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Structural Model of Project Productivity Management Based on Knowledge and Risk Management in Municipal Construction Projects

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Abstract

This research was conducted with the aim of investigating the structural model of project productivity management based on knowledge and risk management in municipal construction projects. The present research is in the category of quantitative research in terms of practical purpose and descriptive survey method. The statistical population of the research consists of all employees of Sari City municipality. The sample size in this research, according to Klein's theory in 2014, 291 samples were selected purposefully. The data collection tools in this research included productivity management questionnaires, the Blish risk management questionnaire and the Nonaka and Takachi risk management questionnaire that use and create in 2009. The method of conducting the present research is that after preparing the mentioned questionnaires, its link has been provided online to statistical samples and the respondents answered each of the questions raised in the questionnaire. Data analysis was done using SPSS26 and AMOS software. The findings of the research showed that the effect coefficient of knowledge management and risk management on the productivity of construction projects is 0.44 and 0.54, respectively, which is statistically significant.

Keywords: Project productivity, Risk management, Knowledge management.

1 | Introduction

In today's world, on the one hand, with the significant progress of science and technology and the expansion of the market of competition between all types of industries, on the other hand, achieving success in higher efficiency and profit in any industry depends on increasing the productivity of companies active in that industry. In the meantime, the construction industry also includes this rule, and the effort to increase

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productivity and efficiency has become one of the main issues of this industry. In general, to improve the productivity of the project, it is necessary to implement the objectives of the project and, in other words, the project management in the best way [1]. Project management is one of the most important specialized fields in the world. In the meantime, there are various tools and ways to manage the complete project process. In our country, contrary to the existence of these techniques, many ongoing projects are faced with cost conditions that are much higher than the initial estimate or with many delays and even failure in the project [2].

Development project management is actually a dynamic, comprehensive and multi-dimensional issue that has occupied the minds of planners, politicians, policymakers and other researchers and specialists, and its main goal is to improve the life process, human capabilities, and expansion of facilities.

Chopra et al. [3] showed in their research that comprehensive quality management is a key strategy in order to maintain competitive advantage and a method for managing organizations to bring about improvement in the overall productivity and efficiency of the organization in order to reach the highest quality status available [4]. Construction industries are of particular importance due to the allocation of a major part of the country's budget to them and application quality management to them for continuous empowerment, meeting the needs of applicants, reducing rework, and increasing the participation rate of employees and working groups, bringing significant profitability. Considering the important role of comprehensive quality management in construction projects and the strong impact of Construction Productivity (CP) on project goals, this research was conducted with the aim of investigating and evaluating the impact of comprehensive quality management on the two factors of CP and project delivery. In this study, the method was structural equation modeling and it was done by using AMOS 22 software. In the first step, the measurement model was evaluated using confirmatory factor analysis, and then the structural model designed according to the research assumptions was analyzed. The results showed the optimal fit of the proposed research model.

According to these results, comprehensive quality management has a direct and significant effect on CP and an indirect effect on project delivery. It was also found that the effect of CP on project delivery is positive and significant [5].

Their research evaluated the maturity level of Knowledge Management (KM) with the Asian Productivity Organization model. This research is of applied and descriptive-survey type. The statistical population includes 12 managers of the headquarters unit of the technology complex, and data collection was done by census. In this research, the KM maturity model of the Asian Productivity Organization has been used to evaluate the maturity level of KM. Statistical analysis software and Excel software were used to analyze the data. Based on the obtained average, the dimensions of leadership, technology, learning and innovation are in good condition with an average above average, and other dimensions are in the next ranks with an average of less than 3.

Also, the total scores of maturity level of KM is equal to 119.8. The results of the research showed that the maturity level of KM is in the initial stage, and this company has started the relevant pilot project. The dimensions of knowledge processes and the status of employees were identified as opportunities for improvement, and the dimensions of leadership of knowledge and technology management were identified as strengths.

De Loecker et al. [6] in his research, using KM to increase the competitive advantage of businesses and integrating KM processes into risk management processes, he sought risk management based on KM with the aim of better management of possible risks and finally presented a framework. There is a concept for it. This research is practical in nature and has been implemented with a mixed qualitative and quantitative research method. In the first stage, with theoretical studies and expert consensus (Delphi technique), the necessary indicators for the variables of KM and risk management processes have been determined. In the next stage, a cross-sectional survey was conducted by distributing a questionnaire designed according to the above indicators among the managers of 376 information and communication technology companies,

members of the country's computer trade union organization, using the structural equation modelling method and SmartPLS3 software to explain the dimensions and relationships of risk management components based on KM.

In the end, a conceptual model was presented and based on this; we concluded that risk management in information and communication technology companies to the extent that KM processes are operationalized in them, according to the conceptual model of the research, is carried out in a better way and in reducing and controlling the identified risks and it will probably work more effectively.

Farooq [7] in his study, showed that today's research indicated that three reasons are involved as the main factors causing problems in risk management, which are ineffective culture, lack of organizational KM, and lack of information technology knowledge. The extraordinary development of cheap and high-speed technologies has transformed the organization's innovations into various forms. This operational complexity and, as a result, risk management are strengthened due to the need for competition to respond as quickly as possible to market changes. If this is your desire to be a leader in the market, you must find new opportunities in time and this action requires a quick reaction. Here's a seemingly intractable conundrum, if you spend a lot of time researching an investment, it's possible that the opportunity won't come up again or if you act with scepticism. Something happens outside of your expectation; Therefore, information is both a part of risk management problems and a part of its solution. But collecting information, regardless of the conceptual knowledge hidden in it is associated with many problems and risks. Therefore, a large part of the problems of risk management does not come from the lack of information, but rather the lack of knowledge and the interpretation of its meanings.

Hubbard [8] conducted research in which she presented the causal model of sustainable environmental development according to KM and green productivity. From the point of view of practical purpose and the point of view of data collection method, this research is descriptive of correlation type. In this research, 459 employees of the city train organization of Isfahan province were considered as the statistical population, the sampling method was a group of random strata and the sample size was determined by the Cochran formula to the number of 209. A standard questionnaire was used to collect the desired information and measure the research variables. The content validity and reliability of the measurement tool were confirmed through Cronbach's alpha coefficient. The data was analyzed using Lisrel software.

The results of the path analysis indicated that the dimensions of KM have a significant effect on the sustainable development of the environment and green productivity, and green productivity has no significant effect on the sustainable development of the environment.

Manesh et al. [9] conducted a study under the title of KM in the Fourth Industrial Revolution. Due to increasing competitive pressure, modern organizations tend to rely on and exploit knowledge to maintain a long-term advantage. This requires a thorough understanding of KM processes and, in particular, how knowledge is created, shared/transferred, acquired, stored/retrieved and applied across an organizational system.

However, since the beginning of the new millennium, such KM processes have been deeply influenced by the emergence of the fourth industrial revolution, also called Industry 4.0, which involves the interconnectedness of machines and their ability to learn and share data autonomously. For this reason, this article examines the intellectual structure and trends of KM in Industry 4.0. Bibliometric analysis and systematic review of literature have been done in a total of 90 related articles. The results show six clusters of keywords that were subsequently examined through a systematic literature review to identify the potential flow of this emerging field and future research avenues capable of making meaningful advances in the managerial knowledge of Industry 4.0 and its implications. Samuel and Justina [10]. They conducted research under the title of implementing effective KM practices to improve the productivity of small and medium-sized construction companies in Nigeria.

The purpose of this study is to assess the potential effects of effective KM practices and their implementation by small and medium construction companies on the productivity of construction projects in the South-South geopolitical zone of Nigeria. A structured questionnaire was implemented using the snowball sampling method to collect data electronically for construction professionals in small and medium-sized companies. With a sample size of 248, a response rate of 54.84% and a reliability index of 0.858, the collected data were analyzed using frequency, percentage, Relative Importance Index (RII) and Kruskal-Wallis H test.

This study showed that there is a high level of agreement and convergence of opinions about the impact of KM on productivity. It was concluded that the implementation of KM improves the productivity of construction SMEs. This study recommends adequate government and management support to implement effective KM practices in small and medium-sized construction companies in order to improve productivity and performance in project construction and delivery.

Octaviana [11] They conducted research titled "the effect of KM on the productivity of employees" with the Mediation of Competence. The purpose of this research is to find out the effect of KM on the work productivity of employees with the mediation of competence in PT. The method used is quantitative research Rahayo Perdana Trans. The population used in this study was PT employees. Qualified Rehayu Perdana Trans has at least a Bachelor's Degree (S1) and previous work experience outside of PT. The data collection method in this research was done by distributing a questionnaire with a Likert scale. According to the results of the data analysis, it can be concluded that all the existing indicators are valid and reliable, so they have a significant effect. Van Tam et al. [12] research aimed at identifying the Critical Factors (CFs) affecting the productivity of Construction Labour (CLP) from the point of view of project managers compared to the perspective of contractors. By fully reviewing previous studies, this study managed 45 CFs affecting labour productivity in the construction industry, which were divided into 6 primary categories, including human resources, management, working conditions, projects, and external factors. A total of 203 valid samples were collected by 56 project managers and 147 contractors who completed the structured questionnaire based on their previous participation or direct implementation of construction projects. These CFs were ranked according to RII and descriptive statistics (mean and standard deviation).

The analysis of the results indicated that there is a wide difference between the views of project managers and contractors regarding the most effective factors affecting the productivity of the construction workforce. Idrees et al. [13] showed that the cost of low productivity in large construction and infrastructure projects is very high, and to deal with this issue, various research has been conducted to identify factors affecting CP.

In this research work, four identified areas should be evaluated in terms of their impact on CP, which are: 1) management, 2) technology, 3) labor, and 4) external. Furthermore, these four regions are further divided into various parameters that drive these four main regions. A structured set of questionnaires is developed and distributed among industry and academics.

The method used for the study is data collection using a structured questionnaire. The collected data has been analyzed and some statistical tests have been performed on the data.

The findings of this study conclude that the three main characteristics affecting CP are planning and scheduling, availability of materials and storage places for materials with RII of 0.69, 0.68 and 0.67, respectively.

Iqbal [14] conducted a study aimed at evaluating the impact of workforce diversity on Project Productivity Performance (PPP). Twenty-one diversity factors were identified through a literature review and validated by industry experts, followed by a survey of 58 companies operating in Singapore.

The responses were analyzed and used to develop a partial least squares structural equation model. The results of the model show that various aspects, such as efficient decision-making and dealing with the issue of the lack of skilled labour, have the greatest impact in the related categories of skills and education and age and experience Therefore, this study contributes to the main body of knowledge and practice in both defining workforce diversity factors and evaluating the relationship between diversity factors and productivity. In

addition, practical strategies corresponding to prioritized factors based on the level of impact on PPP were proposed. These can help construction organizations realize the untapped potential of workforce diversity and its impact on PPP, ultimately increasing industry productivity and sustainable diversity in the workplace.

2 | Productivity in the Construction Industry

The issue of project productivity evaluation is not completely measurable and is influenced by subjective judgment. First, in order to calculate and evaluate productivity, a common point of view should be reached between experts and academics.

In the construction industry, the definition of productivity is considered a complex issue due to the interaction and communication of workers, capital, materials, and equipment, and it is affected by issues such as technical, managerial, and human issues. Productivity is considered the main measure of project activities because the activity cannot be devoid of any purpose and destination. When it comes to productivity, the measurement of any activity is done in relation to the purpose of carrying out that activity. Therefore, it can be checked from two angles completely separate from each other, i.e. effectiveness and efficiency.

Productivity is actually a combination of efficiency and effectiveness, and they are checked in the evaluation of various types of processes. Efficiency refers to working properly. In other words, every work should be done in the best possible way according to the available resources. Efficiency depends on the ability of the project team to estimate the budget and planned time. The use of resources is focused on the form of limitations; on the other hand, its effectiveness is emphasized by doing the right things. In other words, effectiveness refers to meeting the expectations of project stakeholders. Stakeholders' expectations will be completely different from one project to another and from one beneficiary to another. Efficiency is used in measuring internal and short-term processes, while effectiveness is used in measuring customer satisfaction. Therefore, it is necessary to pay attention to both efficiency and effectiveness criteria to evaluate the performance of the project.

Innovation adds to the main dimensions of technical performance, namely efficiency and effectiveness Roska et al. [15] and Song et al. [16] stated, based on the interviews conducted, that the concepts of efficiency and effectiveness in organizations do not have a clear boundary with each other and organizations focus on the concept of efficiency. What most researchers agree with is that the performance of the organization is considered productive when it is efficient and effective. For a better understanding of the relationship between effectiveness and efficiency and, finally, productivity, the productivity matrix is given in *Fig. 1*.

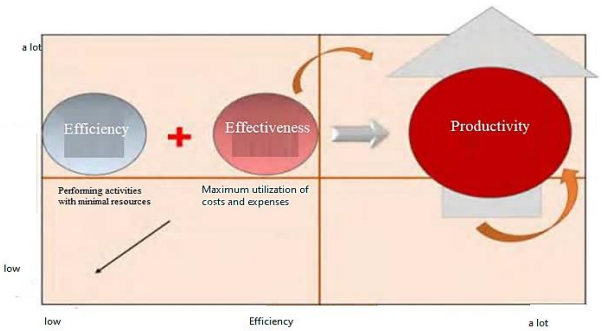

Fig. 1. Productivity matrix relating efficiency and effectiveness [16].

Li et al. [17] believe that cost efficiency quality time is effective on the success of the project, and in addition, it is emphasized that the efficiency effect is greater on the satisfaction of stakeholders. In the concept of efficiency, a comparison between two things is generally used, but in the construction industry, due to its uniqueness, the project is more difficult to compare. Among the methods of dealing with the problem of comparing projects with each other, it is described as a set of different processes. In project-based learning organizations, knowledge acquisition and productivity improvement can be transferred from one project to another. Still, the different nature of the construction industry and the uniqueness of construction projects

do not easily allow the application of productivity improvement techniques as is possible in manufacturing industries.

On the other hand, the share of the construction industry in the gross national product is very significant in most countries, especially in Iran, and improving the performance in this field can be effective from the waste of life, money and time of a wide range of society, so knowing the construction processes, knowing the principles, measuring the performance. It is necessary to improve the process of productivity in line with the new approaches of the world.

Since the productivity in construction industry projects is measured during the completion of the project and its measurement is done according to the comparison of the productivity of several years; Therefore, its calculation is done periodically, and the improvement plan is evaluated. Normally, due to learning in the project, there should be a slight increase in productivity, but due to the existence of huge costs to large-time donations and contractual claims in most construction projects, they face a long-term decrease in productivity [18].

3 | The Importance of Manufacturing Productivity

Productivity is a broad concept, and it can be considered an intellectual process that is explained with the aim of continuous improvement. For sustainable economic development, people must have creative thinking and a revolutionary attitude. In the general sense of productivity, the effective and efficient use of inputs in order to achieve outputs is considered as resources such as energy, raw materials, capital and labour, which are used to create output or output (output refers to the output of an organization) that have the ability to physical nature or intangible nature) is used.

The construction industry is one of the most significant sectors that support the economic development of a country. The construction industry contributes to the economy by an average of 8-10% in different countries. It causes the growth of countries, provides employment for people and acts as a link between the economy and other industries. The construction sector is the engine of a country's growth and connects services and goods with other sectors. Improving CP saves per capita costs and also increases the income of companies. The construction industry is facing many issues, including low productivity rates and declining growth, which have occupied the minds of a number of researchers for years. CP is a comparison between input and output and is a subject of increasing importance.

Poor productivity can lead to cost overruns and schedule slippage in large, labour-intensive construction projects. One of the challenges of evaluating productivity is determining which of the myriad factors that affect project performance are causing changes in CP. In 2009, Dai et al. [19] concluded that a number of variables always influence CP. The findings of this study conclude that the five main factors affecting the productivity of construction are the tools and consumables of construction equipment and the management of coordination engineering drawings and materials. In 2011, Rivas et al. [20] studied the factors affecting the productivity of construction projects in the Chilean construction industry.

The author concluded that the main factors affecting CP are shortages, rework materials, tools and equipment, access to heavy vehicles, and the level of motivation of workers, and these factors have remained unchanged in the United States construction industry for the past 30 years. The authors also concluded that They found that there is a consistent pattern of factors affecting CP, such as tools, equipment, and materials.

The article is about the factors affecting the productivity of subcontractors, which are participation in the initial control design, management skills documents, project relations, fair bidding practices, risk management and planning and coordination according to the literature, construction tools and equipment, materials and management materials. The coordination and planning project of manpower skill and commitment and construction methods were the most repeated among the indicators determined in previous research. It is considered the determining indicator of manufacturing productivity in this research Litvaj et al. [20].

4 | The Need to Pay Attention to Risk Management

Among the issues and problems that can be seen in the construction and construction industry in our country, Iran is non-compliance with safety and HSE. Lack of adequate management in this field, lack of providing work equipment and tools for workers, lack of provision of health equipment, personal protective equipment such as safety shoes, work clothes, fire protection issues, teaching how to work with hazardous construction materials, etc. There are a series of factors that, if not properly trained, will lead to construction projects being executed incorrectly.

In addition, if the managers do not have enough information and knowledge to work, i.e. they are not able to predict possible risks, the project will face irreparable consequences.

Over time, he faced a problem, and the project failed. Many similar projects lead to failure during implementation or after implementation, regardless of their initial studies and risk. Two important factors that are considered important risks are time and cost. In addition to the two mentioned, another factor called work quality has a direct effect on the lack of risk management in construction projects. If we generalize the results, we can claim that the executive and risk management situation in the country is inappropriate, especially for small construction projects.

In addition, according to the conducted investigations, 10 factors were considered as the main obstacles in the way of implementation and implementation of risk management in this type of project. These factors were identified with the priority of the impact: 1) not having enough potential benefits, 2) not being economical, 3) not having enough time, 4) lack of budget, 5) lack of knowledge, 6) lack of government legislation, 7) low profit margin, 8) complexity of analytical tools, 9) competition between small and medium contractors, 10) lack of sufficient manpower.

Other solutions that can be mentioned are the construction of a risk management system for small projects and the use of risk management specialists in construction projects. Due to the small sample size, the necessity of adaptation and generalization of the results is palpable.

Due to the lack of consensus on the definition of small projects, small projects are examined from the two perspectives of project cost and schedule. Therefore, in small construction projects, the impact of obstacles on risk management, the importance of risk management, and the impact of risk management on project performance were evaluated by respondents who responded according to their understanding and experience. From this point of view, the data inevitably became subjective. Questionnaires were prepared to collect information. It was subjective according to experience and judgment, and it was not enough for project risk management [21].

We hope that by planning, managing, and training the country as best as possible in the construction executive system and by providing a series of issues such as creating a culture and providing facilities to contractors and managers, raising the knowledge and awareness of managers and contractors, especially workers and understanding and Correct and motivating behaviour to managers and contractors and healthy project management to achieve the ability to reduce the risks of projects and achieve the best possible efficiency in the results of construction projects.

5 | Knowledge Management Processes

Different studies show KM processes in different ways. KM processes refer to all basic and sub-knowledge activities that differ from one organization to another. There is no consensus among researchers regarding the number of KM processes. Due to the diversity of strategic attitudes in organizations, the influence of senior management and public opinion on KM, the size of organizations, sectoral activities and its interest in implicit and explicit knowledge, in the use of processes and models. There is a difference. In general, in the simplest definition, the process of KM includes knowledge acquisition, knowledge creation, knowledge transfer, knowledge storage and knowledge application. The operational definition of KM processes is the

process of creating knowledge, sharing knowledge and applying it. The reason for this difference is that the definitions at the level of accumulation of processes are different from each other, but they are relatively related to each other. The purpose of KM processes is to create an organization that is aware of its knowledge on an individual and collective level and to use that knowledge to shape itself and make its business process more efficient. In Masdeh et al.'s study [23], seven researched KM processes include identification, creation, collection, organization, storage, dissemination and application.

I. Knowledge identification KI: it includes the steps of an organization to identify the relevant and required knowledge that exists within its scope.

II. KC knowledge creation: an organization can create new knowledge in the field of the organization and at all organizational levels and integrate its results into the organization.

III. KE knowledge gathering: includes the process in which the required knowledge is obtained by consulting and by purchasing from other sources.

IV. KO knowledge organization: includes description, representation, archiving and organization (collection of knowledge).

6 | Application Process

The application of knowledge includes the process by which knowledge is used in the organization to make decisions and perform tasks; as a result, it causes organizational performance. However, the process of applying knowledge is highly dependent on existing knowledge, and knowledge itself is dependent on the processes of knowledge discovery, capture and sharing, as *Fig. 2*. The more efficient the processes of discovery, capture and sharing of knowledge are, the more likely it is that the knowledge required for effective use in decision-making and task performance will be available.

6.1 | Sub-Orientation Process

Directing is a process by which a person with knowledge directs the action of another person without transferring the underlying knowledge to that person. Orientation involves the transfer of instructions with decisions and not the transfer of knowledge required for making decisions and, therefore, has been labelled as a substitute for knowledge. These benefits preserve expertise and prevent the inherent problems of tacit knowledge transfer. Orientation is considered a process that occurs when a production worker communicates with an expert and asks her how to solve a specific problem with the machine and then proceeds to solve the problem according to the expert's instructions. To do this, he does not acquire knowledge so that if a similar problem occurs again in the future, he cannot identify it as an example. Therefore, he is not able to solve it without contacting an expert Migdadi [22].

6.2 | subroutine process

Routines include the application of institutionalized knowledge into procedures, rules, and norms that act to guide future behaviour. Routines generally save more communication than directives because they are embedded in methods with technologies. However, they take time to develop by relying on constant iteration. Routines have the ability to be automated using information technology, such as systems that provide help desk agents, field engineers, consultants, and customer users with specific, automated answers from a knowledge base. Similarly, an inventory management system uses a lot of knowledge about the relationship between demand and supply, but neither knowledge nor directions are transferable through people. In addition, organizational systems are coded with routines that describe business processes in industry segments [23]. Nonaka and Takeuchi mentioned a model that has gained fame under their name. According to them, explicit knowledge can be expressed in the form of words and numbers and shared in the form of data, formulas, specifications, instructions, etc., and is easily transferred between people. On the other hand, hidden (implicit) knowledge exists in people's minds and is deeply in the actions of people's experiences and values. Mental models of intuition and imagination are placed in this field of knowledge. Nonaka and Takeuchi [24]

have presented four types of explicit and implicit knowledge creation and transformation strategies in organizations, which include: socialization, externalization, synthesis, and internalization.

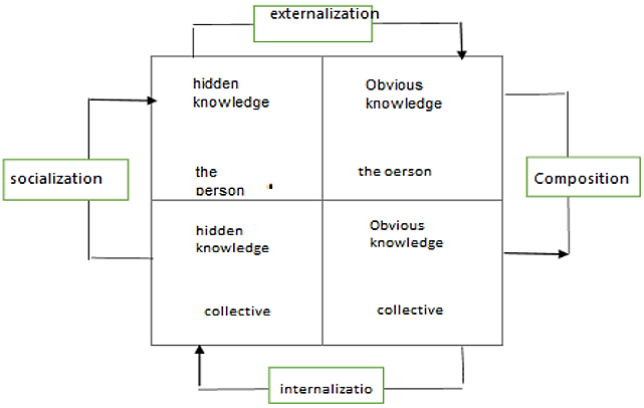

Fig. 2. Nonaka and takuchi model.

7 | Conclusion

In this research, the following results are observed.

Hidden to hidden socialization: the transformation of hidden knowledge into hidden knowledge is possible through socialization. In socialization, people share their experiences and mental models with others to improve knowledge. Socialization is a process in which the tacit knowledge of one person is transferred to another person.

Latent to (manifest) externalization: latent knowledge becomes manifest knowledge through the process of externalization. In this process, people develop tacit knowledge concepts, share them with others and create new knowledge. In the externalization of people's technical knowledge, it takes the form of explicit knowledge.

Explicit to obvious combination: in this process, the obvious knowledge that is in the general externalized stage must be classified and combined. Then, new knowledge is added to the previous knowledge and combined. In this case, more complex explicit knowledge is created. The synthesis process is the process of converting explicit knowledge into explicit knowledge in the form of systematic collections.

Obvious to hidden internalization: internalization is actually the process of converting explicit knowledge into tacit knowledge. This can take place through learning, and documented knowledge plays an important role in this process.

Author Contributions

Seyed Ahmad Edalat Panah led the conceptualization, methodology, and supervision of the research. Seyed Hossein Mahmoudi contributed to data collection, formal analysis, and writing–review and editing.

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Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this article.

References

[1] Adhikari, D. R., & Shrestha, P. (2023). Knowledge management initiatives for achieving sustainable development goal 4.7: higher education institutions' stakeholder perspectives. *Journal of knowledge management*, *27*(4), 1109–1139. DOI: 10.1108/JKM-03-2022-0172

[2] Mattia Bosoni, B. T., & Hartmann, T. (2023). Understanding integration within the Dutch multi-layer safety approach to flood risk management. *International journal of river basin management*, *21*(1), 81–87. DOI: 10.1080/15715124.2021.1915321

[3] Chopra, M., Saini, N., Kumar, S., Varma, A., Mangla, S. K., & Lim, W. M. (2021). Past, present, and future of knowledge management for business sustainability. *Journal of cleaner production*, *328*, 129592. DOI: 10.1016/j.jclepro.2021.129592

[4] Alzoubi, H. M. (2022). BIM as a tool to optimize and manage project risk management. *International journal of mechanical engineering*, *7*(1). https://research.skylineuniversity.ac.ae/id/eprint/192/1/63.pdf

[5] De Bem Machado Silvana Secinaro, D. C., & Lanzalonga, F. (2022). Knowledge management and digital transformation for Industry 4.0: a structured literature review. *Knowledge management research & practice*, *20*(2), 320–338. DOI: 10.1080/14778238.2021.2015261

[6] De Loecker, J., & Syverson, C. (2021). An industrial organization perspective on productivity. In *Handbook of industrial organization* (pp. 141-223). Elsevier. DOI: 10.1016/bs.hesind.2021.11.003

[7] Farooq, R. (2024). A review of knowledge management research in the past three decades: a bibliometric analysis. *Vine journal of information and knowledge management systems*, *54*(2), 339–378. DOI: 10.1108/VJIKMS-08-2021-0169

[8] Hubbard, D. W. (2020). *The failure of risk management: why it's broken and how to fix it*. John wiley & sons. https://books.google.com/books?id=fMbKDwAAQBAJ&printsec=frontcover

[9] Fakhar Manesh, M., Pellegrini, M. M., Marzi, G., & Dabic, M. (2021). Knowledge management in the fourth industrial revolution: mapping the literature and scoping future avenues. *IEEE transactions on engineering management*, *68*(1), 289–300. DOI: 10.1109/TEM.2019.2963489

[10] Samuel, E. I., & Justina, O. C. (2023). Implementation of effective knowledge management practices for improving productivity of Nigerian construction SMEs. *Journal of management research*, *23*(1), 12–29. https://www.indianjournals.com/ijor.aspx?target=ijor:jmr&volume=23&issue=1&article=002

[11] Octaviana, R. D. (2021). The influence of knowledge management towards employee work productivity with mediation of competence at pt. rahayu perdana trans. *International journal of review management business and entrepreneurship (RMBE)*, *1*(2), 205–215. DOI: 10.37715/rmbe.v1i2.2428

[12] Nguyen Van Tam Nguyen Quoc Toan, D. T. H., & Quy, N. L. D. (2021). Critical factors affecting construction labor productivity: a comparison between perceptions of project managers and contractors. *Cogent business & management*, *8*(1), 1863303. DOI: 10.1080/23311975.2020.1863303

[13] Idrees, H., Xu, J., Haider, S. A., & Tehseen, S. (2023). A systematic review of knowledge management and new product development projects: trends, issues, and challenges. *Journal of innovation & knowledge*, *8*(2), 100350. DOI: 10.1016/j.jik.2023.100350

[14] Iqbal, A. (2021). Innovation speed and quality in higher education institutions: the role of knowledge management enablers and knowledge sharing process. *Journal of knowledge management*, *25*(9), 2334–2360. DOI: 10.1108/JKM-07-2020-0546

[15] Ruuska, A., & Häkkinen, T. (2014). Material efficiency of building construction. *Buildings*, *4*(3), 266–294. DOI: 10.3390/buildings4030266

[16] Song, M. L., Cao, S. P., & Wang, S. H. (2019). The impact of knowledge trade on sustainable development and environment-biased technical progress. *Technological forecasting and social change*, *144*, 512–523. DOI: 10.1016/j.techfore.2018.02.017

[17] Li, Y., Zhang, J., Yang, X., Wang, W., Wu, H., Ran, Q., & Luo, R. (2021). The impact of innovative city construction on ecological efficiency: a quasi-natural experiment from China. *Sustainable production and consumption*, *28*, 1724–1735. DOI: 10.1016/j.spc.2021.09.012

[18] Zhang, J., Li, H., Xia, B., & Skitmore, M. (2018). Impact of environment regulation on the efficiency of regional construction industry: a 3-stage data envelopment analysis (DEA). *Journal of cleaner production*, *200*, 770–780. DOI: 10.1016/j.jclepro.2018.07.189

[19] Dai, J., Goodrum, P. M., & Maloney, W. F. (2009). Construction craft workers' perceptions of the factors affecting productivity. *Journal of construction engineering and management*, *135*(3), 217–226. DOI: 10.1061/(ASCE)0733-9364(2009)135:3(217)

[20] Rivas, R. A., Borcherding, J. D., Gonzalez, V., & Alarcon, L. F. (2011). Analysis of factors influencing productivity using craftsmen questionnaires: case study in a Chilean construction company. *Journal of construction engineering and management*, *137*(4), 312–320. DOI: 10.1061/(ASCE)CO.1943-7862.0000295

[21] Litvaj, I., Ponisciakova, O., Stancekova, D., Svobodova, J., & Mrazik, J. (2022). Decision-making procedures and their relation to knowledge management and quality management. *Sustainability*, *14*(1). DOI: 10.3390/su14010572

[22] Machado, H. P. V., & ELIAS, M. L. G. G. R. (2020). Knowledge management: the field's constitution, themes, and research perspectives. *Transinformação*, *32*, e200037. DOI: 10.1590/2318-0889202032e200037

[23] Masdeh, R. A., Habiballah, M. A., & Abu Hamatteh, Z. S. H. (2017). Knowledge management processes and their impact on organizational performance: an empirical study in Jordanian banks. *International journal of business and social science*, *8*(9), 73–84. DOI: 10.5539/ijbm.v11n6p70

[24] Migdadi, M. M. (2022). Knowledge management processes, innovation capability and organizational performance. *International journal of productivity and performance management*, *71*(1), 182–210. DOI: 10.1108/IJPPM-04-2020-0154

[25] Shahzad, M., Qu, Y., Zafar, A. U., Rehman, S. U., & Islam, T. (2020). Exploring the influence of knowledge management process on corporate sustainable performance through green innovation. *Journal of knowledge management*, *24*(9), 2079–2106. DOI: 10.1108/JKM-11-2019-0624

[26] Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: how japanese companies create the dynamics of innovation*. Oxford university press. https://www.jstor.org/stable/155381