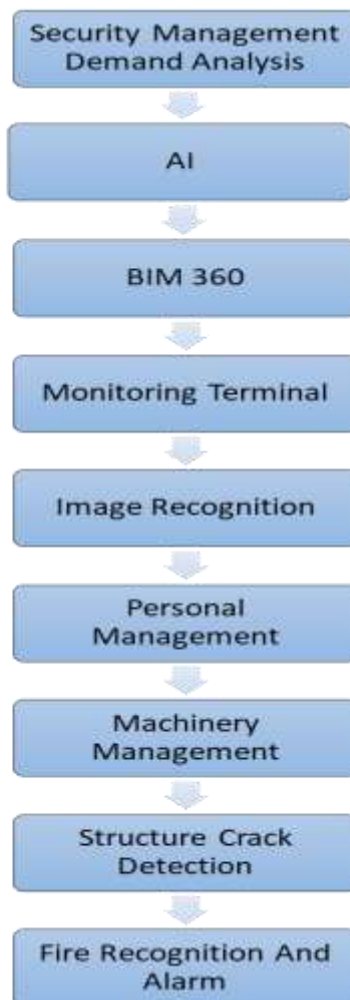


Fig. No. 1 Flow Chart Of Safety Management



**Fig. No. 2 Flow Chart Of Cost Reduce Procedure**

what they are—powerful tools to reduce and address construction risks encountered before, during and after construction of a project. Understanding the technology, where to find it and how to use it are critical first steps to reaping the tremendous risk mitigation benefits. What are “Artificial Intelligence” and “Machine Learning,” and are they the same thing? Artificial intelligence, often referred to simply as “AI,” is the broad idea of using machines (e.g.,

computers) to execute tasks otherwise requiring human review and operation. AI sometimes uses “Machine Learning” to automatically adapt and learn from the processing and review of prior data without express updating by human reviewers and programmers. The application of this technology to reduce risk in the construction industry was greatly expanded by the advent of Natural Language Data Extraction, which allows AI platforms to identify and extract data from

unstructured text in any format or order. Algorithms and platforms now exist to allow users to automatically identify, extract and categorize natural language from various sources such as contract documents, insurance policies, daily reports, change orders and RFI responses. For example, imagine the power of a platform that can automatically identify design issues necessitating a change order from RFI responses, locate information in contract documents and insurance policies, or automatically identify and calculate weather-related delays from schedule updates and daily reports. Identifying and extracting issues and data from natural language displayed in any form is complicated and requires the appropriate AI platform and appropriately trained and developed algorithms. One of the most prevalent and highly developed uses of AI in construction revolves around image recognition. Many companies have taken advantage of this type of AI and machine learning from simple use cases such as photo tagging, which is similar to running a Google search for images.

The platform can identify all types of information from video and photographic images, often critical in tracking the status and progress of construction projects. More specifically, some companies have built predictive models to identify safety risks on projects to avoid potential incidents or accidents. This use case can provide tremendous value, especially now with the focus on safety measures such as the wearing of masks and social distancing. Another area where AI and machine learning have impacted the construction industry relates to scheduling. Given the availability of historical scheduling data and its somewhat structured nature, several companies have been tackling the challenge of providing insights into project scheduling by developing models to optimize and predict schedule results based on historical data.

This allows alternative schedule options to be evaluated instead of locking in the first one that works. While this technology is early in its development, it is anticipated to provide significant value and transparency to the construction industry and help reduce the risk of delays. With many different platforms and applications now offering users in the construction industry the ability to unlock the power and “magic” of AI and machine learning to extract data, including from natural language, knowing how to evaluate platforms is important. Accuracy is key, and AI technology is not

perfect. Users want to find all the relevant information without anything being missed, but also do not want to have large amounts of incorrect responses, which will serve to waste time and limit the value received. In order to achieve both, the model should have high “precision” and “recall” scores. Precision is how often a model incorrectly identifies information (i.e. mislabeling a waiver of subrogation clause as a waiver of consequential damages). Recall is whether the model identifies all instances of an item (i.e. missing a potential cause of delay such as rain from daily reports). Good models will have high precision, as well as high recall scores. Do not be afraid to ask for any platform’s scores for each of its algorithms. It is also important to consider the ease of interaction for users and integration with current systems. An accurate and sophisticated platform that is difficult to use and not integrated with the current systems likely will not be used by the team or will be incorrectly used. Last but certainly not least, is security and privacy. Make sure that the platform where information (whether in the AI/machine learning space or otherwise) is deploying best-in class cyber security measures/practices and will keep company information private. Be sure to have information technology partners and vendors review any proposed platform to confirm that it complies with internal requirements and any commitments for privacy and security that may have made to third parties such as owners or other end users.

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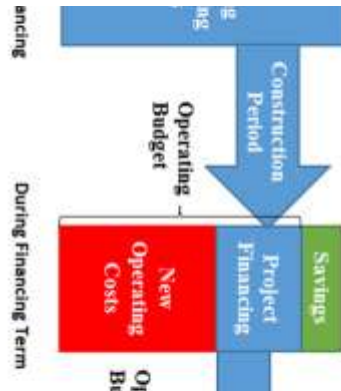


Fig. No. 4 Flow Chart Of Operating Procedure

#### 4.2 Artificial Intelligence In Construction : The Future Of Construction :



Fig. No. 4 Artificial Intelligence In Future Of Construction

When we think of Artificial Intelligence, people generally think of robots and other images in science fiction movies. However, artificial intelligence is not part of some distant future. Many people, maybe even yourself, use artificial intelligence on a daily basis. Artificial intelligence powers digital assistants such as Siri and Alexa to conduct tasks. Similarly, artificial intelligence is beginning to make its way into construction. In the future of construction, artificial intelligence will play a larger role in terms of improving productivity, quality, and safety on the jobsite.

#### 4.3 Artificial Intelligence In Building Construction - Happening Now :

##### 4.3.1 Alerts :

Field reporting software allows foremen to enter (either by manually typing or using voice-to-text) jobsite activity or issues. Systems can be configured to provide alerts and notifications on certain keywords. If a foreman says “delay” or “safety” this can trigger an alert to notify the project manager or safety manager of any potential issues. These alerts keep important project stakeholders informed in real-time even if they are

not on the jobsite.

##### 4.3.2 Optical Character Recognition ( OCR ) :

OCR as artificial intelligence is easy to take for granted because it is inherent part of one’s daily life in construction. Because of OCR technology, users can quickly search drawings we can convert documents and images into editable and searchable data. Many drawing applications rely on OCR to scan drawings, automatically name and number sheets, and hyperlink related sheets together. This saves hours in manually processing drawings for viewing, markups and sharing.

#### 4.4 Emerging Trends Of Artificial Intelligence In Building Construction :

##### 4.4.1 Safety Sensors :

The internet of things has automated our home to make our home more energy efficient. Similarly, the internet of things is automating our jobsites to make them safer. Wearable sensors such as Spot-r identify the location of your workers and provide any alerts if a worker slips or falls.

#### 4.4.2 Drones :

Deploying drones and drone mapping software such as DroneDeploy drastically cuts down the time to gather accurate surveys maps and aerial images of a jobsite. This can be used to track progress without having to be on the jobsite. Additionally the aerial images provide project managers with an additional perspective to identify issues and conflicts they may not view from the ground.

#### 4.4.3 Autonomous Vehicles :

Major tech companies and car manufacturers are developing self-driving vehicles. While Uber and Google conduct pilot projects of self-driving cars, Caterpillar has released a line of autonomous mining equipment used for dozing, drilling and hauling.

#### 4.4.4 Robots :

Autonomous vehicles, robots have started to infiltrate our home (hello Roomba) and the construction site. While robots have not quite made it on the jobsite, Fastbrick Robotics has developed Hadrian X, a bricklaying robot that can build a residential house in 2 days.

#### 4.5 Software's Of AI For Monitoring And Controlling Building Construction :

##### BIM 360 – Connect, Organize, And Optimize Projects

BIM 360 is a unified platform connecting your project teams and data in real-time, from design through construction, supporting informed decision-making and leading to more predictable and profitable outcomes.

##### 4.5.1 Reduce risk, improve quality, and deliver projects on time and on budget:

Predict safety hazards, proactively manage quality, automate tasks, and reduce rework so that you can control costs and stay on schedule.

##### 4.5.2 Construction Quality Management Software :

The construction quality problems that cost the most are the ones that you miss. Standardize on a proactive QA/QC process with construction quality management software that enables the whole team to participate in quality inspections from mobile devices.

##### 4.5.3 Mobile Inspection :

Access checklists on mobile devices, review the criteria for each item and mark as conforming or non-conforming.



Fig. No. 5 Discussion And Inspection Of Contractors

#### V. CONCLUSION

The Artificial Intelligence in Building Construction is playing a major role in constructing, maintaining and managing different aspects of civil engineering problems. AI has shown its potency to perform better than the conventional methods. Thus AI has a number of significant benefits that make them a powerful and Practical tool for solving many problems in the field of building construction and are expected to be applicable in near future by using sophisticated instruments based on the algorithms and database to reduce the efforts of safety alerts for labours, cost of construction and time management.

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