

Problems and Countermeasures of Cost Control in Civil Engineering Management Based on Cloud Computing Technology Under the Background of Manufacturing 2025

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Abstract

The application of information management in manufacturing industry is more and more extensive. Information management has become the main development direction of current civil engineering cost management. Therefore, the problems and Countermeasures of cost control in civil engineering management based on cloud computing technology are put forward. After a brief description of the current information management of engineering cost, a project cost management model based on the cloud computing platform is designed according to the demand of the information management of the current project cost. Through the experimental comparison, it is proved that the project cost management model based on cloud computing is more advantageous than the traditional management mode, whether it is the management cost or the management efficiency.

Keywords: Informatization; manufacturing ; Project cost; Cloud computing; Model

I. Introduction

With the rapid development of science and technology, the level of social life and production is getting higher and higher [1]. As the most important part of the construction field, civil engineering has been accompanied by the development of human history. Therefore, the level of civil engineering construction is often closely related to the productivity of human society [2]. After entering the modern society, the wide application of science and technology makes the scale of civil engineering larger, the technology become more complex, and the final cost of the project becomes higher. Therefore, in the field of contemporary civil engineering, project cost control has always been the most important content of civil engineering construction. The research carried out by various major institutions in the society is also endless [3].

After entering the new century, as a science and technology that affects human society's production and life, information technology has been changing with each passing day, and its application in all walks of life has been continuing [4]. Project cost as a very important part of the construction field, using computer technology to manage and control, has been a very important topic in the application of computer technology in the field of construction [5]. It is against this background that the problems and countermeasures of cost control based on cloud computing technology in civil engineering management are proposed, and it is hoped to contribute to the intelligent management of project cost.

II. State of the art

The rapid development of computer technology and its wide range of applications have provided technical support for the information management of construction project costs. Therefore, relevant research was started long ago.

For example, Guang Lian Da and Luban, who are widely used in the field of building engineering, are very mature engineering cost software [6]. With the further research of the information technology in the field of engineering cost, the domestic research on this aspect is beginning to develop in the direction of the combination of engineering cost and information technology [7]. For example, the project cost forecasting and management platform based on engineering cost information designed by scholar Du coco; the construction cost information management system built by scholar Shu Changjun using virtual database and cross-platform technology [8]. Zhou Fang, a scholar, has designed the project cost information management of the enterprise level by modularization, while Huang Wei has designed the national engineering cost information platform from the national level. There are also scholars who develop engineering cost information management system from the perspective of computer science [9]. In general, there are many studies related to the management of domestic construction cost information, but the functions of these software or systems are relatively single. The data storage is also limited to traditional databases such as SQL databases, and the storage and processing of big data is still weak. The relevant research from the perspective of cloud computing is limited to a few scholars such as Yuan Ding [10]. Therefore, the use of cloud computing and other big data technology for engineering cost information management and control still has a long way to go.

III. Methodology

3.1 Demand analysis of new information management for engineering cost and choice of cloud computing technology

In the current civil engineering cost management and control, most of the application of computer technology still stays on a single personal computer platform. Even if it is possible to inquire the individual project cost of a civil engineering project through the network, it is also achieved through the local area network. This kind of management method is limited to the project-related cost data, and the target of service is also the participating unit of this project. Even so, the sharing of information between units and units is still difficult to achieve. The main reason is that the local area network for participating in various units is different and cannot share the cost information. In addition, the cost data involved in this management way is often small. For the larger scale of civil engineering and more and more complex technology, this management and control method becomes more and more comfortable and adaptable to the demand. So in the study of the problems and Countermeasures of cost control in civil engineering management based on cloud computing technology, this paper plans to use the current cloud computing platform technology to realize the management and control of the project cost. By combining the engineering cost with the depth of network technology, the management and sharing of the large project cost project can be realized, that is, the storage, sharing and management of the data information of the project cost project can be realized through the cloud computing platform.

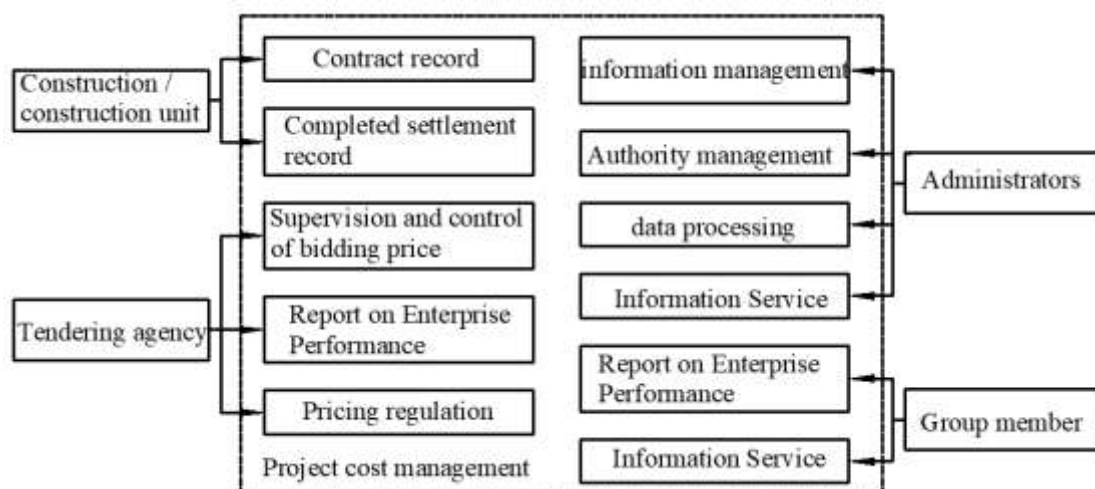


Figure 1 The object of information management for civil engineering cost

In the mode of project cost management and control based on the cloud computing platform, the units involved in the construction of civil engineering can inquire, fill in and deal with the cost information related to the project. As shown in Figure 1, construction and construction units can make use of their contracts and completion settlements for the record, and the bidding agency can supervise the price of bidding control, report the performance of enterprises and supervise the valuation. The administrators of the platform can complete the processing of data such as the management of user information and rights, data entry, data calculation, etc., or complete the query of information through it. The members involved in civil engineering construction can query the relevant information of the project cost on the platform, or report the results to the enterprises through the platform. All the above objects involved in project cost management and control need to support the cloud platform technology to process or query related data. Therefore, the cloud computing platform is the most critical part of the entire platform.

Table 1 Comparison of domestic cloud computing technology platform

Cloud platform	Service mode	advantage	Inferiority
Ali cloud	IaaS, PaaS, SaaS	Mature technology and perfect facilities	Strong closeness and unclear positioning
Big cloud	IaaS, PaaS	Mature technology and strong innovation	Weak infrastructure and maintenance
Sina cloud	IaaS, PaaS, SaaS	Mature technology and strong openness	The front end design is not perfect and cannot be put on record
Tencent cloud	PaaS	Good openness and large user base	Single service

Because the cloud computing platform is the foundation of the entire civil engineering cost management and control, the choice of cloud computing platform must be cautious. At present, the domestic companies that provide cloud computing platforms mainly include Alibaba, Shanda, Sina, and Tencent. These four cloud computing platforms have different performances, as shown in Table 1. Among them, the technologies of Ali, Shanda and Sina are more mature. Tencent's cloud computing technology has a single function because of its late start. Therefore, Tencent's cloud computing platform is not considered. Although the technology of Shanda Cloud Computing Platform is relatively mature, the infrastructure management and operation and maintenance of the platform are relatively weak which poses a great risk to the industries that require long-term management and storage of civil engineering projects. Sina cloud cannot be archival, which is extremely unfavorable to the information management of project cost, so only Ali cloud can be selected. Although the localization of Ali cloud is not clear, and the closure is strong, the cost management of civil engineering projects has been involved in the factors of business secrecy, so the shortcomings of Ali cloud have not so much bad effect on the management and control of the project cost.

3.2 Key technology design of engineering cost management control based on Cloud Computing Technology

After analyzing the requirements of engineering cost management and control, and choosing the cloud computing platform, the key technologies for the cost control and management of civil engineering based on the cloud computing platform are designed. First, the general framework of civil engineering cost and management platform is designed. After determining the cloud computing platform, the whole platform is divided into three levels, the data layer, the management service layer and the application layer according to the characteristics of the civil engineering cost specialty. The structure is shown in Figure 2. The relationship between these three layers is

mutual support, that is, the underlying service is the basis of the upper service. Of course, the introduction between these three layers can provide services separately. The data resource layer is the foundation of the whole platform, and the whole level can provide the storage of data resources and the processing of two major services, that is, to store the various types and structures of the construction cost data transmitted on the upper level. The management service layer is the core of the whole platform, which is responsible for uploading and distributing platforms, mainly providing tasks, resources, users and security management. The application layer is the upper layer of the platform, and its main function is user oriented. At this level, the management, service, and other functions of the project cost data information are encapsulated and interact with users through the unified interface.

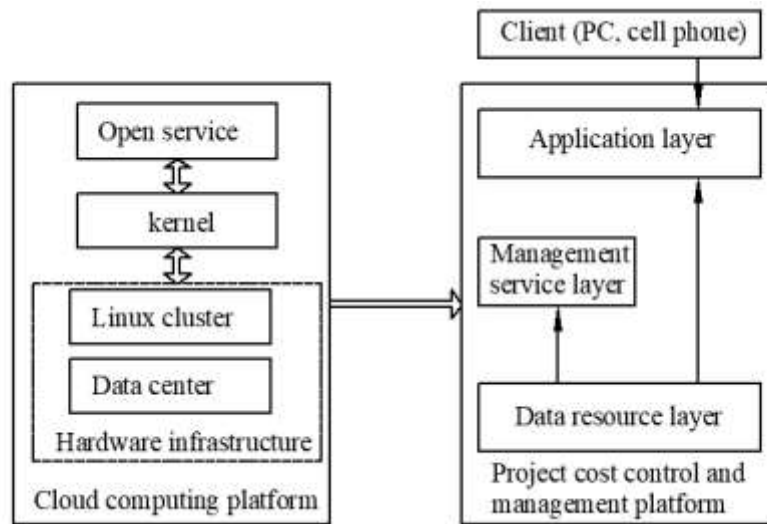


Figure 2 Overall framework of engineering cost management control platform based on Cloud Computing Technology

After the structure of the entire platform has been established, key technologies need to be designed. Because the purpose of the entire platform is to provide project cost management and control for each user, the interaction of project cost information data and user management has become the key technology of the entire platform. In the cost of civil engineering, there are three main aspects, first of all, the original data is uploaded by the user, the next is to download the price of the engineering cost and the data information of the project cost. The uploading of the data information of the project cost is the basic function of the engineering cost users, that is, the user can upload the data information related to the civil engineering cost in the working process to the cloud computing platform. User engineering quotation is mainly targeted at material suppliers, in the current civil engineering materials market. The material offer provided by the cost station does not reflect the real price of all materials on the material market. Therefore, the quotation of material suppliers is added to the project cost management and control platform based on cloud computing. The purpose is to provide a platform for material suppliers' quotation in project cost. Data download is mainly provided by market price, engineering cost related laws and regulations, and the initial information of project completion. If users need higher value and deeper cost information, they need their own rights to meet the relevant requirements, that is, the download of the project cost data is limited by authority.

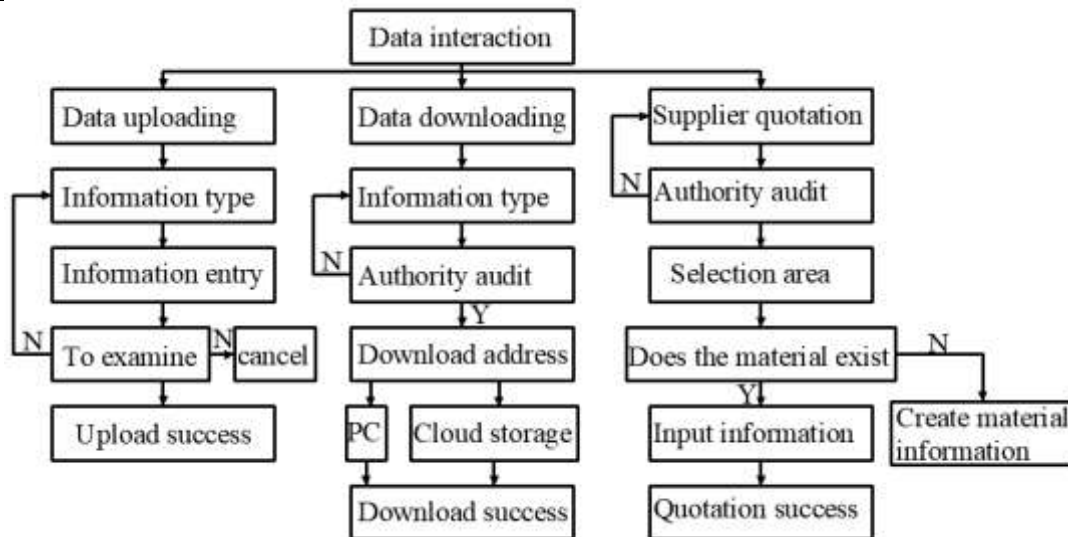


Figure 3 Engineering cost data interaction based on cloud computing platform

According to the above analysis, the interaction of civil engineering cost data information based on cloud computing platform needs to be designed in accordance with figure 3. The first is uploading the original data of engineering cost, which requires users to use relevant user information to enter the platform. After choosing the professional and type of uploading data information, the original data information is entered into the cloud computing platform. The process needs to wait for the platform manager to examine the professional, type, and other formats of the original data information. If the audit is not passed, the user either chooses to cancel the original data information of the cost of uploading the project, or returns the professional and type of refilling the original data information. If the audit is passed, the original data information of the project cost is uploaded to the cloud computing platform. The downloading of project cost data information also requires the selection of the professional and type of project cost data information, and then waits for permission audit. If the downloaded user has the permission to download the data, the downloaded address is selected, and generally two platforms, the personal computer and the cloud storage, are provided. Finally, the user can download the information successfully after the user's choice. If the user's authority does not meet the requirements for downloading the data, the user either abandons the download of the data information or reselects the specialty and type of the downloaded data. Supplier pricing is also based on cloud computing platform for permissions. If it fails, requote. If passed, then the quotation area need to be selected and whether the area has the same material information should be checked. If not, the basic information of the material is created, and the information is entered into the platform. If the relevant material is available, the information is input, and the price is quoted.

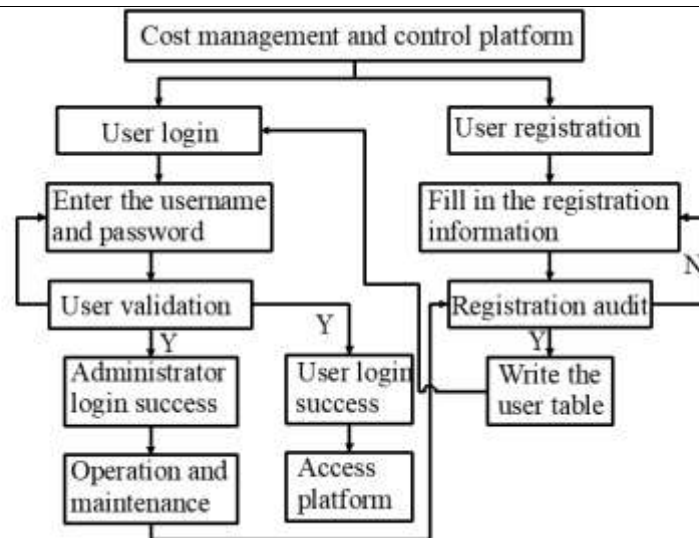


Figure 4 Information management of civil engineering cost based on cloud computing platform

Through the design of three key technologies, such as original data uploading, data downloading and supplier quotation based on cloud computing platform, it can be known that the management and control of engineering cost need the support of user information. Therefore, the user management technology based on the cloud computing platform is designed here, as shown in Figure 4. Users who use civil engineering cost management and control platforms are generally divided into two types: registered users and new users. The user's name and appearance are needed, and the user's verification is needed to enter the platform. After verification, the user's identity is selected to select the related operation, and the administrator is responsible for the maintenance and application of the platform, while the ordinary user visits the platform to upload and download the engineering cost related data. New users should fill in the information and apply for registration. After they pass, they enter the platform user list. If they fail, they will re-enter the information.

IV. Result analysis and discussion

After the civil engineering cost management and control platform based on the cloud computing platform completes the relevant technical design, it is experimentally verified here. The first is to compare with traditional methods of project cost management. Figure 5 shows the comparison of the required cost of the two methods of civil engineering cost management. The entire comparison is based on hardware costs, software costs, and overall costs. First of all, the cost of hardware and the hardware cost of the traditional civil engineering cost management method are about 100,000 yuan. However, the hardware cost of the cloud computing platform-based management method is only 50,000 yuan, that is, in terms of hardware costs, and the traditional approach is twice as much as the design of this article. In the cost of software, the software cost of the management method designed in this paper is 60,000 yuan, while the traditional management method requires 80,000 yuan. For the entire project cost management and control, the cost of traditional management and control methods is about 200,000 yuan, and the cost of the management method based on the cloud computing platform in this paper is 120,000 yuan. By comparing the cost of two management methods in the cost project, it can be seen that the cost management and control platform based on cloud computing platform in this paper has lower cost and more advantages in the process of engineering cost management.

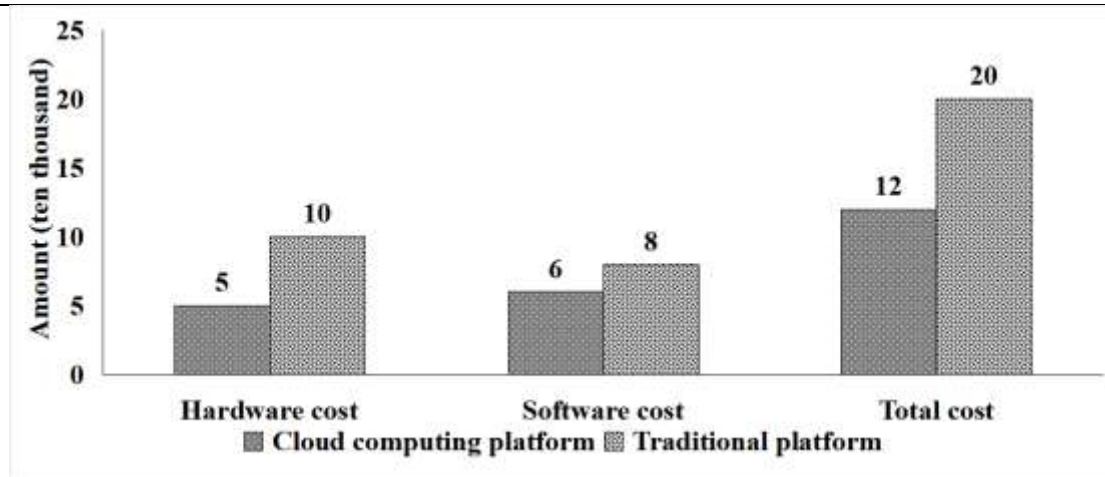


Figure 5 Comparison between cloud computing management platform and traditional management in terms of cost

On the whole, the cost of the two project cost management is compared. In this paper, the key technologies of the two management methods are verified. One is the response time when the project is querying the project cost, and the other is the comparison of the data storage time of the project cost data. The first is to compare the response time of engineering cost data, as shown in Figure 6. The abscissa in Figure 6 is the number of querying data information, and the ordinate is the response time for querying data information. As can be seen from the figure, with the increase in the number of project cost data information, the response time of the two management methods is gradually increasing. The two methods are analyzed separately. For the traditional engineering cost management method, when the number of query data is less than 500, the response time is still within 5 seconds. When the number exceeds 1,000, the time required for the inquiry starts to increase significantly. When the number of query data is greater than 50,000, the time consumed has exceeded 10 seconds. For the platform designed in this paper, the response time of 1000 query data is increased, but it still does not exceed 15 seconds. This result shows that the efficiency of the project cost management method based on cloud computing platform designed in this paper is more efficient.

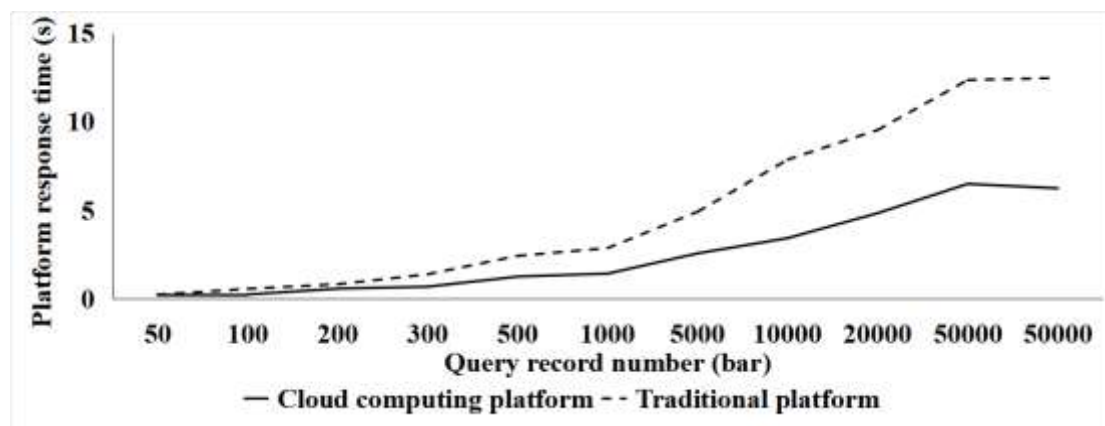


Figure 6 Comparison between cloud computing cost management and traditional cost management in recording and querying

Figure 7 is the response time of two ways to store engineering cost data. As can be seen from the diagram, the two management modes increase gradually with the increase of data information, especially when the size of the project cost data is more than 400M, the time of the two modes is more than 500 seconds. If they are analyzed separately, when the project cost data information is less than 50M, the execution time difference between the two

management modes is not obvious, but as the size of the information gradually exceeds 100M. The time consumption of the traditional project cost management mode in storing data information gradually exceeds the design method in this paper, and this gap increases with the further increase of the file, which shows that the file storage efficiency of the designed management mode is higher than that of the traditional.

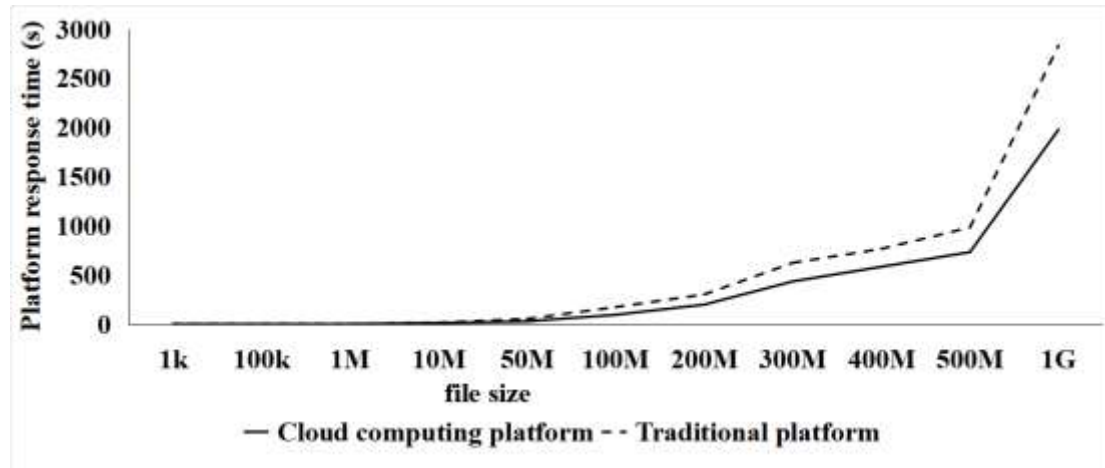


Figure 7 Comparison between cloud computing cost management and traditional cost management in file uploading

V. Conclusion

Civil engineering is a very important part of the construction field. The management and control of project cost has always been a top priority in engineering projects, while the development of informatization technology has made engineering cost management and control more scientific and rational. Therefore, the issues and countermeasures of cost control in civil engineering management based on cloud computing technology are proposed. Based on the analysis results of current civil engineering cost management and control requirements, a civil engineering cost management model based on Ali Cloud computing platform is designed, and then compared with the traditional engineering cost management model. The final experimental results prove that the cost of the project cost management model based on cloud computing platform designed in this paper is much lower than the traditional project cost management model. The efficiency of the project cost management model is higher than that of the traditional management mode in the experiment of the data information query of the project cost and the storage experiment of the project cost data file.

Reference

- [1] L Abdurrahman, A Z R Langi, S Suhardi, et al, "Information Technology Value Engineering Model and Cost Efficiency in IT-Based Firms," IEEE Systems Journal, vol. 99, pp. 1-12, 2017.
- [2] J J. Mcarthur, "A Building Information Management (BIM) Framework and Supporting Case Study for Existing Building Operations," Maintenance and Sustainability. Procedia Engineering, vol. 118:1104-1111, 2015.
- [3] I. Mahamid, "Contractors' perception of risk factors affecting cost overrun in building projects in Palestine," Ies Journal Part A Civil & Structural Engineering, vol. 7, no. 1, pp. 38-50, 2014.
- [4] H Martin, T M Lewis, A. Petersen, "Factors affecting the choice of construction project delivery in developing oil and gas economies," Architectural Engineering & Design Management, vol. 12, no. 3, pp. 170-188, 2016.
- [5] K C Wang, W C Wang, H H Wang, et al, "Applying building information modeling to integrate schedule and cost for establishing construction progress curves," Automation in Construction, vol. 72, pp. 397-410 2016.

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- [6] W Xue, Y Wang, Q Man, "Research on information models for the construction schedule management based on the IFC standard," *Journal of Industrial Engineering & Management*, vol. 8, no. 3, pp. 615-635, 2015.
 - [7] Z Ma, Z. Liu, "BIM-based Intelligent Acquisition of Construction Information for Cost Estimation of Building Projects," *Procedia Engineering*, vol. 85, no. 5, pp. 358-367, 2014.
 - [8] J. Sun, "Construction of dynamic management system of engineering cost based on exponential model," *Revista De La Facultad De Ingenieria*, vol. 32, no. 11, pp. 830-835, 2017.
 - [9] C Jin, Y. Bai, "Analysis on the Construction of Project Cost Information System," *Applied Mechanics & Materials*, vol. 687-691, pp. 1979-1982, 2014.
 - [10] Q R. Xiao, "Project Cost Management and Application of Information Technology to Improve," *Advanced Materials Research*, vol. 971-973, pp. 2354-2357, 2014.
 - [11] L Zhao, J Mbachu, Z Liu, et al., "2 Modelling residential building costs in New Zealand: 3 Time series transfer function approach," *Mathematical Problems in Engineering*, vol. 2020, no. 2, pp. 1-18, 2020.
 - [12] P F Kaming, O A Yahya, A Awaludin, et al., "Study on life cycle costing: a case of building for private high school in Jakarta," *Matec Web of Conferences*, pp. 258, 2019.
 - [13] A Qh, B Muh, B Stn, et al., "A cost-effective building retrofit decision-making model – Example of China's temperate and mixed climate zones – Science Direct," *Journal of Cleaner Production*, pp. 280, 2020.
 - [14] Kanchana S, A Sukumaran, "A CRITICAL STUDY ON COST ESCALATION IN CONSTRUCTION INDUSTRY" *International Journal of Engineering Technologies and Management Research*, vol. 5, no. 2, pp. 194-197, 2020.
 - [15] W He, Y Shi, D Kong, "Construction of a 5D duration and cost optimisation model based on genetic algorithm and BIM," *Journal of Engineering*, 2019.
 - [16] S D Mangan, G K Oral, I E Kocagil, et al., "The impact of urban form on building energy and cost efficiency in temperate-humid zones," *Journal of Building Engineering*, vol. 33, pp. 101626, 2020,.
 - [17] W H Wang, "How to Improve the Quality of Budget Estimate of Preliminary Design and Effectively Control the Engineering Cost," *Construction & Design for Engineering*, 2019.
 - [18] Y Y Gao, "Analysis of the Impact of Project Management on Engineering Cost and Analysis of Cost Control Strategy, Value Engineering, 2019.
 - [19] K Rochman, B Susetyo, "Improvement of cost performance accompanied by quality control using value engineering and six sigma methods in high-rise building project," *International Journal of Engineering & Technology*, vol. 9, no. 2, pp. 560, 2020.