Hindawi
Wireless Communications and Mobile Computing
Volume 2022, Article ID 8505922, 7 pages
https://doi.org/10.1155/2022/8505922

Research Article

Cost Control Analysis of Construction Projects Based on Wireless Communication and Artificial Intelligence Decisions

Huadong Xie[1], **Yungang Ge**[1] **and Jingyi Yi**[2]

[1]*CCCC Second Highway Engineering Co. Ltd., Xi'an 710065, China*
[2]*School of Economics & Management, Tongji University, Shanghai 200082, China*

Correspondence should be addressed to Jingyi Yi; yi_jingyi@outlook.com

Received 31 December 2021; Revised 11 February 2022; Accepted 22 February 2022; Published 9 March 2022

Academic Editor: Kalidoss Rajakani

In decades of development, the country has been vigorously developing infrastructure projects and providing a steady stream of help, so our infrastructure strength has always been world's top part. But now, because of the vigorous development of environmental protection enterprises, a variety of raw materials and environmental treatment costs are getting higher and higher, in order to maintain the profitability of enterprises, so we need to carry out cost control of construction projects to ensure a certain profit. In recent years, various emerging terms such as artificial intelligence and big data have become more and more popular, so in order to ensure the stability of the industry, it is imperative for the construction industry to introduce new technologies for the technological revolution. Wireless communication is also widely used with artificial intelligence to build systems because of the fast speed of interaction. In order to ensure the steady development of the construction industry in the future, we need to control the cost of the project and the introduction of high-tech. The purpose of this paper is to control the cost of construction projects by means of wireless communication and artificial intelligence decision-making. After reviewing the history of the construction industry in recent decades, as well as the price fluctuations of building materials and the relevant laws and regulations on environmental protection and construction in recent years, this paper uses the emerging artificial intelligence and traditional wireless communication methods to carry out the traditional project cost control experiments. After a period of experiments, people found that the use of wireless communication with artificial intelligence decision-making ability can be very good control of construction project costs in a certain range, to ensure the profitability of the project and the maximum use of materials.

1. Introduction

When the country was established decades ago, all kinds of waste flourished. At that time, the best way to change a country was to build roads and bridges and open traffic, that is, if you want to get rich, build roads first [1, 2]. In the area near the lake, pier ferry is used for urban improvement. Under the guidance of the government and the support of policies, China's construction industry has been expanding continuously [3]. Moreover, after so many years of development, the construction industry has passed the stage of savage growth and entered the stage of vigorous national control [4]. However, the current construction industry is supervised by enterprises and departments of various countries such as CSCEC, the Environmental Protection Bureau, and the Railway Bureau, and countless construction enterprises compete. As a result, only qualified and compliant enterprises can establish a position and develop steadily in the construction industry [5, 6]. However, due to the stricter control on environmental protection and the impact of international trade war and other factors, the price of building materials has risen sharply. Now, the construction industry needs a new round of revolution to survive. This is both a challenge and an opportunity [7, 8]. We should make good use of the high-tech and emerging technologies at this time. As long as we make good use of them, this opportunity can be grasped and further developed [9]. We decided to take the most effective way to use artificial intelligence for decision-making to control the cost of construction projects, so as to make steady progress and development [10].

Artificial intelligence and wireless communication are two concepts that have been mentioned for a long time, but the difference is that the development history of artificial intelligence is only a few decades, while the development history of wireless communication is very close to a hundred years. Moreover, because of its confidentiality and concealment, it was often used in war, and great progress has been made during this period [11–13]. However, we find that although artificial intelligence has a short development time, it has great potential, because it has intelligence and learning ability, can become stronger automatically, and is equivalent to an analysis system that can learn by itself; due to its own technical reasons and hardware barriers, wireless communication has also fallen into a stalemate at present. In terms of development potential, artificial intelligence as the main control system can work with any technology in the future, but wireless communication as a technology will have great restrictions [14–17]. These two technologies can be used together, so we can use wireless communication technology and artificial intelligence to make decision-making plan for construction project cost control [18]. The meaning of cost control is to control the original cost of a thing, including manpower, materials, time, and money [19]. In cost control, we should give due consideration to all aspects and select the most suitable cost control scheme [20]. For the construction industry, the proportion of these four expenditures is particularly important. Especially when the construction period is short, at this time, enterprises or units usually choose to quickly purchase a large number of materials and recruit high paid personnel to work quickly to make up for the lack of time, which will cause a great waste [21]. We need a cost forecasting and planning system that can evaluate and analyze various situations.

When designing the cost control system of building system, we should pay attention to some key points of architecture and economics, such as quickly grasping the opportunity, stable chassis, and solid foundation [22, 23]. Moreover, due to the uncertainty of the construction industry, because the construction industry includes the construction of all kinds of water and land buildings such as bridges, commercial houses, school buildings, and lake enclosure, we need to analyze all kinds of situations, because sometimes, the things that need to be purchased and handled are different according to different scenarios [24, 25]. Especially sometimes, because of the fundamental thought of Chinese people, some items need to be placed around the building in time to increase the beauty and form Feng Shui [26]. When the system is designed and improved, more classic design cases and scenario analysis should be injected into the database to help the system make the most appropriate cost control plan according to time, construction period, and scenario characteristics [27–29]. Because the purpose of the cost control plan is to control the cost, and a satisfactory building will bring intangible wealth to people, such as introducing business and reducing discounts, and expanding business is also a part of cost control. The increase of workload can better help use the system to calculate more and more accurate data and can make use of surplus resources to avoid waste; it is conducive to cost control [30, 31].

2. KFLP Algorithm

Nuclear method is an effective method to find nonlinear relationship hidden in unknown nonlinear system. The input signal of nuclear adaptive filter is a filter method to track nonlinear system linearly based on this nonlinear mapping [32–34]. The essence of the nuclear method is an internal product operation, so when the algorithm is represented as an internal product form, the internal product calculation can be replaced directly by the nuclear function. The Mercer theorem states that any regenerative core can be extended as follows:

$$\partial\left(\rho, \rho'\right) = \sum_{i=1}^{\infty} \gamma_i \varphi_i(\rho) \varphi_i\left(\rho'\right). \tag{1}$$

Given the input sequence and the desired sequence, the document-based nuclear split low power cost function:

$$W(\theta) = F\left\{\left|d(\mu) - \theta^T(\mu)\varphi(\mu)\right|^i\right\}, 0 < i < 1. \tag{2}$$

The weight update formula of the KFLP algorithm s:

$$\theta(\mu+1) = \theta(\mu) + \delta \frac{1}{|e(\mu)|^{(1-i)}} \operatorname{sgn}(e(\mu))\varphi(\mu). \tag{3}$$

3. Experiment

3.1. Experimental Purposes. Current reforms in the construction industry are inevitable, so we need to update and upgrade all technologies and systems. At the same time, we should also pay attention to the basic principles of the construction industry, that is, do not steal materials and do not deliberately produce products that do not meet the standards and specifications, so we need to carry out real-time control to ensure that the completion of the target standards of the system.

3.2. Experimental Process. We started with using the KFLP algorithm to work with artificial intelligence to make a holistic analysis of the construction industry and to list all the materials and information required before the construction project was carried out. The wireless communication equipment is then reasonably arranged in the plan according to the functions of the various buildings and then will be buildings according to party A requirements and database cases according to its unique functions to divide the control site; the whole building is divided into small objectives, so that it will be completed in the construction process of safety and reasonable and can contact other small goals at any time, so that all independent buildings will be not only independent individuals but also connected to each other, forming an organic whole, to achieve the goal of interconnecting but not interfering with each other. Finally, the results of the simulation experiment are analyzed, the machine simulation evaluation analysis is carried out, and the next repeated experiment is carried out, and a result suitable for the needs of party A is obtained through many experiments.

3.3. Survey. After the experiment, in order to observe the success of the experiment, we usually invite the relevant construction industry, especially the collection and construction personnel of various materials, and negotiate with the construction personnel and security personnel on the planning and layout and then collect their information. Valuable opinions achieve results, formulate follow-up pilot programs, and continuously improve. This time, 500 material collectors, 300 construction layout personnel, 150 construction project managers, and 90 security personnel in the construction industry who used this wireless communication and artificial intelligence method to innovate costs were invited to conduct a questionnaire survey. The survey contents mainly include knowledge of new technologies, current construction process cost control issues, cost changes after using wireless communication, and artificial intelligence methods.

4. Experimental Results

4.1. Artificial Intelligence and Wireless Communication Work Together to Make Decisions about Estimates of the Cost of Housing Projects. After testing the collaboration between artificial intelligence and wireless communications, we found that we could experiment with this, so we went to the next experiment, which was to test the difference between intelligent and manual procurement.

After the data is counted, the data are tabled and charted, such as Table 1 and Table 2, which are made from Table 1. After the calculation, it is found that the labor measurement price is 46 80,000 yuan, while the intelligent estimate price is 4472 million yuan, and intelligent measurement for material waste is very small; manual measurement of more wood, steel, and stone, and less part of the tile and concrete need to repurchase to increase the cost budget and human resources. So, we think artificial intelligence measurements are still good for housing cost projections (Figures 1 and 2).

4.2. On Using Wireless Communication and Artificial Intelligence Decision Support Technology to Control Labor Cost Results. When we use wireless communication and artificial intelligence decision support technology to control labor cost data and with labor planning for labor cost control data collection and made an analysis and comparison, list 3, mapping the data results reasonably in the graph to make the data comparison more obvious. Finally, we found that the labor cost of the intelligent forecast plan was $156.8 million, while the labor cost of the labor plan was $192,000 and that the intelligent forecast plan only required 14 people to work 32 days, while a manual plan requires 16 people to work for 40 days. And after two rounds of prediction, the final total cost of the two sets of experiments was 604, 000 yuan and 66, 000 yuan, of which the former was intelligent prediction results, and the latter was manual prediction results. Experiments show that intelligent forecasting plan in the duration, materials, and amount is lower than manual plan, so intelligent prediction plan can reduce costs within a certain limit and is effective (Table 3; Figure 3).

Table 1: About manually measuring the material cost of a house.

Material	Quantity/*t*	Price/10,000 yuan
Timber	2.3	4.5
Steel	16	16
Stone	4	10
Concrete	13	2.5
Tile	5	5
The rest of the equipment	3	13

Table 2: About intelligently measuring the material cost of a house.

Material	Quantity/*t*	Price/10,000 yuan
Timber	1.7	3.3
Steel	13.3	13.3
Stone	2.8	5.5
Concrete	12.7	2.53
Tile	4.3	8.5
The rest of the equipment	3	13

4.3. Results of the Questionnaire. By looking at the data in Table 4 and Figure 4, it is possible to carry out a planned analysis of this questionnaire's acceptance of intelligent prediction. Among the 100 samples in this questionnaire, 88 samples have a positive attitude, and the evaluation attitude close to 90% is considered to be very good and negotiable, which is equivalent to a huge improvement. And another 12 people have a skeptical attitude, that is, more than 10% of the people think that they should continue to work hard, indicating that what they have not done fully meets everyone's expectations, so we still need to continue to work hard and combine various smart new features in wireless communication technology, provide more channels for the collection of project cost analysis data, and combine artificial intelligence technology to create a better analysis system and implement a better project cost control plan.

4.4. Project Cost Control. Controlling project cost plays an important role in the profitability of an enterprise, and it is a research direction that every enterprise should focus on. The costs and expenses in the project are redundant and complex, including office management fees, material fees, service fees, and external consulting fees. If the cost is not reasonably controlled, it is likely to cause the situation to make ends meet or even break the capital chain. The project manager must plan and arrange the cost reasonably, summarize and analyze the cost every month, find out the cost expenditure that can be reasonably simplified, and summarize and report it on a regular basis. From the start of bidding to the completion of the construction project, cost control should always be prioritized. Under the condition of ensuring the construction period and quality, a series of measures should be taken to control the cost within a reasonable range and save the cost to the greatest extent.

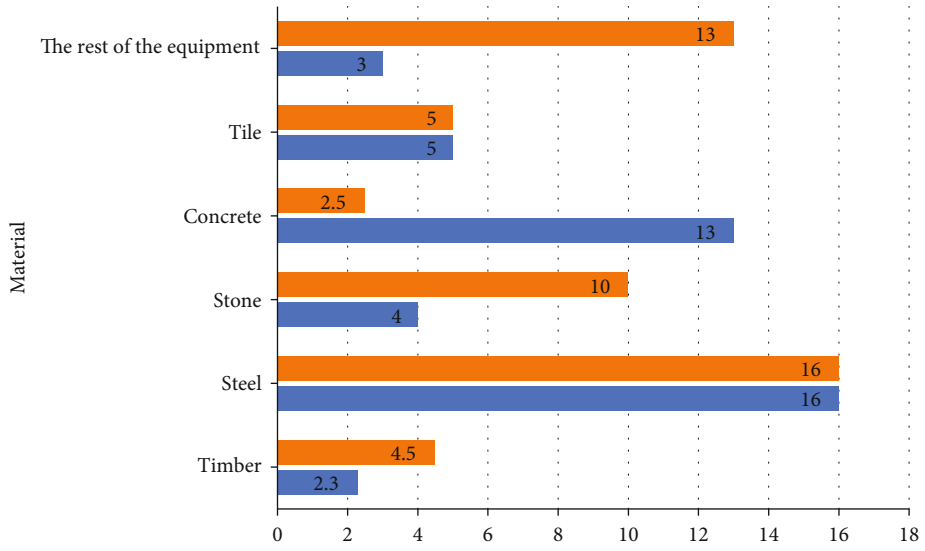

Figure 1: About manually measuring the material cost of a house.

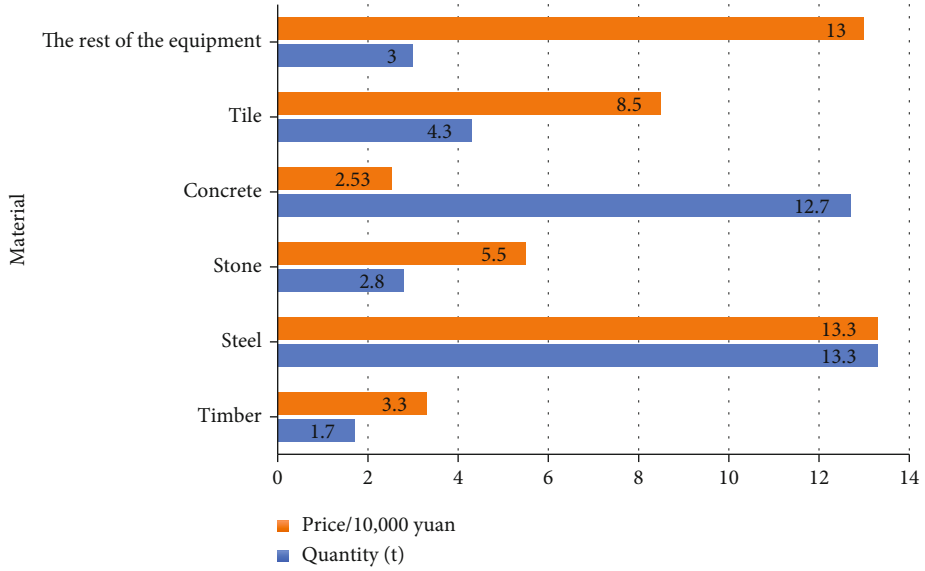

Figure 2: About intelligently measuring the material cost of a house.

Table 3: About using wireless communications and artificial intelligence decision support technology to control labor cost results.

	Number of people/persons	Daily wage/(100 yuan/day)	Working hours/days	Salary/10,000 yuan
Manual plan	17	3.2	40	19.18
Smart predictive plan	15	3. 6	32	15.72

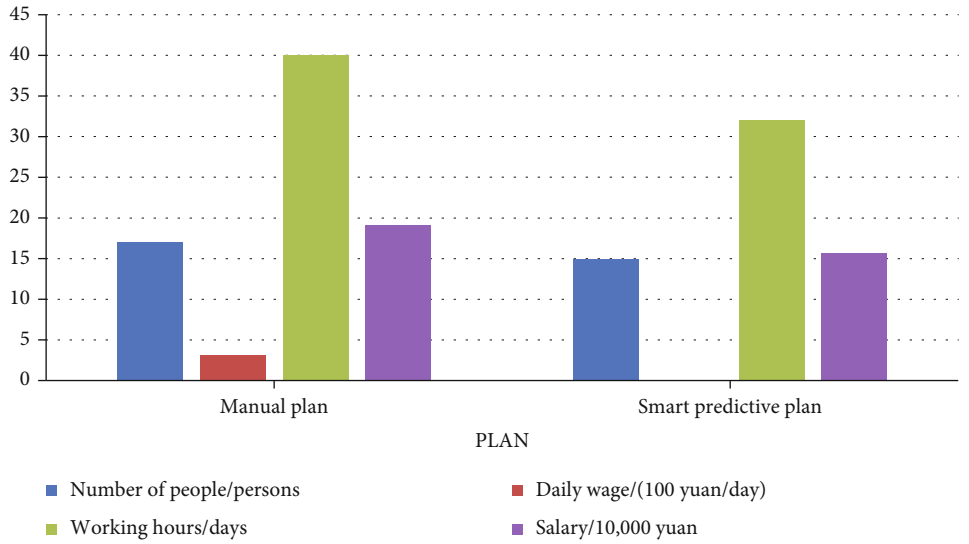

Figure 3: About using wireless communications and artificial intelligence decision support technology to control labor cost results.

Table 4: Evaluation results of the questionnaire.

Evaluation attitude	Smart forecasting plan	Manual planning	The total number of copies
Very good	71	47	117
It is OK	17	29	49
Continue to refuel	12	24	34
Total number of copies/shares	100	100	200

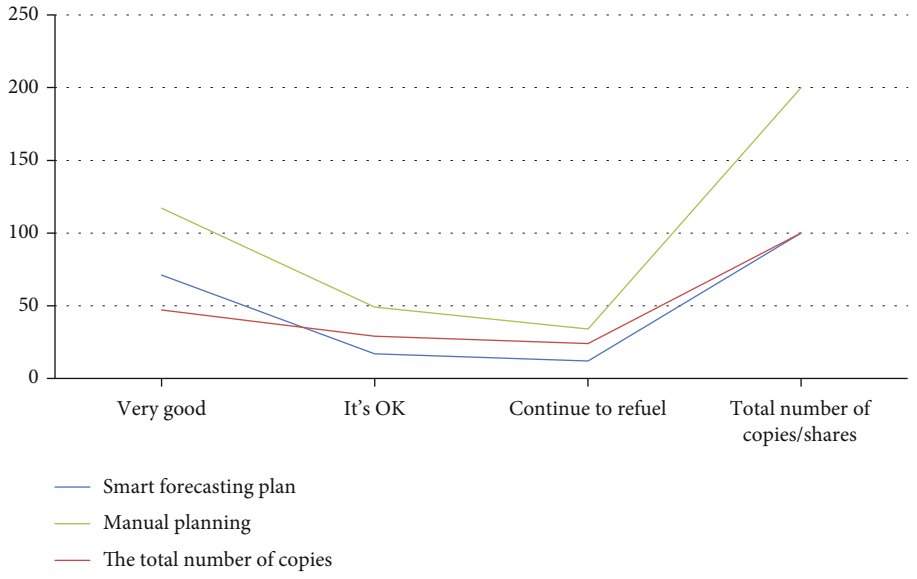

Figure 4: Evaluation results of the questionnaire.

5. Conclusion

Artificial intelligence and wireless communication jointly create an engineering cost control system for the construction projects we need, and due to the calculation speed of the artificial intelligence system and the existence of the database, the engineering cost of the construction project can be effectively controlled. We should always pay attention to and keep the database updated, especially the data collection of building materials on the market, and store it in the artificial intelligence database in time, so that the database can analyze the price of the relevant data in time. It should

also be kept up-to-date on commodity price reviews of individual companies and preferential prices for prime material contractors. When we prepared all the information and tested it, we found an interesting result: that the system controlled the house far more than the bridge. Because of the single bridge construction, so as the system and people after a certain analysis, the results are not very different, and housing because of the construction costs will be due to individual decision-making and form a different program, so as our experiment to housing-based, that is, shown above. Based on the experimental results and subsequent evaluation results, we know that the system has some advantages for cost control, but people think it can go further and need to be updated, so our next goal is to speed up the update and upgrade of the system, adding other different algorithm-assisted use.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

It is declared by the authors that this article is free of conflict of interest.

References

[1] B. M. Hyejung, "Simulation model for studying impact of vehicle-to-vehicle wireless communications on traffic network operations," *Transportation Research Record*, vol. 2189, no. 1, pp. 107–115, 2010.

[2] X. Qian, P. Ren, and H. Song, "Security-aware waveforms for enhancing wireless communications privacy in cyber-physical systems via multipath receptions," *IEEE Internet of Things Journal*, vol. 4, no. 6, pp. 1924–1933, 2017.

[3] C. Liaskos, A. Tsiollaridou, and A. Pitsillides, "Using any surface to realize a new paradigm for wireless communications," *Communications of the ACM*, vol. 61, no. 11, pp. 30–33, 2018.

[4] C. X. Mao, S. Gao, Y. Wang, F. Qin, and Q. X. Chu, "Compact highly integrated planar duplex antenna for wireless communications," *IEEE Transactions on Microwave Theory & Techniques*, vol. 64, no. 7, pp. 2006–2013, 2016.

[5] X. Chen, N. Wei, and T. Chen, "Real-time energy trading and future planning for fifth generation wireless communications," *IEEE Wireless Communications*, vol. 24, no. 4, pp. 24–30, 2017.

[6] M. Cheffena, "Industrial wireless communications over the millimeter wave spectrum: opportunities and challenges," *IEEE Communications Magazine*, vol. 54, no. 9, pp. 66–72, 2016.

[7] B. Gulbahar, "Theoretical analysis of magneto-inductive THz wireless communications and power transfer with multilayer graphene nano-coils," *IEEE Transactions on Molecular, Biological and Multi-Scale Communications*, vol. 3, no. 1, pp. 60–70, 2017.

[8] H. Tian, Z. Liu, W. Xi, G. Nie, L. Liu, and H. Jiang, "Beam axis detection and alignment for uniform circular array-based orbital angular momentum wireless communication," *IET Communications*, vol. 10, no. 1, pp. 44–49, 2016.

[9] X. Yang, D. Liu, Q. Wei, and D. Wang, "Guaranteed cost neural tracking control for a class of uncertain nonlinear systems using adaptive dynamic programming," *Neurocomputing*, vol. 198, pp. 80–90, 2016.

[10] B. C. Callaghan, J. F. Burke, and A. Rodgers, "Expenditures in the elderly with peripheral neuropathy: where should we focus cost-control efforts?," *Neurology Clinical Practice*, vol. 3, no. 5, pp. 421–430, 2013.

[11] N. Olsson, "Reduction lists as tool for cost control in public building projects," *Journal of Facilities Management*, vol. 14, no. 1, pp. 84–100, 2016.

[12] G. Yu and S. Gao, "Analysis on the logistics cost control of self-logistics system in the electric business enterprise," *American Journal of Industrial and Business Management*, vol. 6, no. 12, pp. 1113–1121, 2016.

[13] N. T. Phng and N. T. Giáp, "New results on finite-time guaranteed cost control of linear uncertain conformable fractional-order systems," *Đại học Thái Nguyên*, vol. 225, no. 2, pp. 24–30, 2020.

[14] Y. Ding, L. Yang, D. Zhang et al., "Novel low-cost control system for large high-speed corn precision planters," *International Journal of Agricultural and Biological Engineering*, vol. 14, no. 2, pp. 151–158, 2021.

[15] M. Dahbi, S. Doubabi, and A. Rachid, "Real time implementation for a low-cost control for BLDC motor current ripple minimization," *European Journal of Electrical Engineering*, vol. 22, no. 1, pp. 63–69, 2020.

[16] K. Varma, T. Manideep, and S. S. Asadi, "A critical comparison of quantity estimation for gated community construction project using traditional method vs plan swift software: a case study," *International Journal of Civil Engineering and Technology*, vol. 7, no. 6, pp. 707–713, 2016.

[17] C. M. Wang, B. B. Xu, S. J. Zhang, and Y. Q. Chen, "Influence of personality and risk propensity on risk perception of Chinese construction project managers," *International Journal of Project Management*, vol. 34, no. 7, pp. 1294–1304, 2016.

[18] M. R. Hosseini, E. K. Zavadskas, and X. Bo, "Communications in hybrid arrangements: case of Australian construction project teams," *Engineering Economics*, vol. 28, no. 3, pp. 290–300, 2017.

[19] M. Turner and A. Mariani, "Managing the work-family interface: experience of construction project managers," *International Journal of Managing Projects in Business*, vol. 9, no. 2, pp. 243–258, 2016.

[20] J. Rajprasad and A. R. Thamilarasu, "Application of project management system in construction project," *International Journal of Civil Engineering and Technology*, vol. 8, no. 4, pp. 786–791, 2017.

[21] C. Samantra, S. Datta, and S. S. Mahapatra, "Fuzzy based risk assessment module for metropolitan construction project: an empirical study," *Engineering Applications of Artificial Intelligence*, vol. 65, no. oct., pp. 449–464, 2017.

[22] P. Huang, S. O. Negro, M. P. Hekkert, and K. Bi, "How China became a leader in solar PV: an innovation system analysis," *Renewable and Sustainable Energy Reviews*, vol. 64, pp. 777–789, 2016.

[23] Y. Yoon, J. Jung, and C. Hyun, "Decision-making support systems using case-based reasoning for construction project delivery method selection: focused on the road construction projects in Korea," *The Open Civil Engineering Journal*, vol. 10, no. 1, pp. 500–512, 2016.

[24] H. Karimi, T. Taylor, P. M. Goodrum, and C. Srinivasan, "Quantitative analysis of the impact of craft worker availability on construction project safety performance," *Construction Innovation*, vol. 16, no. 3, pp. 307–322, 2016.

[25] Y. Wang, H. Dong, Z. Zhu et al., "Mitigating greenhouse gas and ammonia emissions from swine manure management: a system analysis," *Environmental Science & Technology*, vol. 51, no. 8, pp. 4503–4511, 2017.

[26] R. Srinivasan, R. Divyaranjani, and D. Rajasekar, "The degree of improvement in the workforce after the preliminary training period in civil construction project sector with reference to Chennai city," *International Journal of Civil Engineering and Technology*, vol. 8, no. 6, pp. 53–66, 2017.

[27] T. F. Guerin, "Evaluating expected and comparing with observed risks on a large-scale solar photovoltaic construction project: a case for reducing the regulatory burden," *Renewable & Sustainable Energy Reviews*, vol. 74, pp. 333–348, 2017.

[28] H. Zhang, S. Gao, D. Li, H. Chen, and L. Yang, "On superimposed pilot for channel estimation in multicell multiuser MIMO uplink: large system analysis," *IEEE Transactions on Vehicular Technology*, vol. 65, no. 3, pp. 1492–1505, 2016.

[29] F. Liu, G. Zhang, and J. Lu, "Heterogeneous domain adaptation: an unsupervised approach," *IEEE transaction on neural networks and learning systems*, vol. 31, no. 12, pp. 5588–5602, 2020.

[30] Y. He, L. Dai, and H. Zhang, "Multi-branch deep residual learning for clustering and beamforming in user-centric network," *IEEE Communications Letters*, vol. 24, no. 10, pp. 2221–2225, 2020.

[31] Y. Yosritzal and A. V. Purnawan, "Competency of West Sumatera provincial road construction project supervising consultants in owner perception," *International Journal of Civil Engineering and Technology*, vol. 8, no. 10, pp. 743–752, 2017.

[32] W. Lei, Z. Hui, L. Xiang, Z. Zelin, X. Xu-Hui, and S. Evans, "Optimal remanufacturing service resource allocation for generalized growth of retired mechanical products: maximizing matching efficiency," *IEEE access*, vol. 9, pp. 89655–89674, 2021.

[33] G. Luo, Q. Yuan, H. Zhou et al., "Cooperative vehicular content distribution in edge computing assisted 5G-VANET," *China communications*, vol. 15, no. 7, pp. 1–17, 2018.

[34] W. Zheng, X. Liu, and L. Yin, "Research on image classification method based on improved multi-scale relational network," *Peer J Computer Science*, vol. 7, article e613, 2021.