



# Modern Engineering Project Management Based on Deep Artificial Intelligence Technology

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**Abstract.** The industrial revolution has driven rapid transformation and development across the industry, and engineering project management is facing opportunities and challenges. With the outbreak of new coronavirus, the process of modern engineering project management has been promoted significantly. Artificial intelligence technology has been widely used for analysis and the large quantity of data in engineering projects is complicated and dynamic. This paper focuses on the application of artificial intelligence technology in modern engineering project management from three aspects including application background, application value, and application suggestions, to promote the awareness of engineering project managers about deep artificial intelligence.

**Keywords:** Engineering · Project management · Artificial intelligence

## 1 Introduction

With the “new infrastructure” construction, information technology is rapidly iterating and updating, and the application of artificial intelligence technology in engineering project management will become more diversified, which greatly improves the quality and efficiency of engineering project management. Artificial intelligence technology is a kind of new technology system that integrates theoretical knowledge of artificial intelligence and computer technology. Nowadays, under the background of rapid development of science and technology, the development and growth of artificial intelligence technology has gained the general attention of the society and become an important support force to promote social and economic development and improve people’s living standards, and has relatively broad development prospects.

In engineering management, the adoption of artificial intelligence technology increases which plays a positive role in the orderly promotion of management and reduces the negative impact of management negative factors [1, 2]. With the in-depth research of artificial intelligence technology in the field of computers and its social influence, how to effectively combine artificial intelligence technology with engineering project

management practice has become a hot topic of discussion in the engineering project management community. And then, this paper adopts the literature research method and analyzed which sorts out the current research results related to the application of deep AI in engineering project management, making a comprehensive analysis of the match between deep AI and engineering project management. The focus of AI in engineering project management application research has been discussed to further explore the expanding field of AI technology in engineering project management applications in the future. The purpose is to further explore the potential expansion of AI technology in engineering project management.

## **2 Background of Artificial Intelligence Application in Engineering Project Management**

With the rapid development of information technology, artificial intelligence is applied to automatic data collection, and “Internet+” is penetrating more and more widely in the field of engineering construction, digital technologies such as big data, 5G, mobile Internet, and cloud computing, which are at the forefront of the field and promoting the transformation and upgrading of engineering construction industry and sustainable development [3, 4]. Compared with mobile Internet and cloud computing, artificial intelligence is more disruptive information technology. And with the transition of engineering construction enterprises to digitalization, informatization, and standardization, as well as the increasing demand for site informatization, digitalization, and intelligence, artificial intelligence has gained wide attention in the engineering construction industry. Especially since the outbreak of the new crown epidemic in 2020 and the “social quarantine”, the engineering construction industry is changing to off-site construction methods, and companies are investing more in off-site construction methods to ensure that projects and personnel are in a controlled environment. This has further accelerated the process of digitization of engineering construction, which has led to the application of artificial intelligence in engineering project management more and more widely [5].

### **2.1 Reducing the Difficulty of Product Design**

With the gradual deepening of the application of intelligent technology in engineering management, the difficulty is significantly reduced when designing products, and through the adoption of intelligent technology, the production, and monitoring of products can be well controlled automatically. And given the production of product models, it is only necessary to write a good artificial intelligence running program under the corresponding provisions and complete the production of models with the help of relevant instruments and equipment in turn. The problems that occur in the production of product models can be well avoided. In traditional management, although automation management has been achieved, only to control the actual use of the model. This model control can only reduce the probability of error in the use of the model with the utilization of artificial intelligence technology, it can eliminate this defect, making the complex engineering management more practical and easy, not only can save a lot of human resources investment, but also can reduce production costs.

## **2.2 Providing the Accuracy of Engineering Progress Management**

Engineering management is not independent but needs to be interlinked with each other, and the quality of the whole project management will be affected if the different management links of steps are not well connected when progress control is carried out. Artificial intelligence technology is integrated into each stage of engineering management so that a feasible and reliable implementation plan can be formulated.

## **2.3 Enhance the Strictness of Engineering Quality Management**

In managing the quality of the project, the use of intelligent technology can minimize personnel input and human errors. Based on the premise of standardizing the construction steps, the progress of project implementation should be grasped, and then the construction quality supervision plan should be adjusted on this basis to ensure the quality of project implementation. This can strictly control the quality of project implementation, realize the comprehensiveness of quality management work, and implement more detailed control of each link in electronic engineering.

# **3 The Relationship Between the Influencing Factors of Engineering Management and Deep Artificial Intelligence Technology**

## **3.1 Factors Affecting the Success or Otherwise of Engineering Management**

In engineering management, especially in the intelligent management of engineering, in general, countries or group enterprises with strong scientific and technological, and economic bases will develop relatively perfect management systems and improve the quality of management through the use of scientific management methods. Management means to improve the quality of management. The key factors to ensure the success of project management in engineering management are performance objectives, cost objectives, scope objectives, and time objectives in the management process.

## **3.2 The Relationship Between Intelligent Technology and Engineering Management**

The innovation and development of intelligent technology have made various social industries face unprecedented development opportunities. By strengthening the application of intelligent technology in engineering management and combining computer knowledge with network technology, engineering managers can analyze various data and information in management more conveniently and accurately, and carry out a more detailed analysis of the management situation of the whole process of engineering management, to improve the efficiency of management.

Some expert opinions are considered to cater to the practitioners' needs, such as understanding the technology, business value focus, use case evaluation, and implementation approaches, among others [3] (Fig. 1).

One important innovation is the conceptualization of implement a cross-industry standard process for data mining [6], and the fundamental structure is provided in Fig. 2 (Fig. 3).

	Preparing	Discovering	Understanding	Designing	Implementing
Goal	Collecting and structuring information about three context factors	Collecting domain problems and existing AI solutions	Understanding domain problems and AI solutions through abstraction	Matching domain problems and AI solutions in a problem-solution-matrix	Deriving the prerequisites for the successful implementation of selected use cases
Key Component	TOE framework to consider the context of potential use cases	Problem and opportunity perspective to develop use cases from two points of view	Domain structure, AI functions and solution types to understand AI characteristics and its potential	Problem-solution-matrix to sort and combine identified problems with solutions	Decision areas and necessary considerations for purposful use case implementation
Output	Requirements for use cases from technology, organization, and environment context	List of relevant domain problems and possible AI solutions	Abstract assignment of domain problems and AI solutions to problem and solution classes	Feasible list of use cases with a problem-solution-fit	Strategic and contextual implications for use case implementation

Fig. 1. Method Overview for Developing AI Use Cases

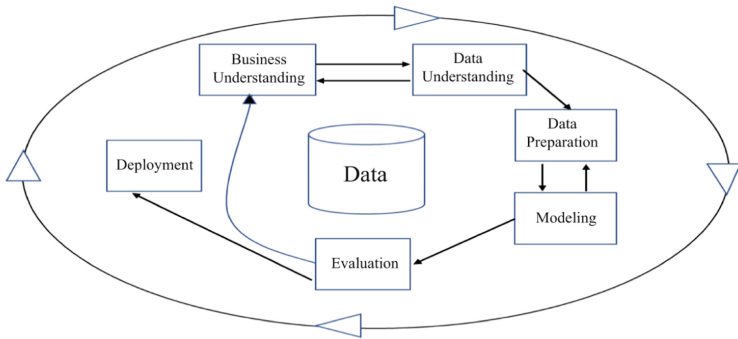


Fig. 2. Structure of cross-industry standard process

4 Intelligent Technology Applications in Engineering Management

4.1 Application of Artificial Intelligence Technology in Engineering Management Performance

Strengthening the application of artificial intelligence technology in the field of engineering management is an important measure to realize the development of management in the direction of efficiency. With intelligent technology, the static management performance and dynamic management performance of management systems can be well improved. And then the efficiency and speed of the management system can be enhanced in the shortest time by using artificial intelligence technology. The optimization of management performance through the use of artificial intelligence technology is also fully reflected in other aspects. The first step is the automated mechanical and electrical equipment in the process of engineering implementation, which only fully satisfy all the process requirements in the engineering management link, and can improve the integrity of management and quality level. The second is the utilization of artificial intelligence technology in the CNC system so that it has coverage and tailorability.

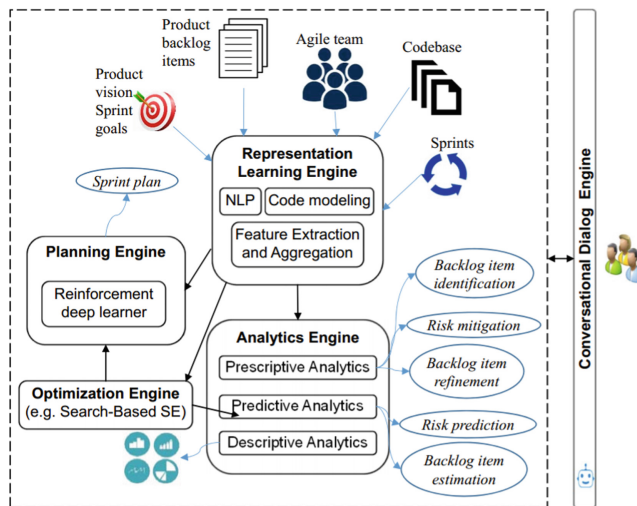


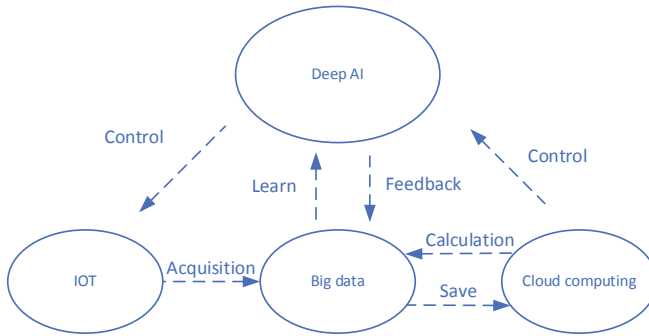
Fig. 3. The architecture of AI-powered agile project management [7]

#### 4.2 Artificial Intelligence Technology Intelligent in Engineering Management Control

The use of artificial intelligence technology to control engineering management requires the realization of remote-control level, automatic control level, and autonomous control level of engineering management so that the management system can independently complete many different types of management and operation tasks. The engineering automation control technology in the traditional mode shows relatively many problems, such as the singularity of the target object, but the variety of influencing factors faced when implementing management.

#### 4.3 Artificial Intelligence Technology to Optimize Design Engineering

Artificial intelligence technology is applied to engineering management to gradually realize the level of management control automation. In the design of the management system, the process is relatively complex, requiring designers to have professional knowledge and rich experience. In the traditional model of design solutions, mainly in the process of experimentation fully combined with traditional design experience, mostly purely manual design and production, this approach will show a lot of instability, so the design solution has a very low rate of compliance, in addition, will also cause great late problems, facing difficulties in the modification and optimization of the design. Nowadays, the development and application of artificial intelligence technology provide important support to improve the quality of system design. The organic combination of intelligent CAD technology and computer software technology can reduce the phenomenon of time wastage in designing the system, and also improve the quality and technical level of the design to a great extent (Fig. 4).



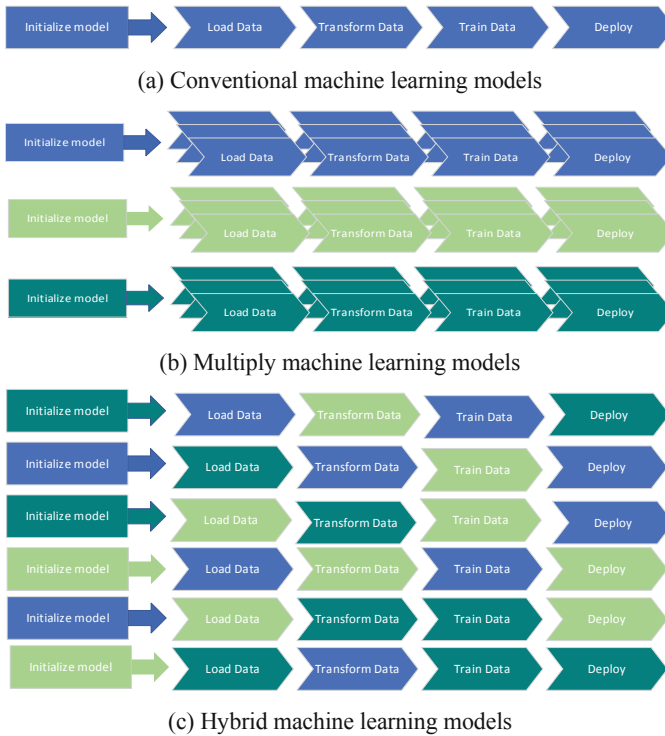
**Fig. 4.** The framework of the novel technology

## 5 Artificial Intelligence in Engineering Project Management Application of Extended Potential Research Direction

### 5.1 Data Categorization and Data Standard

Compared to production-based industries, engineering construction projects are characterized by complexity and one-off, and their data are highly variable. Different project types, scales, organizations, and scenarios will generate different data, resulting in a large amount of data that cannot be judged consistently and the validity of the data is reduced. Therefore, it is necessary to establish standards for project data structure in advance, i.e., classification, definition, logical relationship analysis, and modeling, to make data collection, mining, and analysis possible, and also to correct previous cognitive biases and different assumptions of human factors.

The organization is a decisive factor in whether the project objectives can be achieved. The engineering project management organization is constructed according to the characteristics, and complexity of the project, and needs to adapt to different contexts inside and outside the project, especially for major projects. As the organizational activities involve stakeholders' intentions and concepts, organizational methods, and organizational means, they are non-linear interactive activities, and the data and knowledge generated by them mostly present natural language, and non-structural and dynamic changes, which cause great obstacles to the application of artificial intelligence in project management organization. From the analysis of organization theory, the key to the effectiveness of the organization lies in the two major aspects of organization construction and organization collaboration. If artificial intelligence is to be used as auxiliary decision-making or monitoring and collaborative management means, it is necessary to standardize the organization first. For example, the organization standardization module, including organizational processes, documents, contracts, etc., can be established to make the organization present certain rules and facilitate machine learning; secondly, ontological methods can be used to study the dynamics of organizational behavior, internal mechanisms and key factors affecting the organization, and artificial intelligence methods can be used to provide relevant parameters for organizational construction (including the selection of design units, construction units, and other participating units) so that the organization can be constructed more scientifically. In addition, we can collect relevant data in the process



**Fig. 5.** Machine learning workflow

of organizational activities, evaluate the behavior of each project participant, calculate the organizational effectiveness, and benchmark it with project objectives and contract control factors, as an effective basis for controlling and optimizing organizational behavior (Fig. 5).

## 5.2 Choice of Algorithm

Algorithms in artificial intelligence are expressions that transform realistic problems into classification and regression problems, simulate natural intelligent behavior mathematically, and mechanically fit the intrinsic relationships of data, with specific applications in recognition, prediction, search, and other functions. As seen from the literature, there are numerous AI algorithms, each with its specialty in accuracy for different engineering project data characteristics. It is a challenge to choose the appropriate algorithm to achieve the accuracy goal in a certain scenario. The accuracy of cost, quality, schedule, and safety data increases with the certainty of construction content at different stages of engineering project management, and the causes of changes in the formation of these data vary with risk probability, while most algorithms currently used for engineering project management make predictions by fitting correlations corresponding to data sets to some extent, and rarely can apply inference models to explain the causal relationship is rarely explained by applying inference models.

### 5.3 Integration of Artificial Intelligence and Other Technologies

With the enhanced complexity of engineering projects and the input of engineering intelligence technology, the risk control ability of engineering project management puts forward higher requirements to adapt to the new era. The key to risk control of engineering projects lies in the risk perception of the project construction environment and the synergy of project implementation monolith or organization. In the risk control of risk perception of the project construction environment, it is necessary to further study the integration methods of artificial intelligence and sensor, and other technologies to achieve automatic monitoring and identification of various risk factors, automatic compliance check of specifications, management of risk in the platform built with BIM model as the center control information and other effects. Meanwhile, artificial virtual organizations involving artificial intelligence are studied according to the concept of artificial society to improve the efficiency of risk control.

## 6 Conclusion

This study further argues the match between artificial intelligence and engineering project management by analyzing the literature on the application of artificial intelligence in engineering project management to clarify the role that artificial intelligence can play. At the same time, the expansion of AI in engineering project management applications is highlighted in data categorization and data standards, organization construction and collaborative management, selection of algorithms, and integration of AI with other technologies to provide a path framework for the future development of AI in engineering project management application. The engineering construction industry will promote transformation and upgrading with the advantages of deep AI, and develop towards data wisdom, management informatization, and production industrialization.

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