Front. Eng. Manag. 2022, 9(2): 221–238
https://doi.org/10.1007/s42524-022-0195-3

REVIEW ARTICLE

Qianwen ZHOU, Xiaopeng DENG, Ge WANG, Amin MAHMOUDI

Linking elements to outcomes of knowledge transfer in the project environment: Current review and future direction

Abstract A project is a specific effort to create a unique product, so it is a favorable place for knowledge creation and development. Knowledge can be transferred inside and outside projects and their parent project-based organizations, thus affecting project performance and organizational competitiveness. However, the current research on the elements and outcomes of knowledge transfer (KT) in the project environment lacks completeness and clarity, and that on the different levels of KT is fragmented. This study aims to conduct comprehensive research to determine and link the elements and outcomes of KT in the project environment. The authors systematically analyzed the relevant literature from 2000 to 2021, which showed an increasing publication trend. They divided KT in the project environment into three levels according to the transfer scenario: Intra-project, cross-project, and cross-organizational KT. Five-dimensional transfer elements and two-dimensional transfer outcomes were then identified and analyzed from previous literature. Lastly, the relationships between the transfer elements and outcomes were gathered to create a comprehensive model. Importantly, the knowledge gap in the current literature was highlighted, and future research directions were put forward. This study builds a theoretical framework linking transfer elements to outcomes that can serve as a basis for scholars and practitioners to develop effective strategies for KT in the project environment.

Keywords knowledge transfer, knowledge management, project management, project environment, literature review

Received January 13, 2022; accepted March 15, 2022

Qianwen ZHOU, Xiaopeng DENG (✉), Amin MAHMOUDI
Department of Construction and Real Estate, School of Civil Engineering, Southeast University, Nanjing 211189, China
E-mail: dxp@seu.edu.cn

Ge WANG
College of Public Administration, Huazhong Agricultural University, Wuhan 430070, China; Antai College of Economics and Management, Shanghai Jiao Tong University, Shanghai 200030, China

The study is funded by the National Natural Science Foundation of China (Grant Nos. 72171048, 72101053, and 71771052) and the Humanities and Social Science Project of Ministry of Education of China (Grant No. 21YJCZH008).

1 Introduction

With the advent of the knowledge economy era, project teams have gradually realized the importance of knowledge resources in enhancing core competitiveness and innovation capabilities (Hanisch et al., 2009; Zhang and Huang, 2020). Projects are temporary work to create a unique product, service, or outcome (Li et al., 2020; He et al., 2021). The role of knowledge in projects is reflected in its sharing and flow, which means that knowledge is more valuable when it is owned by more individuals (Jafari Navimipour and Charband, 2016). A large amount of knowledge is created during a project's lifetime, but knowledge is easily lost with the dissolution of the project (Schindler and Eppler, 2003; Ren et al., 2019). If effective knowledge exchange and transfer between different individuals, projects, and organizations can be realized, the possible loss of knowledge can be greatly reduced, thus avoiding the waste of time and resources (Buvik and Tvedt, 2017; Zhou et al., 2022b). Knowledge transfer (KT) exists between project members, different participating organizations of the project, and different projects. However, a project has the characteristics of one-off and goal-oriented, which makes KT challenging (Kivrak et al., 2008). KT is usually interdisciplinary and multi-functional, which demonstrates the complexity of the transfer process and outcomes (Dip, 2021). Therefore, better managing KT within and outside a project is worth pondering (Bakker et al., 2011; Schröpfer et al., 2017).

KT in the project environment refers to the process in which organizations, projects, or individuals transmit knowledge through various means in an environment with the project as the production or operation unit, and then the recipients accept the transferred knowledge and apply it (Aerts et al., 2017; Zhou et al., 2020). KT embodies

the multi-faceted nature of the subject, boundary, and process, which indicates that it must be summarized at multiple levels (Szulanski, 1996; Cacciatori, 2008; Martinkenaite, 2011). The existing research concentrates on three levels: Intra-project KT (IPKT), cross-project KT (CPKT), and cross-organizational KT (COKT). IPKT is KT between different members of the project team; CPKT, different projects; and COKT, different organizations participating in the project.

In recent years, scholars have focused on the elements of KT and the corresponding transfer outcomes (Martinkenaite, 2011; Teo and Bhattacherjee, 2014). KT elements can be divided into five dimensions: The knowledge sender and receiver, the relationship between the sender and receiver, knowledge characteristics, transfer media, and transfer context, which are the decisive factors of the difficulty, quantity, and quality of KT (Shahbaznezhad et al., 2019). KT outcomes include two dimensions, namely, the amount of knowledge transferred and the extent to which the receiver applies knowledge (Martinkenaite, 2011; Teo and Bhattacherjee, 2014). Although these studies provide significant insights, they suffer from (1) the fragmentation between three research levels of IPKT, CPKT, and COKT; (2) lack of completeness and clarity regarding the elements and outcomes of KT in the project environment; and (3) limited efforts on the relationship between the elements and outcomes of KT, which make the influence path between them unclear. Given the diversity of concepts and methods and the fragmentation of related research, a holistic perspective is needed to express the corresponding relationship between the elements and outcomes of KT in the project environment. This study supplements existing research efforts by conducting a systematic literature review of KT in the project environment and analyzing the transfer elements and outcomes of IPKT, CPKT, and COKT. Specifically, the following research questions require great attention: (1) How are three levels of KT (IPKT, CPKT, and COKT) defined, and what are their scopes? (2) What are the elements and outcomes of KT in the project environment, and how can they be linked? (3) What are the knowledge gaps and research directions for the current research on the KT in the project environment?

This study aims to establish an integrated framework that determines and links the elements and outcomes of KT in the project environment through a comprehensive analysis of the existing literature. It provides an overall assessment of the existing literature and an overview of knowledge gaps. This study is organized as follows. Section 2 introduces the main theoretical background, which becomes the basis of this study. Section 3 describes the methodology and research framework. Section 4 analyzes the results, including the elements and outcomes of KT from three levels. Section 5 conducts an in-depth analysis of the results and discusses knowledge gaps and future directions. Section 6 concludes the work.

2 Theoretical background

2.1 KT in the project environment

Teece (1977) first proposed the concept of KT. He indicated that technology transfer can accumulate a large amount of practical knowledge for enterprises. Szulanski (1996) stated that KT involves knowledge senders and receivers, who need to transfer, acquire, absorb, and apply knowledge in their interaction. Subsequently, scholars put forward that KT means the knowledge source transfers knowledge to potential recipients, and ensuring that the recipients fully absorb the knowledge and can guide actions accordingly is necessary (Davenport and Prusak, 1998; Skovvang Christensen and Kaasgaard Bang, 2003). KT is an interactive process between the sender and receiver that depends on specific contexts. Therefore, KT that occurs in different contexts should be specifically studied. KT in the project environment has gradually become a hot spot (Newell et al., 2006; Ajmal and Koskinen, 2008).

According to the different scenarios in which the transfer occurs, the research on KT in the project environment can be divided into three types. (1) IPKT refers to the sum of KT activities between project members (Zhou et al., 2022a). In a project team, members who possess specific knowledge send the knowledge to other members. Then, other members receive the knowledge and use it to improve their technical and management levels (Aerts et al., 2017; Ni et al., 2018). During continuous KT among project members, useful knowledge is possessed by a growing number of members, thereby increasing the project's knowledge reserve and improving teamwork ability and work efficiency (Sang et al., 2019). (2) CPKT is the process by which knowledge is transferred from the source project team to the recipient project team so that knowledge can be received, internalized, and reused by the latter (Zhao et al., 2015). CPKT includes horizontal KT between projects and vertical KT between the project-based organization (PBO) and projects (Zhou et al., 2020). Through CPKT, the project team can transfer the knowledge acquired during construction and operation to other projects or the construction enterprise, avoiding knowledge loss caused by the disbandment of the project team. And (3) COKT refers to the KT between different participating organizations involved in the project. Each participating organization transfers and absorbs knowledge while jointly completing the project task to obtain knowledge resources that can enhance their competitive advantages (Lawson and Potter, 2012; Lievre and Tang, 2015). Organizations involved in COKT include project owners, design units, contractors, material suppliers (Sun et al., 2019), and academic research units (Liu et al., 2020).

2.2 Elements and outcomes of KT

With the development of KT theory, scholars conducted many studies to explore the factors affecting KT. Szulanski (1996) divided the influencing factors into four dimensions: Knowledge characteristics, the sender, the recipient, and knowledge context. Gupta and Govindarajan (2000) proposed that transfer channels and their richness should also be considered. Cummings and Teng (2003) set up a framework including the knowledge sender and receiver, the relationship between the sender and the receiver, knowledge characteristics, and transfer context. Therefore, the elements influencing KT can be divided into five dimensions: The knowledge sender and receiver, the relationship between the sender and receiver, knowledge characteristics, transfer media, and transfer context. The five-dimensional transfer elements have become a generally accepted theoretical framework for research and laid a good foundation for KT in the project environment (Zhao et al., 2015; Zhou et al., 2020).

The research on the transfer outcomes starts as the dependent variables when studying the factors influencing KT. Szulanski (1996) defined the results of KT as on time, on budget, and on satisfaction. According to Garavelli et al. (2002), KT can be divided into two phases: One is the knowledge flow from the knowledge sender to the receiver; the other is the knowledge application of the knowledge recipient. Therefore, scholars proposed that the transfer outcomes also include two dimensions: One is the amount of knowledge transferred and the amount of knowledge accepted by the knowledge receiver (Milagres and Burcharth, 2019); the other is the extent to which the knowledge receiver applies the transferred knowledge (Ambos and Ambos, 2009; Tshuma et al., 2018). In the field of project management, scholars began to pay attention to the results of KT and use different standards to measure the transfer outcomes, such as the effectiveness (Ciabuschi et al., 2011; Sun et al., 2019) and successfulness (Lee and Ram, 2018; McGowan Poole, 2020) of KT. Although many scholars recognized the significance of KT for projects, comprehensive studies of the transfer elements and outcomes within and outside projects and their parent PBOs are quite rare. Considering the knowledge intensity of the project and the importance of knowledge flow, developing a systematic research framework for the smooth occurrence and effective completion of KT has great theoretical and practical significance.

3 Methodology

Literature review is a scientific method that mainly solves specific problems by identifying, evaluating, and synthesizing all relevant studies (Milagres and Burcharth, 2019; Xu and Zou, 2021). To ensure the rigor and objectivity of the research method, the authors selected and analyzed papers on KT in the project environment following the PRISMA statement method (Moher et al., 2010). PRISMA means "preferred reporting items for systematic reviews and meta-analyses". It uses systematic and clear methods to discover, select, and evaluate related literature and then analyze collected data from the publications. As shown in Fig. 1, the whole process includes four stages: Identification, screening, eligibility, and content analysis.

Phase I: Identification refers to a comprehensive search and identification of relevant articles, including the two sub-phases of searching and filtering. At first, the samples in this study were collected from Web of Science, Scopus, and SpringerLink, the main databases of global scientific articles. The publication time was from January 2000 to June 2021. The search terms used were "project" AND ("KT" OR "knowledge sharing" OR "knowledge exchange" OR "knowledge flow"). After removing duplicates, a total of 865 papers were gathered, including journal articles, conference papers, thesis dissertations, and book chapters. Subsequently, the search scope was limited to full-text published articles in English academic journals. After checking the source, authors, and language, the papers that are not journal papers, not written in English, or not available in full-text version are removed. After this series of operations, 329 papers remained.

In Phase II, the title, authors, source, keywords, and abstract of the papers were screened. At this phase, the authors of this work assessed whether the paper is relevant to "project" and "KT". Papers that do not explore the influencing factors and outcomes of KT in the project environment were excluded. In Phase III, eligibility means reading the full text version of the selected 85 articles after phase II. Articles would be excluded if they did not focus on KT in the project environment but only used KT as a background for other activities. Following the above standards, 64 articles were included in the scope of this literature review.

Lastly, in Phase IV, the authors conducted content analysis on the selected papers, including descriptive and conceptual results. The former mainly conducts statistical and quantitative analysis on publication year, journal, method, and research level, while the latter summarizes the five-dimensional KT elements, the transfer outcomes, and the relationship between the elements and outcomes in the project environment.

4 Results

4.1 Descriptive results

This section mainly provides the statistics and overview of the articles' publication year, related journal, method, and research level.

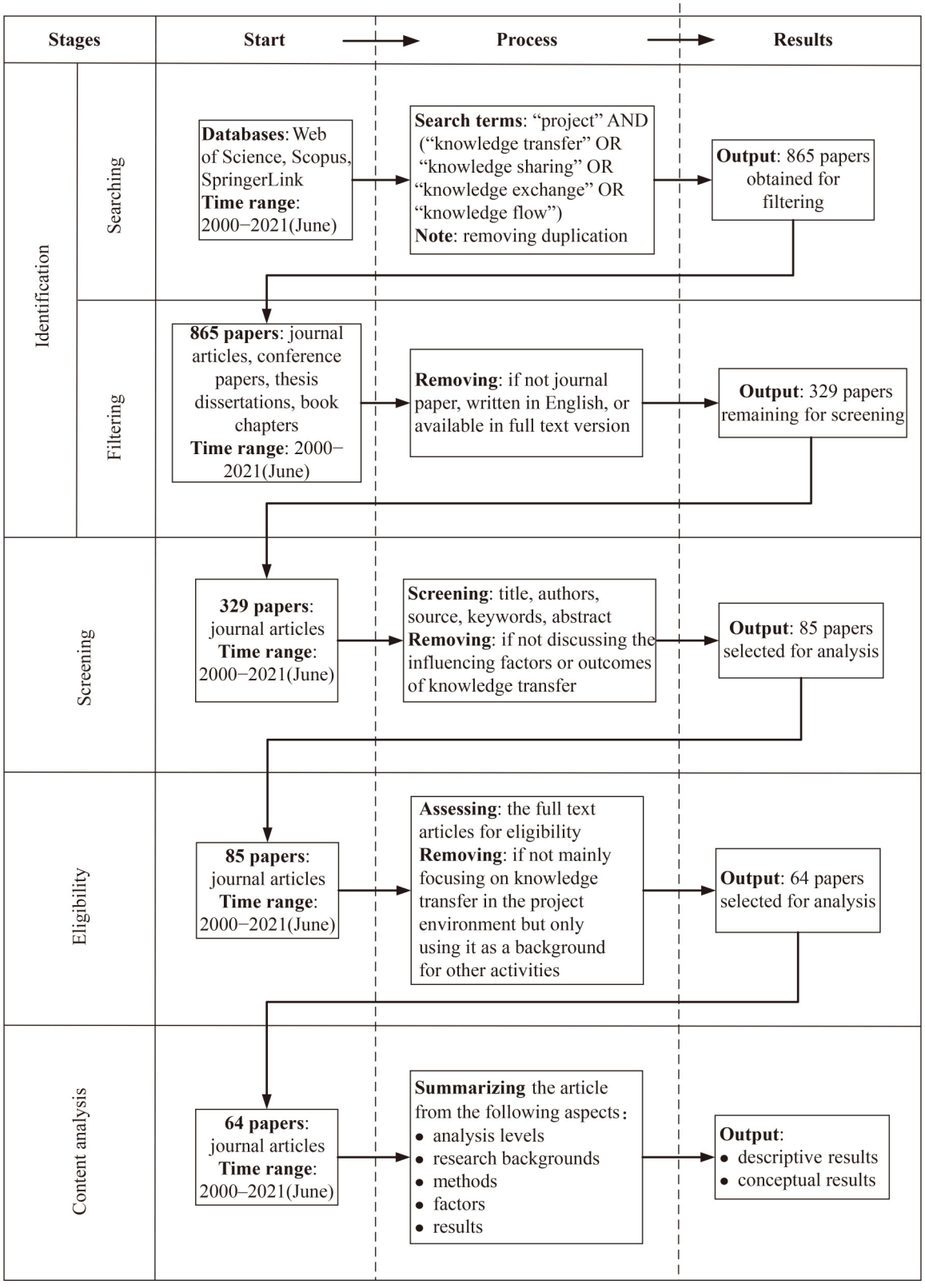


Fig. 1 Research methodology.

4.1.1 Year and journal distributions

Figure 2 demonstrates the yearly numbers of publications since 2000, with an overall trend of growth. From 2001 to 2007, except in 2002 and 2003, one related paper was published every year. From 2008 to 2013, the number of

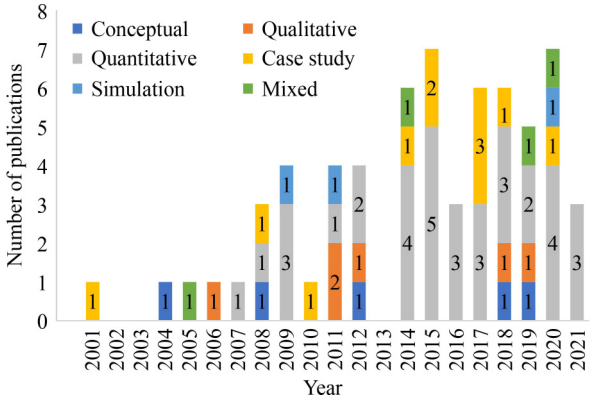


Fig. 2 Numbers of publications per research method and year (up to June 2021).

publications fluctuated, ranging from 0 to 4. Except that only three related papers published in 2016, five to seven papers were published each year from 2014 to 2020. This result shows that KT in the project environment has attracted ever-increasing attention from scholars, and the research in this field has been significantly developed. These 64 papers were published in more than 30 different journals related to project management, knowledge management, and organizational management. Among them, ten journals has published two or more related papers, namely, *Research Policy*, *Journal of Knowledge Management*, *International Journal of Project Management*, *Automation in Construction*, *Journal of Management in Engineering*, *Journal of Construction Engineering and Management*, *Project Management Journal*, *Knowledge Management Research & Practice*, *Engineering Construction & Architectural Management*, and *Management Learning*.

4.1.2 Research methods

Afterward, the authors carefully read the selected 64 papers, coded them, and conducted a comprehensive analysis in the form of data. The data included author information, analysis levels, research background, keywords, methods, and results. At this stage, preliminary tables, graphs, and reports were used to facilitate comprehensive surveys and statistics. In terms of methods, over half of the 64 articles (35 articles) used quantitative research methods, whereas 6 used qualitative approaches. Eleven, five, three, and four papers used case study, conceptual, simulation, and mixed methods, respectively. An interesting phenomenon is that the research methods of the publications from 2018 to 2020 are relatively scattered. The results indicate that current research methods are becoming increasingly diverse, and the outcomes are gradually enriching.

4.1.3 Research levels

According to the scenario in which KT occurs, KT in the project environment includes IPKT, CPKT, and COKT. The factors involved in the different levels of KT are not entirely the same. Therefore, the three types of KT should be first described separately. Table 1 demonstrates the information of some selected papers belonging to the ten journals that has published two or more related papers, as well as their analysis levels and research methods.

(1) IPKT

Among the 64 papers, 19 explored KT within a project. According to statistics, the number of articles using the quantitative method is the largest (15 articles). The steps of KT within the project are as follows. The first step is the formation of personal knowledge. The accumulation of personal knowledge plays a vital role in the growth of team knowledge. The second step is the formation of project team knowledge. The transfer of personal knowledge and the absorption, improvement, and coding of knowledge are completed within the team (Buvik and Tvedt, 2017). The third step is the mutual transfer of personal knowledge and project team knowledge. In the selected literature, the main factors influencing IPKT include organizational structure (Gopal et al., 2018), organizational culture (Ovbagbedia and Ochieng, 2015), incentive mechanism (Decker et al., 2009), and trust among members (Park and Lee, 2014).

(2) CPKT

The number of articles on CPKT is the largest, with a total of 27. Among them, 12 articles used the quantitative method, and 7 articles used the case study method. CPKT refers to KT from the source project to the recipient project through horizontal transfer (direct transfer between projects) or vertical transfer (knowledge is transferred from projects to PBOs and then to other projects) (Zhou et al., 2020). Most of the selected literature focused on horizontal transfer, studying the influencing factors and transfer effect (Frank and Ribeiro, 2014; Ren et al., 2018). Some studies also explored vertical KT, such as Bakker et al. (2011) and Zhou et al. (2020).

(3) COKT

Of all the selected literature, 18 articles had COKT as the research goal. Most of the papers (8 articles) has used quantitative method. At different stages of project construction, the tasks of each organization vary, along with the process and influencing factors of knowledge exchanges between organizations. Therefore, the KT participants proposed in the selected literature are also distinct, including owners, design units, contractors, material suppliers (Sun et al., 2019), and academic research units (Liu et al., 2020), as well as universities, public organizations, and customers (Takahashi et al., 2018).

4.2 Conceptual results

Conceptual results mainly include three parts: Five-dimensional KT elements, KT outcomes, and link between the transfer elements and outcomes. The purpose

Table 1 Selected papers belonging to journals that has published two or more related papers

Journal	Reference	Analysis level	Research method
Research Policy	Prencipe and Tell (2001)	Cross-project (CPKT)	Case study
	Cacciatori (2008)	Cross-project (CPKT)	Case study
Journal of Knowledge Management	Mueller (2012)	Cross-project (CPKT)	Qualitative
	Lievre and Tang (2015)	Cross-organization (COKT)	Case study
	Ren et al. (2018)	Cross-project (CPKT)	Quantitative
International Journal of Project Management	Bakker et al. (2011)	Cross-organization (COKT)	Qualitative
	Park and Lee (2014)	Intra-project (IPKT)	Quantitative
	Zhao et al. (2015)	Cross-project (CPKT)	Qualitative
	Aerts et al. (2017)	Cross-organization (COKT)	Case study
	Wei and Miraglia (2017)	Cross-project (CPKT)	Case study
	Mahura and Birollo (2021)	Cross-project (CPKT)	Case study
	Stock et al. (2021)	Intra-project (IPKT)	Quantitative
Automation in Construction	Alashwal and Abdul-Rahman (2014)	Cross-project (CPKT)	Quantitative
	Wen and Qiang (2016)	Cross-project (CPKT)	Quantitative
Journal of Management in Engineering	Lê and Law (2009)	Cross-organization (COKT)	Simulation
	Zhang and He (2016)	Intra-project (IPKT)	Quantitative
	Ni et al. (2018)	Intra-project (IPKT)	Quantitative
	Sun et al. (2019)	Cross-organization (COKT)	Quantitative
	Zhou et al. (2020)	Cross-project (CPKT)	Quantitative
Journal of Construction Engineering and Management	Javernick-Will and Levitt (2010)	Cross-organization (COKT)	Qualitative
	Joseph Garcia and Mollaoglu (2020)	Intra-project (IPKT)	Quantitative
	Gao et al. (2020)	Intra-project (IPKT)	Simulation
Project Management Journal	Ajmal and Koskinen (2008)	Cross-project (CPKT)	Conceptual
	Wiewiora et al. (2014)	Cross-project (CPKT)	Case study
	Mueller (2015)	Cross-project (CPKT)	Case study
	Buvik and Tvedt (2017)	Intra-project (IPKT)	Quantitative
	Takahashi et al. (2018)	Cross-organization (COKT)	Quantitative
Knowledge Management Research & Practice	Decker et al. (2009)	Intra-project (IPKT)	Quantitative
	Frank and Ribeiro (2014)	Cross-project (CPKT)	Conceptual
	Hermans and Castiaux (2017)	Cross-organization (COKT)	Case study
Engineering Construction & Architectural Management	Schröpfer et al. (2017)	Intra-project (IPKT)	Quantitative
	Sang et al. (2019)	Intra-project (IPKT)	Quantitative
	Liu et al. (2020)	Cross-organization (COKT)	Simulation
Management Learning	Newell et al. (2006)	Cross-project (CPKT)	Qualitative
	Cacciatori et al. (2012)	Cross-project (CPKT)	Quantitative

of this section is to identify the elements and outcomes of KT in the project environment and relate them holistically.

4.2.1 Five-dimensional elements of KT in the project environment

At this stage, the content analysis method was used to extract elements mentioned and validated in the literature that influence KT in the project environment. Content analysis refers to a systematic technique for compressing many words into fewer content categories based on explicit coding rules (Hsieh and Shannon, 2005). By using content analysis, a detailed and systematic examination of the content of a particular subject can be performed to extract sub-factors and variables (Mohammadi et al., 2018). After the first round of review, 38 variables were identified as the influencing factors of KT. In the second round of review, five variables were extracted. Next, some variables with the same meaning were combined or

removed. As shown in Table 2, 35 variables of KT were identified, which belong to five dimensions.

(1) Knowledge sender and knowledge receiver

In this dimension, the most concentrated factors are transfer intention, receive intention, and absorptive capacity. Scholars proposed that KT largely depends on the willingness of the knowledge sender to express knowledge and communicate with the receiver (Cheng et al., 2009; Wei and Miraglia, 2017). As the other critical participant in the transfer process, the knowledge recipient's receive intention also affects KT (Bakker et al., 2011; Ren et al., 2018). Besides, projects or individuals with higher absorptive capacity have lower transfer costs and faster transfer speed in KT, which significantly improve the efficiency and final effect of transfer (Lawson and Potter, 2012; Zhao et al., 2015). Another factor that cannot be ignored is supplier protectiveness, which is mentioned by scholars in COKT (Lawson and Potter, 2012; Liu et al., 2020). When knowledge providers and receivers come from different organizations, an important task of suppliers is protecting their valuable proprietary knowledge to maintain a competitive advantage.

(2) Relationship between the knowledge sender and receiver

The statistical results indicate that trust is the factor getting the most attention in this dimension. The higher the degree of trust between two individuals or projects is, the stronger their willingness is to transmit and receive knowledge (Bosch-Sijtsema and Postma, 2010; Park and Lee, 2014). Five studies indicate that the higher the similarity between two projects is, the better the effectiveness of CPKT is (Zhao et al., 2015). Park and Lee (2014) explored the similarity of expertise and project value between partners within the project. Besides, some scholars defined different types of distances between the knowledge sender and receiver as geographical distance (Betz et al., 2014), relational distance (Bakker et al., 2011), knowledge distance (Joseph Garcia and Mollaoglu, 2020), and organizational distance (Liu et al., 2020). These studies suggested that the greater the distance between KT participants is, the worse the transfer effect is.

(3) Knowledge characteristics

As shown in Table 2, the most frequently mentioned variable by scholars in this dimension is knowledge tacitness, followed by knowledge complexity, embeddability, and ambiguity. Knowledge tacitness reflects the degree of tacit knowledge in the project that is difficult to encode, hindering KT to a certain extent (Andersson et al., 2015; van Waveren et al., 2017). Knowledge with high complexity hinders members inside or outside the project from using coding for KT (Lievre and Tang, 2015). Additionally, project knowledge is embedded in certain cognitive and normative systems, and the management methods vary from organization to organization. This kind of knowledge embeddedness also affects KT (Tshuma et al., 2018).

(4) Transfer media

Table 2 demonstrates that communication and transfer channels are the most frequently mentioned factors in this dimension. According to Antwi-Afari et al. (2016), the enhancement of communication capability can promote the effect of COKT in technology transfer projects. Transfer channel is a collective term used to describe the media of KT between sender and receiver (van Waveren et al., 2017), including project meetings, communication through social software, and delivery of coding materials (Souza da Conceição et al., 2019). Besides, meeting systems and document exchange are regarded as specific transfer media, which could affect the transfer effect (Jensen et al., 2019; McGowan Poole, 2020).

(5) Transfer context

Forty-two publications studied factors in the transfer context dimension, indicating that this dimension is the most concerning dimension. Factors involved in this dimension can be roughly divided into project characteristics, organizational characteristics, and network characteristics. According to Seres et al. (2009) and Hermans and Castiaux (2017), the transfer effect in different types of projects (e.g., housing construction, transportation, petrochemical, and hydropower projects) varies. Time urgency, temporary nature, project uncertainty, and standardization are also important factors related to project characteristics. Temporary nature leads to the fluidity and instability of the project team, and time urgency forces members to complete the project task at a specific time, which reduces their willingness to transfer knowledge (Sun et al., 2019). Newell et al. (2006) and Raziq et al. (2020) pointed out that the project's standardization level impacts KT. Additionally, scholars put forward the following context factors related to organizational characteristics: Organizational structure (Gopal et al., 2018), organizational culture (Antwi-Afari et al., 2016), incentive mechanism (Andersson et al., 2015), and information technology (Betz et al., 2014). In recent years, the factors of network characteristics have also attracted scholars' attention. For example, different network structures between the knowledge senders and receivers exert different effects on KT (Schröpfer et al., 2017).

4.2.2 Outcomes of KT in the project environment

Table 3 illustrates all outcomes of KT based on the selected literature. In the research of Liu et al. (2020) and Gao et al. (2020), the amount of knowledge that the receiver obtains from the sender is used to measure the transfer effect. Both studies use the simulation method to demonstrate the transfer process and result. Using the amount of knowledge transferred simplifies the model to

Table 2 Five-dimensional elements of KT in the project environment

Five-dimensional transfer elements	Definition and how it affects KT	Source references			Sum
		IPKT	CPKT	COKT	
Knowledge sender and knowledge receiver					**14**
Transfer intention (TI)	The extent to which the knowledge sender is willing to send knowledge to others, which is the basis for KT	Cheng et al. (2009)	Bakker et al. (2011); Wei and Miraglia (2017); Ren et al. (2018); Zhou et al. (2020)	Sun et al. (2019); Liu et al. (2020)	7
Transfer ability (TA)	The ability of the knowledge sender to send knowledge after an effective assessment of the needs and abilities of the receiver	Joseph Garcia and Mollaoglu (2020)	Zhao et al. (2015)	Liu et al. (2020)	3
Supplier protectiveness (SP)	The degree to which the knowledge supplier protects its core competitiveness; the higher the degree of protection, the less conducive to KT			Lawson and Potter (2012); Liu et al. (2020)	2
Receive intention (RI)	The extent to which the knowledge receiver has the will to receive knowledge from others, which is also the basis for KT	Cheng et al. (2009)	Wei and Miraglia (2017); Ren et al. (2018); Zhou et al. (2020)	Sun et al. (2019); Liu et al. (2020)	6
Absorptive capacity (AC)	The receiver's ability to acquire, evaluate, and internalize the transferred knowledge; the stronger the absorptive capacity, the better the transfer effect	Decker et al. (2009); Joseph Garcia and Mollaoglu (2020)	Zhao et al. (2015)	Svensson (2007); Lawson and Potter (2012); Liu et al. (2020)	6
Reciprocity (RE)	A common social norm that makes project members to adopt rewarding attitudes and behaviors towards people who help them	Zhang and He (2016)	Ren et al. (2019)		2
Relationship between the sender and receiver					**22**
Trust (TR)	The confidence that people hold in the behavior of others, which lays the foundation for knowledge exchange with others	Decker et al. (2009); Park and Lee (2014); Nesheim and Smith (2015); Zhang and He (2016); Buvik and Tvedt (2017); Ni et al. (2018)	Wiewiora et al. (2014); Ren et al. (2019); Zhou et al. (2020)	Lê and Law (2009); Bosch-Sijtsema and Postma (2010); Ko (2014); Sun et al. (2019)	13
Similarity (SI)	The degree of overlap between partners' knowledge bases or workflows, which helps increase their willingness to participate in transfer activities	Park and Lee (2014)	Zhao et al. (2015); Mueller (2015); Ren et al. (2018; 2019)		5
Geographical distance (GD)	Projects are highly dispersed in different locations, which hinders communication and KT	Betz et al. (2014)	Ren et al. (2018)	Liu et al. (2020)	3
Relational distance (RD)	The distance between the knowledge sender and receiver in approval, obligation, and other relations		Zhao et al. (2015)	Bakker et al. (2011); Liu et al. (2020)	3
Knowledge distance (KD)	The distance between the knowledge sender and receiver in original knowledge base and knowledge level	Joseph Garcia and Mollaoglu (2020)		Liu et al. (2020)	2
Organizational distance (OD)	The distance between the knowledge sender and receiver in regulation, organizational structure, regulatory framework, etc.			Liu et al. (2020)	1
Past experience (PE)	The past cooperation experience of KT participants; the richer the experience, the more conducive to the transfer effect		Bakker et al. (2011); Andersson et al. (2015)	Ciabuschi et al. (2011)	3
Knowledge characteristics					**8**
Knowledge tacitness (KTA)	The degree to which the knowledge is hidden and difficult to code; the higher the degree of tacitness, the less conducive to KT	Decker et al. (2009)	Andersson et al. (2015); van Waveren et al. (2017); Tshuma et al. (2018)	Lievre and Tang (2015)	5
Knowledge complexity (KC)	The total amount of information required to describe a certain knowledge; the higher the complexity of knowledge is, the more difficult it is to transfer knowledge		Cacciatori et al. (2012); Tshuma et al. (2018)	Lievre and Tang (2015)	3
Knowledge ambiguity (KA)	The degree to which the knowledge can be clearly and precisely expressed			Lawson and Potter (2012); Liu et al. (2020)	2
Knowledge embeddability (KE)	It is highly related to the project context, participants, and transfer activities	Decker et al. (2009)	Tshuma et al. (2018)	Liu et al. (2020)	3
Transfer media					**16**
Communication (CM)	The basic way of sending and receiving information; through smooth communication, knowledge can be easily expressed to others	Park and Lee (2014)	Cacciatori et al. (2012); Ren et al. (2018; 2019)	Antwi-Afari et al. (2016); Liu et al. (2020)	6

(*Continued*)

Five-dimensional transfer elements	Definition and how it affects KT	Source references			Sum
		IPKT	CPKT	COKT	
Transfer channel (TC)	The richness of KT channels and methods, which is conducive to increasing the smoothness and convenience of communication	Decker et al. (2009); Souza da Conceição et al. (2019)	Sapsed et al. (2005); van Waveren et al. (2017); Tshuma et al. (2018); Zhou et al. (2020)		6
Meeting system (MS)	The regulations that the project holds regular meetings and members to attend on time are required		Jensen et al. (2019); Ren et al. (2019)	Javernick-Will and Levitt (2010); Aerts et al. (2017)	4
Document exchange (DE)	The extent to which the sender and receiver transfer knowledge in the form of documents, charts, reports, etc.	Decker et al. (2009); Souza da Conceição et al. (2019)	Jensen et al. (2019)	McGowan Poole (2020)	4
Transfer context					**42**
Temporary nature (TN)	It results in the liquidity and instability of project teams, which affects the participants' enthusiasm for KT		Ren et al. (2018); Zhou et al. (2020)	Sun et al. (2019)	3
Time urgency (TU)	The pressure felt by project teams and members to complete project tasks within a specific time, which reduces transfer willingness		Mueller (2014); Zhao et al. (2015); Ren et al. (2018; 2019); Zhou et al. (2020)	Lê and Law (2009); Sun et al. (2019)	7
Project uncertainty (PU)	The uncertainty of project requirements, new technology and product scope	Stock et al. (2021)			1
Project type (PT)	The process of KT in different project types is different, and the effect is also different	Seres et al. (2009)	Andersson et al. (2015)	Hermans and Castiaux (2017)	3
Standardization (SD)	Many projects built by the PBO are repeated projects, and the standardized procedures are learning from past projects; in this context, the organizations are reluctant to transfer knowledge because they want projects to remain the same	Raziq et al. (2020)	Newell et al. (2006)		2
Organizational structure (OS)	The arrangement of various departments and levels within the organization formed through organizational design	Zhang and He (2016); Gopal et al. (2018); Raziq et al. (2020)	Mueller (2014)	Ciabuschi et al. (2011); Lee and Ram (2018)	6
Organizational culture (OC1)	A pattern of shared basic assumptions learned by a group as it solved its problems of external adaptation and internal integration	Ovbagbedia and Ochieng (2015)	Owen et al. (2004); Ajmal and Koskinen (2008); Mueller (2012); Wiewiora et al. (2014); Wei and Miraglia (2017); Tshuma et al. (2018); Ren et al. (2019); Mahura and Birollo (2021)	Antwi-Afari et al. (2016)	10
Organizational climate (OC2)	Code of conduct, values, ways of thinking, belief system, etc., shared by members of an organization	Chelagat et al. (2019)	Zhou et al. (2020)		2
Incentive mechanism (IM)	Taken by the organization to promote knowledge-transfer activities; the better the incentive mechanism is set, the more it is conducive to KT	Decker et al. (2009); Zhang and He (2016); Ni et al. (2018)	Andersson et al. (2015); Tshuma et al. (2018); Ren et al. (2019); Zhou et al. (2020)	Aerts et al. (2017)	8
Information technology (IT)	The wide application of IT tools can conquer communication barriers, thereby improving KT effectiveness	Decker et al. (2009); Betz et al. (2014); Zhang and He (2016); Gopal et al. (2018); Souza da Conceição et al. (2019)	Newell et al. (2006); Formentini and Romano (2011); Wei and Miraglia (2017); Ren et al. (2018)	Ciabuschi et al. (2011)	10
Coordination (CO)	Coordination mechanism that used to improve the interaction between different organizations or departments		Wen and Qiang (2016)	Zhang and Min (2021)	2
Use of codification (UC)	The extent to which the project has absorbed lessons or solutions from previous projects and stored them in best practices, databases, manuals, and reports		Cacciatori et al. (2012); Alashwal and Abdul-Rahman (2014); Mahura and Birollo (2021)	Javernick-Will and Levitt (2010)	4
Network structure (NS1)	Different network structures have different effects on KT; a strong tie promotes KT, while a weak tie hinders KT	Schröpfer et al. (2017); Gao et al. (2020)		Takahashi et al. (2018)	3
Network strength (NS2)	The number of exchanges and connections between people or organizations; the higher it is, the better the transfer effect is	Decker et al. (2009); Schröpfer et al. (2017)		Takahashi et al. (2018); Sun et al. (2019)	4

Note: Sum = the number of non-repetitive papers associated with the elements.

Table 3 Outcomes of KT in the project environment

Transfer outcomes	Definition and how it affects KT	Source references			Sum
		IPKT	CPKT	COKT	
Amount of knowledge transferred (AKT)	The amount of knowledge received by the receiver in the KT activity	Gao et al. (2020)		Liu et al. (2020)	2
Successful/Effective KT (SKT)	A combination of the characteristics and the type of knowledge being transferred and the transfer mechanisms and tools used	Decker et al. (2009)	Ajmal and Koskinen (2008); Bakker et al. (2011)	Lee and Ram (2018); McGowan Poole (2020)	5
Receiver's knowledge application (RKA)	The extent to which the receiver applies the transferred knowledge	Souza da Conceição et al. (2019); Joseph Garcia and Mollaoglu (2020)	Frank and Ribeiro (2014); Andersson et al. (2015); Tshuma et al. (2018)	Lê and Law (2009); Bosch-Sijtsema and Postma (2010); Antwi-Afari et al. (2016)	8
Effectiveness of KT (EKT)	The extent to which KT is completed on time, on budget, and on the satisfaction of the recipient	Gopal et al. (2018); Gao et al. (2020)	Zhao et al. (2015); Ren et al. (2018; 2019); Zhou et al. (2020)	Svensson (2007); Ciabuschi et al. (2011); Sun et al. (2019)	9
Project performance (PP)	The extent to which the project team achieves the project goals	Park and Lee (2014); Gopal et al. (2018); Raziq et al. (2020); Stock et al. (2021)	Landaeta (2008)	Ko (2014); Aerts et al. (2017)	7
Innovation performance (IP)	After the organization adopts new knowledge or technology, the degree of increase in its value			Zhang and Min (2021)	1
KT	The extent to which the receiver has learned knowledge, mastered skills, and reduced dependence	Ovbagbedia and Ochieng (2015)	Cacciatori et al. (2012); Wei and Miraglia (2017); Jensen et al. (2019)	Lawson and Potter (2012); Takahashi et al. (2018)	6

a certain extent and makes the transfer effect more measurable. Some scholars proposed the limitations of this measurement method because the recipient may not have implemented the transferred knowledge, which means that the transfer process is incomplete (Bosch-Sijtsema and Postma, 2010). Additionally, some researchers used successful KT or effective KT to represent the transfer outcomes (Decker et al., 2009; Bakker et al., 2011). These studies pay more attention to whether KT is completed and whether the knowledge is transferred smoothly rather than the result of knowledge application.

Regarding the transfer outcomes in the second stage, the receiver's knowledge application and the effectiveness of KT are the most mentioned in the literature. In different situations, the standards for measuring the receiver's knowledge application vary. For example, knowledge application within the project is reflected in the promotion of the project performance brought by members using the transferred knowledge (Joseph Garcia and Mollaoglu, 2020). At the cross-project level, the project's activity mode can be used by other similar projects through KT, and knowledge application is reflected in the extent to which the transferred knowledge is used in recipient's project (Frank and Ribeiro, 2014; Tshuma et al., 2018). According to Antwi-Afari et al. (2016), cross-organizational knowledge application refers to how the organization uses the knowledge absorbed from other organizations in operation. Moreover, scholars also gave different definitions of the effectiveness of KT (EKT). Zhao et al. (2015) measured EKT by the completion time of the project task, the realization degree of the project goal, and the improvement level of business value after KT. Zhou et al. (2020) used the improvement of project knowledge reserves, the completion of project goals, and the improvement of technology and management level to measure EKT. Overall, EKT reflects the extent to which KT is completed on time, on budget, and on the satisfaction of the recipient (Gopal et al., 2018).

Project performance is an extension of knowledge application because the improvement of project performance brought about by KT can be regarded as the result of knowledge application (Gopal et al., 2018). Project performance is defined as the extent to which a project team realizes the project goals (Landaeta, 2008), whereas project outcome is measured as the quality of project completion and the degree of satisfaction with user needs (Ko, 2014). Gopal et al. (2018) divided project outcome into two aspects: Product outcome (e.g., schedule and cost optimization) and service quality (e.g., individual satisfaction and mutual association). Innovation performance is a deeper concept than project performance, and only one article explored it deeply. Following Zhang and Min (2021), the innovation performance of the new product development (NPD) project means not only the achievement of project targets but also the market recognition of the new product. Another situation needs a special explanation. Scholars regarded KT as the dependent variable and discussed the impact of various factors on KT (Ovbagbedia and Ochieng, 2015). For example, Lawson and Potter (2012) directly used the learned technical knowledge, mastered technical skills, and reduced technical dependence to measure KT.

4.2.3 Link between elements and outcomes of KT in the project environment

In this section, a comprehensive framework of causal relationships between transfer elements and outcomes is first obtained from the selected literature. Figure 3 shows the five dimensions of factors affecting KT and transfer outcomes in the project environment. The representative factors of each dimension are the factors that frequently appear in the reviewed literature. Additionally, the analysis of the selected literature demonstrates that the relationship between the elements of different dimensions is not isolated. They affect each other and ultimately influence the transfer outcomes. Milagres and Burcharth (2019) proposed that the same factor can promote or hinder KT in various ways. Therefore, the authors summarized the influence paths and influence directions (positive or negative) of the transfer elements on the outcomes. All dimensions are connected in Fig. 4, which provides an overall summary of the relationship between the transfer elements and outcomes in the project environment.

In the selected literature, the factors of the knowledge characteristics dimension have two main influence paths on the transfer outcomes: One is to affect RKA directly (Tshuma et al., 2018), and the other is to impact the transfer outcomes by affecting RI (Liu et al., 2020). As for the factors of the relationship dimension, they have a certain degree of mutual influence, such as similarity promoting trust (Park and Lee, 2014). The influence paths of factors in this dimension on the transfer outcomes also include direct effects (Ko, 2014) and indirect effects by increasing or reducing TI (Zhou et al., 2020). Additionally, most factors (i.e., CM, TC, and DE) in the transfer media dimension directly impact EKT or SKT. Only Ren et al. (2019) proposed that the meeting system positively affects the transfer effectiveness by influencing communication. Moreover, the transfer context is the dimension that contains the most factors, and the causal relationship between these factors and the transfer outcomes is the most complicated. Factors in this dimension can directly affect the transfer results through the intermediary effects of factors (e.g., TR, CM, TI, and RI) belonging to the dimensions of relationship, transfer media, and transfer subject. Lastly, according to the selected literature, the influence of the transfer subject on the transfer outcomes is direct. For example, the positive effects of AC on AKT, SKT, EKT, and KT are explored in the literature.

5 Discussion

5.1 Comprehensive framework of KT in the project environment

As mentioned earlier, KT in the project environment includes three levels: IPKT, CPKT, and COKT. Figure 5 demonstrates the transfer elements and outcomes and their relationships at the three levels. At the IPKT level, except for the dimension of transfer media, factors in the other dimensions can directly affect the transfer outcomes. Transfer media impacts the transfer outcomes through the intermediary effect of the relationship between the knowledge sender and receiver. Therefore, handling the relationships between individuals within the

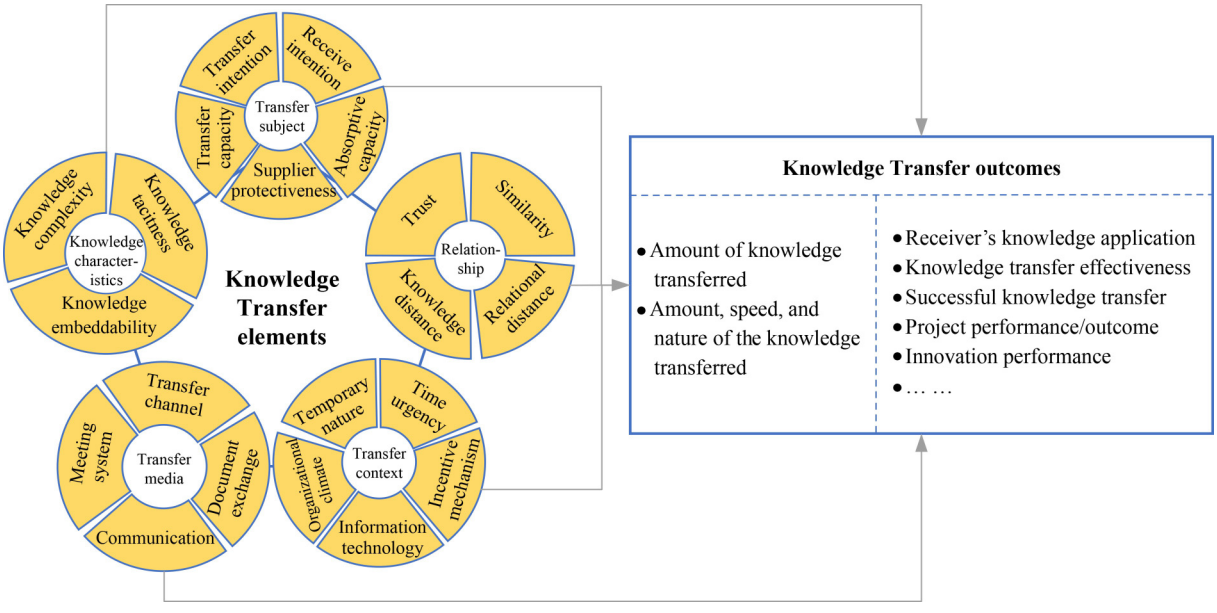
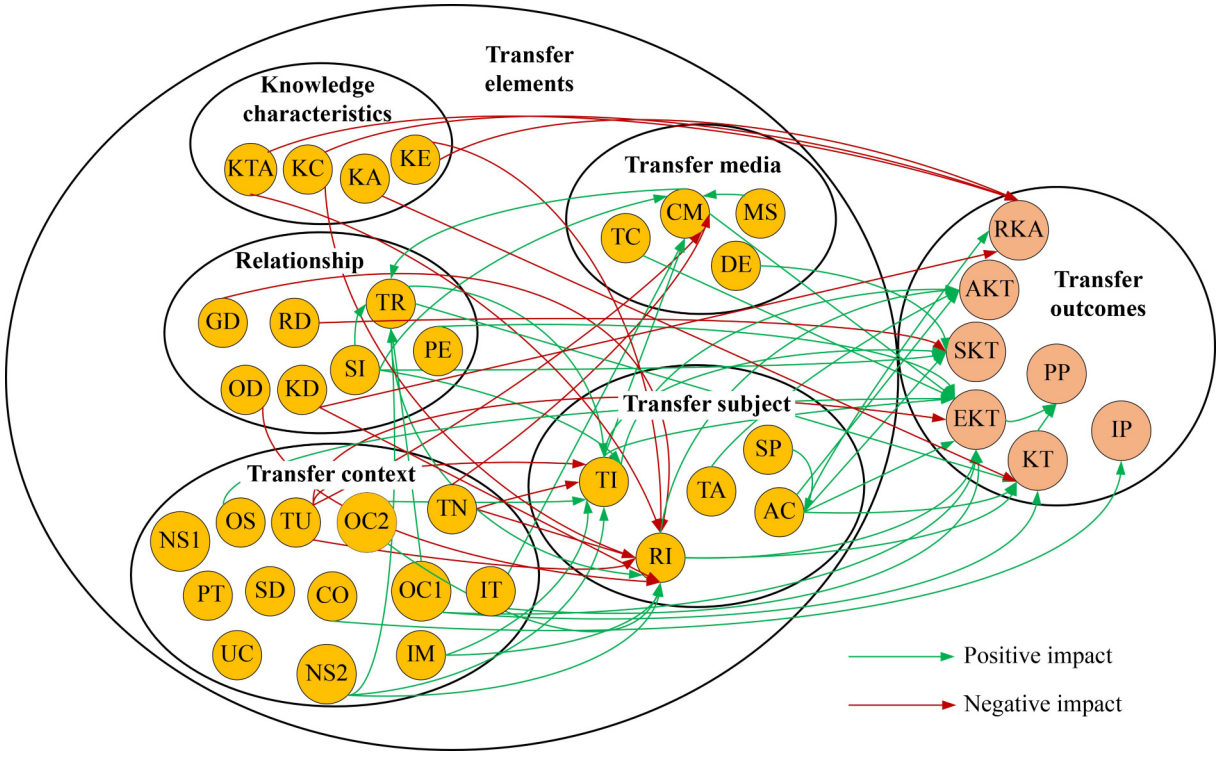


Fig. 3 Framework of KT elements and outcomes in the project environment.



Transfer subject: TI = Transfer intention; TA = Transfer ability; SP = Supplier protectiveness; RI = Receive intention; AC = Absorptive capacity; **Relationship**: TR = Trust; SI = Similarity; GD = Geographical distance; RD = Relational distance; KD = Knowledge distance; OD = Organizational distance; PE = Past experience; **Knowledge characteristics**: KTA = Knowledge tacitness; KC = Knowledge complexity; KA = Knowledge ambiguity; KE = Knowledge embeddability; **Transfer media**: CM = Communication; TC = Transfer channel; MS = Meeting system; DE = Document exchange; **Transfer context**: TN = Temporary nature; TU = Time urgency; PT = Project type; SD = Standardization; OS = Organizational structure; OC1 = Organizational culture; OC2 = Organizational climate; IM = Incentive mechanism; IT = Information technology; CO = Coordination; UC = Use of codification; NS1 = Network structure; NS2 = Network strength
Transfer outcomes: AKT = Amount of knowledge transferred; SKT = Successful/Effective knowledge transfer; RKA = Receiver's knowledge application; EKT = Effectiveness of knowledge transfer; PP = Project performance/outcome; IP = Innovation performance; KT = Knowledge transfer

Fig. 4 Relationship between the transfer elements and outcomes.

project is critical for members to improve the effectiveness of IPKT. Scholars proposed that project managers can build a project environment of mutual trust to reinforce relationship management (Nesheim and Smith, 2015; Buvik and Tvedt, 2017). At the CPKT level, the relationship between various factors in different dimensions is more complicated. Each dimension has one or several factors that directly impact the transfer outcomes. According to the selected literature, relationship impacts transfer context, and transfer context affects transfer media and transfer subject. Therefore, transfer context is in a significant position of the model. Based on previous studies, the cultural atmosphere of knowledge sharing should be cultivated, and project construction should be optimized to improve the effectiveness of CPKT (Zhao et al., 2015; Zhou et al., 2020). At the COKT level, each dimension has one or several factors that directly influence the transfer outcomes. Knowledge characteristics, relationship, transfer context, and transfer media influence the transfer outcomes through the intermediary effect of the transfer subject. Therefore, the willingness and ability of project participating organizations to carry out cross-organizational transfer activities must be improved (Lawson and Potter, 2012; Sun et al., 2019).

5.2 Knowledge gaps and recommendations for future research

According to the above analysis, the authors highlight the knowledge gaps, and provide recommendations to help better manage the process of KT within and outside the project and optimize the transfer outcomes in future research work.

(1) The elements of KT should be deeply explored, and the relationships between transfer elements and outcomes need further research. For example, in research on the transfer context, scholars pay more attention to organizational characteristics than project and network characteristics. Project characteristics are the most unique attributes in the research on project KT. However, the

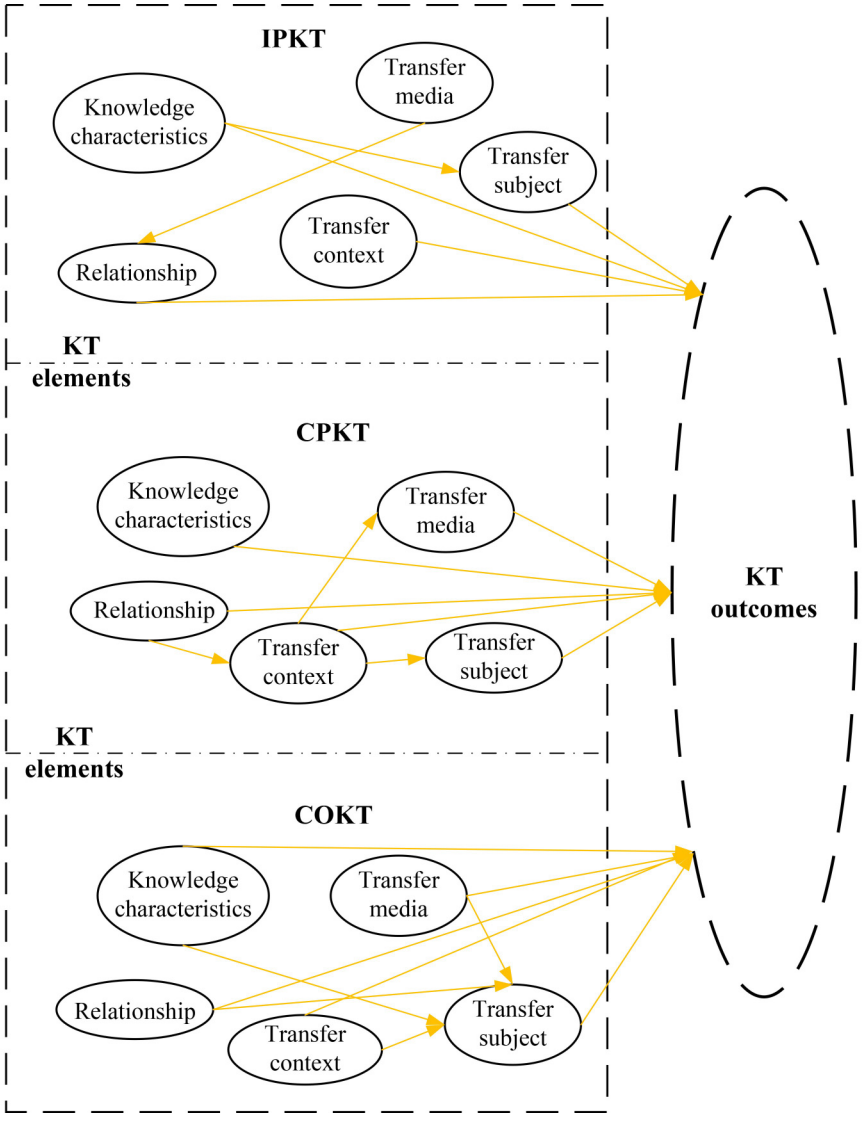


Fig. 5 Comprehensive framework of KT in the project environment.

existing research does not reveal the causalities between some factors (e.g., project uncertainty, project type, and standardization) and transfer outcomes. This article suggests scholars pay attention to project characteristics and the manner in which they affect the transfer outcomes, which can open a promising way for follow-up research. Besides, some papers explored the influence of network characteristics on KT in project management and proposed a new concept of project network (Schröpfer et al., 2017; Gao et al., 2020). In this context, studying the influencing factors and outcomes of project KT from the network perspective is valuable. However, the ambiguity of knowledge and complexity of the network make it difficult for scholars to clearly understand the mechanism of KT in the project network. With the emergence of new technologies, data mining and machine learning can be used to construct a network model, explore the structural characteristics of the network, and thus deeply analyze the laws of knowledge flow.

(2) There is a hysteresis effect in knowledge learning and absorption (van Wijk et al., 2008). For example, KT takes a certain time to complete, so knowledge may no longer be needed when transferred to the recipient. In this case, the recipient receives the knowledge but often no longer applies the knowledge, resulting in the failure of knowledge reuse. However, few studies focus on the timeliness of the transfer process and knowledge application. Therefore, the authors call for future research to expand the scope of the investigation and adopt more direct observation and case study methods to reveal better the dynamics of the transfer process and the complexity of the results. As many scholars prefer to measure KT effectiveness and project performance subjectively, the reliability of this data collection method is also questioned (Martinkenaite, 2011). In attempting to deal with these problems, subjective evaluation and objective measurement can be combined as an available approach.

Using different standards to measure "successful knowledge transfer" and "organizational/project performance" at different stages of project or PBO development may help improve the quality of research.

(3) The literature review suggests that most papers used quantitative research methods such as questionnaire surveys, limiting the inference of causality between variables from different dimensions. According to the description in the literature, a positive or negative linear relationship exists between factors, but it may be curvilinear. For example, with strengthening the relationship between transfer participants, when a certain threshold is exceeded, under the premise of fixed time and energy, the increase in the cost of maintaining the relationship may affect the transfer effect. Therefore, future research can focus on whether a curvilinear relationship exists between the transfer elements and outcomes. Furthermore, qualitative data is a vital resource that cannot be ignored, and there are many ways to help researchers make greater use of them. For example, multiple case studies may be combined with specific project scenarios to reveal the relationship between the transfer elements and outcomes.

(4) The framework of this study indicates that the smooth implementation of KT requires high-level coordination across the entire project and even organizational structures, mechanisms, and cultures. To solve the problem appearing in project knowledge management, the authors remind researchers to adopt a holistic perspective at the organizational level. The purpose of project management is not only to complete the one-time tasks of the project but also to promote the sustainable development of the organization. Additionally, research at the IPKT level pays more attention to individuals, but few scholars focus on individuals in the transfer process at the CPKT and COKT levels. No matter at what level, the investigation of individuals is a fundamental research approach because management measures at the organization and project levels are ultimately implemented at the individual level. The authors encourage individual-focused research to expand the KT mechanisms identified at the overall level.

(5) The existing research fails to capture the factors affecting KT and its related outcomes in different stages (e.g., decision making, design, construction, completion, and acceptance) of the project life cycle. Considering that the purpose of KT at different project stages is diverse and the participants involved in each phase are not the same, future studies can categorize transfer elements and outcomes into stages of the project life cycle. Moreover, KT is a complicated dynamic interactive evolution process in which related parameters are constantly changing (Martinkenaite, 2011; Shahbaznezhad et al., 2019). The use of computer simulation and artificial intelligence (AI) can contribute to exploring the transfer elements and outcomes and their relationships. Specifically, system dynamics and agent-based modeling can be used to simulate the actual situation of KT across the project life cycle. Some AI methods (e.g., neural networks, genetic algorithms, and decision trees) can predict the hidden effects of related factors, which can provide a reference for project practitioners to implement effective KT strategies.

5.3 Research contributions

This study contributes to the research field of project management from the following three aspects. First, this article divided KT in the project environment into three levels according to the transfer scenario, namely, IPKT, CPKT, and COKT. The current research on these three levels is relatively scattered, and a comprehensive framework with a high degree of recognition has not been formed. The smooth implementation of KT at any level requires high-level coordination of the entire project and organizational structure, mechanism, and culture. Project knowledge management aims to complete the one-time task of projects and promote the sustainable development of PBOs and enterprises. Therefore, this study can enlighten other researchers to comprehensively consider the different levels of KT in the project environment.

This study identifies and analyzes 35 factors of five-dimensional transfer elements and 7 factors of two-dimensional transfer outcomes. The results show that the elements of KT still need to be discussed in some dimensions. For example, in the research on the transfer context dimension, more scholars pay attention to organizational characteristics rather than project and network characteristics. Project characteristics are the most unique attribute in project KT research. How factors such as project uncertainty, project type, and degree of standardization affect KT need to be further explored. Therefore, this research provides a complete and clear framework for the transfer elements and outcomes in the project environment, and points out the direction for factors that require further research.

Lastly, this study fills the gap in the research of project knowledge management by developing a comprehensive model to link the elements and outcomes of KT in the project environment. According to the existing literature, there are positive and negative linear relationships between factors, but these relationships may be curvilinear. The authors suggest that future research can combine multiple case studies with specific project scenarios to reveal the complex relationship between the transfer elements and outcomes. This article helps project managers and members choose and control different elements in KT process to improve the transfer outcome. In other words, the integration of the relationship between the factors provides more ideas for scholars and practitioners to optimize the transfer results from factors of different dimensions.

6 Conclusions

This study conducts a literature review of KT in the project environment and summarizes and links the transfer elements and outcomes from three levels: IPKT, CPKT, and COKT. First, based on the sample with 64 selected papers from relevant journals, statistics indicate that the number of papers published in the past two decades (2000–2021) showed an upward trend. The quantitative method was used most frequently among all the selected articles, followed by the case study and qualitative methods. The elements of KT were identified and grouped into five aspects: The knowledge sender and receiver, the relationship between the sender and receiver, knowledge characteristics, transfer media, and transfer context. Transfer outcomes were divided into two dimensions: The amount of knowledge transferred and the degree of knowledge application of the knowledge receiver. Then, 35 factors of transfer elements and 7 factors of transfer outcomes were determined by reviewing the 64 articles. The top-cited factors of transfer elements included trust, organizational culture, information technology, incentive mechanism, transfer intention, time urgency, and so on. The most common outcome factors were the effectiveness of KT, the receiver's knowledge application, and project performance. Moreover, relationships between the transfer elements and outcomes were identified and gathered for creating an integrated roadmap. Finally, the authors systematically emphasized the literature contributions and gaps related to KT in the project environment, which provide the direction for project management and knowledge management fields that need to be studied deeply.

Despite the contributions to the research of project management and knowledge management, several limitations of this study need to be acknowledged. This research restricts the search of articles to English journal articles in Web of Science, Scopus, and SpringerLink. There may be some articles in other databases or other languages that can provide a widespread understanding of this research. Expanding the survey scope of the literature is suggested. More databases can be used to collect articles related to this topic, and non-English papers can be collected to make the study more robust. A more comprehensive survey can help future researchers explore more research possibilities.

References

Aerts G, Dooms M, Haezendonck E (2017). Knowledge transfers and project-based learning in large scale infrastructure development projects: An exploratory and comparative ex-post analysis. International Journal of Project Management, 35(3): 224–240

Ajmal M M, Koskinen K U (2008). Knowledge transfer in project-based organizations: An organizational culture perspective. Project Management Journal, 39(1): 7–15

Alashwal A M, Abdul-Rahman H (2014). Using PLS–PM to model the process of inter-project learning in construction projects. Automation in Construction, 44: 176–182

Ambos T C, Ambos B (2009). The impact of distance on knowledge transfer effectiveness in multinational corporations. Journal of International Management, 15(1): 1–14

Andersson U, Gaur A, Mudambi R, Persson M (2015). Unpacking interunit knowledge transfer in multinational enterprises. Global Strategy Journal, 5(3): 241–255

Antwi-Afari M F, Pärn E A, Owusu-Manu D G, Edwards D J (2016). Conceptualization of the absorptive capability paradox in technology transfer projects: A study of the Ghanaian construction industry. Mindanao Journal of Science and Technology, 14: 57–78

Bakker R M, Cambré B, Korlaar L, Raab J (2011). Managing the project learning paradox: A set-theoretic approach toward project knowledge transfer. International Journal of Project Management, 29(5): 494–503

Betz S, Oberweis A, Stephan R (2014). Knowledge transfer in offshore outsourcing software development projects: An analysis of the challenges and solutions from German clients. Expert Systems: International Journal of Knowledge Engineering and Neural Networks, 31(3): 282–297

Bosch-Sijtsema P M, Postma T J B M (2010). Governance factors enabling knowledge transfer in interorganisational development projects. Technology Analysis and Strategic Management, 22(5): 593–608

Buvik M P, Tvedt S D (2017). The influence of project commitment and team commitment on the relationship between trust and knowledge sharing in project teams. Project Management Journal, 48(2): 5–21

Cacciatori E (2008). Memory objects in project environments: Storing, retrieving and adapting learning in project-based firms. Research Policy, 37(9): 1591–1601

Cacciatori E, Tamoschus D, Grabher G (2012). Knowledge transfer across projects: Codification in creative, high-tech and engineering industries. Management Learning, 43(3): 309–331

Chelagat T, Onyango J, Kokwaro G, Rice J (2019). From strategy to action: A qualitative study on salient factors influencing knowledge transfer in project-based experiential learning in healthcare organisations in Kenya. BMJ Open, 9(9): e031100

Cheng M M, Schulz K D, Booth P (2009). Knowledge transfer in project reviews: The effect of self-justification bias and moral hazard. Accounting and Finance, 49(1): 75–93

Ciabuschi F, Dellestrand H, Kappen P (2011). Exploring the effects of vertical and lateral mechanisms in international knowledge transfer projects. Management International Review, 51(2): 129–155

Cummings J L, Teng B S (2003). Transferring R&D knowledge: The key factors affecting knowledge transfer success. Journal of Engineering and Technology Management, 20(1–2): 39–68

Davenport T, Prusak L (1998). Learn how valuable knowledge is acquired, created, bought and bartered. Australian Library Journal, 47(3): 268–272

Decker B, Landaeta R E, Kotnour T G (2009). Exploring the

relationships between emotional intelligence and the use of knowledge transfer methods in the project environment. Knowledge Management Research and Practice, 7(1): 15–36

Dip J A (2021). What does U-multirank tell us about knowledge transfer and research? Scientometrics, 126(4): 3011–3039

Formentini M, Romano P (2011). Using value analysis to support knowledge transfer in the multi-project setting. International Journal of Production Economics, 131(2): 545–560

Frank A G, Ribeiro J (2014). An integrative model for knowledge transfer between new product development project teams. Knowledge Management Research and Practice, 12(2): 215–225

Gao S C, Song X Y, Ding R G (2020). Promoting information transfer in collaborative projects through network structure adjustment. Journal of Construction Engineering and Management, 146(2): 04019108

Garavelli A C, Gorgoglione M, Scozzi B (2002). Managing knowledge transfer by knowledge technologies. Technovation, 22(5): 269–279

Gopal J, Sangaiah A K, Basu A, Gao X Z (2018). Integration of fuzzy DEMATEL and FMCDM approach for evaluating knowledge transfer effectiveness with reference to GSD project outcome. International Journal of Machine Learning and Cybernetics, 9: 225–241

Gupta A, Govindarajan V (2000). Knowledge flows within multinational corporations. Strategic Management Journal, 21(4): 473–496

Hanisch B, Lindner F, Müller A, Wald A (2009). Knowledge management in project environments. Journal of Knowledge Management, 13(4): 148–160

He Q, Xu J, Wang T, Chan A P C (2021). Identifying the driving factors of successful megaproject construction management: Findings from three Chinese cases. Frontiers of Engineering Management, 8(1): 5–16

Hermans J, Castiaux A (2017). Contingent knowledge transfers in university–industry R&D projects. Knowledge Management Research and Practice, 15(1): 68–77

Hsieh H F, Shannon S E (2005). Three approaches to qualitative content analysis. Qualitative Health Research, 15(9): 1277–1288

Jafari Navimipour N, Charband Y (2016). Knowledge sharing mechanisms and techniques in project teams: Literature review, classification, and current trends. Computers in Human Behavior, 62: 730–742

Javernick-Will A, Levitt R E (2010). Mobilizing institutional knowledge for international projects. Journal of Construction Engineering and Management, 136(4): 430–441

Jensen P A, Rasmussen H L, Chatzilazarou S (2019). Knowledge transfer between building operation and building projects. Journal of Facilities Management, 17(2): 208–219

Joseph Garcia A, Mollaoglu S (2020). Individuals' capacities to apply transferred knowledge in AEC project teams. Journal of Construction Engineering and Management, 146(4): 04020016

Kivrak S, Arslan G, Dikmen I, Birgonul M T (2008). Capturing knowledge in construction projects: Knowledge platform for contractors. Journal of Management Engineering, 24(2): 87–95

Ko D G (2014). The mediating role of knowledge transfer and the effects of client–consultant mutual trust on the performance of enterprise implementation projects. Information & Management, 51(5): 541–550

Landaeta R E (2008). Evaluating benefits and challenges of knowledge transfer across projects. Engineering Management Journal, 20(1): 29–38

Lawson B, Potter A (2012). Determinants of knowledge transfer in inter-firm new product development projects. International Journal of Operations & Production Management, 32(10): 1228–1247

Lê M A T, Law K H (2009). System dynamic approach for simulation of experience transfer in the AEC industry. Journal of Management Engineering, 25(4): 195–203

Lee N S, Ram J (2018). New product development processes and knowledge transfer in automotive projects: An empirical study. Knowledge and Process Management, 25(4): 279–291

Li Y, Yang Q, Pasian B, Zhang Y (2020). Project management maturity in construction consulting services: Case of Expo in China. Frontiers of Engineering Management, 7(3): 384–395

Lievre P, Tang J (2015). SECI and inter-organizational and intercultural knowledge transfer: A case-study of controversies around a project of co-operation between France and China in the health sector. Journal of Knowledge Management, 19(5): 1069–1086

Liu H, Yu Y, Sun Y, Yan X (2020). A system dynamic approach for simulation of a knowledge transfer model of heterogeneous senders in mega project innovation. Engineering, Construction, and Architectural Management, 28(3): 681–705

Mahura A, Birollo G (2021). Organizational practices that enable and disable knowledge transfer: The case of a public sector project-based organization. International Journal of Project Management, 39(3): 270–281

Martinkenaite I (2011). Antecedents and consequences of inter-organizational knowledge transfer: Emerging themes and openings for further research. Baltic Journal of Management, 6(1): 53–70

McGowan Poole C D (2020). IT outsourcing, knowledge transfer and project transition phases. VINE Journal of Information and Knowledge Management Systems, 50(2): 219–246

Milagres R, Burcharth A (2019). Knowledge transfer in interorganizational partnerships: What do we know? Business Process Management Journal, 25(1): 27–68

Mohammadi A, Tavakolan M, Khosravi Y (2018). Factors influencing safety performance on construction projects: A review. Safety Science, 109: 382–397

Moher D, Liberati A, Tetzlaff J, Altman D G, PRISMA Group (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. International Journal of Surgery, 8(5): 336–341

Mueller J (2012). Knowledge sharing between project teams and its cultural antecedents. Journal of Knowledge Management, 16(3): 435–447

Mueller J (2014). A specific knowledge culture: Cultural antecedents for knowledge sharing between project teams. European Management Journal, 32(2): 190–202

Mueller J (2015). Formal and informal practices of knowledge sharing between project teams and enacted cultural characteristics. Project Management Journal, 46(1): 53–68

Nesheim T, Smith J (2015). Knowledge sharing in projects: Does employment arrangement matter? Personnel Review, 44(2):

255–269

Newell S, Bresnen M, Edelman L, Scarbrough H, Swan J (2006). Sharing knowledge across projects: Limits to ICT-led project review practices. Management Learning, 37(2): 167–185

Ni G D, Cui Q B, Sang L H, Wang W S, Xia D C (2018). Knowledge-sharing culture, project-team interaction, and knowledge-sharing performance among project members. Journal of Management Engineering, 34(2): 04017065

Ovbagbedia O O, Ochieng E G (2015). Impact of organisational culture on knowledge transfer in Nigerian heavy engineering projects. Proceedings of the Institution of Civil Engineers: Management Procurement and Law, 168(5): 241–247

Owen J, Burstein F, Mitchell S (2004). Knowledge reuse and transfer in a project management environment. Journal of Information Technology Case and Application Research, 6(4): 21–35

Park J, Lee J (2014). Knowledge sharing in information systems development projects: Explicating the role of dependence and trust. International Journal of Project Management, 32(1): 153–165

Prencipe A, Tell F (2001). Inter-project learning: Processes and outcomes of knowledge codification in project-based firms. Research Policy, 30(9): 1373–1394

Raziq M M, Ahmad M, Iqbal M Z, Ikramullah M, David M (2020). Organizational structure and project success: The mediating role of knowledge sharing. Journal of Information & Knowledge Management, 19(2): 2050007

Ren X, Deng X, Liang L (2018). Knowledge transfer between projects within project-based organizations: The project nature perspective. Journal of Knowledge Management, 22(5): 1082–1103

Ren X, Yan Z, Wang Z, He J (2019). Inter-project knowledge transfer in project-based organizations: An organizational context perspective. Management Decision, 58(5): 844–863

Sang L, Xia D, Ni G, Cui Q, Wang J, Wang W (2019). Influence mechanism of job satisfaction and positive affect on knowledge sharing among project members: Moderator role of organizational commitment. Engineering, Construction, and Architectural Management, 27(1): 245–269

Sapsed J, Gann D, Marshall N, Salter A (2005). From here to eternity? The practice of knowledge transfer in dispersed and co-located project organizations. European Planning Studies, 13(6): 831–851

Schindler M, Eppler M (2003). Harvesting project knowledge: A review of project learning methods and success factors. International Journal of Project Management, 21(3): 219–228

Schröpfer V, Tah J, Kurul E (2017). Mapping the knowledge flow in sustainable construction project teams using social network analysis. Engineering, Construction, and Architectural Management, 24(2): 229–259

Seres S, Haites E, Murphy K (2009). Analysis of technology transfer in CDM projects: An update. Energy Policy, 37(11): 4919–4926

Shahbaznezhad H, Rashidirad M, Vaghefi I (2019). A systematic review of the antecedents of knowledge transfer: An actant-object view. European Business Review, 31(6): 970–995

Skovvang Christensen K, Kaasgaard Bang H (2003). Knowledge management in a project-oriented organization: Three perspectives. Journal of Knowledge Management, 7(3): 116–128

Souza da Conceição C, Broberg O, Paravizo E, Jensen A R (2019). A four-step model for diagnosing knowledge transfer challenges from operations into engineering design. International Journal of Industrial Ergonomics, 69: 163–172

Stock G N, Tsai J C A, Jiang J J, Klein G (2021). Coping with uncertainty: Knowledge sharing in new product development projects. International Journal of Project Management, 39(1): 59–70

Sun J, Ren X, Anumba C J (2019). Analysis of knowledge-transfer mechanisms in construction project cooperation networks. Journal of Management Engineering, 35(2): 04018061

Svensson R (2007). Knowledge transfer to emerging markets via consulting projects. Journal of Technology Transfer, 32(5): 545–559

Szulanski G (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. Strategic Management Journal, 17(S2): 27–43

Takahashi M, Indulska M, Steen J (2018). Collaborative research project networks: Knowledge transfer at the fuzzy front end of innovation. Project Management Journal, 49(4): 36–52

Teece D J (1977). Technology transfer by multinational firms: The resource cost of transferring technological know-how. Economic Journal, 87(346): 242–261

Teo T S H, Bhattacherjee A (2014). Knowledge transfer and utilization in it outsourcing partnerships: A preliminary model of antecedents and outcomes. Information & Management, 51(2): 177–186

Tshuma B, Steyn H, van Waveren C (2018). The role played by PMOs in the transfer of knowledge between projects: A conceptual framework. South African Journal of Industrial Engineering, 29(2): 127–140

van Waveren C, Oerlemans L, Pretorius T (2017). Refining the classification of knowledge transfer mechanisms for project-to-project knowledge sharing. South African Journal of Economic and Management Sciences, 20(1): a1642

van Wijk R, Jansen J J P, Lyles M A (2008). Inter- and intra-organizational knowledge transfer: A meta-analytic review and assessment of its antecedents and outcomes. Journal of Management Studies, 45(4): 830–853

Wei Y, Miraglia S (2017). Organizational culture and knowledge transfer in project-based organizations: Theoretical insights from a Chinese construction firm. International Journal of Project Management, 35(4): 571–585

Wen Q, Qiang M (2016). Coordination and knowledge sharing in construction project-based organization: A longitudinal structural equation model analysis. Automation in Construction, 72(3): 309–320

Wiewiora A, Murphy G, Trigunarsyah B, Brown K (2014). Interactions between organizational culture, trustworthiness, and mechanisms for inter-project knowledge sharing. Project Management Journal, 45(2): 48–65

Xu X X, Zou P (2021). System dynamics analytical modeling approach for construction project management research: A critical review and future directions. Frontiers of Engineering Management, 8(1): 17–31

Zhang L, He J (2016). Critical factors affecting tacit-knowledge sharing within the integrated project team. Journal of Management Engineering, 32(2): 04015045

Zhang L, Huang S (2020). New technology foresight method based

on intelligent knowledge management. Frontiers of Engineering Management, 7(2): 238–247

Zhang Z, Min M (2021). Research on the NPD coordination, knowledge transfer process and innovation performance of interfirm projects in China. Asia Pacific Journal of Management, in press, doi:10.1007/s10490-021-09755-z

Zhao D, Zuo M, Deng X N (2015). Examining the factors influencing cross-project knowledge transfer: An empirical study of IT services firms in China. International Journal of Project Management, 33(2): 325–340

Zhou Q W, Chen S, Deng X P, Mahmoudi A (2022a). Knowledge transfer among members within cross-cultural teams of international construction projects. Engineering, Construction, and Architectural Management, in press, doi:10.1108/ECAM-09-2021-0838

Zhou Q W, Deng X P, Hwang B G, Ji W Y (2020). Integrated framework of horizontal and vertical cross-project knowledge transfer mechanism within project-based organizations. Journal of Management Engineering, 36(5): 04020062

Zhou Q W, Deng X P, Hwang B G, Yu M (2022b). System dynamics approach of knowledge transfer from projects to the project-based organization. International Journal of Managing Projects in Business, 15(2): 324–349