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Mechanisms for capturing and transferring tacit knowledge between projects

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Abstract: This article aims to describe the difficulties and mechanisms for adopting a process of capturing and transferring tacit knowledge between projects. The method adopted is a systematic literature review. The articles used as references were extracted from the Scopus and Web of Science databases, totalling 102 articles. As a result, it was possible to identify factors that hinder and contribute to the capture and transfer of tacit knowledge in conducting projects, as well as to propose mechanisms that allow the knowledge management process to occur more successfully. As a contribution, this article also presents how informal spaces and socialisation are fundamental for the exchange of tacit knowledge between people involved in the projects.

Keywords: knowledge capture; knowledge transfer; project management; knowledge management; tacit knowledge.

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1 Introduction

Organisations operate in competitive environments that increasingly demand creative and innovative capacity (Ali et al., 2020). In this context, organisations that seek better profit margins and need to respond quickly to customer needs realise that one of the most important assets is knowledge (Moraes et al., 2020). Nickols (2000) highlights that knowledge is evidenced in the ability of an individual to understand the set of information that consists of facts, opinions, ideas, methods, principles, techniques, etc., which are sufficient to make things happen. Davenport and Prusak (1998) state that knowledge involves contextual information and the vision of those who absorb it, thus allowing for the incorporation of new experiences on an individual basis.

Knowledge management is carried out by adopting procedures that handle the information at the time it is generated so that it is captured and transformed into knowledge (Jugdev, 2007; Zhou et al., 2020). This activity contributes to establishing a process of transferring this knowledge for practical use (Nonaka and Takeuchi, 1995), both by an individual and in a comprehensive way by organisations (Frank and Echeveste, 2011).

In this competitive environment and seeking to effectively manage knowledge, organisations seek to structure their activities into projects to ensure the best knowledge transfer (Ren et al., 2019). Thus, when it comes to organisations that work with the project-oriented model (Gemünden et al., 2018), knowledge management helps to structure the information and knowledge acquired, so that they can be transferred further on to the other members of the organisation, bringing benefits to subsequent projects that the organisation will undertake (van Donk and Riezebos, 2005). Project-based organisations are those types of organisations in which the preponderance of products or services are provided through projects for either internal or external customers (Hobday, 2000). The adoption of the term project-oriented organisations in this study, instead of PBO comes from the concept of organisations that deliver multiple projects simultaneously or in sequence, which could deliver internally for different clients, and

perform a multitude of projects simultaneously (Gemünden et al., 2018). In addition to the concern of any type of project, the objective is to transform information into knowledge. Gemünden et al. (2018) highlight that new needs have emerged, including the need to learn quickly and intensively based on the knowledge acquired in each project. It is believed that this knowledge enhances competitiveness through the sharing of innovative practices (Ulhaq et al., 2017).

The knowledge that transits both individuals and corporations can be distinguished between explicit and tacit. Explicit knowledge can be evidenced in numbers, texts, scientific formulas, as this type of knowledge can be more easily structured and treated (Nonaka and Takeuchi, 1995). Furthermore, explicit knowledge is easily made tangible, as it is often presented as data (records or transactions) becoming information when there is a format, a transmitting agent, and a receiver (Davenport and Prusak, 1998).

Tacit knowledge, in turn, is that internalised in the human being, subjective, which has greater difficulty in being externalised. Nonaka and Takeuchi (1995) state that tacit knowledge is linked to the way each individual sees the world around them. This type of knowledge is constituted by the experience acquired by each individual in dealing with situations. Therefore, if knowledge has not yet been articulated, that is, if the individual is still unable to articulate exactly what he knows, or how to put it into practice, this knowledge is considered tacit (Nickols, 2000).

It is noteworthy that several articles such as those by Bresnen et al. (2003), Goffin and Koners (2011), Jugdev (2007) and Schindler and Eppler (2003) present the failures that occur during the information gathering process, within the project lifecycle. These studies suggest the need to develop a way of learning and a knowledge transfer model for members of other projects and for the entire organisation.

It was possible to extract from the literary review various barriers (Frank and Echeveste, 2011) found in projects, which delay or hinder the transfer. Schindler and Eppler (2003) reinforce that there may be some cultural aspect in teams and individuals that could harm the transference. There is the possibility that these individuals perceive the knowledge transmitted as worthless, for reasons such as unavailability of information, difficulty in finding the 'sender' of knowledge at the right time, lack of trust between people, or even because project members do not realise the benefits to generate information after project tasks are completed (Mainga, 2017).

When understanding the characteristics of knowledge and how it is captured (Boh, 2007; Frank and Echeveste, 2011), it is common to find situations in which tacit knowledge is not understood, nor the process of capturing it is treated as an activity of registration information. Therefore, it is important to investigate some factors that influence tacit knowledge throughout the knowledge management process, in its capture and transfer from one project to another.

The social aspect is another important theme for the transfer of tacit knowledge between projects. Social relationships are defined as the bonds and connections established by social interactions (Hansen, 2002), indicating frequent communication and reciprocal cooperation, accompanied by mutual trust between project teams (Tiwana and McLean, 2005). Social integrations between projects must be provided by organisations allowing individuals, project team members, to exchange experiences and enable activities that allow the organisation to share, communicate and transfer knowledge, which is internalised, either at the individual level or in the members project teams or organisational level (Enkel et al., 2018).

Based on what was presented, this article aims to describe the difficulties and mechanisms for adopting a process of capturing and transferring tacit knowledge between projects. From this objective, it is possible to contribute by explaining the causes that prevent the tacit knowledge transfer process from being adopted and offering solutions identified in the academic literature that can be used for application in project-oriented companies.

The paper is structured as follows. Section 2 examines the systematic literature review explaining the methodological procedures. Section 3 then, will be used to present the results of the systematic review and the findings. Section 4 presents the final remarks as well as the possible future studies considering the inferences found in this article and will contribute to organisations and their projects.

2 Methodological procedures

The research presented here was carried out through a systematic literature review (SLR), to conceptually understand how tacit knowledge is captured and transferred between project teams. In this context, it is possible to verify in which situations knowledge capture occurs and how transfers occur in favourable environments. SLR is different from a traditional literature review approach, such as narrative, in that it has a scientific method that can be replicated by anyone who wants to reproduce the same research. This type of procedure also allows the theoretical corpus, where the constructs are detailed, to be minimised, aiming to focus on the results of systematic research (Penha et al., 2020; Pollock and Berge, 2018).

The realisation of this SLR followed the six phases of the procedure prescribed by Pollock and Berge (2018):

- 1 clarifying research goals and objectives
- 2 seek relevant research
- 3 collect data
- 4 assess the quality of studies
- 5 synthesise the evidence
- 6 interpret the findings.

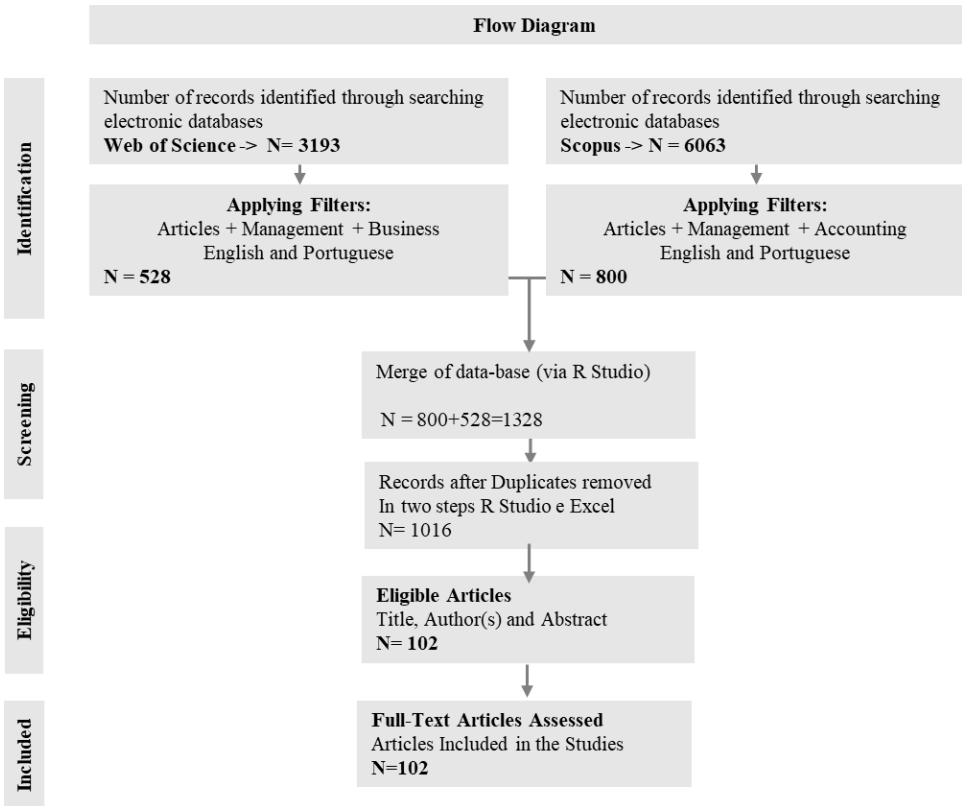
The phases and activities presented here are intended to ensure rigor and robustness in this type of research and ensure its reliability. In this sense, the first stage of this research was motivated by the following question: ‘what does the academic literature offer regarding the capture and transfer of tacit knowledge to the project management area?’.

We use the Scopus and Web of Science (WoS) databases as a source for research since they are currently the main existing databases of abstracts and citations of literature, covering the main scientific journals in different areas of knowledge. As a research argument, the words ‘knowledge’, ‘transfer’, ‘captur*’ and ‘project manag*’ were used. We inform you that the words used here are in line with a previous research that aimed to refine the search strategy in rounds in the databases. The words adhere to studies such as those by Frank and Echeveste (2011), Boh (2007), Jugdev (2007) and Zhou et al. (2020). The string used to perform the searches was *((‘knowledge’) and ((transfer*) or*

(‘*captur**’)) and (*project manag**)). It should be explained here that the Boolean operators ‘and’ and ‘or’ were also used, as well as the asterisk (wildcard) so that there were no limitations in the search or exclusion of articles due to word restrictions that could be relevant to the search. For example, *manag** allows bringing articles containing the words: manager, management, managing, among others.

The search, in the databases, was carried out on 17 May 2021, and the search arguments were recorded for future reproduction, both in the Scopus and WoS databases. Both databases were searched with the same arguments and with the same filters, to include only scientific articles, excluding congress publications, books, etc., for the English and Portuguese languages, and finally, the filter for the administration and business sector, which is the sector in which the project management area is located.

Figure 1 Research flow diagram



Source: Adapted from Pollock and Berge (2018)

The search result brought a total of 528 relevant articles in the search carried out in the WoS database and with the same search criteria and filters it brought exactly 800 articles within the Scopus database. Thus, with a total of 1,328 articles selected, adding the two databases, a package in R Studio was used to merge and then remove duplicate articles, or those that could not be extracted. A total of 1,019 articles could be summarised. From R Studio, the article list was exported to a Microsoft Excel spreadsheet. Even so, three duplicate articles were found, based on the search for the

digital object identifier (DOI) which is one of the information exported from the databases, resulting in 1,016 articles for subsequent screening. The details of the procedures exemplified in Figure 1 are based on the prescriptions of Pollock and Berge (2018).

Pollock and Berge (2018) determine a flow consisting of four steps for the construction of the corpus of analysis, suggesting that the methods for identifying articles should undergo screening of titles and abstracts, to remove irrelevant articles. Then, eligibility criteria are applied where the set of articles is evaluated to include or exclude according to the main question of their review.

The inclusion criteria applied were:

- 1 dealing with a model, a description or an explanation for capturing/transferring lessons learned or knowledge from/to projects
- 2 dealing with difficulties/barriers or mechanisms/solutions related to knowledge management.

The topics above, in order to be maintained could appear as theoretical definition, as a framework, as a model, or even as a tool with examples provided by the authors. Following these criteria, some examples of articles that were removed from the base were:

- 1 that are not related to projects and also does not comprise any topic related to knowledge management
- 2 focusing in specific problems rather than exploring knowledge management, like programming or software issues
- 3 related to knowledge in universities/schools, medical experiments, weather forecast, mathematical programs, etc.
- 4 that deal with specific technical issues, like radio-frequency identification (RFID), chip development and installation, augmented reality, etc.

Following the procedures of this SLR, 1,016 identified underwent a screening that consisted of reviewing the articles by title, abstract, and author. As the articles were evaluated, they were classified as relevant or not to answer the question that was the subject of the review. A total of 102 articles were selected. It should be noted that this process took place in several rounds with all the information recorded to ensure its audibility. We reinforce that to select the 102 articles, the question initially elaborated was revisited in each article examined to meet the proposed protocol by Pollock and Berge (2018).

Systematic reviews expose studies to rigorous methodological scrutiny (Tranfield et al., 2003). According to these authors, to reduce human error and bias, SLRs employ data-extraction forms, as proceed by our studies. Into the excel spreadsheet containing all meta-data according to the process, some columns were included in order to register historical record of the decisions made during the process, as explained below.

The last phase of this research was the analysis by the in-depth reading of the corpus consisting of 102 articles. A careful reading of the articles allowed for the categorisation of content, which enabled a grouping of findings and comparison of categories. The activities applied in this last phase are in line with the prescriptions of Pollock and Berge

(2018) in phase 5 synthesise the evidence and phase 6 interpret the findings. Although some quantitative treatments have been applied, in this research we prioritised the qualitative analysis of the articles to constitute a matrix that could represent the findings of this study.

Thus, the 102 articles were mapped by full reading and content categorisation. From this stage, the analyses made it possible to reach the following categories:

- 1 difficulties in capturing and transferring knowledge
- 2 mechanisms for capturing and transferring knowledge.

For each defined category, a set of articles was selected. By answering the key question in each article, it was possible to select the articles that could answer the question at the same time that each article was registered as to its relevance and by the above categorisations.

As for the results, we clarify that they are based on a data behaviour pattern. The in-depth reading of the corpus of analysis led to the registration of categories, here understood as types of barriers and mechanisms used. Thus, after selecting the articles that were considered relevant to answer the research question (Tranfield et al., 2003) the topic of barriers or difficulties is quite evident in dozens of articles.

3 Presentation and discussion of results

In this section, the results of the analyses carried out are presented. First, it follows the descriptive analysis of the metadata of the selected articles. Next, the categories obtained from the qualitative analysis of the content of the articles are presented.

3.1 Descriptive data analysis

Based on the analysis, it was evidenced that the predominant journal is the *International Journal of Project Management* with 16 articles. Additionally, eight articles distributed in three other publications specialising in project management also appeared in the database. The second most fruitful journal was the *Journal of Knowledge Management* with ten articles. Another nine articles related to knowledge management appeared distributed in six other publications, three of which were in the *International Journal of Knowledge Management Studies*. The predominance of these publications is attributed to the research argument. It is noteworthy that the number of articles that brought the subject of knowledge in the engineering and construction industry is significant. Although there are only eight articles from publications specialising in engineering and construction when analysing the 102 articles, a total of 33 of them present in content, knowledge situations in projects within the referred industry. We can infer that this industry segment, as well as the literature in this regard, is at a more mature stage concerning the project management discipline.

We used the same approach to define articles that dealt with research and development (R&D), new product development (NPD), information technology (IT) or information system development (ISD) which relevance points to difficult translation of knowledge into practical implications for strategic intentions about innovation (Byosiere et al., 2010). It might be possible to perform a quality assessment of the research articles,

by examining the fit or gap of each article comparing the research methodology and research questions (Tranfield et al., 2003). The table below resumes the articles and author that mention such type of project into their studies.

Table 1 List of the most relevant type of projects into the articles

<i>Type of project</i>	<i>Number of articles</i>	<i>Authors</i>
Research and development	26	Foos et al. (2006), Kim et al. (2013), Goffin et al. (2010), Landaeta (2008), Giudice and Maggioni (2014), Hansen (2002), Garrety et al. (2004), Marchiori and Franco (2020), Oya et al. (2008), Vaccaro et al. (2009), Lam (1997), Leseure and Brookes (2004), Lapré and van Wassenhove (2003), Christensen and Bukh (2009), Formentini and Romano (2011), Byosiére et al. (2010), Rolland and Kaminska-Labbé (2008), Lindner and Wald (2011), Fetterhoff et al. (2011), Huber (1999), Fuller et al. (2011), Goffin and Koners (2011), Frishammar et al. (2015), Nemanich et al. (2010) and Roth (2003)
New product development	6	Frank and Echeveste (2011), Kim et al. (2013), Goffin and Koners (2011), Goffin et al. (2010), Foos et al. (2006) and Mainga (2017)
Engineering and construction	33	Carrillo and Chinowsky (2006), Zhou et al. (2020), Wanberg et al. (2017), Akhavan et al. (2018), Bartsch et al. (2013), Matsumoto et al. (2005), Fuller et al. (2011), Schindler and Eppler (2003), Goffin and Koners (2011), Breunig (2016), Reychar et al. (2012), Goffin et al. (2010), Duffield and Whitty (2016), Bresnen et al. (2003), Haass and Azizi (2019), Oluikpe (2015), Vaccaro et al. (2009), Chan et al. (2009), Lapré and van Wassenhove (2003), Cacciatori (2008), Mainga (2017), Jugdev (2007), Wiewiora and Murphy (2015), Davidson and Rowe (2009), Siemieniuch and Sinclair (2004), Christensen and Bukh (2009), Swan et al. (2010), Formentini and Romano (2011), Roth (2003), Byosiére et al. (2010) and Drnec et al. (2002)
Information technology/ information system development	12	Weiser and Morrison (1997), Tiwana and McLean (2005), Joshi et al. (2007), Vlaar et al. (2008), Paul (2006), Wang et al. (2008), Tan et al. (2012), Naicker (2013), Taylor (2005) and Vaccaro et al. (2009)

Then, the seminal authors most commonly found in the articles were identified. Among all the authors included in Table 2, Etienne Wenger stands out, who together with Jean Lave in 1991 presented the concept of communities of practice in the article ‘Situated learning: legitimate peripheral participation’. Etienne Wenger presents a second work entitled ‘Communities of practice: learning, meaning and identity’ published for the first time in 1998, which becomes the reference for other authors on the subject. The author presents a mechanism based on the social theory of learning to promote learning. It should be noted that this mechanism is one of the main suggestions that this article proposes as a knowledge transfer activity. The respective author is cited in 16 articles in the database, as can be seen in Table 2.

Table 2 List of the most frequent seminal authors in the database

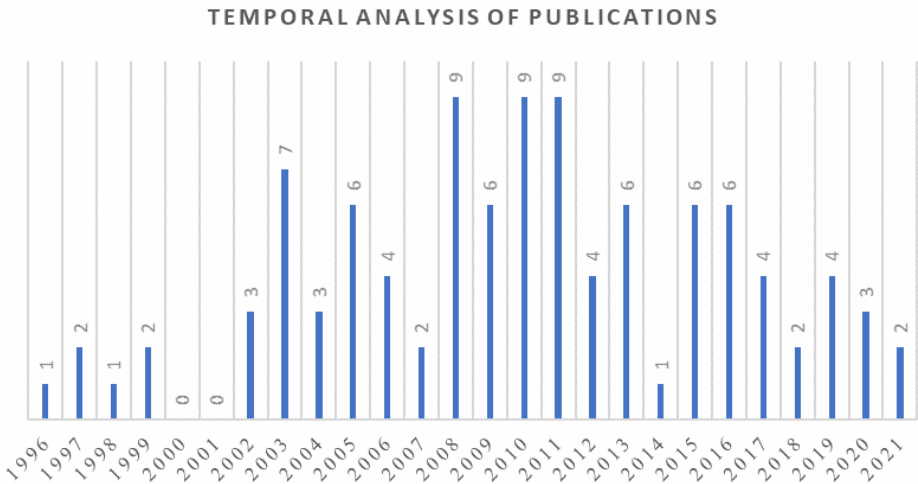
<i>Seminal authors</i>	<i>Main topics covered</i>	<i>Number of articles cited</i>
Davenport and Prusak (1998)	Working knowledge Knowledge in organisations	18
Hansen (1999) and Hansen et al. (1999)	Knowledge management – strategic Knowledge transfer	24
Nonaka and Takeuchi (1995)	Knowledge creation – SECI model	24
Polanyi (1966)	Tacit knowledge	15
Wenger (1998)	Community of Practice	16*

Note: *Wenger, E. (1998) *Communities of Practice: Learning, Meaning and Identity*, Cambridge University Press, is cited in eight articles. Other articles presented by Wenger along with other authors are cited eight more times.

Source: Survey data (2021)

Referencing the temporal analysis of the 102 articles (Figure 2), the most prevalent years in which the articles were published are 2008, 2010 and 2011, with a frequency of 9 publications for each year. It is noteworthy that before the period between 1996 and 2007, a total of 31 articles were published, that is, an average of three articles per year. Considering the most recent period, that is, the last 10 years, there were a total of 38 publications or an average of fewer than four articles per year.

Figure 2 Temporal analysis of publications (see online version for colours)



Source: Survey data (2021)

In the most recent articles, the themes continue to address the challenges of knowledge transfer in organisations, its importance for the success of projects and the impacts that knowledge generates on competitiveness. Although 20% of the articles were published in the last five years, there are no analyses or mentions of cloud computing or big data related to knowledge management, which could be the subject of a future study.

We can infer that, from the number of articles published over 10 years ago, there is a predominance of articles dealing with engineering and construction, the development of new products, and research and development. These segments have a greater degree of maturity in project management, in some more developed countries, and have already faced greater difficulties in knowledge management during the process of installing mechanisms for capturing and transferring tacit knowledge. Other business segments or other locations that are not yet mature in this concept will be able to take advantage of this experience when they go through the same difficulties.

3.2 *Qualitative analysis of articles*

In respect of the qualitative research results, the difficulties or barriers to capture and transfer knowledge were one of the most relevant themes found during the analyses. This result corroborates the research by Frank and Echeveste (2011) who studied this theme. Understanding these difficulties, as well as adopting strategies to deal with them, is part of Knowledge Management so that it can flow.

After analysing the literature, a process resulting from the exercise of abstraction of the research corpus, it was possible to classify the contents of the articles into 11 categories that present different difficulties exemplified by the authors. As a result of the analysis, Table 3 presents the most frequent types of difficulties.

Table 3 Difficulties in capturing and transferring tacit knowledge in Projects

<i>Categories of difficulties</i>	<i>Characteristics</i>	<i>Examples</i>	<i>Authors</i>
1 Organisational environment	The values, customs, behavioural norms that guide how individuals in an organisation act or react in their daily lives and are configured in the work environment of that organisation.	Context-specific influence; Disintegration of the project team; Conflict between project and organisation objectives; Lack of organisational support for the adoption of a favourable climate between projects.	Bartsch et al. (2013), Bresnen et al. (2003), Duffield and Whitty (2016), Formentini and Romano (2011), Frank and Echeveste (2011), Mainga (2017), Dow and Pallaschke (2010), Zhou et al. (2020), Schindler and Eppler (2003) and Xu and Ma (2008)
2 Social aspects	Bonds and connections are established by interactions between individuals, indicating frequent communication and reciprocal cooperation, accompanied by mutual trust between project teams.	The social distance between team members. Lack of knowledge exchange events.	Bartsch et al. (2013) and Frank and Echeveste (2011)

Table 3 Difficulties in capturing and transferring tacit knowledge in projects (continued)

<i>Categories of difficulties</i>	<i>Characteristics</i>	<i>Examples</i>	<i>Authors</i>
3 Project characteristics	Peculiar nature of a unique, temporary undertaking, involving different characteristics between it, varying degrees of risk, uncertainty, urgency, and complexity, etc.	Pressure for deadlines and costs, finite timeliness of the project; Focus on short-term deliveries; Discontinuing nature of projects.	Bartsch et al. (2013), Carrillo and Chinowsky (2006), Frank and Echeveste (2011), Lindner and Wald (2011), Mainga (2017), Zhou et al. (2020), Ren et al. (2019) and Schindler and Eppler (2003)
4 Temporal aspects	Factors related to the time (duration and moment) in which the project team has to invest in knowledge-related activities.	Long time between cause and effect of the problem; Time is taken to codify knowledge; Lack of time to dedicate to sharing knowledge.	Frank and Echeveste (2011) and Schindler and Eppler (2003)
5 Competencies	Knowledge, Skills, and Attitudes are inherent to the individual, the group, and/or the organisation that facilitates or hinders the transferability of knowledge.	Difficulties in externalising knowledge; Difficulties in perceiving knowledge transfer activities; Ability of recipient to decode knowledge; Attitude (willingness) to absorb knowledge.	Bartsch et al. (2013), Bresnen et al. (2003), Fetterhoff et al. (2011), Formentini and Romano (2011), Frank and Echeveste (2011), Mainga (2017), Schindler and Eppler (2003) and Xu and Ma (2008)
6 Communication	It is characterised by the critical role of the context, the interaction between the sender and the receiver, the means used, and the content involved in the knowledge transfer process.	Low priority for communication activities; Lack of Standard in communication; Communication capacity of the issuer.	Bresnen et al. (2003), Frank and Echeveste (2011) and Xu and Ma (2008)
7 Cultural aspects	Basic beliefs are normally assimilated and held by a group, which govern the perception, thoughts, feelings, and actions of an individual member of a group and which are typical of the group as a whole.	Cultural differences between project teams; Syndrome was not created here; Belief that the context is unique (no identification of connection between projects); Culture of self-censorship	Bresnen et al. (2003), Duffield and Whitty (2016), Formentini and Romano (2011), Frank and Echeveste (2011), Fuller et al. (2011), Mahura and Birollo (2020), Mainga (2017), Dow and Pallaschke (2010), Newell et al. (2006), Ren et al. (2019) and Schindler and Eppler (2003)

Table 3 Difficulties in capturing and transferring tacit knowledge in projects (continued)

<i>Categories of difficulties</i>	<i>Characteristics</i>	<i>Examples</i>	<i>Authors</i>
8 Educational aspects	A continuous process of formation or development of intellectual, technical, and procedural faculties within an organisation.	Not allowing or not providing adequate time for training; restricting coaching opportunity or access to new trainees; Lack of formal learning incentives and structures outside the projects; Lack or failure in training.	Bartsch et al. (2013), Duffield and Whitty (2016) and Mahura and Birollo (2020)
9 Infrastructure and technology	The necessary infrastructure, including technological aspects, such as systems and platforms to conduct the capture and transfer process, considering the tacit nature of knowledge.	Lack of structure for Cross-regional knowledge exchange; Lack of mechanisms to capture project learning; Lack of Integration between IT systems and processes; Cost implications.	Bartsch et al. (2013), Bresnen et al. (2003), Duffield and Whitty (2016), Formentini and Romano (2011), Mahura and Birollo (2020), Mainga (2017) and Schindler and Eppler (2003)
10 Procedural aspects	Processes, methods, and activities inherent to the project and the organisation that impact the transferability of tacit knowledge.	There is a lack of integration of the experience record in the project processes.	Bresnen et al. (2003), Carrillo and Chinowsky (2006), Duffield and Whitty (2016), Frank and Echeveste (2011), Mahura and Birollo (2020), Mainga (2017), Ren et al. (2019) and Schindler and Eppler (2003)
11 Motivational aspects	A disposition that generates an action in individuals to achieve their goals. It ranges from emotional, organic, to social phenomena. It is the process responsible for initiating, directing, and maintaining behaviours related to the achievement of objectives.	Members see no value in the encoding process; Project team members see no benefit in being involved in post-project reviews.	Smith (2007), Bartsch et al. (2013), Duffield and Whitty (2016), Formentini and Romano (2011), Frank and Echeveste (2011), Mainga (2017), Newell et al (2006), Xu and Ma (2008), Zhou et al. (2020) and Schindler and Eppler (2003)

Based on the analysis performed, it is possible to highlight the difficulties resulting from the organisational environment (1), which occur when the practices, procedures, and climate within the organisation do not provide a favourable environment for the transmission of knowledge (Carrillo and Chinowsky, 2006; Mahura and Birollo, 2020). In this sense, cases can be cited in which the strategic or organisational objectives

conflict with the culture of knowledge transmission (Schindler and Eppler, 2003), with the organisation's profit and revenue objectives as opposed to the necessary investments or financing for application in knowledge management. There are also aspects inherent to an organisational environment, the context in which projects and project team members find themselves (Frank and Echeveste, 2011; Mahura and Birollo, 2020), where there may be geographic dispersion, physical limitations, language barriers, time zones etc.

For the nature of tacit knowledge, the environment is required to provide favourable conditions to facilitate the transfer, with the institutionalisation of social processes between individuals and between projects, provided by the organisation (Mainga, 2017). Based on this premise, the social aspects (2), within the organisational environment, which are so relevant to tacit knowledge, appear both as facilitators and aspects that hinder the capture and transfer of knowledge. Frank and Echeveste (2011) highlight that there is a possibility of social distancing between the members of the organisation, especially when there are hierarchical differences.

Project characteristics (3) are also factors that make knowledge management difficult. As for tacit knowledge, this can be harmed when the characteristics of the project affect the social relations between projects, when socialisation practices are not allowed, when there is a lot of fragmentation in contacts (Ren et al., 2019), when there is pressure for deadlines and costs (Frank and Echeveste, 2011; Mainga, 2017; Schindler and Eppler, 2003) when teams are naturally dispersed throughout and at the end of the project (Bartsch et al., 2013), when the knowledge needed to be acquired was distant in time (Bresnen et al., 2003; Frank and Echeveste, 2011), or even when the capture of knowledge that would take place through the suggested mechanisms takes a long time to be collected due to other priorities and urgencies.

Another category that has a strong connection with the characteristics of the project is the temporal factor (4). The pressure for deadlines and costs inherent to the projects (Lindner and Wald, 2011; Mainga, 2017) trigger difficulties such as the temporal distance between the cause and the effect of the problem. This situation is related to the time taken to codify knowledge, and the lack of time to dedicate to sharing this codified knowledge (Schindler and Eppler, 2003). This temporal distance between the origin of knowledge and the recipients is unfavourable to tacit knowledge, due to the loss of individual and corporate memory, the loss of the opportunity for reuse as relevant, as recommended by Tan et al. (2012).

Concerning competencies (5) they can be related to the individual, a group, or the organisation as a whole. These same three levels are associated with difficulties in capturing or transferring tacit knowledge, whether due to lack of knowledge, deficient skills, or even a negative attitude to perform some activity. Thus, for tacit knowledge to be converted into skills to be used in subsequent projects, some barriers need to be overcome, such as difficulties in externalising knowledge to receivers (Frank and Echeveste, 2011), difficulties or willingness to absorb knowledge (Szulanski, 1996; Xu and Ma, 2008.), lack of ability to decode knowledge (Xu and Ma, 2008), lack of ability to visualise learning opportunities outside projects (Bartsch et al., 2013), lack of understanding of knowledge among people (Fetterhoff et al., 2011), among others.

Referencing to the role played by knowledge agents (brokers) (Bresnen et al., 2003), they can encourage the exchange of lessons learned and enhance the use of tacit knowledge. The skills of these agents can also have a positive or negative impact when they master what is explicit and what is tacit; when they have skills to share information; when they have a profile of conduct and leadership in knowledge sharing and transfer

practices (Formentini and Romano, 2011). Even when they have a profile to foster social activities, interactions between teams to exchange experiences (Goffin et al., 2010).

Communication aspects (6) constitute another factor identified by the authors when dealing with the influence of communication for the capture and transfer of tacit knowledge. It is recognised that communication will occur more successfully when it is between agents who share similar and adherent social, cultural, and linguistic characteristics. The existence of a trusting relationship between individuals will facilitate communication and mutual understanding (Foos et al., 2006; Ren et al., 2019; Zhou et al., 2020). If there are elements of communication, supported by the relationship of trust, the first steps will be taken so that the transfer of tacit knowledge takes place (Foos et al., 2006).

On the other hand, the lack of definition of standard communication procedures, the inexistence of communication activities between the members of the organisation (Bresnen et al., 2003), or even the inability of the knowledge issuer to communicate (Xu and Ma, 2008), are the difficulties found within the communication elements. It is possible to associate the communication aspects identified here, with the grouping related to the communication skills of the interlocutors or given the procedural aspects (which we will discuss later), when we identify the inexistence of processes, including communication, established for the interaction between the team members.

One of the most important categories, since it has the largest number of examples and situations found, was the cultural aspect (7). Individual beliefs and behaviours, assumptions, manifestations, always connected to the context, social group, or organisation, influence and impact knowledge management activities. As tacit knowledge resides in the perceptions and behaviour of human beings, the factors that influence behaviour in projects also influence knowledge transfer. From the convictions about the unique context of that project, through the culture of individualism (Frank and Echeveste, 2011), to the culture of knowledge is power (Dow and Pallaschke, 2010), to the habits of not reporting problems, not exposing flaws, or just showing success (Mahura and Birollo, 2020), are examples of cultural aspects that impact the tacit knowledge transfer process.

In addition, there is a behavioural component within the cultural aspects that were identified during the analysis, which is evidenced in the following elements: fear of making mistakes, fear of asking or exposing oneself, fear of taking risks, resistance or effort to learn some technology, even the reluctance to absorb new processes, new technologies or IT systems (Mahura and Birollo, 2020; Mainga, 2017).

Within the educational aspects (8), the focus is on the qualification and training of project team members and other members involved with the projects. The first training gap concerns the lack of mastery over the concept and nature of tacit knowledge and how it occurs. The training of teams in the concepts of knowledge management and its benefits so that they can carry out activities related to the capture and transfer of tacit and explicit knowledge is the first step. As causes, the difficulties related to transfer, identified in the analysis are: lack of priority for training; lack of capacity of project members to conduct activities inherent to the capture or transfer of knowledge; in addition, not providing time or budget for training, restricting the opportunity or access to coaching for new trainees (Mahura and Birollo, 2020). It was also identified that organisations lack incentives and formal learning structures outside of projects (Bartsch et al., 2013), whose connection with integrative and social activities is fundamental for capturing tacit knowledge.

Those responsible for knowledge management within organisations, aware of these factors, should insert mechanisms that facilitate knowledge activities such as instituting the capture and transfer as standard activities within their schedules, establishing learning goals, strengthening social activities between members of the organisation, among other activities. These mechanisms are discussed further in the section on facilitating mechanisms.

According to Mahura and Birollo (2020), it is during formal training that space arises for managers and team members to acquire and share knowledge among themselves. During this exchange of experiences, the transfer of tacit knowledge can take place. Mentoring activities, training of new hires, peer training sessions, discussion sessions between projects are some of the suggestions provided to mitigate the difficulty inherent in the training category.

Infrastructure together with technology (9) represents a separate chapter within knowledge management. The literature suggests the adoption of some information and communication technology systems (ICT), which consists of a technological base associated with formal procedures, structures, and methods (Chan et al., 2009; Lindner and Wald, 2011; Newell et al., 2006; Vaccaro et al., 2009). Another approach found in the literature was the ISD, an acronym for the concept of information systems development (Joshi et al., 2007; Tiwana and McLean, 2005; Wang et al., 2008), which are constituted teams that hold knowledge, to control the technical challenges and the transfer of knowledge in the development of information systems (Wang et al., 2008). In this sense, Naicker (2013) proposes to develop a framework, using IT infrastructure and capabilities as a promoter of the knowledge management process.

Regarding the difficulties of the infrastructure together with the technology, problems with the infrastructure for the storage of documents were evidenced, with access difficulties, limitations of viewing authorisation, even the lack of technology for capturing knowledge. Bartsch et al. (2013) and Formentini and Romano (2011) highlight the implication of costs for the search and transfer of knowledge, scarcity of resources, lack of integration, or incompatibility between IT systems and processes within the company. These latest authors alert to the fact that there is a predominance of dealing with explicit knowledge to the detriment of tacit knowledge, and that the development of some technology or the provision of infrastructure must consider the different types of knowledge (that is, tacit and explicit) requiring different approaches to its transferability.

Another aspect identified in the literature that connects with infrastructure is the procedural aspect (10), which comprises the methods, tools, and processes for capturing and transferring knowledge. The act of recording lessons learned, how they are captured, the flow of information (Frank and Echeveste, 2011), the integration between processes and tools (Mahura and Birollo, 2020), all characterise the procedural aspect of management knowledge. Otherwise, the collected content (information captured) is often not reused due to lack of context. Either because they are difficult to understand or because it is not specific enough for the new purposes, or because they are described in a very generic way, or even because they are not visualised when necessary (Schindler and Eppler, 2003). Also, regarding the processes, we can highlight the non-mandatory use of lessons learned (Mainga, 2017), as this is another aspect that indicates that knowledge is neglected, whether due to lack of knowledge, governance failures, or lack of commitment to knowledge management. We can say that the training of members of the organisation regarding the concept of the nature of tacit knowledge and the way it occurs will facilitate

the creation of organisational procedures that allow the capture and transfer of this kind of knowledge.

Another category that appears frequently in the literature corresponds to motivational factors (11). This factor can impact the creation and flow of knowledge (Mueller, 2012), and motivation can be intrinsic, when part of an inner action of each individual, or extrinsic when there is influence from external factors, such as environmental, organisational, and cultural. Mueller (2012) proposes that intrinsic motivation can positively influence knowledge sharing among project teams. As motivation can be influenced by external factors, working in this direction, through training and rewards, can influence the motivation of individuals in the capture and transfer task. Käser and Miles (2002) draw a positive correlation between the level of intrinsic motivation of individuals to share knowledge and the degree of trust between them.

Starting from personal motivation and evolving to the collective level, as the degree of intrinsic motivation increases, trust increases, and the potential for sharing tacit knowledge also increases. Käser and Miles (2002) state that individuals take the initiative to share tacit knowledge mainly when they are intrinsically motivated and want to do it, because they see value in the sharing process. Examples of motivational factors that hinder tacit knowledge are: team members who do not perceive value in the coding process (Formentini and Romano, 2011); lack of communication of experiences (positive for modesty), or fear of negative sanctions (in case of errors) (Schindler and Eppler, 2003); project team members see no benefit from engaging in post-project reviews (Mainga, 2017); lack of incentives explicitly linked to project learning (Mainga, 2017; Zhou et al., 2020); the search for information only when there is a problem (Newell et al., 2006), among others. Lack of motivation to learn can also occur when the benefits of knowledge exchange are not clear (Bartsch et al., 2013).

The manager's awareness on the existence of the aforementioned categories is the first step towards the construction of a consistent tacit knowledge management plan in the organisation. This plan should be enriched, with one more approach suggested in this article. With one more suggested technique to leverage the capture and transfers of tacit knowledge in project management. For abstraction and presentation of a model that groups these techniques into similar mechanisms, the concept of Mahura and Birollo (2020) was considered, which suggests that knowledge transfer practices are classified between formal and informal.

We are also based on Christensen and Bukh (2009), who suggest two perspectives, the artefact-oriented, focused on capturing explicit elements, and the process-oriented perspective, which focuses on the tacit or implicit dimensions of knowledge. Still, in the view of these authors, each of these two perspectives proves to be more effective depending on the degree of standardisation or customisation of the solution. From both concepts, the capture and transfer activities were grouped into eight different mechanisms, and for each of the mechanisms, we present the best practices through the examples as shown in Table 4.

The capture and transfer mechanisms most appropriate to the tacit knowledge collected during the analysis were grouped as an offer of a portfolio of activities that can be implemented in the organisation and its projects. Thus, practitioners can leverage the practice of capturing and transferring tacit knowledge.

Table 4 Appropriate mechanisms-tacit knowledge capture and transfer

<i>Mechanisms</i>	<i>Examples</i>	<i>Authors</i>
1 Organised groups for knowledge exchange	COP – community of practice PMC – project management community COE – centre of expertise (excellence).	Bresnen et al. (2003), Fernie and Green (2003), Garrety et al. (2004), Haass and Azizi (2019), Wanberg et al. (2017) and Wenger et al. (2002)
2 Use of social structures and activities - socialisation.	Meetings; special team events Face to face interactions Knowledge sharing connections changing reporting structures Practice-based learning approach Learning cafes Expert group meeting.	Byosiere et al. (2010), Eltigani et al. (2020), Enkel et al. (2018), Fernie et al. (2003), Garrety et al. (2004), Haass and Azizi (2019), Landaeta (2008), Ren et al. (2019) and Wanberg et al. (2017)
3 Favourable environment for the culture of knowledge	Informal knowledge networks Error tolerant environment The balance between rigor and freedom in learning Environment (favourable) for changes together with leadership commitment.	Bresnen et al. (2003), Eltigani et al. (2020), Fernie and Green (2019), Foos et al. (2006), Garrety et al. (2004), Lindner and Wald (2011) and Ren et al. (2019)
4 Project reviews	Project reviews or audits Post-project review Review of the action plan.	Goffin and Koners (2011), Haass and Azizi (2019), Landaeta (2008) and Schindler and Eppler (2003)
5 Learning goals	Knowledge goals at each stage of the project Project-specific tacit knowledge measures to measure progress in integrating tacit knowledge Rewards for achieved knowledge goals.	Bharadwaj and Saxena (2005), Foos et al. (2006), Ren et al. (2019) and Schindler and Eppler (2003)
6 Systematisation of lessons learned	Project debriefing; brainstorming sessions; dialogue sessions; storytelling; expert debriefing; interviews; learning history; lessons learned or best practices workshops.	Goffin and Koners (2011), Haass and Azizi (2019), Lindner and Wald (2011) and Dow and Pallaschke (2010)
7 Six Sigma combined with the knowledge creation mechanism	Socialisation – brainstorming, nominal group, five why analysis, etc. Externalisation – value stream map, fishbone diagram; Failure modes and effects analysis – FMEA. Combination – design of experiments; multiple regression; simulation; quality function deployment (QFD). Internalisation – error proofing; training for frontline operators; job rotation.	Anand et al. (2010)

Table 4 Appropriate mechanisms-tacit knowledge capture and transfer (continued)

<i>Mechanisms</i>	<i>Examples</i>	<i>Authors</i>
8 New roles	Debriefer; knowledge manager; knowledge broker individuals; brokers	Bresnen et al. (2003), Garrety et al. (2004), Landaeta (2008) and Schindler and Eppler (2003)

The mechanisms were grouped into eight practices, according to similar characteristics. Organised groups for knowledge exchange (1) are about gathering and sharing knowledge through experts and informal discussion on a specific topic. One of these groups, formed to work with tacit knowledge, is called communities of practice, whose objective is the common search for knowledge to present solutions.

Wenger et al. (2002) highlight that communities of practice are groups of people who meet periodically to share experiences, discuss a specific topic and deepen knowledge or expertise in a given topic. Knowledge in these communities is built as individuals share ideas through collaborative actions such as narration and joint work (Bresnen et al., 2003). Communities of practice can also use information technology tools to create maps of knowledge and experiences, or create networks of contacts between professionals, facilitating connections and helping to bring the sender and recipient of knowledge closer together.

The mechanisms, use of social structures and activities (2) and providing a favourable environment for the culture of knowledge (3), refer to the very nature of tacit knowledge, which is facilitated as members can socialise and exchange experiences, which members perceive benefits and feel motivated to create knowledge.

An existing procedure in organisations and projects, identified in the revised literature as recurrent, is the project review (4). This mechanism can be applied during or post-project, or even recurrently. Several suggested review techniques consider how tacit knowledge occurs, and that can be leveraged and serve as a powerful knowledge transfer tool.

The adoption of learning goals (5), applied to the project and the team members, proposed by the authors presented in Table 4, can also enhance learning. Learning goals are associated with the motivational factors illustrated in this article, which should be considered in this regard.

Systematise the lessons learned (6), make them a constant practice, make project members aware of the benefits, encourage learning and knowledge goals, and consider the techniques suggested by the authors, avoiding only the simple recording of healthy information, one of the most present mechanisms in the reviewed literature.

Anand et al. (2010) expose a variety of practices inherent to the Six Sigma mechanism allied to the knowledge creation mechanism (7) for the capture and transfer of explicit and tacit knowledge in projects. The authors present a model in which each practice is inserted within the SECI model of knowledge creation by Nonaka and Takeuchi (1995).

The last proposed mechanism is the creation of new roles (8) within the organisation. In this sense, it is necessary to understand the need to develop positions that play the role of knowledge enablers. Zhou et al. (2020) propose horizontal and vertical knowledge transfer mechanisms based on the concept that horizontal transfer occurs directly between individuals and vertical transfer occurs through the responsibility of an existing

organisational structure in the company. People inserted in these new roles must think of this verticality, being responsible for the organisation's knowledge management, acting as a knowledge agent.

4 Final remarks

The practical applications of this article include the importance of developing a structured process, within organisations dealing with projects, of a knowledge management practice. Starting with the awareness of managers and projects related to people in the organisation about how knowledge occurs, knowing the differences between explicit and tacit knowledge, how and when these types of knowledge occur. Going through the awareness by organisations about the factors that influence knowledge capture and transfer, and finally, the mechanisms that can be applied to project members, whether before, during, or after the life cycle of these projects, are the first steps.

As contributions, this article shows the consolidation of knowledge management concept, tacit knowledge concept and how the latter occurs in projects. This article also presents the notion that informal spaces are fundamental for the exchange of tacit knowledge. After the systematic review, there are several contributions found, that could assist the projects and their organisations, starting with the presentation of a large number of initiatives to overcome the intrinsic barriers, more successfully, by adopting some of the mechanisms rose in this article.

Although project managers and other members of the project team and portfolio should also use informal practices to recover knowledge between projects. These practices meet different needs and complement the use of formal practices.

Project-oriented companies, to maintain their competitive advantages and their capacity to innovate and, in terms of projects, to grow the success rates in successful projects, must not only rely on the treatment of traditional information and techniques. Companies must develop their capabilities and improve their practice in knowledge management, adopting a culture favourable to knowledge. Competencies, as well as the other categories listed here, influence each other, for example, the competencies of individuals can be influenced by the organisational environment, culture, infrastructure, in addition to motivational aspects. It should be noted that this influence between the categories listed here may be the object of future study.

Aware that few academic studies correlate the mechanisms presented here, adopted in a structured manner and aligned with the organisations' strategy. Such studies can lead to beneficial concrete actions to overcome knowledge transfer difficulties. Therefore, a future study that deals with these actions, proposing a guideline, should be the object of a scientific article.

This study sought to identify the difficulties and provide suggestions for capturing and transferring tacit knowledge in projects within the same organisations. During the studies, it was identified that some themes could be explored in the future, such as horizontality or verticality in the transfer of knowledge between projects, when knowledge is transmitted directly or through the organisation and its installed mechanisms. In this sense, it can be researched on project support structures, its role as a broker in the capture and transfer of knowledge, and its role as a mediator or moderator in the knowledge management process. Another topic discussed, which deserves further study, is the influence among themselves among the categories listed as difficulties, that

is, how each category influences the other, acting as a barrier or facilitator to the transferability of knowledge.

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