The Use of Artificial Intelligence Algorithms to Improve the Evaluation Process of Project Documentation

Alexander Nikitin[a], Sergey Sinenko[b]
National Research Moscow State University of Civil Engineering (NRU MGSU), Russia, 129337, Moscow, Yaroslavskoe shosse, 26
A.Nikitin56@gmail.com, sasin50@gmail.com

Keywords: Artificial intelligence, project, project documentation, evaluation, BIM.

Abstract: The authors of the article consider the possibilities of using artificial intelligence (AI) algorithms in the evaluation of project documentation developed using information modeling technologies (BIM). The purpose of the study is to reflect the role of AI in evaluating design solutions in the current realities and in the future. During the research, the authors consider the main AI algorithms possible for use in the evaluation of project documentation, their advantages, and also emphasize the issues and difficulties associated with the introduction of AI technologies into the process of evaluating project documentation. As a result of the conducted research, the main risks of using AI in assessment, as well as prospects for the development and implementation of AI in the methodology of evaluating project documentation, have been identified.

1 INTRODUCTION

The digital transformation and reorientation of the construction business to the use of information modeling (BIM) technologies is taking place at an enormous pace (Verstina, 2022). The digital building model becomes an integral part of the building design and construction process and is used throughout the entire life cycle of the facility. The digital model is increasingly being used as the main tool for making important decisions related to the construction and operation of a building, helps to determine the technical and economic component of the future building, as well as to prevent possible risks. It helps to communicate quickly to all project participants, regardless of their location (Slavin, 2018).

The use of a complex information model requires a scrupulous assessment of the applied design solutions and can take up a large human and time resource. This affects the timing and cost of the project (Sinenko,2018).

Artificial intelligence (AI) technologies are actively being introduced into the project management and design process. Therefore, the use of AI algorithms significantly changes the approach to evaluating project documentation.

The volume of the global market for the use of AI in various spheres of life is shown in Figure.1

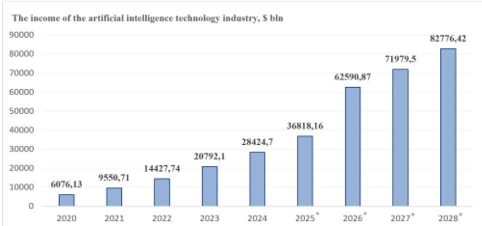

Figure 1: The volume of the global AI market.

Evaluation of project documentation is one of the important tasks in project management, which ensures that project documents are complete, accurate, and meet the requirements of the terms of reference and regulatory requirements. The introduction of AI algorithms into the evaluation process provides a wide range of capabilities that can automate and optimize the evaluation of project documentation (Cross, 2004).

The object of the study is artificial intelligence.

The subject of the study is artificial intelligence in the evaluation of project documentation.

[a] https://orcid.org/0009-0002-6755-8247
[b] https://orcid.org/0000-0002-2212-750X

The purpose of the study is to determine the role and capabilities of AI in evaluating project documentation.

Research objectives:

1. Analysis of scientific and practical work in the field of design and evaluation of project documentation using AI.

2. Analysis of the application of AI algorithms for the evaluation of project documentation

3. Identification of factors and risk analysis of AI implementation for project evaluation in project organizations.

2 METHODOLOGIES

The authors identify several AI algorithms that improve the evaluation of project documentation.
Such algorithms include:

1. Machine learning. This is one of the most recognizable and widely used AI algorithms. The design industry has accumulated a huge reservoir of unstructured data and design solutions in paper form. Machine learning allows you to process and digitize all this information (Fuge, 2014). To properly configure the AI, it is necessary to involve experts in the field of design. Their skills and practical knowledge are needed primarily to create the cognitive part of AI. The main training material is also the accumulated database of typical and repetitive comments on the project documentation (Duffy, 1996).

2. Neural networks. Neural networks can be used to identify hidden dependencies between project parameters, which helps to more accurately determine the characteristics of the project, such as cost, risks, labor intensity, etc.

3. Natural Language Processing (NLP). Allows computers to process human language. NLP is used to analyze text, extract key information from documentation, and automatically generate reports. It is especially useful when evaluating project documentation prepared by international design teams (Brown, 2020).

4. Expert systems. This is an AI algorithm that includes expert knowledge in specialized areas of design (engineering systems, design solutions, architecture, etc.). Expert systems are useful for evaluating unique or technically complex objects, where the knowledge of a leading expert or group of experts may not be enough to correctly evaluate documentation.

An important role in deciding on the use of a particular AI algorithm is played by the level of the building information model provided for the evaluation of project documentation (Chahal, 2007). The ISO 19650 standard describes five levels of maturity of the information model (LOD) from LOD 100 to LOD 500, each level provides a different degree of detail and content of the model. LOD 100 usually represents conceptual solutions, LOD 500 information about each element of the model. Figure 2 shows the differences between the levels of the BIM model.

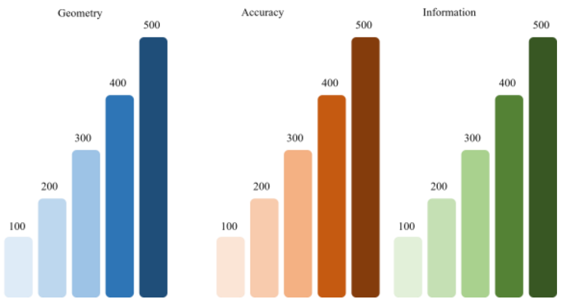

Figure 2: Differences between the levels of the BIM model.

For the successful transformation of the project business, when switching to the use of AI algorithms in project activities, including for evaluating project documentation, it is necessary to take into account the factors listed in table 1.

Table 1: Factors influencing the implementation of AI in design organizations.

The factor	Specifications
The strategy of the project office	Having a strategy and understanding how AI will be integrated into the business processes of a project organization plays a key role. Organizations must define goals, expectations, and plans for the implementation of AI.
Availability of resources and financial opportunities	Successful implementation of AI requires not only a sufficient amount of money, but also the availability of qualified specialists in the field of data processing, analytics and programming. Organizations must be prepared to invest in the necessary resources.
Availability of an archive of project documentation and comments on it	The quality and availability of project data are key indicators of successful AI implementation. Design organizations should have a high level of accumulated data in the field of design solutions.

Education and training of personnel	Designers should be prepared to use new technologies and methods of work related to AI. Education and training of specialists play an important role in the successful implementation of AI.
Organizational culture and organizational structure change	Implementation requires changes in the culture of the organization and its organizational structure.

3 RESULTS

Various algorithms and methods of artificial intelligence are used to assess the quality of the BIM model. Table 2 summarizes the application options for AI algorithms that can be useful in evaluating project documentation, depending on the maturity level of the BIM model.

Table 2: Application options for AI algorithms.

The level of the BIM model	The AI algorithm	Description
LOD 100, LOD 200	Image Processing	Computer vision algorithms are used to automatically analyze images and detect the main elements of the model at the initial levels of documentation development.
	Cluster analysis	Data clustering helps in grouping model elements by type or function at the lower LOD levels.
LOD 300	Neural networks	Neural networks are used to analyze elements and their relationships at a more detailed level of the model
	Genetic algorithms	Genetic algorithms are used to evaluate the optimal arrangement of model elements and their configuration at more advanced LOD levels in order to improve the quality of the model.
LOD 400 и LOD 500	NLP	Analysis of metadata and documentation of the model.
	Expert systems	Verification of the model's compliance with standards and requirements of regulatory documents.

During the research, the authors emphasize the advantages (Table 3) and risks (Table 4) of using AI in evaluating project documentation.

Table 3: Advantages of AI algorithms.

Advantages	Description
Increasing the speed and efficiency of project evaluation	AI algorithms including machine learning and neural networks are able to analyze and process large amounts of project documentation in a short time, which significantly speeds up the project evaluation process.
Improving the accuracy and quality of the assessment	It avoids human errors and bias in the evaluation of project documentation, which leads to more accurate and objective evaluation results.
Data analysis	Analyzes information from large volumes of structured and unstructured data, which makes the assessment more in-depth and detailed.
Automation of routine tasks	Automates routine tasks of evaluating project documentation, freeing up the time of experts and employees to perform more complex and important tasks.
Improving competitiveness	Organizations that use AI algorithms to evaluate project documentation are more competitive in the market due to increased productivity, quality of decision-making and efficiency.
Increasing the level of security	It can be used to detect potential threats and errors in project documentation, which helps to prevent emergencies.
More accurate forecasting	It helps to predict possible risks, problems or successes of a project based on the analysis of

	archived data and scenarios of development of events.
Increasing transparency	It helps to automate the process of verifying the compliance of project documentation with requirements and standards.
Cost reduction	Effective use in project evaluation helps to reduce personnel costs and increase productivity.
Increasing the level of analytics	Analyzes and interprets project data at a deeper level, which allows you to identify non-obvious dependencies and influences in the project documentation.

These advantages show that the use of AI in the evaluation of project documentation has great potential to improve management processes and improve the efficiency of the project organization. Having significant advantages over traditional assessment methods, AI has a number of disadvantages and when making a decision by a design organization in favour of using AI algorithms, it is necessary to clearly understand and structure the risks of implementing AI. The authors analysed the possible risks of using AI algorithms (Raina, 2019).

Table 4: Risks of using AI algorithms.

Risks	Justification
Insufficient quality of project documentation	The poor quality of project documentation, which analyzes AI algorithms in their work, strongly affects the accuracy of estimates. Incomplete, unreliable or untimely data can lead to erroneous results when evaluating project documentation.
The quality of training materials	If distorted data is used for AI training, the subsequent assessment will not be correct.
Conflict with experts	Specialists involved in the verification of project documentation may not understand how AI works and how exactly it performs its assessments. This may lead to a conflict in the interpretation of the verification results.
The need for constant updating and support	AI models require constant updating and support to ensure their accuracy and effectiveness. Making changes and updates can create additional costs.
Loss of control over the evaluation process	In case of incorrect implementation or provision of incorrect data, the organization may lose control over the project evaluation process.

4 CONCLUSIONS

The use of artificial intelligence algorithms in the evaluation of project documentation has great potential to improve the efficiency, accuracy and quality of project management processes (Ruhaak, 2021). Using artificial intelligence algorithms, project managers can simplify document analysis, improve decision-making capabilities, free specialists from routine tasks and ensure the success of the project (Berger, 2016). AI algorithms improve the quality of the assessment by automatically analysing a large amount of data and reducing human influence on the assessment results. This approach helps to improve the objectivity and reliability of the assessment process. At the same time, it is necessary to clearly understand the limitations and risks associated with the use of AI algorithms in the evaluation of project documentation. The main risk is the need for careful pre-configuration and control of the AI training procedure (Telichenko, 2023). The use of algorithms and automated systems is gradually changing the requirements for the skills and roles of professionals, reducing the need for manual data processing and increasing the need for analysis and interpretation of the results obtained from artificial intelligence. The project business gets much more benefits from using AI algorithms in the form of improving decision-making processes, reducing the time for the documentation evaluation procedure, improving the quality of the project, saving resources by optimizing production processes.

Continued research and development in the field of artificial intelligence for project management will further optimize the evaluation process and expand the capabilities of project teams to achieve a better product.

REFERENCES

Brown, T., B., Mann, B., Ryder, N., Subbiah, M., Kaplan, J., Dhariwal, P., et al., 2020, Language models are few-shot learners. *34th Conference on Neural Information Processing Systems (NeurIPS 2020)*, Vancouver, Canada.

Cross, N., 2004. Expertise in Design: An Overview Design Studies.

Duffy, A., H., B., Brown, D., C., Maher, M., L., 1996. Guest Editors. AI EDAM journal, Special Issue: Machine Learning in Design, Vol. 10, No. 2, Spring, Cambridge University Press, New York.

Fuge, M., Peters, B., Agogino, A., 2014. Machine Learning Algorithms for Recommending Design Methods.

Chahal, K. S., Emerson, P., 2007. Quality control and quality assurance in design and construction. Journal of the institution of engineers, Architectural engineering division. Vol. 88, No. 29, India.

Verstina, N. G., Kisel, T., N., Kulakov., K. YU., 2022. Introduction of innovative technologies at enterprises in the investment and construction sector: problems and determining factors, E-Management.

Berger, R., 2016. Digitization in the construction industry, Munich.

Raina, A., McComb, C., Cagan, J., 2019. Learning to Design from Humans: Imitating Human Designers Through Deep Learning, ASME. JMD.

Ruhaak, A., 2021. How data trusts can protect privacy.

Sinenko, S., Ahmetgaliev, A., Slavin, A. 2018. Practical aspects of construction of high-rise buildings in Russia. *Paper presented at the IOP Conference Series: Materials Science and Engineering*, 365(6)

Slavin, A., Sinenko, S., Yoshin, N, 2018. The evolutionary development of the methodology of operational planning of construction production. Paper presented at the IOP Conference Series: *Materials Science and Engineering*, 365(6).

Telichenko, V. I., Lapidus, A. A., Slesarev, M. Yu., 2023 Analysis and synthesis of images of environmentally oriented innovative technologies of construction production. Vestnik MGSU 18(8):1298-1305.