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Information and Knowledge Management
ISSN 2224-5758 (Paper) ISSN 2224-896X (Online)
Vol.13, No.6, 2023

Implications of Knowledge Management Processes for Project Performance:Systematic Review, Gap Analysis and Scientometric Analysis

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Abstract
The purpose of this study is to review the current Knowledge Management (KM) trends and make inference for future directions of KM in project-based organizations and project performance through a Systematic Literature Review (SRL) and Scientometric analysis. First a Google advanced search was conducted and produced five hundred and seventy six (576) papers A SLR of 38 articles from 2000 – 2022 was conducted to narrow the study. Key stages in the systematic review included the formulation of the research questions, the identification of relevant research, data extraction and assessment of the risk of bias, data synthesis, summary and interpretation of the findings. Further, 981 academic documents on the topic were retrieved from Publish or Perish database. Then, co-occurrence and co-citation analysis were performed along with network visualization to examine research interconnections' patterns. As a result, relevant key words, network of terms co-occurrences with 68 keywords, 793 links, and total link strength of 1,486 was revealed. The most popular keywords within the period, together with their frequency, mean year of publication, links, and total link strength were identified.
Keywords: Knowledge Management, Systematic Literature Review, Scientometric Analysis, Project Performance, Bibliometric
DOI: 10.7176/IKM/13-6-01
Publication date: September 30th 2023

1.0 Introduction

By their nature, construction projects are one – time capital investments that are made in accordance with specifications and requirements (Abdul, 2013). The tasks are increasingly intricate and sophisticated and the relationship between the team members and contractual arrangements is more complex and diversified (Musa *et al.*, 2022). Due to this, many project organizations on the global market have been forced to establish new procedures for operating within the confines of regulations and norms (Jarrar, 2002). Success is frequently connected with a company's growth and knowledge has long been seen as a driving force behind successful project development (Anumba, Charles and Carrillo, 2005).

The PMBOK (2017), defined Project management as the process of applying knowledge, skills, tools, and techniques to effectively and efficiently manage project activities to achieve project requirements. The construction sector is heterogeneous and complex and it is thought to be a "store of expertise" which include: the construction team, design team, manufacturers of building products and materials, and experts who provide a range of services for clients, customers and the wider community (Anumba, Charles and Carrillo, 2005). Knowledge related to the product and process is essential to enabling the construction delivering process run effectively to produce quality outcome (Anumba, Charles and Carrillo, 2005).

The aim of KM therefore, seeks best practices in all business activities to provide better service to its clients. KM also improves project performance and increases profitability. This means that, in knowledge – intensive organization, the focus is on the specialized technical or functional area of professional knowledge and competence. Specialized expert knowledge and problem-solving know – how are the true outputs of knowledge-intensive industry (Kululanga and Mccaffer, 2007).

According to the PMBOK (2017), organizations require in-depth information on how to use integrated change control, project plan execution and project plan formulation. They must set up organizational policies that facilitate the use of KM. KM can therefore help the site management team from repeating past errors; by capturing best practices, lessons learnt and especially, the solutions to problems that arise on site, similar situations in the future can be dealt with efficiently and effectively (Mohamed and Anumba, 2006).

Yet, organizational performance and ways of doing things are shaped by the degree of bureaucracy of organizational learning and innovation. Meanwhile, an organization's efficiency is high if it can manage its

knowledge and use technology to efficiently and precisely store, retrieve, manipulate, and access knowledge (Kiziltas, Dikmen and Talat Birgonul, 2003).

While knowledge management has attracted a global attention in the construction industry, only a few numbers of reviews have evaluated KM and project performance (Asrar-ul-haq and Anwar, 2016; Costa and Monteiro, 2016). Other reviews were done on scientometric analysis on construction project complexity by Ghaleb et al.(2022) and sustainable development through the perspective of construction (Wang and Guo, 2022).This review is aimed at providing a more specific reference on the impact of KM on construction project performance for academics and construction professionals by aggregating theoretical and empirical current papers. The systematic review analysis was intended to provide a complete outlook of existing research in order to identify knowledge gaps and forecast future research directions and the scientometric technique further analysis the common author keyword used within the period with the VOSviewer to answer the following research questions: 1. What are the current research's main findings regarding the knowledge management processes (KMPs)? 2. Which methods were used by the sample papers? 3. What are the knowledge gaps in these papers? 4. What keywords and topics are mostly investigated in the research of knowledge management processes in construction project?

1.2 Knowledge management and construction project performance

The need for continuous improvement and project performance in the construction industry has resulted in various initiatives for improving the construction process (Kamara *et al.*, 2002; Nakamori, 2020). Knowledge is seen as an essential corporate asset to boost growth performance in the challenging corporate environment (Yusof, Hassan and Bakar, 2012). Construction project performance relies on different dimensions of project management. Among those, KM is of paramount importance since effective project management starts with the integration of KM processes and people within a construction project (Demirkesen and Ozorhon, 2017).

Knowledge is an essential resource to the companies in construction sector due to the nature of these construction projects. The performance of a project required new aptitudes, outlooks, models and responsibility through the organizations (Yusof *et al.*, 2019). Since the construction industry influences an economy's gross domestic product (GDP) more than any other industries (Irani, Beskese and Love, 2004).

According to Yusof et al. (2012), knowledge is a critical component of sustainable corporate performance in today's difficult business environment including construction firms. Construction work is a sector of the economy which is driven by knowledge (Forcada *et al.*, 2013). Every stage of the project's lifecycle, from design to conclusion, generates knowledge about the goods and activities involved (Calnan et al., 2021). The reason for the increased importance of knowledge lies in the fact that effective management of knowledge in an organization brings many positive outcomes that lift the organization to the level of success. Stakeholders in the construction industry should ensure effective implementation of KM for construction project performance.

Methodology

This paper aims to provide an analytical scan of the current literature on the topic knowledge management processes and project performance through systematic and bibliometric analysis. The first step was to identify the research questions to fill a knowledge gap. The selection of keywords for this SLR's search strategy was the next step in creating a search string. The information that the database will retrieve is determined by keywords, thus, this step is crucial in referencing pertinent works in KM. Google advanced search was conducted using the search terms knowledge management practices AND construction project, knowledge management process AND construction project, and knowledge management processes AND project performance in the following data bases: Science Direct, SAGE, Emerald, Taylor and Francis and Google Scholar. An adequate number of data bases ensure a comprehensive search because inadequate data bases may yield a biased sample of primary studies and thus, may influence the accuracy of summary effects (Vassar *et al.*, 2017). This step included in the SLR aimed at identifying the variables affecting organization and construction project performance and the relevance of knowledge management to project delivery.

The search produced five hundred and seventy six (577) papers. After removing 240 duplicates, the remaining papers were 337. Additional search was done on the references in the included studies bringing the articles to be screened to be 395. The references were ordered alphabetically by author's names to avoid bias by publication year and by 'relevance'. Next, the studies were assessed against the list of research questions. After reading the abstract, the methodology used and the result, 356 were removed based on the inclusion and the exclusion criteria. Reading these papers helped to gain a deeper understanding of the topic at hand and helped to identify the gaps in literature. Inclusion and exclusion criteria were applied and were based on the review questions. Articles with information addressing the study topics were included. Unrelated, unavailable full texts, and literature reviews were the most common exclusion factors. After further screening the remaining papers that met the inclusion criteria were 38.

Figure one is the PRISMA flow diagram template used in the SLR which contain the databases and the

number of articles retrieved, the inclusion and the exclusion criteria and the final papers obtained. The papers were refined to achieve a sample of relevant results of references to work on. SLR procedure for organizational sciences guided the methodological steps (Tranfield, Denyer and Smart, 2003; Denyer and Tranfield, 2009). Additionally, the SLR steps were applied (Chalmers, Hedges and Cooper, 2002).

Further, search was done using Google Scholar on publish or perish and retrieved 986 academic documents from 2000 - 2022. VOSviewer version 1.6.16 which is a computer program, developed to build and view bibliometric maps was used to carry out this studies because of its emphasis on graphical representations of maps, adaptability for visualizing larger networks, and text mining capabilities (Shen & Wang, 2020; van Eck & Waltman, 2023).

There were 68 keywords in all that were collected and linked to the theme. The Bibliometric analysis provides a quantitative scientific mapping tool in addition to completing the SLR**.** It focuses on the structural and dynamic elements of scientific research. Visual maps can more accurately depict the study environment and focus on crucial research topics (Al Husaeni and Nandiyanto, 2021).

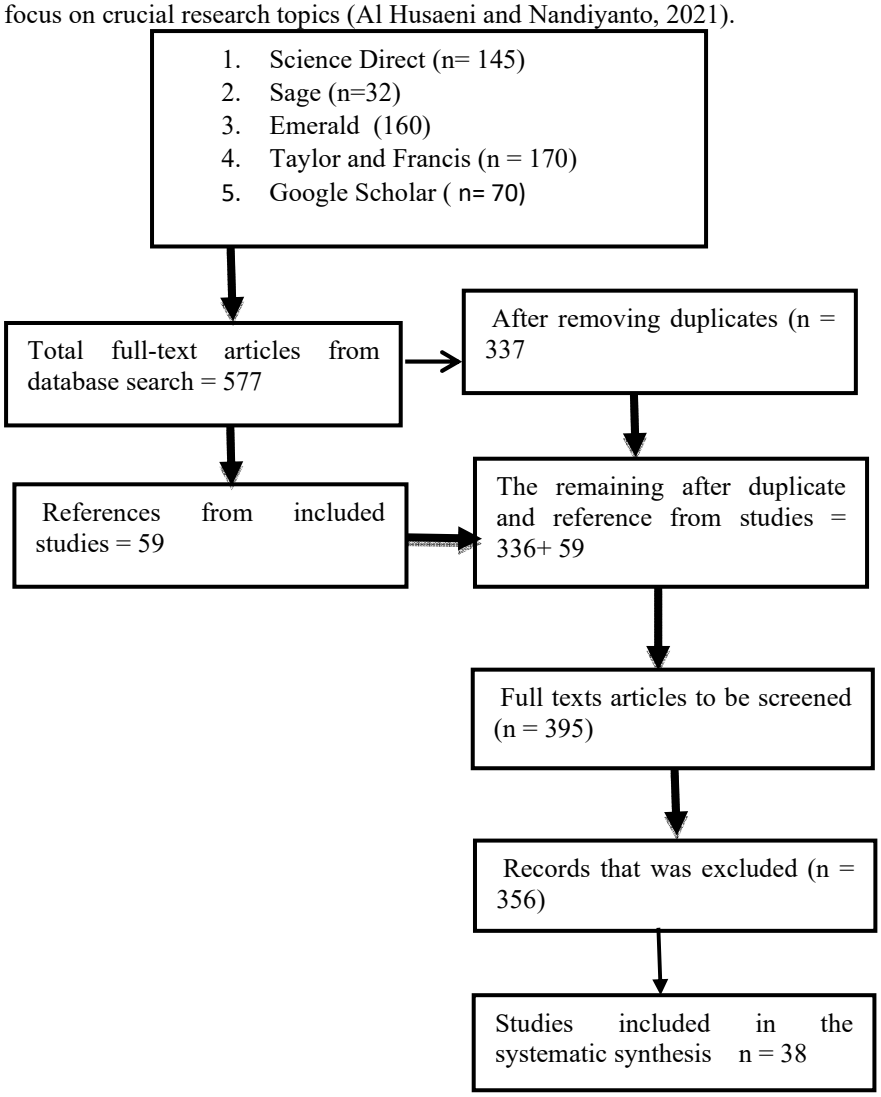


Figure 1: PRISMA flow diagram of the result of the search.

3.0 Results and discussion

An analysis of the countries of origin found that 9 of the studies reviewed were the UK. The next contributors to the SLR were the Malaysia with 5 studies, China and India with 3 studies each, Ghana, Sweden, Taiwan and US with 2 studies each, the detailed report is found in Figure 2. There have been an increasing number of studies produced on this topic in recent years, with a peak in 2019. This is likely related to the increase in research related to construction project and the rise in project performance issues in the industry. The detailed report is in figure 3. In total, 38 publishing contributed to this study. Emerald with 18 publications, Science Direct with four publications and Taylor and Francis with three publications contained the most articles reviewed in this paper, the detailed report is found in figure 4.

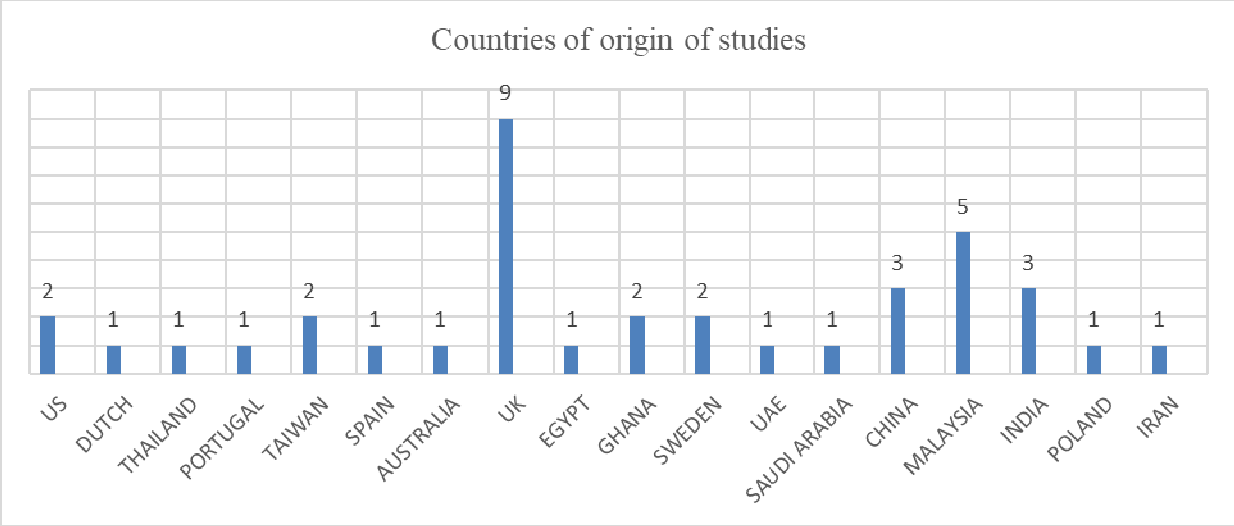
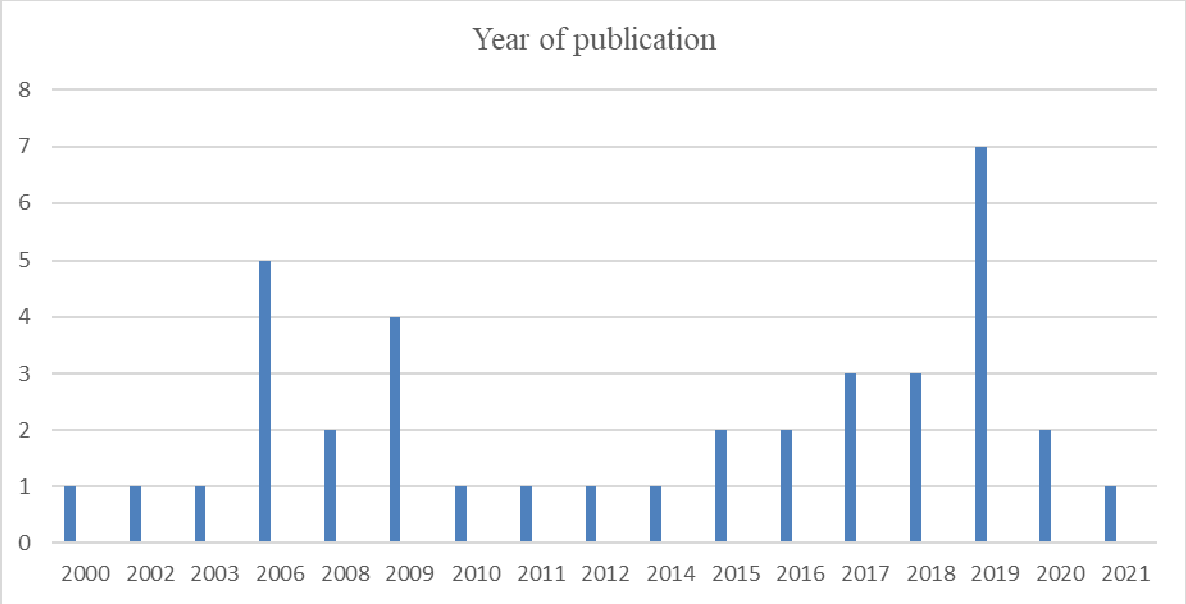


Figure 2



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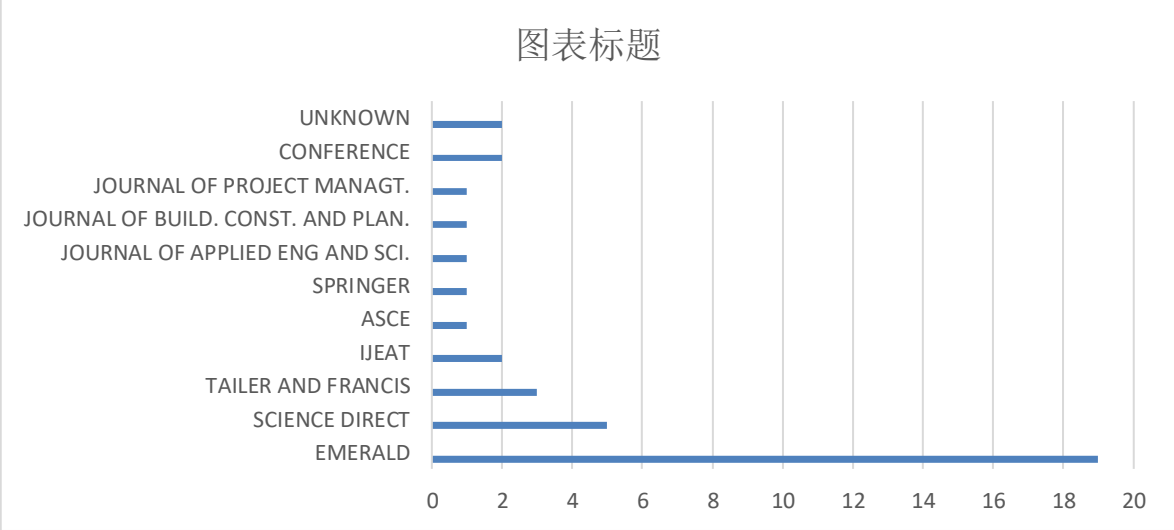

Figure 4

3.2 key Themes in the Literature

Key themes in the literature emerged during the literature review. Similar keywords were utilized in other research, which allowed for the observation of this review. The following are the topics that were found to be most prevalent:

1. Strategies - for effective KM implementation.
2. Barriers – to the implementation of KM.
3. Factors – for effective KM process.
4. Training and education –for KM implementation.
5. Leadership commitment – to ensure effective implementation of KM.
6. Trust- to effectively share project knowledge.
7. Techniques and technology –for implementing KM.
8. Gaps / Recommendations.

3.3 Strategies for Knowledge management implementation

From 2000 - 2004, the contribution to managing organizational knowledge in the construction industry involves people, processes and knowledge content, as well as a culture, that is opened and willing to share knowledge and information. The commitment includes financial support and regular communication from top management as well as from all other members of the organization (Egbu, 2000). Studies on knowledge strategies indicated that knowledge was managed through organizational and contractual frameworks as well as people-based strategies. The full utilization of the intellectual assets of Architectural and Engineering Construction (AEC) enterprises, particularly in the collection and reuse of project knowledge and in the integration of people and technology – based initiatives, were hindered by the lack of a proactive KM strategy (Kamara *et al.*, 2002). According to Abdul (2013), knowledge management solutions must be developed to address both implicit and explicit knowledge.

Research findings of the publication in 2004 indicated how tacit and explicit knowledge was shared in an individual project. A range of KM tools, both IT and non-IT, were used to facilitate knowledge sharing but there was a strong emphasis on IT tools compared to other tools such as mentoring, conferences and research collaboration. There was also poor IT infrastructure for accessing knowledge and lack of an integrated database system according to Carrillo et al. (2004). The extent to which the IT systems were utilized to manage the knowledge process (for instance, in the collection, transfer and reuse of organizational information on its processes and procedures) was not entirely evident, even though they are not generally referred to as KM-specific systems but it was established that the focus of KM within the AEC sector was on organizational performance. It was also clear that effective KM required a combination of mechanistic and organic approaches in an integrated approach that took an organizational culture and technological issues into account (Kamara *et al.*, 2002; Carrillo *et al.*, 2004).

Lin and Lee (2012) suggested an innovative and useful way to record and portray construction in order to successfully improve construction project knowledge implementation. The result indicated that project-based communities of practice (CoPs) effectively exchange knowledge and experience within the context of the projects. This can provide a platform for members to assist one another in problem-solving. Implementing practice-based KM system to share implicit and explicit knowledge can gain valuable experience from earlier construction projects typically involve participants with different knowledge, experiences and skills who come together to solve common tasks. However, the project participants had little chance to learn from their collective good or poor experiences.

3.4 Barriers to knowledge management in construction project

Farzin *et al.*(2014) concluded in their findings that, organizations implement KM systems because the results shall include increased effectiveness, efficiency and organizational competitiveness. KM practices are specific to each context and may influence organizational effectiveness. Knowledge management Systems are implemented by organizations because they promote organizational competitiveness and effectiveness. Each context-specific KM practice has the potential to affect an organization's effectiveness (Anumba, Charles and Carrillo, 2005).

The construction industry has yet to fully gain these available benefits from KM to improve the project performance. Some of the barriers that have been outlined in previous research as to why the construction industry is yet to gain these benefits are as follows: Social barriers, People related, culture, lack of learning, motivational barriers and Loss of faith in sharing knowledge. In addition is technical barriers: lack of time, converting knowledge, trying to solve large problems and unique project (Carrillo, Anumba and Kamara, 2000; Carrillo and Chinowsky, 2006b).

The review of literature identified the following barriers within the industry: lack of standard work processes to KM, Several firms indicated a lack of time as the main obstacle to KM within their organizations. Other obstacles were employee resistance to sharing knowledge, lack of management support, employee

opposition to sharing. Other significant hindrances to KM include: services obstruction, inadequate site communication and information, insufficient design, local inhabitants and cooperation and motivation challenges (Carrillo *et al.*, 2004; Mohamed and Anumba, 2006).

Chileshe and Shokri-Ghasabeh, (2014) identified top management, people's resistance to change, time, commitment and investment as the obstacles to KM implementation in the construction sector. Other studies indicated lack of resources and lack of clear standards to effectively capture lessons learned from previous project, lack of KM systems, lack of leadership support, lack of awareness of KM practices, lack of understanding of KM, and employee resistance were among the hurdles to the implementation of KM in some organizations (Esmi and Ennals, 2009; Hackman, Agyekum and Smith, 2017). Guribie and Tengan (2019) highlighted the poor KM infrastructure by the Ghanaian construction organizations. Yusof *et al.*(2019) identified four challenges as: strong market competition, time restraints, high complexity of construction tasks, and budget restraints, but time and money were two aspects that were commonly taken into consideration.

Takhtravanchi *et al.*(2018) indicated three main challenges that hinder knowledge integration process within the traditional procurement system in terms of capturing and sharing knowledge within a project and transfer it to the next project. These challenges were: Organizational culture, Contractual boundaries, and KM system (policies and strategies).

3.5 Factors for effective implementation of knowledge management processes

Questions remain on which aspect is more essential to KM processes: the human element or the technological factor. ICTs are used by some organizations for knowledge creation and dissemination. Despite the widespread use of technology in businesses, human knowledge is considered to be the foundation and the company's intellectual property. The organization's competitive advantage is this information, which is unique (Rhodes *et al.*, 2008; Becerra-Fernandez and Sabherwal, 2010).

It was revealed that, managing people is more important but difficult than managing technology usage. The processes of knowledge creation and knowledge application may depend on other processes such as acquisition, sharing and codification and all these depend on the human factor as the main enabler through its processes. It deals mainly with tacit knowledge which is the knowledge in human minds, people's attitudes, culture, social values and aspirations (Anumba, Charles and Carrillo, 2005; Sallam *et al.*, 2018).

Other studies revealed that, there were several variations in approaches to KM between design firms and construction firms as well as between large and medium-sized businesses. According to the report, large engineering design firms and construction companies engage in quite different KM activities. There was more focus on knowledge sharing, which is one aspect of KM. Specific knowledge – sharing initiatives could be seen at the two main firms which had made significant investments in KM. The results further indicated that certain requirements must be met for KM implementation to succeed. In particular, the establishment of a reward strategy, a willingness to share knowledge, a clear definition of rules, a friendly and satisfying knowledge exchange system and well –function KM organizations were believed to be the significant underlying factors for KM and successful implementing KM processes (Carrillo and Chinowsky, 2006b; Lin and Lin, 2006) .

Knowledge management in the construction industry has been successful because of the establishment of a reward plan, willingness to share knowledge, a mechanism to authorize activities, a friendly system to exchange and reuse knowledge and top management support. By preserving best practices, lessons learned and particularly the solutions to problems that happen on the site, KM helps prevent the site management team from duplicating past mistakes. Similar circumstances in the future may be handled successfully and efficiently. The benefits of minimizing issues on the construction site include the reduction of the cost in solving problems and the likelihood of recurring issues. By documenting best practices, lessons learned and particularly the solutions to problems that arise on site, similar situations in the future could be dealt with effectively and efficiently to lower the cost of problem – solving and decrease the repetition of problems. On the other hand, the systematic methods for the production, capture, storage, sharing and reuse of a professional's domain knowledge of goods, people and procedures were still lacking among site management teams but these challenges could be well addressed by incorporating KM processes into site management procedures, which will have a considerable positive impact on how construction projects are delivered (Lindgren, Emmitt and Widén, 2018).

Other findings showed that the three most crucial factors determining the effectiveness of a KM effort were leadership, organizational culture and the use of technology. For construction companies to become continuous learning organizations, its KM must be extremely effective. The organizational culture is fundamentally about motivating people to produce, preserve, and exchange knowledge as well as share. Despite the differences in these companies, they gave some excellent examples of high – performing businesses with the use of KM processes (Ribeiro, 2009).

Transparency and cultural change, trust and top management commitment were identified to ensure the effective implementation of KM. The exchange of explicit knowledge could have been possible without implementing any new solution by simply creating a new space on the existing Intranet system where documents

could be exchanged (Dave and Koskela, 2009). Collaborative KM is crucial given the nature of the construction industry since it addresses the problem of acquiring, generating, sharing, applying and storing knowledge among teams of workers. This means that there is a significant relationships between knowledge processes and organizational structure and from this point of view of KM, knowledge is regarded as the foundation of a firm's performance (Rhodes *et al.*, 2008).

Therefore, for effectiveness, the organizational culture should be well shared inside the organization at both the corporate and project levels. Similarly, organizations utilizing major learning sources and using mechanisms to enhance learning are observed to be much more effective than the others (Kiziltas, Dikmen and Talat Birgonul, 2003).

Kmieciak (2021) demonstrated that, knowledge donating and knowledge gathering are both positively correlated with both vertical trust and horizontal trust. Knowledge donation, as opposed to knowledge gathering, is closely tied to idea generating, which is closely related to concept realization. Knowledge sharing behavior and idea realization are not directly related. The relationship between vertical trust and idea formation is mediated by knowledge donation.

Moreno (2015) identified a collaboration and team working, performance management, autonomy and freedom, reward and recognition and achievement orientation to be the positive predictors of different dimensions of firm's performance and KM practices. The study finds performance management and reward and recognition dimensions of organizational learning as positive predictors of KM process and leadership dimensions of KM practices.

According to Takhtravanchi *et al.*(2018) having an open environment was identified as a critical success factor which means providing a trusted working environment where project members dedicate enough time to sharing their knowledge with each other. As knowledge is an asset of organizations, the level and liability of sharing knowledge is important for organizations. It is more significant in projects undertaken through the traditional procurement system due to the separation of the designing and construction team.

This means that, the communication and collaboration of these teams are based on the provisions of their organizations' contract in view of Hassan *et al.*,(2016). Further discussion indicated that knowledge acquisition, conversion, application, and protection, have a significant relationship with growth performance. To learn from each project, knowledge assets need effectively sharing, efficiently and transferred deliberately and systematically. Due to this, construction organizations need to integrate KM processes to improve project management practices, which can lead to higher project and business performance (Boon *et al.*, 2022).

In effect, human and technological factors influence knowledge processes but the approach of the implementation within the firms are different. Effective implementation depends largely on leadership commitment, trust to share knowledge, trusted environment and reward system. To ensure effective knowledge processes like: acquisition, sharing, application and conversion can improve on growth performance in the construction industry.

3.6 Information technology for knowledge management Processes

Due to developments in the IT and communication fields, the majority of building projects are now connected to their corporate networks and have internet access. The idea of collaborative KM, hence, becomes much more beneficial and practical. There are several workable KM solutions that are emerging for collaborative KM. The most effective methods foster a vibrant social atmosphere where informal and transparent information sharing occurs (Dave and Koskela, 2009).

The KM strategies appeared to have two distinct perspectives: the personalization approach prioritizes human contact while the codification strategy primarily focuses on the content management system. However, the two approaches had the same objective of encouraging innovation and creativity within enterprises. There may not be a plan or mechanism in place to capture new ideas if businesses are too heavily toward human factors. On the other hand, if businesses place too much emphasis on strategy and management, the strategic directives or policies may stifle creativity. As a result, in order to achieve good project performance, a delicate balance must be struck between human elements and the management system (Hou *et al.*, 2015; Costa and Monteiro, 2016; Payal, Ahmed and Debnath, 2019). Construction is an industry that needs to better manage its knowledge resources in order to improve business processes and satisfy its clients. However, several IT and contextual issues highlighted in this paper need to be addressed in order to ensure the development of an effective KM strategy (Carrillo, Anumba and Kamara, 2000).

To adopt such a system, much transparency and culture change are needed, and if successful, can have a substantial positive effect on the company and the project performance. To facilitate knowledge capture and reuse, Web 2.0 technologies, such as blogs and wikis, can be deployed in a broad context within different organizations in the AEC sectors. However, this will require data to be able to assess such information (Dave and Koskela, 2009). The tacit knowledge and experience of project staff play a significant role in the knowledge flows during project transition. They argued that to encourage and support appropriate social interaction between

team members and to improve the creation, dissemination and shared understanding of tacit project experience, it is necessary to balance codification KM strategies with "soft" personalization strategies (Senaratne and Sexton, 2008).

The KM community has recently embraced the idea of social capital and the appropriate mix of people to create a true culture of value creation. An earlier argument made the case that, a true value – creation culture can only be found through the proper blending of human networks and social, intangible and technological assets, where problems with change management, learning and trust must be successfully merged with the goal of knowledge-enabled value creation, as knowledge was inextricably related to human experience and the social practice of knowing (Rezgui, Hopfe and Vorakulpipat, 2010a).

The studies helped with the understanding of when and why soft personalization and codified knowledge may be used and it confirms a balance between their utilization. As the definition level increases, less interaction – intensive processes were required, allowing for more deliberate use of knowledge integration. Interaction – intensive procedures were especially necessary when strategies and solutions diverge from conventional practice, which means that technological change and uncertainty were crucial. Drawings or codified knowledge are heavily used in the study. In contrast to earlier findings, suggesting the need for a more discussion on the best sorts of codified knowledge to use when and how.

Having demonstrated in the research how knowledge evolves, the techniques employed and where issues arise, may offer construction players learning possibilities. There was a greater chance of avoiding mistakes, as well as perhaps a better comprehension of how to spread systemic innovation among construction firms (Lindgren, Emmitt and Widén, 2018). Payal et al. (2019) discovered a substantial correlation between an organization's performance and its KM approach. The study showed a substantial relationship between the KM process and the KM strategy. The findings showed that the KM process mediates the relationship between the KM strategy and the organizational performance.

Singla et al. (2020) identified in their study the six knowledge asset constructs which include human capital, structural capital, relational capital, human capital capacity building process and project performance, as well as one performance construct. Both conceptual models are statistically excellently fit, according to the study. Relational capital and structural capital, according to the models' findings, have direct impacts on project success, whereas human capital has an indirect effect. Relational capital, structural capital, and human capital capacity-building processes mediate project performance.

3.7 Education and Training

Further studies were done on Knowledge Integration Potential to ensure the productivity of construction firms. It was critical that top management in Egypt's construction sector understood the anticipated benefits of implementing carefully designed training and development strategies for organizational performance. Additionally, the implementation of an incentive scheme specifically focused on departmental information sharing may have a favorable impact on KM on organizational performance. Better use of the KM system may result from the rotation of staff across various departments (Elfar, Elsaid and Elsaid, 2017)**.** According to Renukappa et al (2019), KM – related training strategies included communication skills, time management skills, training on the job, mentorship, leadership abilities and client management in the training programs created for KM in the construction industry in the Kingdom of Saudi Arabia (KSA). The outcome of the study revealed that training interventions were a challenging activity that required the consideration of different issues discussed in a comprehensive way for efficient implementation of KM strategies.

3.8 Leadership commitment/ organizational culture

A clear understanding of what knowledge means for the company, what knowledge has to be attained, and what the main enablers and barriers are for internal knowledge generation and cross-functional knowledge are all necessary for the effective execution of KM activities. Given their connection to project performance, knowledge sharing and knowledge acquisition have been empirically and theoretically examined most frequently defining what knowledge is valued and how to use it in research publications (Egbu, 2000; Anumba, Charles and Carrillo, 2005; Rhem, 2017; Kerzner, 2018).

Ribeiro (2009) discovered in his research that individuals and the knowledge they produce are the most critical elements for enhancing business performance and ultimately, for collective learning in a project – based industry like construction. The findings showed that the three most crucial factors determining the effectiveness of a KM effort were leadership, organizational culture and the use of technology. For construction companies to become continuous learning organizations, its KM must be extremely effective.

The organizational culture is fundamentally about motivating people to produce, preserve, and exchange knowledge as well as to share. Therefore, for effectiveness, the organizational culture should be well shared inside the organization at both the corporate and project levels. Similarly, organizations utilizing major learning sources and using mechanisms to enhance learning are observed to be much more effective than the others

(Kiziltas, Dikmen and Talat Birgonul, 2003).

As a result, the main critical success factors (CSFs) that need to be focused on through performing KM in construction companies are: leadership support, trust building, risk management, proper technology, teamwork and effective communications (Adi, Hiyassat and Lepkova, 2021). Leadership plays a significant role in promoting knowledge sharing and transfer in the organization. A leader is responsible to develop trust among employees and motivate them to share and transfer their knowledge (Asrar-ul-haq and Anwar, 2016).

Hartmann and Naaranoja 2006 indicated that facilitating conditions will require commitment, equality and appraisal. Commitment and equality can be obtained through a more strategically based selection of projects and the provision of time in these projects to allow for intensive collaborative work. The Management should show more trust in the capabilities of employees to solve problems and should not force employees to search for quick and dissatisfying solutions. The research further indicated that challenges in knowledge sharing in project-based organizations do not only concern the flow of knowledge between the organisations but also with the projects delivery.

3.9 Trust to effectively share project knowledge.

The findings demonstrate how communication, trust and reciprocity between project teams can have an impact on knowledge transfer depending on the organizational environment and project parameters (Ren *et al.*, 2019). The use of mechanisms and techniques to encourage a knowledge sharing culture include reciprocity, a shared vision, trust and teamwork (Carrillo and Chinowsky, 2006b). Social factors such as culture, trust, and relationship were often thought as important influential factors of KM practices. Hence, many socio-technical approaches to KM have been initiated in many construction organizations (An and Ahmad, 2010; Yu and Yang, 2018).

3.10 Gaps / Recommendations

This second review process also identified knowledge and investigation gaps. The method of data collection procedure, countries of research, journals and keywords were most present in the publications. A lack of information from one or more areas was considered a gap in the literature. For example, the most methodology used were quantitative and valid responses were received for analysis but two studies had response rate below 50% (Carrillo *et al.*, 2004; Carrillo and Chinowsky, 2006b). The authors acknowledged that using a postal questionnaire could affect the reliability and validity of the data. Moreover, respondents may have finished the questionnaire because of their individual interest in KM and their responses, therefore, may not reflect the views of the industry in general (Carrillo *et al.*, 2004).

About 36 of the studies were limited to the developed countries with only two from the developing countries. The demonstration of social relations between the project teams has been discussed as the basis of knowledge transfer and project based organization can set appropriate organizational context such as institution and culture to facilitate their social relations development and further promote their knowledge transfer but the single – source data is a limitation of this study (Ren *et al.*, 2019).

Other findings were restricted to a single case, two or five cases limiting the generalizability (Carrillo and Chinowsky, 2006b; Ribeiro, 2009; Staykova and Underwood, 2017; Senaratne *et al.*, 2021). Another constraint was the inability to interview the right people who could respond to a variety of questions relating to KM process. Other gaps related to the topic of studies were the area of research. For instance, others were done in the manufacturing and the public sector which is notably different from the global project- based industry. Another limitation is that the study was done in the small and medium enterprise which could not be generalized (Egbu, 2000).

Grover and Froese (2016) developed a problem – solving collaborative approach for a continuous feedback from different participants. This can ultimately result in creating a continuously evolving knowledge base of best practices that can be used in future projects. The 3D BIM model in the platform made the discussions more holistic and engaging as the visualization made it easy to identify conflicts between different building elements and to anticipate future risks related to delays, safety, or other issues but the limitation of this study is that knowledge is stored in the company's database which demands more data to assess the information.

The recommendations given in these articles are often generic with little to no overview of how to implement the ideas.

Literature indicated five success factors as: reward strategy, willingness to share knowledge, mechanism to approve activities, friendly system to exchange and reuse knowledge, and top management support, proved to be essential in bringing successful outcomes to KM in construction(Carrillo and Chinowsky, 2006a), but the authors recommended future studies on various application of KM in construction projects to verify the applicability and reliability of the critical success factors identified in the study (Taylor, Lin and Lin, 2014).

Another study adopted an interpretive approach as knowledge is inherently identified and linked to human experience and the social practice of knowing, resulting in the need for such methodological approach. The

authors recommended a further exploratory studies on value creation within specific organizations to understand the various factors affecting the attainment of value-creating KM. Rezgui et al. (2010b) indicated in their studies that, the right KM adoption strategy should be put in place to develop and nurture core organizational competencies, and create intellectual capital.

Grover and Froese (2016) developed a problem – solving collaborative approach for a continuous feedback from different participants. This can ultimately result in creating a continuously evolving knowledge base of best practices that can be used in future projects. The 3D BIM model in the platform made the discussions more holistic and engaging as the visualization made it easy to identify conflicts between different building elements and to anticipate future risks related to delays, safety, or other issues. They recommended that, the construction industry needs to adopt some innovative ways to capture and reuse the knowledge of their workers and move away from the current trend of storing project review documents in company databases which demands more data to assess the information.

Hackman, Agyekum and Smith (2017) recommended an adequate platform for exchange of knowledge and a management models and develop adequate knowledge storage systems They recommended a future work into the strategies, enablers and processes which are critical in different countries on people and reward, and a qualitative study to complement the outcomes of the quantitative study. Mohamad and Zin (2019) underlined the direct and significant positive impact of KM on firm competitiveness which is mediated by innovation and that KM is a critical factor of firm competitiveness The authors suggested an extension of the study in terms of sample size and other countries.

Payal et al. (2019) discovered a substantial correlation between an organization's performance and its KM approach. The study also showed a substantial relationship between the KM process and the KM strategy. They suggested future research into the strategies, facilitators and procedures which are critical in different countries on people and rewards and a qualitative study to complement the outcomes of the quantitative study. They suggested additional research to support knowledge transfer by examining additional antecedents (Ren *et al.*, 2019).

4.0 Scientometric Analysis Results

The Scientometric Analysis generate a network model and identifies research subjects (Ghaleb *et al.*, 2022). In order to visualize the intellectual perspective of a particular knowledge area and help academics find the answers to their questions and achieve their objectives, scientometric analysis creates network models (Hudha *et al.*, 2020). The content of publications is effectively represented through the abstract and keywords (Rashid, Rehman and Ashiq, 2021). Consequently, clusters reflecting the key elements of the research area are established using keywords as a unit of analysis (van Eck and Waltman, 2023)

To reveal the study pattern, the following analyses were carried out: document co-citation and clustering analysis, author key words and keyword co-occurrence analysis. Before performing a clustering analysis, keyword co-occurrence and author co-citation analyses give a general overview of the subject field.

4.1 Keyword Co-Occurrence Analysis

Keywords are words or phrases that express the research field inside the domain boundaries and reflect the entire document content (van Eck and Waltman, 2023). In this study, VOSviewer software uses data from the Google Scholar with Publish or Perish database to perform keyword co-occurrence analysis and build networks (Al Husaeni and Nandiyanto, 2021). The generated map is a distance-based network, and the distance between nodes shows how closely related the terms are to one another. Node size is directly inversely proportional to the number of documents containing a certain keyword, and the closer distance between nodes often signifies the stronger association between the keywords. The minimum number of occurrences was set at 10. Out of 4,603 keywords, 108 keywords remain with high recurrence counts.

A network of terms co-occurrences with 68 nodes, 793 links, and total link strength of 1,486 is shown in Figure 5. The most popular keywords are listed in Table 1 together with their frequency, mean year of publication, links, and total link strength.

Table :1 Selected keywords with network parameter

Keyword	Occurrences	Year Published	Links	Total Link Strength
Application	26	2011	45	31
Article	19	2008	25	14
BIM	15	2015	27	19
Business performance	10	2005	16	16
Case study	23	2010	39	22
Cause	12	2013	26	12
Client	15	2007	21	11

Table :1 Selected keywords with network parameter

Keyword	Occurrences	Year Published	Links	Total Link Strength
Construction company	22	2015	28	13
Construction industry	34	2014	102	66
Construction project	41	2014	123	65
Context	18	2008	27	29
Cost	26	2013	53	23
Culture	27	2011	28	19
Dimension	19	2007	31	17
Design	32	2010	55	34
Dynamic capability	10	2011	18	10
Economic performance	12	2008	14	20
Effect	51	2008	146	76
Empirical study	17	2010	32	14
Environmental performance	12	2011	18	15
Evaluation	17	2010	21	22
Evidence	36	2006	79	28
Example	15	2006	20	16
factor	45	2010	130	70
Finding	20	2006	29	13
evidence	36	2006	79	28
field	23	2008	32	20
financial performance	17	2007	37	25
firm	50	2007	116	72
firm performance	23	2007	77	55
Implementation	22	2012	43	18
Implication	33	2005	48	25
Information technology	18	2008	29	15
Innovation performance	10	2010	13	16
Intellectual capital	9	2006	15	11
Job performance	18	2910	30	19
Knowledge management system	28	2007	38	18
Knowledge sharing	14	2009	18	11
Leadership	22	2008	37	19
Learning	24	2007	35	19
Measure	29	2005	44	28
Organizational learning	15	2006	19	14
Organizational performance	24	2006	44	29
performance indicator	18	2013	28	18
Performance management	9	2008	11	13
Performance measure	17	2006	36	23
Project	40	2010	117	58
Project management	17	2012	27	16
Project manager	20	2015	40	20
Project performance	29	2010	29	25
Quality	28	2009	29	25
Resources	19	2005	45	25
Risk	19	2011	38	19
Safety	21	2013	42	20
Safety performance	20	2011	50	26
Structure	27	2006	42	27
Survey	23	2009	33	20
Task	21	2006	30	16
Task performance	19	2007	30	15
Team	31	2004	57	33
Team performance	18	2006	28	11
Technology	22	2009	36	29
Term	25	2011	39	15

Table :1 Selected keywords with network parameter

Keyword	Occurrences	Year Published	Links	Total Link Strength
Time	29	2010	32	15
Trust	18	2006	25	17
Use	29	2009	39	28
Value	21	2008	42	23
Way	15	2008	26	15

Source: Author's search

Table 1 is the result of the VOSviewer statistical technique, the word "effect" with 53 occurrences is the most common author keyword in the literature, the word "firm" with 50 occurrences is the second most common, The term "project performance" has been used in a variety of contexts, including "performance indicator," "organizational performance, "performance management," and "performance measure." It has also been used to refer to "project performance," "business performance," "firm performance," and "team performance." The total of these items is 148. This indicates that the phrase "project performance" can be seen as the author keyword that has been used in the literature the most.

Additionally, the term "knowledge management" is implied in a number of expressions, including "knowledge management system," "knowledge sharing," "learning," and "organizational learning."

The frequency of these items will add up to 81 occurrences. So, the second phrase will be "knowledge management." The time period that researchers have used this keyword in their studies is shown by the mean year of publication. For instance, with a total occurrence of 75, papers that mentioned the construction business and construction projects attracted higher attention in 2014. However**,** in 2011, 2013, 2006, 2004, 2005, 2010, and 2008, keywords that attracted more attention in publications were: cost, culture, Evidence, team, quality, time, and leadership. Other keywords such as: Intellectual capital, safety performance, trust, task performance, client, BIM, dynamic capability, innovation performance, environmental performance and empirical studies did not attract higher attention due to their low occurrences in publication. The links show how many nodes are connected to a specific node, whereas the total link strength shows how strong all of the linkages are that are connected to that node (Wang and Guo, 2022).

For instance, the keyword (effect) has a total link strength of 76, which is the greatest of all the nodes and indicates the keyword has the strongest inter-relatedness to project performance. This indicates that, project performance is possible with the "effect" of some factors .The second highest of the numbers 72 and 70 are (Firm) and (factor). Construction projects and the industry, on the other hand, come in third with scores of 65 and 66, respectively. This indicates there is a strong link between project performance, construction firm, factors and effects.

4.2 Co –Word Map Network visualization

In the network visualization, items are represented by their label and a circle. The size of the label and the circle of an item is determined by the weight of the item, the larger the label of the circle the heavier the weight. For some items, the label may not be displayed. This is done in order to avoid overlapping labels. The color of an item is determined by the cluster to which the item belongs. Lines between items represent links. By default, at most 1000 lines are displayed, representing the 1000 strongest links between items (van Eck and Waltman, 2023).

Figure 6 below represent the visualization of keywords and the relatedness of co -citation links. The word "Project performance" is related to the following keywords: trust, client, risk, construction project, construction industry, factors, BIM, project manager, quality, team, survey, effect, firm, economic performance, measure, dimensions, job performance, culture, design, learning, evidence, structure and knowledge sharing. The keywords with the larger circles are: "effect", "factor", "construction project" "firm" and "construction industry". This indicates a stronger link between these key words and "project performance" within the period of 2006 -2014. Beyond 2014 – 2022, there was little attention on these keywords.

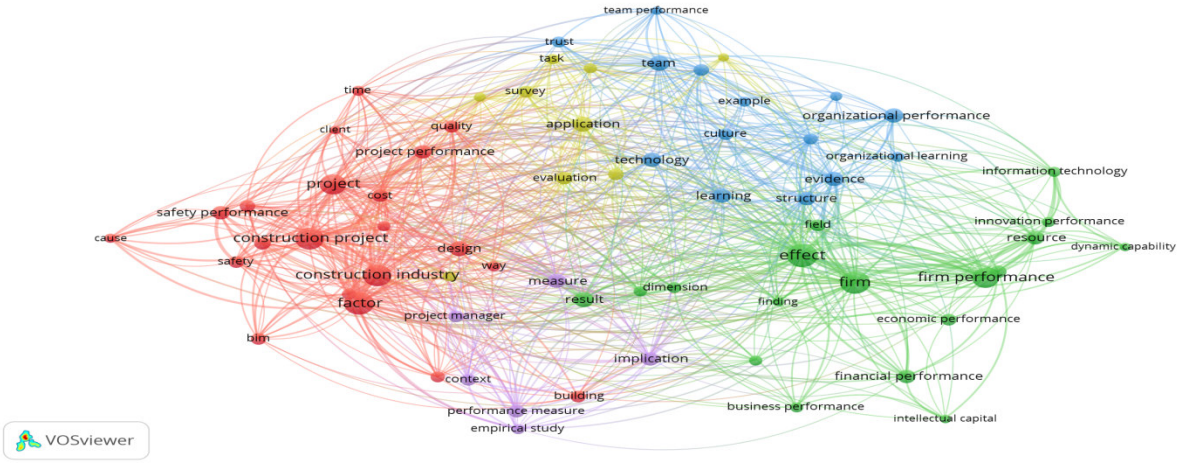

Fig 6: Network visualization

4.3 Network visualization

The results of the visualization of the co-word map network of research developments regarding knowledge management and project performance as shown in Figure 7 below. Cluster 1, the red color consists of 21 items including BIM, building, case study, cause, client, construction, cost, factor, implementation, implication, performance indicator, project, project management, quality, project performance, risk, safety, safety performance, time and way. Cluster 2, the Green color consists of 17 items including construction company, culture, evidence, example, knowledge management, knowledge sharing, leadership, learning, organizational performance, performance management, structure, team, team performance, technology, trust and use.

Cluster 3, the Blue color consists of 14 items including: business performance, dynamic capability economic performance, information technology, firm, firm performance, findings, innovation performance, intellectual capital, resources and values. Cluster 4, the Yellow color consists of 11 items, namely application, article, dimension, design, evaluation, field, job performance, survey, task, task performance and term. Cluster 5, The Purple color consists of 5 items including context, empirical study, measure, and performance measure and project manager. The color bar indicates how scores are mapped to colors. In the overlay visualization shown in Figure 7, colors indicate impact factors of journals. For example, journals colored blue have an impact factor below 1, journals colored green have an impact factor around 2, and journals colored yellow have an impact factor of 3 or higher.

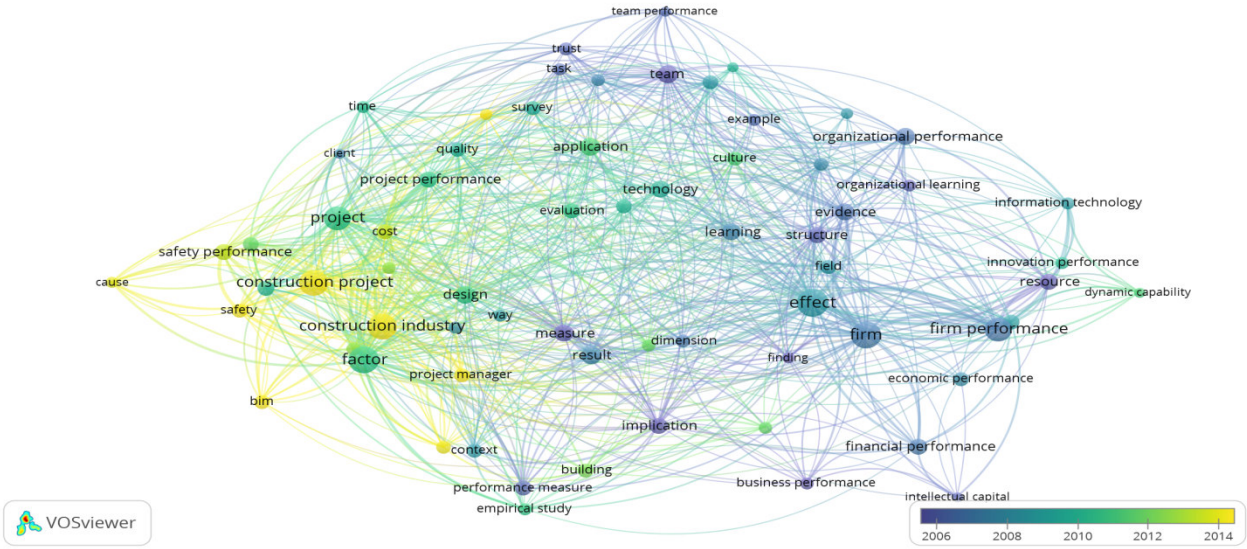

Fig. 7: Overlay visualization

4.4 Co-Word Map Density Visualization

By highlighting the items that are deemed crucial for study, density Co-Word maps can be used to gain an

understanding of the basic structure of bibliometric maps (Al Husaeni and Nandiyanto, 2021). The default color schemes include blue, green, and yellow. The density map means that the more yellow the color is with the diameter of the largest circle, the denser the keyword, this means that, it appears more often in literature. If the color fades, it blends in with the green background, the less often it occurs (van Eck and Waltman, 2023). Considering the findings displayed in Figure 8, on knowledge management and project performance, keywords such as effect, firm, factor and construction industry appeared more frequently in literature from 2006- 2014. Keywords like team performance, project performance, BIM and dynamic capacity appeared in the faded colour, which means they appear less in literature.

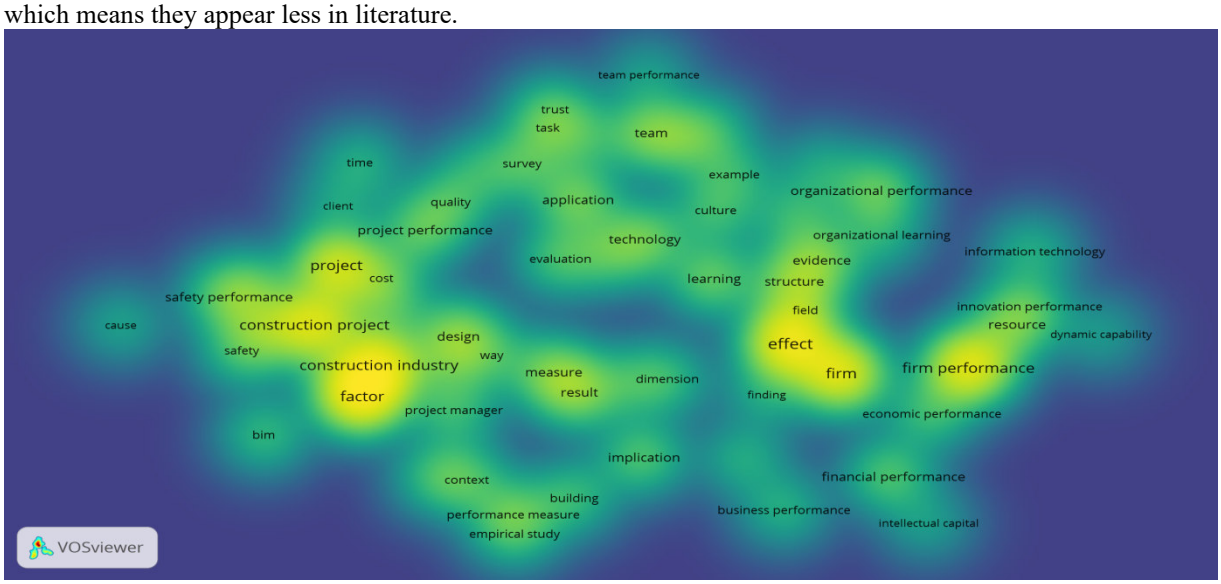

Fig. 8: Density visualization

5.0 Conclusion

The thorough analysis presented in this work concludes with several relevant practical implications for both scholars and practitioners. This review noted key information of the research such as publishers, methods used, keywords and gaps present. A total of eight keywords were identified throughout the literature. These are: strategies, barriers, factors, training and education, techniques and technology, leadership commitment and trust and recommendations. According to the findings of various researches, for effective organizational performance, there should be KM processes to achieve their goals.

Research into knowledge exchange on web platforms and knowledge personalization is necessary, as a widely researched topic, calls for frequent reviews that can aggregate new conceptualizations. The sample papers analyzed by this review showed broad conceptualizations of explaining the relationship between knowledge management strategies, knowledge transfer, knowledge infrastructure and organizational and project performance. To fully comprehend the role that organizational learning and dynamic capacities play in mediating KM processes and performance, more research is required. The systematic review could clearly show that there is insufficient literature on the topic about KM and construction project performance. This is an indication for the required further information and calls for future researchers to explore in the subject area. The information on the topic can be used for further researchers. Keywords such as effect, firm, factor and construction industry appeared more frequently in literature from 2006- 2014. Keywords like team performance, project performance, BIM and dynamic capacity appeared less in literature.

5.1 Implication for practice

Engineers can share implicit and explicit knowledge with others while also gaining valuable experience from earlier construction projects because majority of engineers agreed that KM is essential and significant in light of construction management; Integrating KM eliminates mistakes and improves on experiences from the project; Well-developed training and development plans have a greater impact on the project performance ; Knowledge management should be supported by technical and administrative innovations in the firm; Training interventions must take context into account; Incorporating knowledge involves care for individual growth in teamwork, meetings to integrate knowledge, trust in teamwork, documentation of experiences to externalize knowledge.

5.2 Limitation

The data for the review was retrieved from Google Scholar because institutional subscriptions have an impact on the type of databases to get information. This study is also limited to purely correlational and quantitative nature

and hence the results of the study may be strengthened with qualitative investigation of academic document. Future research may explore in the context of other performance areas such as team and organizational performance

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