

Application Requirements of Artificial Intelligence in the Field of Building Materials Informatization

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Abstract

Under the background of the continuous development of information technology, strengthening the construction of grassroots material management information platform of construction industry projects is conducive to promoting the information development of construction industry and improving the economic benefits of enterprises. For the construction industry, material management is not only to ensure the supply demand and normal operation of the project site, but also an important part of the profits of each project. However, the information platform of construction enterprises often has problems such as cumbersome operation, low professional level of operators, repeated and cumbersome data recording. Moreover, the large amount of data in the grassroots construction project department can rarely be effectively used, and the large amount of data recorded by the system rarely forms historical data through analysis and forms empirical data for the enterprise. From the perspective of optimization of information platform by artificial intelligence technology, this paper describes the existing problems of information platform for building materials management, analyzes the development needs of information management for grassroots materials in construction industry projects, and then takes the price analysis of steel reinforcement materials in material management as an example to illustrate. A constructive idea is put forward for the optimization scheme of artificial intelligence technology embedding information platform.

Keywords

Construction Industry; Material Management; Information Construction; Artificial Intelligence (AI).

1. Introduction

With the continuous development of the market economy, the market competition in the construction industry is becoming increasingly fierce. Under the background of the development and innovation of social information technology, most construction enterprises strengthen the information construction, integrate market information resources, strengthen the ability to cope with market changes, and improve their competitiveness. Materials management in the construction industry also requires the construction and transformation of information technology. The traditional information management of materials procurement is based on the establishment of the database of each project department at the grass-roots level, and the superior company can supervise each project as a whole, thus enhancing the overall planning ability of the company's overall development. In addition, in order to facilitate information exchange and sharing for each project, material management departments manually input material procurement data information on the information platform, which can provide historical reference for the procurement of the same type of materials. The operator can provide reliable reference information for the procurement decision of the current project

by consulting the recorded information in other project history databases. This is also just as the study of scholar Cong Song shows that the automatic generation of charts and diagrams through database software similar to PL/SQL Develop can significantly simplify the work flow of material personnel, improve the work efficiency of the material department, and provide effective and reliable data for superiors in a timely manner [1]. The grass-roots departments of informatization use in construction units are often very skilled in engineering construction knowledge, but they are not professional information operators, and the level of information knowledge is not high. The application of artificial intelligence technology can well solve the above problems, through artificial intelligence embedded information system to assist the operator, can improve the accuracy of staff work. For example, through the Internet of Things technology and artificial intelligence algorithms, the amount, location and status of building materials can be monitored in real time, which helps on-site employees find shortages or abnormal situations in time, and take appropriate measures to ensure the smooth progress of the project. Through deep learning and data mining technology, Artificial Intelligence (AI) can analyze and forecast a large amount of procurement data, help procurement personnel more accurately grasp the market dynamics and supplier situation, and thus develop more reasonable procurement plans and strategies, which not only helps reduce procurement costs, but also helps reduce procurement costs. It can also improve the quality of procurement and create greater value for enterprises. Moreover, artificial intelligence technology can greatly improve the efficiency of material procurement management. The traditional material procurement process involves a large number of manual operations, such as supplier information screening, procurement planning, order processing, etc., which are cumbersome and time-consuming. Artificial intelligence technology can quickly complete these tasks in an automated and intelligent way, greatly reducing the time and cost of manual operation. In the process of building materials information management, through the use of artificial intelligence technology, management efficiency can be significantly improved, procurement decisions can be optimized, accurate supply chain management can be achieved, personnel work efficiency can be improved, and enterprise competitiveness can be enhanced.

2. Application Requirements Analysis

2.1. Insufficient Control of Material Procurement Process

Material procurement management is the basis of material management. If there is no efficient and complete process system for overall management, it will not only affect the normal operation of project procurement, but also make it difficult to complete the material record and acceptance work in the later period. From the perspective of the entire procurement management process, material procurement management is not only a part of the procurement of materials, but also includes project material plan submission, material market research, budget procurement plan reporting, procurement method approval, tender document approval, contract preparation and signing, on-site material transportation acceptance, financial reimbursement and asset registration management. However, there is a disjointed problem in the procurement process of most enterprises and institutions. In the procurement process, emphasis is often placed on the acceptance of intermediate materials procurement, while there is a lack of standardized control over the planning and project establishment in the early stage of procurement and the reimbursement and warehousing in the later stage [2]. Due to the irregular operation of the overall procurement process, the superior leadership's judgment and participation in the management and control of the project procurement decision are affected, and the project risk is increased. The deeper reason is that the procurement management personnel are not skilled in the use of the company's information system, which leads to the failure to standardize the registration of the procurement process in the early stage and form a

historical document, which is easy to lead to problems such as the unclear responsibilities of the acceptance directors of various departments of materials, the difficulty of determining the ownership of materials, and the untraceable procurement process of materials, which affects the normal operation of the daily work of the project. To solve the above problems, it is necessary to automatically process purchase orders through AI, including order generation, review, and sending, so as to improve order processing efficiency and reduce human errors.

2.2. The Execution Accuracy of the Material Management System is Not Strong

For the submission of materials and materials documents, although the construction unit will set up some concise management systems, it will rarely form a unified format of record documents, and the standardization of documents is not strong. Each construction project department usually has a certain degree of autonomy in the naming of the project documents submitted by the superior company, and the lack of inspection control process often leads to the inconsistency and irregularity of the naming format of the documents of each project department. When the superior company receives the materials, it needs to manually check and correct the errors, thus reducing the efficiency of the superior company's material summary. Another part of the reason is that the material management function stays at the level of meeting the normal supply of on-site materials, but the requirements of timeliness and accuracy in project management are difficult to ensure. Most project procurement management still presents the phenomenon of "heavy construction, light procurement". Project management leaders mainly focus on construction schedule and project quality, and material procurement can meet the requirements of construction schedule [3]. Due to the nature of the work of the construction unit, sometimes in order to meet the needs of the site, when the supply of on-site materials is relatively urgent, the procurement and recording work is difficult to meet the progress requirements. The labor information recording and registration method of the construction unit can not meet the requirements of real-time supervision records, and there is often a certain lag for the records of materials in and out of the warehouse information platform. Relying on manual operation and execution system, it is difficult to register and execute efficiently and accurately when the amount of materials is very huge, which requires AI technology to implement the implementation of the enterprise system through intelligent prediction, automated processing, real-time monitoring and data analysis and other functions to reduce problems in the work process.

2.3. The Rate of Information Flow and the Degree of Work Cooperation are Not High

In the inspection and assessment of project materials, the most common problems faced in material management are non-standard processes, delayed submission of plans by purchasing departments, and non-standard or missing name specifications of purchased materials [4]. For each project department of the construction unit, the items purchased have corresponding national standards or industry standards, but the temporary and urgent plans often lack detailed procurement information, and because most of the department plans submitted in the project are retained through paper documents, it is very time-consuming and inefficient to conduct material procurement inquiries. Although the person in charge of materials in the materials department can register the plan and purchase by using Excel and other electronic forms, the procurement of materials for construction projects has the characteristics of large procurement volume, complex and diverse procurement types, and multiple combination of procurement payment forms. There may be dozens or even hundreds of materials of different types of the same materials. Does not significantly improve work efficiency. For the material departments of each project department, the correlation between the recorded information and data is not strong. When filling in a certain procurement plan, there is a problem of repeated inquiry and quantitative quantity for the materials previously purchased by other project

departments. For other departments of the project department, the information flow between departments is not strong, unable to timely understand the information and data of the materials being purchased and have been purchased, and can not quickly and conveniently understand the status of material procurement and the supply of on-site materials. In addition, for the acceptance and delivery of on-site materials, fast and efficient recording tools are also needed to do a good job of recording while providing timely supplies to various demand departments for superior inspection. This requires effective tools to integrate and analyze registration resources, and to share and update information in real time to optimize workflow. Moreover, if the voice assistant can be embedded in the information platform, it can understand and respond to the voice or text instructions of the personnel, and provide real-time decision-making suggestions and information support, which help reduce communication barriers and improve collaboration efficiency, and is also one of the functional requirements of the current procurement informatization.

2.4. Low Integration of Work Informatization

Since entering the information age, in order to improve the market adaptability and enterprise competitiveness of the construction industry, a series of documents such as "Several Opinions of the Central Committee of the Communist Party of China and The State Council on Further Strengthening the Management of Urban Planning and Construction", "Outline of the National Informatization Development Strategy" and "Outline of the Informatization Development of the Construction Industry in 2016-2020" have been issued. It specifically puts forward requirements such as strengthening the construction of information infrastructure, promoting the upgrading of management information systems, and expanding new functions of management information systems [5]. However, the application of information technology in the construction industry is still in its infancy. Under the background of rapid changes in today's market environment, all kinds of new manufacturing products are emerging in an endless stream. In the face of increasingly rich market supply choices, manual statistics of market inquiry budget, material inspection, supplier evaluation and other information can not meet the requirements of normal operation of enterprises. Taking a large state-owned enterprise as an example, the project department adopts a four-level management system and a three-level corporate governance system for the parent-subsidiary company. Although the enterprise has established its own information platform, with the increase in business volume, the lack of basic database construction and the formation of a complete information management system, the original platform cannot meet the increasing data processing needs and is stopped running [6]. In addition, for small and scattered engineering teams, information should also be realized in the procurement of materials, so that the unit can fully investigate the market during the construction process, ensure the quality of the project, improve the cooperation between project departments and construction efficiency, reduce the production cost of the construction unit and improve profits[7] . Although the application of information technology in the construction industry has achieved initial results, the current material management system can not meet the needs of daily work, and the information level still needs to be improved.

2.5. Application and Performance Requirements of Artificial Intelligence Technology

At present, artificial intelligence technology has achieved technology landing in many fields such as finance, medical care, security, education, transportation, manufacturing, retail, and application scenarios are becoming more and more abundant. Cloud computing platform provides flexible resources and services for AI, reduces the threshold and cost of AI, and promotes the popularization and application of AI [8]. Now is the social development background of "artificial intelligence +", the integration of various industries and artificial intelligence technology, not only promotes the improvement of the business level of all walks

of life, enhances the core competitiveness of enterprises, saves human resources and technical costs, in addition, the development of the industry also synchronously promotes the rapid development of artificial intelligence technology, and constantly optimizes the algorithm of artificial intelligence. The accuracy of AI decision-making is constantly improving.

The informatization level of the construction industry is relatively slow compared with other industries. In this context, the informatization management level of material procurement is not particularly comprehensive, mainly due to the low professionalism of personnel, the cumbersome operation of the platform and the incomplete use of data. In the construction unit, the personnel responsible for material procurement management are often engineering professionals, and the level of mastering and using information technology is low. In the construction units that use information management technology, especially the construction units such as central enterprises and state-owned enterprises, the information management system used is often very complex, which further enhances the requirements of users and increases the difficulty of work, not to mention making full use of the usual large amount of data to draw useful conclusions for enterprises. Most of these problems can be solved by the application of artificial intelligence technology. By re-embedding intelligent assistants in the information system, the workload can be reduced, such as repeated entry of the same data in different forms, providing real-time operation guidance and suggestions for managers, reducing the difficulty of operation and improving work efficiency. In addition, the data analysis and mining capabilities of artificial intelligence can be used to automatically build intelligent data analysis models, conduct in-depth analysis and mining of large amounts of data in the material procurement process, and extract valuable information and rules, so as to help enterprises make more accurate procurement plans, optimize supplier selection, and reduce procurement costs. It can also help users find on-site material problems in time, provide early warning in time, and ensure the stability of material management and reduce risks.

In the AI optimization of material procurement management information in the construction industry, there are many aspects to consider performance requirements, but mainly involving algorithms, security and accuracy. First of all, accuracy is crucial, AI algorithms must have a high degree of accuracy, can accurately identify and recommend suppliers and procurement solutions that meet the actual needs, so as to ensure the effectiveness and rationality of procurement decisions. In addition, the information system must be stable and reliable, able to continue to operate without interruption, to ensure the smooth progress of the procurement process. Strict security measures exist to ensure that user data and privacy are adequately protected against any form of disclosure or abuse. In addition, the response speed and the scalability of the system are also important indicators to measure the performance of the system, the system should respond quickly to the user's operation requests to meet the needs of real-time processing procurement tasks, scalability requirements after the application of AI, the system can be flexibly adjusted with the expansion of the scale of the enterprise and the increase in business needs, providing strong support for the long-term development of the enterprise.

3. Data Requirement Analysis

3.1. Data Source and Quality Assurance

In the construction unit, the data source is often the data entered by the project department of the construction site, and the data is always authentic and credible from the grassroots level. As proposed by Chai Yawu, the grassroots material management database can enhance the efficiency of material information transmission. It provides guarantees for the maintenance and management of material information base, inter-departmental information provision and inquiry, the standardization of superior information submission and the efficiency of

information processing [9]. Academic Almansour Mohammed collected qualitative data from 25 low-level employees of FinTech start-ups in the UK, Analysis of the collected data reveals how the implementation of disruptive digital technologies such as artificial intelligence in the daily operations and digital marketing of fintech startups affects internal organizational resources, including employees [10]. Among the construction units, the most representative research data is the price changes of bulk materials. Through the research of the material procurement data that has occurred through AI technology, the company can provide reference for the price positioning of the materials that have been purchased for the projects managed by the subordinate departments, provide reference for the market inquiry and procurement, and determine the bidding plan through data analysis, thus saving the company's cost.

In order to facilitate the detailed illustration, the steel bar price of Nangang in Nanjing area is taken as an example. From the perspective of using AI to analyze price data, the project cost control is explored to specifically explain how to optimize the function of information platform through AI to help construction project operators. Other similar functions can be optimized with reference to this analysis model. As an important bulk material for building construction, the accuracy and integrity of the data of the steel bar is directly related to the progress and quality of the project, which is representative. When using AI tools for material price analysis and optimizing the information platform, this paper takes the data of Nangang steel bars in Nanjing area as the key analysis object, and the data content comes from the actual platform recorded data on the site. The data source mainly records the daily information price of steel bar futures in 2023, as well as the daily price increase compared with the previous day, and the steel bar price does not change on holidays and weekends, as shown in the figure below:

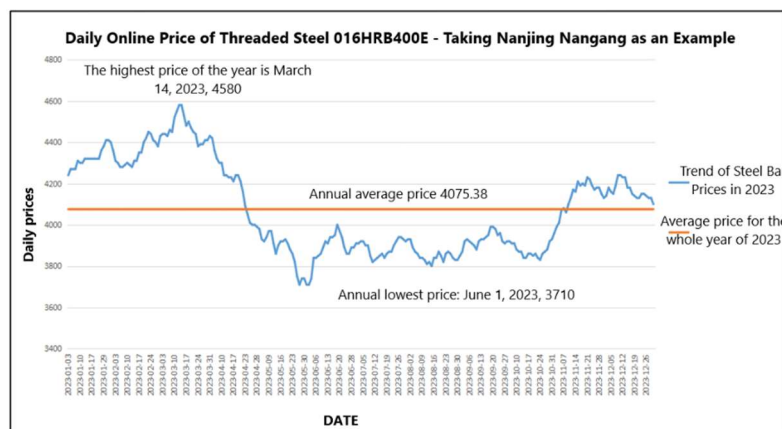


Figure 1. 2023 Nanjing Nangang rebar daily net price price

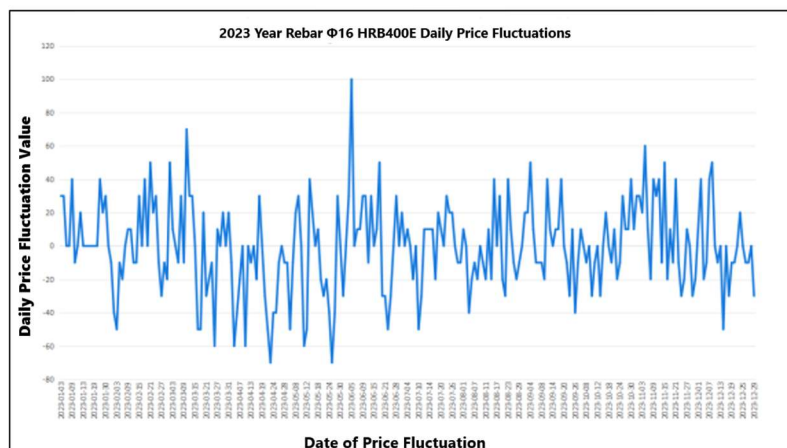


Figure 2. 2023 Nanjing Nangang rebar daily net price fluctuation

In order to ensure that there is enough credible data to provide AI for analysis and decision-making, a data verification mechanism can be established in the information platform. In the data entry stage of the operator, set verification rules to ensure that the data format is correct and the information is complete. For data that does not meet the rules, the system should automatically prompt and refuse to enter. Strengthen the implementation of data audit, all the entered data need to be reviewed by the material Department auditors to ensure the authenticity and accuracy of the data. For the data in question, such as the price increase is too large, the system can automatically prompt the operator to communicate with the supplier to confirm, and can intelligently provide contact information. In addition to the above methods, the information platform sets up some automatic programs to clean and integrate the data on a regular basis, delete duplicate, incorrect or invalid data, and ensure that the information in the database is clean and accurate.

3.2. Possible Methods and Problems in Data Processing

In terms of data processing, we will use AI technology to conduct in-depth analysis of the data registered on the database platform, mainly the big data processing technology of data mining and data analysis. The information database platforms involved in construction units are often software companies such as Guanglianda and Cathay New Point. First of all, through data mining technology, the procurement, warehousing, use and other data of NANGang steel bar materials registered during the project department of the research target were extracted and organized to form a structured data set. After the completion of data statistics, spss, MATLAB, Minitab Statistical Software and other software were used for preliminary analysis and pre-processing of the data content, from filling in missing items to eliminating outliers by boxplot, QQ chart and other methods, and a series of operations such as data cleaning were conducted to form standardized and research data.

The processed data is analyzed using machine learning algorithms to identify patterns and trends in the data, such as the stability of supplier supply, seasonal changes in steel bar consumption, etc., similar to the method used by Duan Jin and other scholars to predict the compressive strength of recycled aggregate concrete through artificial intelligence technology. They studied the 28-day compressive strength of recycled aggregate concrete using four AI techniques based on the sociopolitical algorithm (i.e. ICA) and the XGBoost-XGBoost model. According to the performance index, the optimal model of the developed model is ICA-XGBoost model [11]. Similarly, for steel bar as a building material, the main research method is also a detailed analysis of steel bar price data, modeling through several representative artificial intelligence models, analysis of the future steel bar net price, can predict the price trend of steel bar. We can also analyze the same materials supplied by different suppliers in the dimension of suppliers to determine the potential suppliers with strength in the cooperation. In addition, we can use the prediction model to predict the demand for steel bars, and predict the demand for steel bars in the future period of time according to historical data and project progress, so as to provide data support for purchasing decisions. The above functions are implemented automatically through the artificial intelligence technology embedded in the information platform, which automatically calls the function to form a decision model according to the data of the platform, and finally draws a general conclusion and a specific model, and automatically feedbacks to the operator for suggestions.

Data processing is a crucial step in the construction of artificial intelligence prediction model. The quality of data processing directly determines the accuracy of subsequent model analysis and prediction. In practice, we often face many problems. For the problems involved in the analysis and the data itself, it is common for the data to be incomplete or exist outliers. Incomplete data may lead to the lack of necessary information in the training process of the model, while the outlier may mislead the training direction of the model. In addition, the

diversity of data sources may lead to problems with inconsistent formats or ununified units, which will affect the integration and analysis of the data, and may even lead to wrong conclusions. In addition to the above mentioned data security and privacy protection are also issues that cannot be ignored. During data processing and analysis, we need to ensure the confidentiality, integrity and availability of data. For the problems involved in model selection, we need to choose the right model for analysis according to specific problems and data characteristics. For example, when predicting the 28-day compressive strength of recycled aggregate concrete, Duan Jin and other scholars used four different models for research and selected the most appropriate model for prediction, which shows that various model methods need to be flexibly used in practice to select the optimal model through comparison and verification. Moreover, model optimization is the key to improve the accuracy of prediction. After selecting the AI analysis model, it is also necessary to optimize the model performance by adjusting the model parameters and improving the model structure.

4. Technical Implementation Scheme

The technical solution to the problem is mainly divided into two aspects, for the problem of the data itself and the problem involved in processing the data model, we can consider separately to solve. Data interpolation techniques, such as mean interpolation, median interpolation and nearest neighbor interpolation, can be used to estimate and fill the missing values when the data is incomplete and there are outliers. For outliers, we can use statistic-based methods (such as IQR rules, Z-score methods, etc.) or model-based methods (such as isolated forests, etc.) to detect and deal with them, and we can reduce their impact on the model by removing, replacing, or correcting outliers. For the problem of inconsistent data formats, we need to develop unified data standards and standardize data processing, including unified data formats, unified data units, processing duplicate data, etc. Through data cleaning and conversion, we can ensure the consistency and comparability of data, and provide high-quality data support for subsequent analysis and prediction. Finally, to solve the problem of data privacy, we can strengthen the access control of the database platform, limit the access rights to the data, and avoid unauthorized access and disclosure. At the same time, we can also use data encryption technology to encrypt sensitive data to prevent data from being stolen or tampered with during transmission and storage, which includes selecting the appropriate loss function, optimizer, learning rate and other parameters.

The selection of AI data analysis model and parameter selection are important points for data analysis. Selecting the right AI model is the basis for ensuring that the platform can efficiently and accurately process a large amount of material data, while parameter adjustment is the key to ensure that the model can play the best performance in practical applications. In order to solve the above problems, first of all, we should attach great importance to the selection of AI models. First of all, the demand of the information management platform of the Department of Materials and materials was deeply analyzed, and the types of problems (such as prediction, classification, optimization, etc.) that needed to be solved by the model were clearly defined. Then evaluate the suitability and performance of different AI models, such as linear regression, decision trees, neural networks, etc., according to the needs. Finally, the model is trained and tested through small-scale data sets to evaluate the effect of the model in practical application and select the model with the best effect. After a suitable AI model is selected, reasonable initial values of model parameters are set according to the characteristics and experience of the model. Algorithms such as grid search, random search or Bayesian optimization can be used to search for the optimal parameter combination in the parameter space, and cross-validation technology can be used to evaluate the performance of the model under different parameter combinations and select the parameter combination with the best performance. When the finally determined

model is tested during actual operation, regularization, ensemble learning and other technologies can be used to prevent overfitting and improve the generalization ability of the model. The model parameters can be dynamically adjusted according to data feedback and performance indicators to ensure that the model always maintains the best performance and gradually improves the prediction accuracy and stability of the model.

5. Other Issues to Consider

After the material management information platform of construction units is embedded with AI, the most important issue that may not be mentioned is data security. After the introduction of AI technology, enterprises will face greater data security risks. AI systems need to access and process a large number of sensitive data, such as supplier information and purchase prices. Data may be leaked or illegally exploited. The problems that may be involved in privacy protection are mainly that the AI system has a strong data processing capacity, but it may also infringe on personal privacy. If the employee information and personal information of suppliers collected in the procurement process are not properly protected, it may cause privacy disclosure problems. Because the storage function of AI is powerful, once exposed, the information of the entire company will be leaked, which may affect the normal operation of the company. After the use of AI technology, the demand and cost of computing power will also be greatly improved, and the operation of AI technology needs strong computing power support, which means that enterprises need to invest more money to buy high-performance servers, storage devices and other hardware resources, and the training and reasoning of AI models also need to consume a lot of computing resources, increasing the operating costs of enterprises.

After the introduction of AI technology, the construction unit needs to ensure that the new AI system can be seamlessly connected with the existing information system. However, due to the differences in technical architecture and data formats between different systems, it may lead to compatibility problems and affect the normal operation of the system, which will lead to system compatibility problems. And after the use of AI technology, it also needs continuous maintenance and update, which requires the company to constantly monitor and adjust the use of AI. AI technology needs constant maintenance and updates to maintain its performance, so as technology continues to evolve and data changes, enterprises need to make regular adjustments and optimizations to their AI models. In the process of using AI, if there are security loopholes or defects in the AI technology used by enterprises, they also need to be repaired in time to avoid potential risks.

Human cost is also an issue that needs to be focused on, enterprises need to have the relevant skills and knowledge of talents to manage and maintain the new system, the current market lack of talents who understand both construction procurement management and AI technology, so enterprises need to increase the cultivation and introduction of talents to meet the new business needs.

Finally, the most important thing is that with the in-depth application of AI technology in the information management of material procurement in the construction industry, enterprises should not only pursue the efficiency of technology, but also pay great attention to the compliance with laws, regulations and ethics. When using AI for decision-making, analysis, and prediction, companies must ensure that all operations comply with laws and regulations such as data protection, privacy rights, and algorithmic fairness to avoid potential legal risks and social controversies. Just as the generative artificial intelligence such as ChatGPT proposed by Liu Xianquan has certain logical reasoning ability and creative ability, and even has the ability to program independently through its own, so it has the possibility of independent consciousness and autonomous will from human beings [12]. Therefore, enterprises should avoid over-reliance on AI system, because once the system fails or makes mistakes, it is

necessary to avoid over-reliance on AI system. Enterprises may face serious problems such as decision-making errors and operational disruptions, which may affect corporate reputation and long-term interests and even bring legal risks.

6. Conclusion

The application of information platform in material department of construction industry is very common at present, and most material departments have introduced advanced information management tools, such as material management system, supply chain collaboration platform, etc., in order to achieve real-time update and sharing of material information. However, although these platforms can efficiently process material data and improve the accuracy and efficiency of material allocation, some old enterprises have a low level of information technology and a low level of personnel information technology, resulting in low material management efficiency. In this case, the introduction of AI can make up for the shortcomings of old enterprises in data processing and analysis, and further improve the accuracy and efficiency of material allocation by automating and intelligently processing material data. At the same time, AI can also assist employees to deal with complex material management tasks, reduce their workload, and continuously improve the level of material management through continuous learning and optimization, such as analyzing the input material price data and giving appropriate strategic procurement recommendations. However, the application of AI technology requires the selection of appropriate AI models and effective parameter adjustment is the key to ensure the performance of the platform. In practical applications, it is necessary to flexibly adjust the technical scheme according to the specific situation to meet the changing needs. When using AI technology, it is necessary to pay attention to data security and privacy protection, strengthen talent training and introduction, and ensure the deep integration of technology and business. In addition, it is necessary to comply with ethical and regulatory requirements, avoid the abuse or illegal use of technology, and ensure the steady development of the material management platform. Through these measures, the material sector of the construction industry will be able to make better use of AI technology and promote the intelligent process of the industry.

References

- [1] Cong Song. Implementation of statistical chart of special service Recuperation based on PLSQL Developer [J]. Chinese Medical Equipment, 2019,35(01):92-94.
- [2] Ye Jingling. Analysis and solution of existing problems in material procurement management under the new situation [J]. Enterprise Technology and Development, 2020(11):250-252.
- [3] ZHAO Xiaodian. Problems and Countermeasures of material Management in Project Management [J]. Anhui Architecture, 2019,27(03):196-197.
- [4] LIANG Huiying. Current Situation Analysis and Suggestions on material Procurement Management of Construction Enterprises [J]. Railway Procurement and Logistics, 2019,15(11):36-38.
- [5] Development outline of informatization in construction industry from 2016 to 2020 [J]. Engineering Quality, 2017,35(03):89-92. (in Chinese)
- [6] WEI Guangming. Construction and Application of material Procurement Information Platform for Construction Enterprises [J]. Railway Procurement and Logistics, 2019,14(07):45-46.
- [7] Li Xiaofeng. Construction and significance of Construction materials procurement information platform [J]. Modern Industrial Economy and Information Technology, 2019,9(09):65-66+70.
- [8] Chai Hongfeng, Li Zhixin, Wang Yifan, et al. Development trend of financial risk monitoring technology based on artificial intelligence [J]. New Finance, 2024,(03):4-10.
- [9] Chai Yawu. Thinking on the Construction of Railway material price Database [J]. Railway Purchasing and Logistics, 2020,15(08):41-43.

- [10] Mohammed A .Artificial intelligence and resource optimization: A study of Fintech start-ups[J].Resources Policy,2023,80
- [11] Duan Jin, Asteris Panagiotis G. Nguyen Hoang,etl,2021.A novel artificial intelligence technique to predict compressive strength of recycled aggregate concrete using ICA-XGBoost model.Engineerin
- [12] Liu Xianquan. Research on Criminal liability of generative Artificial intelligence like ChatGPT [J]. Modern Law,2023,45(04):110-125.