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Software Project Managers' Knowledge Transfer: An In-Depth Interview

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Abstract: There have been many studies in the past that have demonstrated knowledge transfer in a variety of settings. However, only a small proportion of research has focused on knowledge transfer for software project managers. This study explores knowledge transfer factors with the goal of gaining a better understanding of those factors for software project managers at all levels, including those who have prior expertise in the field and those who are new to the field. Qualitative data was acquired through in-depth interviews with 12 software project managers using semi-structured questions to investigate all factors involved. In accordance with the findings, nine potential factors have been identified as influencing knowledge transfer among software project managers. It is anticipated that the findings of this study will be advantageous to the corporate sector, public authorities, and entrepreneurs in the field of project management. The findings can be used as guidelines for software project managers' practices and progress in knowledge transfer within project management to maximize profits in the business.

Keywords: Knowledge Transfer, Knowledge Transfer factor, Project Management, Project Manager, Software Project Manager, Thai Project Manager

1. Introduction

Within an organization, software project managers are responsible for ensuring that software and digital projects are completed on time, within budget, and on schedule. They are responsible for the successful completion of all software projects and for overseeing employees who work on those projects on behalf of the organization. Meanwhile, organizations around the world are evolving in tandem with technological breakthroughs in order to energetically drive digital transformation (Baiyere, Salmela & Tapanainen, 2020; Bharadwaj, El Sawy, Pavlou & Venkatraman, 2013; Dal Mas, Piccolo, Edvinsson, Skrap & D'Auria, 2020; Verhoef et al., 2021; Vial, 2019) with the intent of enhancing product sales and revenues, improving customer satisfaction, and streamlining procedures (Baiyere et al., 2020; Caliskan, Özkan Özen, & Ozturkoglu, 2020; Hess, Matt, Benlian, & Wiesböck, 2016; Sebastian et al., 2020).

The drive toward digital transformation encompasses a diverse array of digital technology and software-related projects (Karimi & Walter, 2015). Each project is frequently headed by a software project manager who coordinates operations across schedule, scope, and budget constraints (Ehsan et al., 2010; Gillard & Price, 2005; Kaleshovska & Pulevska-Ivanovska, 2019) , achieving business objectives and long-term organizational performance (PMI, 2017) with predictions indicating that the Asia-Pacific area will require two million project managers over the next decade (Pant, 2021).

There are numerous skills that a project manager must possess in order to successfully manage an organization's project, including leadership skills, administrative skills, and communication skills (Alvarenga, Branco, Guedes, Soares, & Silva, 2019; Yoon, Yan, & Kim, 2020). These skills can be honed and enhanced through training, on-the-job experience, and knowledge transfer by more experienced project managers. Thus, businesses must prioritize the transfer of this knowledge and skills. Additionally, having an effective knowledge transfer process provides firms with a competitive edge (Osterloh & Frey, 2000; Pawliczek & Rössler, 2017; Yeong & Lim, 2011) but the majority of project managers continue to lack adequate transfer of project management expertise (Carbone & Gholston, 2015; Palm & Lindahl, 2015).

Previously published research has examined knowledge transfer in a variety of contexts (Dameri & Demartini, 2020; Greser et al., 2021; Haglund & Wåhlberg, 2015; Karanikić & Bezić, 2021; Kuciapski & Weichbroth, 2021; Tshuma, Steyn, & Van Waveren, 2018). However, there are few studies which have concentrated on the knowledge transfer of software project managers, despite the explosion of digital and software initiatives. Furthermore, due to a lack of adequate project management expertise, these software project managers must spend considerable time developing their skills without being rewarded with promotion by existing project

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managers. With the increasing number of digital transformation projects, Thailand is experiencing a shortage of software project managers and the country's companies tend to be relatively underdeveloped.

As a result, this research asks the following question. 'What factors influence knowledge transfer for software project managers?'. To address the question, the authors conducted a literature review on knowledge transfer and project manager, followed by an explanation of the methodology. Then the findings and conclusion are discussed in detail, and closes with a discussion and limitations section.

2. Literature Review

2.1 Knowledge Transfer and Project Manager Definition

There have been numerous definitions of knowledge transfer in the past (Argote & Ingram, 2000; Carlile & Rebentisch, 2003; Liyanage, Elhag, Ballal, & Li, 2009; Singley & Anderson, 1989; Szulanski, 1996), all of which are consistent in theme, stating that knowledge transfer is the transfer of experience and expertise from a sender to a receiver within a particular environment until the receiver acquires new expertise in that environment. Meanwhile the project manager is a job title associated with the management of projects within a business or industry, such as construction, research, or software development. This comprises the planning, execution, monitoring, and control of the project, as well as its closure (Wessels, 2007). The project manager is accountable for the overall project management, including goal development, project staff management, resource stewardship, and ensuring the project's success through the use of project management skills, techniques, and tools (Millhollan & Kaarst-Brown, 2016). The success of a project is highly dependent on the project manager's ability (Millhollan & Kaarst-Brown, 2016; Wessels, 2007).

2.2 Knowledge Transfer in Project Manager Context

From the author's literature review, it was found that there has been a lot of past research on the factors affecting knowledge transfer for project management as well as the outcomes of knowledge transfer from various industries)Ajmal & Koskinen, 2008; Al-Gharibeh, 2011; Al-Salti, Ali, & Hackney, 2011; Argote & Ingram, 2000; Bacon, Williams, & Davies, 2020; Bellini, Aarseth, & Hosseini, 2016; Davenport & Prusak, 1998; Ekambaram & Økland, 2018; Eskerod & Skriver, 2007; Glaser, Blake, Bertolini, te Brömmelstroet, & Rubin, 2021; Haglund & Wåhlberg, 2015; Hlova, 2019; Ibidunni, Kolawole, Olokundun, & Ogbari, 2020; Jalil & Shahid, 2008; Karlsen & Gottschalk, 2015; Li, Sun, Shou, & Sun, 2020; Liyanage et al., 2009; Lockett, Kerr, & Robinson, 2008; Osterloh & Frey, 2000; Owen, Burstein, & Mitchell, 2014; Porrawatpreyakorn, Quirchmayr, & Chutimaskul, 2009; Quinn, Anderson, & Finkelstein, 1998; Reagans & McEvily, 2003; Sarker, Sarker, Nicholson, & Joshi, 2003; Simonin, 2004; Sutling, Mansor, Widyarto, Lecthmunan, & Arshad, 2015; Tshuma et al., 2018; Voigt, 2009; Wei & Miraglia, 2017; Zarinpoush & Gotlib Conn, 2006; Zhao, Zuo, & Deng, (2015. Some studies examine the sender of project management knowledge (Disterer, 2002; Landaeta, 2015; Waveren, Oerlemans, & Pretorius, 2014; Wiewiora, Trigunarsyah, Murphy, & Liang, 2009); others examine the receiver of project management knowledge (Bakker, Cambré, Korlaar, & Raab, 2011; Vinke-de Kruijf, Hulscher, & Bressers, 2013; Zhao et al., 2015); and yet others examine environmental factors (Ajmal & Koskinen, 2008; Bellini et al., 2016; Disterer, 2002; Karlsen & Gottschalk, 2015; Ren, Yan, Wang, & He, 2019).

These previous studies have identified potential roles connected to knowledge transfer in the context of project manager, including sender, receiver, and environment roles. Additionally, they discussed a variety of factors that contribute to such responsibilities.

In addition, past studies have attempted to examine the relationship of knowledge transfer to project managers (Eskerod & Skriver, 2007; Mannan, Haleem, & Jameel, 2013). However, there is a only a modicum of research stating factors affecting knowledge transfer in software project managers context. Consequently, the authors gathered the factors and indicators discovered during the studies in order to propose a set of potential factors, as illustrated in figure 1 while the sender of knowledge is an expert software project manager, and the receiver is a less experienced software expert project manager. Also, the details on the source of each indicator were revealed in table 2 so as to make a comparison with those factors.

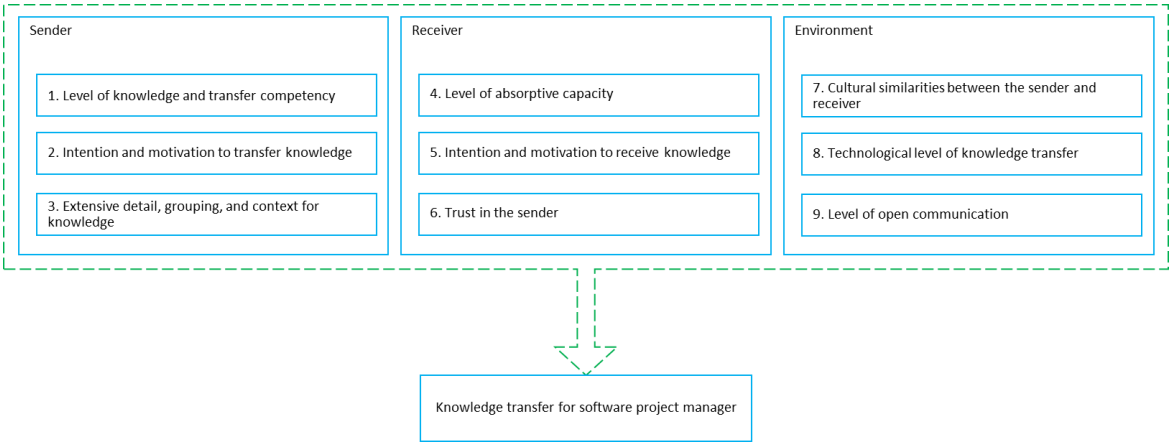

Figure 1: Potential factors from Literature Review

3. Research Methodology

Many studies which involved the generation of knowledge transfer factors employed a qualitative approach (Al-Salti et al., 2011; Glaser et al., 2021; Lockett et al., 2008; Porrawatpreyakorn et al., 2009; Zhao et al., 2015). For this study, the authors therefore compiled the potential factors and indicators that they had uncovered during their literature review and executed a qualitative study to explore their findings. The qualitative data was acquired through in-depth interviews with 12 participants using semi-structured questions (Morgan, 1993; Morse & Field, 1995) since they enabled objective comparisons of persons while also allowing for natural investigation of subject matter relating to that individual. The findings are then used to complete a holistic investigation into all factors. Since it has been shown that project management jobs require a higher level of skill, experience, and effort than routine tasks (Havermans, Van der Heijden, Savelsbergh, & Storm, 2019), the authors constructed the sample into six senior managers with more than four years of software project management experience in Thailand and six junior managers with 0-4 years of software project management experience in Thailand, using non-probability sampling with purposive sampling (Tongco, 2007). Given the authors' skills and experience in software project management, a sample group that is representative of the research goal could be selected. The in-depth interview took approximately 90 minutes per interviewee and occurred between March and April 2021.

In this regard, the author used the field note technique to independently collect all data from the sample at each step (Harrelson, 1994) and provided data collecting instruments such as a sample group interview form, notepad, and audio recorder. After the research was completed, confidentiality was maintained, and information was erased. The author began by introducing himself explaining the objectives and benefits of the research to the informants, and obtained permission to record information, and recording audio during the interview. The interview was then initiated by obtaining the respondent's first and last names, gender, age, education level, current position, and years of experience as a software project manager's contributor, before shifting on to interview questions about their experiences as a sender, the perspective of the receiver of the knowledge transfer, and the environment that affects knowledge transfer, as well as asking a few follow-up questions to ascertain the factors and metrics affecting knowledge transfer in all dimensions for software project managers.

Following the conclusion of the interview, the author discussed the results with the informants. The data from the interviews were then compared to the proposed prospective elements to corroborate the factors affecting knowledge transfer for software project managers, and the results were distributed to all interviewees to ensure that the author accurately understood the informant's account. The author then use thematic analysis (Braun & Clarke, 2006) to determine the data's theme by transcribing the data in order to synthesize meanings consistent with the research objectives by considering data similarities and differences in order to organize the data and eliminate superfluous data, and finally interpret the data by attempting to extract meaning from the available data and correlating it.

Afterward, the triangulation approach was used to validate the data (Carter, 2014), which considers the source of data to be individuals with varying levels of experience in project management, supplemented by

observations and questioning during the interview, as well as the examination of data from pertinent document sources to establish validity.

Along with the interview analysis and approach outlined above, the authors monitored the project managers' knowledge transfer activities without participating in order to gain an even more complete insight.

The authors chose software project managers with varied years of experience in software project management, spanning from 0 to 25 years to generate a representative sample. The information is included in table 1.

Table 1: Qualitative Research Contributors

No.	Code	Software project management experience (years)
1	SPM1	15
2	SPM2	5
3	SPM3	10
4	SPM4	25
5	SPM5	20
6	SPM6	23
7	JPM1	0
8	JPM2	1
9	JPM3	3
10	JPM4	0
11	JPM5	0
12	JPM6	2

4. Findings

The author discovered that the findings were consistent with the majority of the potential factors. The 12 respondents agreed that the sender's Level of knowledge and transfer competency (factor no.1), Extensive detail, grouping, and context for knowledge (factor no.3), and the Intention and motivation to receive knowledge (factor no.5) are factors affecting knowledge transfer for software project managers. While 11 informants interviewed agreed that the Technological level of knowledge transfer (factor no.8) is also a factor. In addition, 10 respondents said the factors included the Intention and motivation to transfer knowledge (factor no.2) and the Level of absorptive capacity (factor no.4). Nine respondents viewed agreed that the Trust in the sender (factor no.6) is one of the factors that affect as well.

However, 5 respondents, comprising three senior software project managers and two junior software project managers, considered that the Cultural similarities between the sender and receiver factor (factor no.7) had no effect on knowledge transfer for software project managers and 6 respondents, comprising three senior software project managers and three junior software project managers, believed that the Level of open communication (factor no.9) factor had no effect on knowledge transfer as well.

Furthermore, the findings led to the discovery of three novel control factors by the author as shown in figure 2 (factor no.11, 12, 13 in table 2)

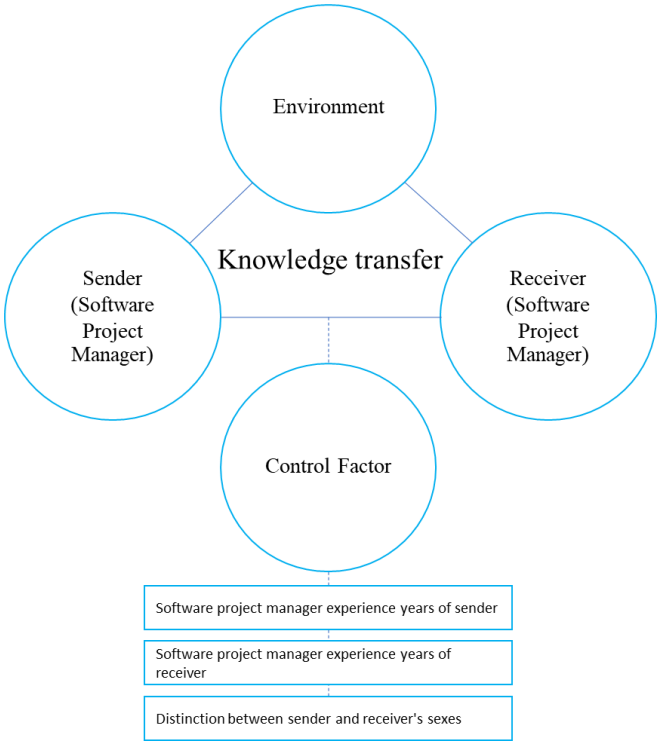

Figure 2: Potential factors after interview

Additionally, the findings enabled the creation of some new potential indicators within the existing factors on the condition that they are endorsed by more than 30% of interviewees. Additional statistical techniques should be used to validate all these potential factors and indicators. The findings are summarized in table 2.

Table 2: Origin of indicator

Group	Potential factors	Potential indicators	Source
Sender	1. Level of knowledge and transfer competency	The sender must have already-acquired mastery of knowledge in what is being conveyed.	In-depth interview and literature review (Davenport & Prusak, 1998; Liyanage et al., 2009)
		The sender must have the ability to transfer knowledge.	In-depth interview and literature review (Al-Salti et al., 2011; Davenport & Prusak, 1998; Glaser et al., 2021; Ibidunni et al., 2020; Karlsen & Gottschalk, 2015; Liyanage et al., 2009; Porrawatpreyakorn et al., 2009; Sarker et al., 2003; Zarinpoush & Gotlib Conn, 2006; Zhao et al., 2015)
		The sender must be trustworthy.	In-depth interview and literature review (Porrawatpreyakorn et al., 2009; Sarker et al., 2003; Zarinpoush & Gotlib Conn, 2006)
		The sender must possess knowledge transfer techniques.	In-depth interview and literature review (Glaser et al., 2021; Ibidunni et al., 2020; Karlsen & Gottschalk, 2015; Liyanage et al., 2009; Porrawatpreyakorn et al., 2009; Zarinpoush & Gotlib Conn, 2006)
	2. Intention and motivation to transfer knowledge	The sender must be motivated to provide knowledge.	In-depth interview and literature review (Liyanage et al., 2009; Lockett et al., 2008; Osterloh & Frey, 2000; Porrawatpreyakorn et al., 2009)
		The sender must have the intention of transferring knowledge.	In-depth interview and literature review (Argote & Ingram, 2000; Porrawatpreyakorn et al., 2009; Simonin, 2004)
		The sender must pass on the knowledge on a regular basis.	In-depth interview and literature review (Argote & Ingram, 2000; Simonin, 2004)

Group	Potential factors	Potential indicators	Source
	3. Extensive detail, grouping, and context for knowledge	The sender must have clear information of the knowledge transfer's content.	In-depth interview and literature review (Al-Gharibeh, 2011; Al-Salti et al., 2011; Lockett et al., 2008; Simonin, 2004; Zarinpoush & Gotlib Conn, 2006)
		The sender must group the knowledge transfer's contents.	In-depth interview and literature review (Al-Gharibeh, 2011; Bacon et al., 2020; Zhao et al., 2015)
		The sender must sequentially prioritize the content of the knowledge transfer.	In-depth interview and literature review (Al-Gharibeh, 2011; Bacon et al., 2020; Zhao et al., 2015)
Receiver	4. Level of absorptive capacity	The receiver must be capable of learning.	In-depth interview and literature review (Al-Salti et al., 2011; Argote & Ingram, 2000; Davenport & Prusak, 1998; Glaser et al., 2021; Liyanage et al., 2009; Porrawatpreyakorn et al., 2009; Sarker et al., 2003; Zhao et al., 2015)
		The receiver must have prior knowledge of project management.	In-depth interview and literature review (Jalil & Shahid, 2008; Li et al., 2020; Sutling et al., 2015)
		The receiver must make enquiries of and have interactions with the sender.	From in-depth interview
	5. Intention and motivation to receive knowledge	The receiver must be motivated to learn.	In-depth interview and literature review (Glaser et al., 2021; Liyanage et al., 2009; Lockett et al., 2008; Osterloh & Frey, 2000; Porrawatpreyakorn et al., 2009; Simonin, 2004)
		The receiver must be willing to learn.	In-depth interview and literature review (Glaser et al., 2021; Liyanage et al., 2009; Lockett et al., 2008; Osterloh & Frey, 2000; Porrawatpreyakorn et al., 2009; Simonin, 2004)
		The receiver must constantly acquire knowledge.	From in-depth interview
	6. Trust in the sender	The receiver must trust the sender.	In-depth interview and literature review (Bellini et al., 2016; Glaser et al., 2021; Lockett et al., 2008)
		The receiver must have a good relationship with the sender.	In-depth interview and literature review (Al-Salti et al., 2011; Bacon et al., 2020; Ibidunni et al., 2020; Porrawatpreyakorn et al., 2009; Reagans & McEvily, 2003; Zarinpoush & Gotlib Conn, 2006; Zhao et al., 2015)
		The receiver must respect the sender.	From in-depth interview
Environment	7. Cultural similarities between the sender and receiver	The sender and the receiver must have a similar cultural background.	In-depth interview and literature review (Ajmal & Koskinen, 2008; Al-Gharibeh, 2011; Bacon et al., 2020; Eskerod & Skriver, 2007; Karlsen & Gottschalk, 2015; Liyanage et al., 2009; Quinn et al., 1998; Sarker et al., 2003)
		Both the sender and the receiver's temperaments must be compatible.	From in-depth interview
		The sender and receiver must interact in the same language, for example, Thai or English.	From in-depth interview
	8. Technological level of knowledge transfer	Technology, such as equipment and software, is required for knowledge transfer.	In-depth interview and literature review (Al-Gharibeh, 2011; Liyanage et al., 2009; Lockett et al., 2008; Zarinpoush & Gotlib Conn, 2006)

Group	Potential factors	Potential indicators	Source
		Knowledge transfer must be accompanied by visual representations.	From in-depth interview
		Knowledge transfer must be accompanied by computer animation.	From in-depth interview
	9. Level of open communication	Knowledge transfer requires open and direct contact between sender and receiver.	In-depth interview and literature review (Bellini et al., 2016; Porrawatpreyakorn et al., 2009; Sarker et al., 2003; Zarinpoush & Gotlib Conn, 2006)
		The content transferred must have a legitimate cause for its origin.	From in-depth interview
		Knowledge transfer requires amicable conversation.	From in-depth interview
Control factor	10. Software project manager experience years of sender	Sender with greater expertise, and years of experience as a software project manager will transfer more efficiently.	From in-depth interview
Control factor	11. Software project manager experience years of receiver	Receiver with greater expertise, and years of experience as a software project manager will receive more efficiently.	From in-depth interview
Control factor	12. Distinction between sender and receiver's sexes	The transfer of knowledge is more efficient when performed with individuals of the opposite sex.	From in-depth interview
Transfer result	Efficiency of knowledge transfer for software project managers	Effective knowledge transfer to project managers will result in increased knowledge flow in project management.	In-depth interview and literature review (Ekambaram & Økland, 2018; Haglund & Wåhlberg, 2015; Hlova, 2019; Tshuma et al., 2018; Voigt, 2009; Wei & Miraglia, 2017)
		Effective knowledge transfer to project managers will contribute to the reduction of repeated problems throughout the project.	In-depth interview and literature review (Ekambaram & Økland, 2018; Haglund & Wåhlberg, 2015; Hlova, 2019; Tshuma et al., 2018; Voigt, 2009; Wei & Miraglia, 2017)
		Effective knowledge transfer to project managers will help to keep the project's costs down.	In-depth interview and literature review (Ekambaram & Økland, 2018; Haglund & Wåhlberg, 2015; Hlova, 2019; Tshuma et al., 2018; Voigt, 2009; Wei & Miraglia, 2017)

Findings are discussed in details along with interview excerpts as follows:

4.1 Sender

4.1.1. Level of knowledge and transfer competency (factor no.1)

The interview results corroborated the literature review. All 12 respondents agreed that the sender's knowledge level and ability to transfer knowledge is a factor affecting knowledge transfer for software project managers. The sender must be knowledgeable and competent in project management, possess excellent communication, presentation, and knowledge transfer skills on both broadly and in depth, and be able to easily explain the content to the receiver, as demonstrated by the following interview excerpts:

> *"Occasionally, project managers perform admirably but are unable to communicate their abilities to the receivers. The person transferring must be able to communicate and transfer to the receiver in order for the receiver to comprehend the sender's thoughts, which includes not only education from textbooks, but also bringing real knowledge and experience to the receiver."* – JPM1

"We should develop positive relationships with learners and seek out individuals that are interested in participating in the beginning. Let us converse and play together to ensure that there are no disconnects between learners and lecturers. Utilize the tutorial to break the content into sections." – SPM6

4.1.2. Intention and motivation to transfer knowledge (factor no.2)

The interview outcome was consistent with the literature review. Ten contributors said that the motivation and intention of senders were factors that influence knowledge transfer for software project managers. The sender must be willing to pass on knowledge, pay attention to the receiver, and have a desire to develop people in their own careers. Examples of interview excerpts are as follows:

"Senders must be teaching people, closely supervise the students, keep simulating events and stimulating learners in different situations to show learners to visualize." – SPM1

"Senders must not be jealous of their own knowledge. Do not try to figure out how much knowledge the learners have and listen to the perspectives of the students. The senders must be friendly with the learners so that the learners have the courage to talk to them and not consider themselves superior." – JPM2

4.1.3 Extensive detail, grouping, and context for knowledge (factor no.3)

The findings of the interviews confirmed the literature review. Twelve respondents were questioned and agreed that specifics, groups, and a good understanding of the knowledge context influenced knowledge transfer for software project managers. The sender must employ effective instructional principles and methodologies, including continual training and knowledge verification, as demonstrated by the following interview excerpts:

"If trainers have teaching principles in place, such as describing what a project charter is and what deliverables are, they can communicate more effectively and help learners understand more concretely." – JPM1

"Must instill in learners an awareness of their issues and a desire to learn how to address them. We need to focus on teaching with a workshop for real practice, on teaching methods, on using content that is appropriate for learners, on creating a positive learning environment, on maintaining a teaching order, and on educating people to be honest by first bringing the learners' and teachers' emotions together. and teach without relying on books, but rather on actual practice, adapting knowledge to the learner's surroundings. You must recognize that you did not study for the exam." – SPM6

4.2 Receiver

It consists of 3 factors according to the potential factors.

4.2.1 Level of absorptive capacity (factor no.4)

The results of the interview matched those of the literature review. Ten respondents highlighted the belief that a software project manager's level of knowledge absorption capacity is a factor impacting knowledge transfer. The receivers must comprehend the content learned and organize their thoughts in accordance with the content, as well as interact with the senders to ensure their comprehension. The following are some examples of interview excerpts:

"If learners are adaptable and capable of swiftly learning and comprehending project management ideas, they will communicate more effectively with teachers." –SPM1

"If someone has the ability to comprehend what they have studied, there is a systematic order of cognitive processes in their head that facilitates thinking, analyzing, and making accurate distinctions, all of which contribute to good study." – JPM2

Furthermore, the findings recruit a new potential indicator within this factor: "The receiver must have inquiries and interactions with the sender". The following is an illustration of interview excerpts:

"The learner must interact with the educator, express ideas, consider them from a variety of angles, and ask the questions back to educator. While the educator is required to respond to these queries in order to ensure two-way communication." – SPM5

4.2.2 Intention and motivation to receive knowledge (factor no.5)

The results of the interview were in line with the literature review. All 12 interviewees agreed that a factor influencing knowledge transfer for software project managers is the receiver's motivation and willingness to learn. The receiver must have a love for project management and a desire to work in this profession, as well as an eagerness to learn, explore new chances for experimentation, set personal goals, and seek development and self-training. The following are some examples of interview outcomes:

> *"Not everyone has the ability to manage a project. You must consider how willing employees are to work in project management. How well do you understand this professional field? What are your thoughts on this line of work? How motivated are you to learn? Are you willing to fight in any circumstance?"* – SPM1

> *"You must be inquisitive and attempt to ask as many questions as possible in your brain. You are not required to consider complicated questions. You can even pose a brief question. Tell me what you don't know. Always be willing to learn. Personally, I believe that a successful project manager must be eager to learn, have a defined timeframe for learning, and then use that knowledge."* – JPM2

Moreover, the findings identify a new potential indicator for this factor: "The receiver must constantly acquire knowledge". The following is an example of interview excerpt:

> *"The learners must be proactive, ready to learn, and always collecting knowledge in order to swiftly grasp the project environment."* – SPM6

4.2.3 Trust in the sender (factor no.6)

The results of the interview coincided with the literature review. Trust in the sender is a factor impacting knowledge transfer for software project managers, according to ten contributors. The receiver must be receptive, show respect for, believe in, and trust the sender. As illustrated in the following interview excerpts:

> *"Typically, as people age, they work more, get more confidence in themselves, and become more sensitive to other people's comments, which prevents them from properly comprehending what they have learnt. As a result, learners must recognize that they do not know all about project management, without fluff or preconceived notions about the teachers, and attempt to open up and absorb what they teach us."* – JPM2

> *"Must appreciate and accept the instructor or have already known the instructor. Otherwise, they would disregard what was taught to them. There could also be disagreements with the instructor."* – SPM4

Additionally, the findings establish a new indicator for this factor: "The recipient must respect the sender.": "The receiver must respect the sender". The following is an excerpt from an interview.

> *"The learner must show respect for the instructor and have faith in him or her. This will help bridge the cultural divide."* – SPM1

4.3 Environment

It consists of 3 factors related to the potential factors.

4.3.1 Cultural similarities between the sender and receiver (factor no.7)

The interview results accorded with the literature review. Seven respondents viewed cultural compatibility between sender and receiver as a factor in knowledge transfer for software project managers. This culture also has an effect on how each project is managed. While five informants believed that such factors had no effect on knowledge transfer, the following interview excerpts demonstrate otherwise:

> *"In my experience, I've met foreign students from a variety of cultural backgrounds, which is rather prevalent in contemporary times. As a result, it is unrelated to and irrelevant to teaching and learning. Teachers must conform to the highest international standards in order to be qualified to teach anyone."* – SPM3

Additionally, two new indicators for this factor are established in the findings: "Both the sender and the receiver's temperaments must be compatible" and "The sender and receiver must interact in the same language, for example, Thai or English". The following excerpts are taken from interviews.

> *"The idea is that both sides' cultures, languages utilized during the transfer, and project management styles are relevant."* – JPM1

"Learners and teachers must understand one another's cultures, temperaments, and goals for learning and teaching. It will help them communicate more effectively with one another. For instance, if the Thai people's culture collides with that of Japanese professors. We must recognize that Japan handles projects in an orderly, precise, rigorous, and timely manner, whereas Thailand is more adaptable. If we comprehend one another's cultures, we will understand what the other person wishes to learn and teach. Also, it is crucial that both the learners and the teachers have similar temperaments" – JPM2

4.3.2 Technological level of knowledge transfer (factor no.8)

The results of the interview mirrored what was found in the literature. According to 11 informants, the technology level employed to impart knowledge is a factor that affects knowledge transfer for software project managers. Documents, gadgets, and software are all examples of technologies that are used to present, communicate, and measure knowledge transfer. The following are some examples of interview outcomes:

"Today's technology is critical since it benefits both parties and creates learning opportunities. This enables us to communicate more frequently without needing to meet in person every time. Additionally, it aids in resolving the issue of when teachers' and students' available time do not coincide. Today, numerous internet tools are available. These tools should also include questions for learners to answer." – SPM1

"The recipient should have tangible results from their education. The instructor should provide the homework but leave the answer unframed and have the student attempt it to demonstrate their comprehension. Teachers must select the appropriate technologies and resources. If the educator picks simple-to-understand tools, learning will be simple. Additionally, we should have a mechanism to teach online without physically meeting." – JPM3

Also, the findings identify two new indicators for this factor: "Knowledge transfer must be accompanied by visual representations" and "Knowledge transfer must be accompanied by computer animation". Excerpts from interviews are included below.

"In order to facilitate the transfer of knowledge, technology and equipment such as a whiteboard or a graphical presentation should be made readily available. Do not speak exclusively in the absence of these items." – JPM6

"Technology-assisted transfer is preferable to manual transfer, particularly for video clips, animations, or presentation slides." – SPM3

4.3.3 Level of open communication (factor no.9)

The interviews supported the literature review. Half of respondents evaluated the effect of open communication on knowledge transfer for software project managers. This type of communication includes candid exchanges throughout the transfer of knowledge. The remaining half of respondents believed that such a factor had no effect on knowledge transfer, as evidenced by the following interview excerpts:

"Students appreciate friendliness. Open communication facilitates learning. because students expressed their entire thought." – JPM3

Furthermore, two new indicators for this factor are identified in the findings: "The content transferred must have a legitimate cause for its origin" and "Knowledge transfer requires amicable conversation". Below are samples from interviews.

"A more effective transfer is contingent upon experience, technique, and preparation. It is dependent upon one's ability to educate using the material of one's own experience. That is, we can communicate in a variety of ways, depending on the individual." – SPM3

"Our messaging should be clear and transparent. Our communications should be clear, and any content transferred must have a justifiable reason for its origination." – SPM4

4.4 Control factor

Apart from those nine potential factors, the interview results showed the following new control elements that may affect knowledge transfer for software project managers: "Sender with greater expertise, and years of experience as a software project manager will transfer more efficiently", "Receiver with greater expertise, and years of experience as a software project manager will be more efficiently transferred" and "The transfer of

knowledge is more efficient when done with individuals of the opposing sex", as evidenced by the following interview excerpts:

> *"It is necessary for instructors to have extensive project management expertise. In both the wide and deep perspectives, it will improve knowledge transfer. Receiver will have little difficulty understanding."* – JPM6

> *"If the receivers are highly qualified and have previous experience working as a project manager, they will grasp the concept immediately."* – SPM2

> *"Sexes are frequently oppressed against one another. The transfer of knowledge between different sexes draws the attention of both parties' attention. make it more effective."* – JPM2

5. Discussion

The findings of this study comply with what has been discussed in the literature review with some new indicators having emerged. The authors summarized the findings in the table 3.

Table 3: Findings compare to literature

Past Literature	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Control factors
(Davenport & Prusak, 1998)	x			x						
(Quinn et al., 1998)							x			
(Osterloh & Frey, 2000)		x			x					
(Argote & Ingram, 2000)		x	x	x						
(Reagans & McEvily, 2003)						x				
(Sarker et al., 2003)	x			x			x		x	
(Simonin, 2004)		x	x		x					
(Zarinpoush & Gotlib Conn, 2006)	x		x			x		x	x	
(Eskerod & Skriver, 2007)							x			
(Jalil & Shahid, 2008)				x						
(Lockett et al., 2008)		x	x		x	x		x		
(Ajmal & Koskinen, 2008)							x			
(Porrawatpreyakorn et al., 2009)	x	x		x	x	x			x	
(Liyanage et al., 2009)	x	x		x	x		x	x		
(Al-Salti et al., 2011)	x	x	x	x		x				
(Al-Gharibeh, 2011)			x				x	x		
(Karlsen & Gottschalk, 2015)	x						x			
(Zhao et al., 2015)	x		x	x		x				
(Sutling et al., 2015)				x						
(Bellini et al., 2016)						x			x	
(Ibidunni et al., 2020)	x					x				
(Bacon et al., 2020)			x			x	x			
(Glaser et al., 2021)	x			x	x	x				
In-depth Interview										x

According to Table 2 (Origin of indicator) and Table 3 (Findings compare to literature), senders must have mastery of Knowledge of what they are transferring and must be capable of transferring information, as well as trustworthy and skilled in their field. Subsequently, their motivation to supply knowledge, intention to transmit knowledge, and willingness to do so on a regular basis are all required. They should also be familiar with the content of the knowledge transfer, be able to group it, and prioritize it in a progressive manner.

Simultaneously, receivers must be able to learn and possess prior understanding of project management, be eager to learn and motivated to do so, and have trust in the sender, a positive relationship with the sender, as well as respect for the sender. However, the author discovered that receivers must also engage in inquiries and exchanges with the sender and must constantly acquire knowledge.

Meanwhile, both senders and receivers must consider environmental variables, such as cultural context, technology, and direct communication. These indicators match the literature review. However, the findings reveal new emerging indicators, including temperament compatibility, same-language contact, visual representations, computer animation, content origin, and amicable dialogue.

Furthermore, the findings reveal previously unknown control indicators, including years of experience as a software project manager from both senders and receivers, as well as individuals of the opposite sex. This could be a set of indicators unique to software project managers in the context of Thailand.

6. Conclusions

The purpose of this study is to identify potential factors that influence knowledge transfer among software project managers at all levels. Based on the review of literature, the authors identified potential roles connected to knowledge transfer in the context of project manager, including sender, receiver, and environment roles. The authors also addressed a number of potential factors that play a part in such roles. Following the results of the interviews, it was discovered that these factors are consistently affecting knowledge transfer in the context of software project managers. Three new control factors, which are the number of years of experience in the role of software project manager of the sender, the number of years of experience in the role of software project manager of the receiver, and a distinction between sender and receiver's sexes were discovered. Also, some new indicators, which were not previously identified, were also uncovered.

The author believes that the findings of this study will be useful from both an academic and a practical standpoint. From an academic perspective, this study demonstrates the principles of knowledge transfer between project managers as well as the development of a body of knowledge at the individual level. It shed light on potential factors from three perspectives: that of the sender, that of the receiver, and that of the surrounding environment, Further research in other areas will benefit from these findings. Furthermore, these findings lend support to the elements' potential functions in knowledge transfer among project managers, which is useful in the practical world. Characteristics of both the sender and the receiver have been revealed in this context. Also demonstrated is the importance of environmental factors in knowledge transfer, as well as the proper potential element in such a context. Public institutions, commercial businesses, and entrepreneurs who are active in project management can use the factors as recommendations for project manager practice, improvement, and development to achieve a competitive advantage in the marketplace. Further research in this field could be undertaken to study the findings in greater depth using statistical methods compared against the control factors so that the potential factors may be validated across all factors.

Finally, the scope of this study is limited to the context of Thailand. Future research in a more international context could definitely be undertaken in order to develop the performance of software project managers worldwide.

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Critical Factors for a Successful Knowledge Management Implementation: A Systematic Literature Review

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Abstract: Nowadays, knowledge is considered a key resource for organizations, crucial for obtaining long-term sustainable competitive. In line with this principle, many organizations are making efforts toward the implementation of knowledge management (KM) initiatives, recognizing that their competitive foundation lies in the effective way to capture, retain, store and share knowledge. Although companies are increasingly competing based on their ability to effectively manage knowledge, there are still numerous challenges for organizations that intend to implement a KM system. Thus, for a successful implementation of KM in organizations, it is crucial to understand which factors are critical for the effectiveness of KM processes and lead to competitive advantage. Although there are many studies related to critical success factors of KM, few bring together the CSFs in a systematic and extensive manner. This paper aims to have a comprehensive and up-to-date view of the critical factors that lead to the success of KM implementations in organizations. Data was collected from a systematic literature review, using PRISMA flow diagram to summarize it. The critical success factors collected were standardized and categorized into categories and dimensions. In this sense, 25 categories of critical success factors were created and categorized in 4 dimensions: Organization, Technology, Knowledge and KM Capability, and External Influence. The results found suggest that factors related to the organization and people, such as the definition of a clear strategy, the definition of performance measures to evaluate and monitor the strategy, the involvement of top management, or even the organizational culture itself, represent some of the factors that have the most influence on the successful implementation of KM initiatives. With this research, it is expected to contribute from a theoretical perspective to the KM area through the compilation, categorization and classification of a set of critical success factors reported in the literature. From a practical perspective, the results of this study can help any organization, regardless of sector, supporting the preparation and improvement of strategies in this area.

Keywords: Knowledge management, Critical success factors, Systematic literature review, Knowledge management processes

1. Introduction

In recent decades, there has been a growing interest for organizations in knowledge management (KM) as a field of study. Nowadays, knowledge is considered a key resource for organizations, critical for obtaining long-term sustainable competitive advantage (Girard & Girard, 2015; Shivakumar & Pradeepkumar, 2019; Obeso et al., 2020). Many organizations are making efforts toward effective management activities, focusing not only in key processes, but also in knowledge management practices, to improve their efficiency (Bitkowska, 2015). A large part of the existing organizational knowledge is resident only in employees' mind, with a high risk of losing key knowledge with the exit of skilled employees (Slagter, 2007). For this reason, companies seek to convert individual knowledge, the combination of experiences and personal understanding, into organizational knowledge (Obeso *et al.*, 2020). Therefore, it is crucial for organizations to have mechanisms to ensure the utilization of useful knowledge. According to Paliszkiewicz (2011), to obtain a competitive advantage, a company must create and acquire new knowledge, transfer it to the right parts of the organization, interpret and integrate it with the existing one, to finally be used and achieve better performance.

The development of KM initiatives is supported by several tools and techniques for better managing knowledge processes, such as Communities of Practices, Knowledge Bases (e.g. Wiki) and Lessons Learned (Young, 2010). Although companies are increasingly competing based on their ability to effectively manage knowledge, there are still numerous challenges for organizations that intend to implement a KM system. Some of the most significant challenges facing organizations adopting knowledge management initiatives are related to people and culture; the lack of a "sharing" culture and understanding of KM benefits are great examples of obstacles to implementation (Yang, Yeh & Lee, 2010). Thus, for a successful implementation of knowledge management, it

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is crucial to understand which factors are critical for the effectiveness of knowledge management processes and lead to competitive advantage – the critical success factors (CSFs) of KM.

In the literature, many studies highlight the critical factors of KM implementation in organizations. For instance, Moffett, McAdam & Parkinson (2002) describe the development of a conceptual model for KM implementation, identifying a set of critical success factors. The number of studies related to Knowledge Management CSFs has been increasing over time due to the continual development in this field. However, these studies are very dispersed and few bring together the CSFs in a systematic and extensive manner, with no sector restrictions (Yang, Yeh & Lee, 2010; Sensuse et al., 2018). The literature lacks an up-to-date study with a holistic and comprehensive view of the CSFs of KM implementation. Therefore, it becomes extremely important to compile these success factors, since the way organizations live is also changing over time.

Yang, Yeh & Lee (2010) conducted a systematic literature review on the CSFs for the adoption of KM. Nevertheless, that research was undertaken in 2010 and may be outdated. Since KM is a dynamic and increasingly sought-after field, CSFs need continuous attention to ensure their sustainability. More recently, Sensuse *et al.* (2018) also conducted a systematic literature review on the same topic. However, it is a conference article with some restrictions, basing the research on 15 papers.

For the above reasons, the main motivation of this study is to have a comprehensive and up-to-date view of the critical factors that lead to the success of KM implementations in organizations. Today, organizations are increasingly dynamic and what works for one may not work for others. Consequently, a comprehensive and detailed study identifying KM factors common to a large number of organizations, with no sector or size restrictions, might be helpful for organizations. Naturally, there is always a need for adaptation according to each organization's reality. This research includes a systematic literature review with papers between 2000 and 2021.

On the other hand, since KM is considered by many authors as a process involving several activities (e.g. knowledge creation, capture, sharing and application) (Alavi & Leidner, 2001), it would also be interesting to study which KM processes are most important for organizations implementing KM, relating them to CSFs, if possible. Therefore, this research is directed towards these processes, with the additional objective of understanding which are the most outstanding processes in the literature. This review can be used to identify possible gaps in the literature and also to help organizations to understand how they can enhance the success of KM implementations.

2. Literature Review

Knowledge is a crucial resource for companies, playing a key role in organizational effectiveness. To improve organizational effectiveness it is important not only a constant focus on improving key processes but also an effective knowledge management during the process activities (Bitkowska, 2015).

In literature, several authors consider knowledge management as a process involving various activities (Alavi & Leidner, 2001). Although there is a wide range of terms to describe KM activities or processes, it is possible to find a consensus regarding their basic categories and concepts (Alavi & Leidner, 2001; Chedid, 2020). For this, some studies adopted four KM processes commonly used in literature and defined in the *'European guide for good practice in knowledge management'*, also considered by Chedid (2020):

1. Knowledge Creation: continuous process related to the acquisition of new contexts, new views and new knowledge, through the interactions amongst individuals or between individuals and their environment (Nonaka, Toyama & Konno, 2000);
2. Knowledge Capture: the inclusion of the knowledge into the existing knowledge base of an organization (Nielsen, 2006);
3. Knowledge Sharing: process of applying the created knowledge and sharing it from individual to individual or groups (Sun, 2010);
4. Knowledge Application: process of using effectively knowledge to fill a gap or need (Paliszkiewicz, 2011).

The interest in organizational knowledge has led to the implementation of KM in many organizations (Alavi & Leidner, 2001). To achieve a successful outcome, any KM practice must be based on three fundamental interdependent elements: people, processes and systems (technology) (Igbinovia & Ikenwe, 2018). KM involves

people, the main conveyor of knowledge, and the way they interact and share knowledge (Awad & Ghaziri, 2004; Igbinovia & Ikenwe, 2018). Processes are another important component, corresponding to the methods by which KM initiatives are achieved. Igbinovia & Ikenwe (2018) state that people firstly design and then operate processes, while processes define the roles and knowledge needed by people. Lastly, systems or technologies are devices that support the implementation of KM, in particular the people and processes involved (Igbinovia & Ikenwe, 2018).

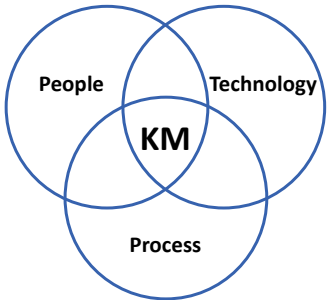

Figure 1: Core Elements of Knowledge Management

The decision of implementing knowledge management must be well considered, since it requires a major shift in organizational culture and a commitment at all levels of an organization to be successful (Gupta, Iyer & Aronson, 2000). Indeed, according to Awad & Ghaziri (2004), the biggest challenge in KM is explaining what it is and how it can benefit a corporate environment. If the culture does not encourage cooperation and trust, employees will not cooperate (Awad & Ghaziri, 2004).

In this sense, understanding the critical success factors (CSFs) of KM implementation might be a huge advantage for organizations, reducing the risk of failure (Othman et al., 2018). According to Othman *et al.* (2018), many researchers defined the critical success factors (CSFs) as "the keys in which acceptable outcomes would result in accomplished competitive performance". In this area, the CSFs are activities and actions needed to implement KM successfully (Ghomi & Barzinpour, 2018). The identification of these factors will support organizations to better evaluate the status of KM implementation and identify improvements (Theriou, Maditinos & Theriou, 2011).

According to Othman et al. (2018), several researchers indicate leadership, resources, information technology (IT) and culture as vital factors for a successful KM implementation. In the study of Ghomi & Barzinpour (2018), which was taken in a university, the authors found the following critical success factors of using KM tools: (i) human-motivational factors (motivation, resources, human resource management); (ii) information technology; (iii) education; (iv) leadership and management support; (v) processes and activities; (vi) structure; (vii) culture; (viii) measurement; (ix) organizational infrastructure; strategy and goal; and (x) communication.

3. Material and Methods

The methodology used for this research is a systematic literature review (SLR). Denyer & Tranfield (2009) defined a SLR as "a specific methodology that locates existing studies, selects and evaluated contributions, analysis and synthesizes data, and reports the evidence in such a way that allows reasonably clear conclusions to be reached about what is and is not known". This study follows the five established steps presented by Denyer & Tranfield (2009), illustrated in figure 2 and described below.

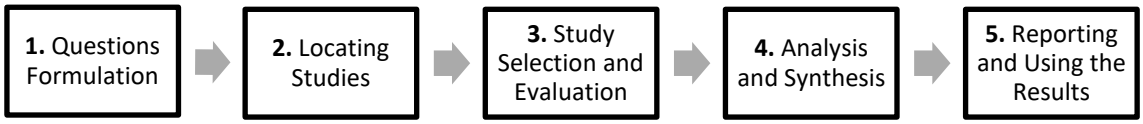

Figure 2: Five SLR steps

3.1 Step 1: Questions Formulation

This step aims to establish the focus and purpose of the research, asking framed questions. The purpose of this research is to analyse the state of knowledge that exists in the literature related to the CSFs of KM practices. Since the KM field is very oriented to KM processes, this research is directed towards there processes, with the

additional objective of understanding which are the most outstanding processes in the literature, formulating the following questions:

- What are the main CSFs for implementing knowledge management strategies in organizations?
- At the level of the CSFs identified, what are the most relevant KM processes for companies implementing KM initiatives?

It should be noted that this study focuses on four KM processes: Knowledge creation, Knowledge sharing, Knowledge capture and Knowledge application.

3.2 Step 2: Locating Studies

This step involves the identification of relevant studies, including search terms, based on key-words and concepts directly related to the research questions, in proper databases (Snyder, 2019).

The authors made several attempts before establishing the final search string. To avoid losing important results, besides the KM processes identified previously, the authors also considered in the keywords other processes also widely cited in the literature that could be related to the previous ones: knowledge transfer, knowledge storage and acquisition, as well as KM processes in general.

With the final search string (Figure 3), the author performed a search on March 06, 2022, in Scopus database, since it is multidisciplinary and offers the widest coverage of papers throughout the available databases (Mongeon & Paul-Hus, 2016). Initially, a total of 239 hits were found.

3.3 Step 3: Study Selection and Evaluation

The purpose of this phase is to use a set of selection criteria to assess the relevance of each research for answering the review questions and discard those that do not meet the criteria (Denyer & Tranfield, 2009).

In this research, the search was limited to articles published in English and Portuguese, which are the languages that the authors understand. All the articles with no author identification were also excluded. With the application of these criteria, a total of 223 publications were selected out of the 239 initially identified. Afterward, the authors examined the title, abstract and keywords, which made it possible to determine the articles that were clearly related, or not, to the research question. In this process, the authors found many articles related to knowledge management, however, without reference to critical success factors, therefore they were excluded. On the other hand, articles mentioning CSFs but not related to KM initiatives were also excluded. Additionally, in some articles, the authors could not conclude by reading only the title and abstract, so these were not excluded and moved to the next phase. A total of 89 publications were selected for further analysis.

3.4 Step 4: Analysis and Synthesis

This step aims to review and analyse each of the selected articles, reading them in their entirety. Thus, it is possible to break down individual studies into different topics and describe how each relates to the other, allowing to reformulate the information and develop knowledge that is not apparent from the isolated reading of studies (Denyer & Tranfield, 2009).

Of the 89 articles selected previously, there were 17 studies that the authors could not obtain in full text. After reading the remaining 72 articles, 21 papers with no relevant content were also excluded, since they did not meet the selection criteria, with a final total of 51 articles obtained and included in this research.

During this synthesis process, a database was created in a spreadsheet containing, among other data collected, the main contributions of each paper, the CSFs mentioned and KM processes that address. Other complementary information was also identified, such as the author, title, year of publication, journal and methodology followed in each study.

3.5 Step 5: Reporting and Using the Results

This step aims at reporting the main results of the analysis and synthesis of the selected papers (Denyer & Tranfield, 2009). The information extracted from the studies has been combined and categorized; in this way, the results can be discussed and any research gaps and future research can also be identified.

In order to summarize the SLR followed in this study, the authors used the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) flow diagram, shown in figure 3, since it is widely accepted for both meta-analysis and systematic reviews (Liberati *et al.*, 2009).

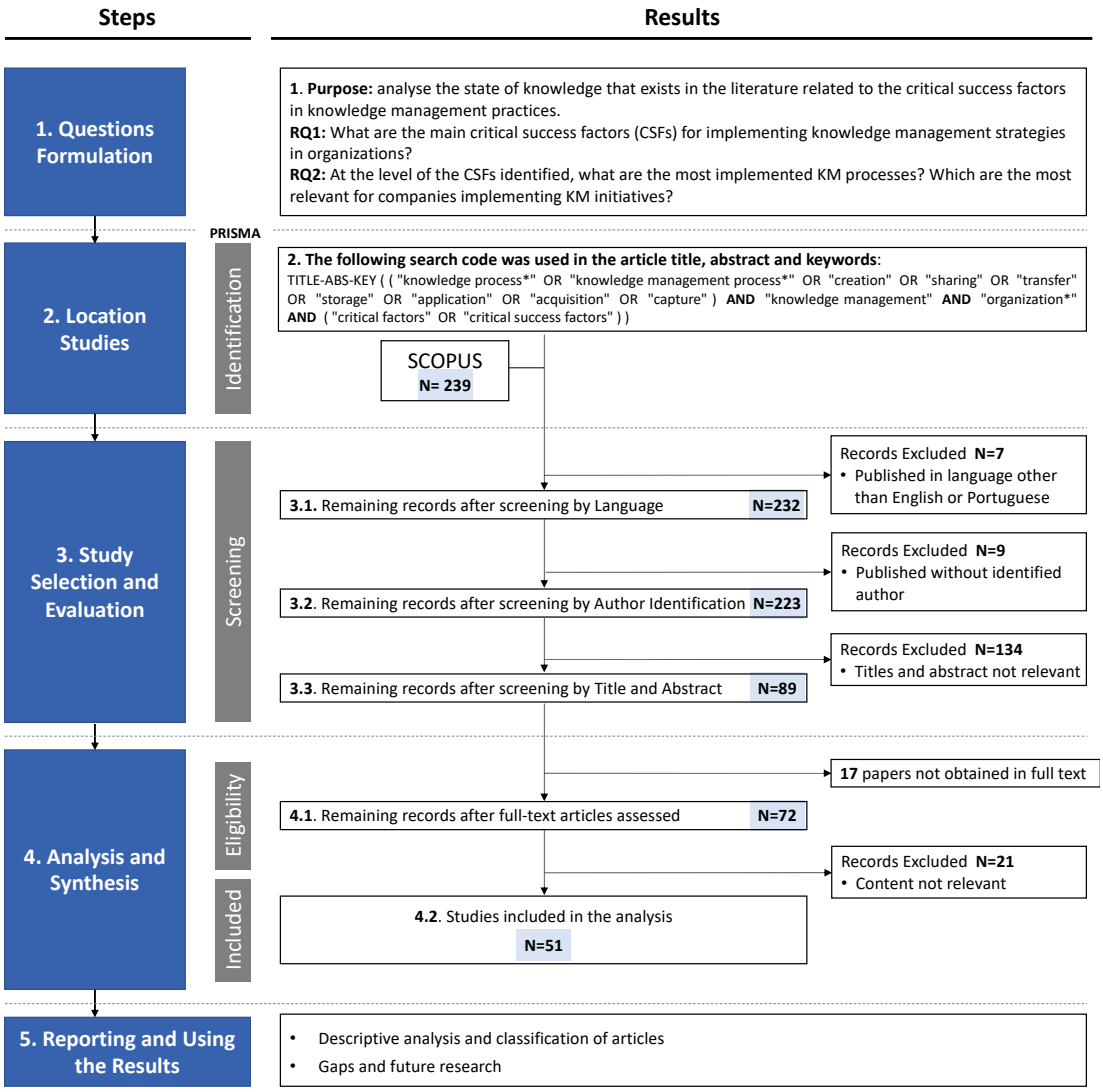

Figure 3: Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) methodology

4. Results

4.1 Overview of the included articles

Figure 4 shows that the papers obtained were published between 2000 and 2021 and the preferred way to publish research is via journals. Most of the articles are published between 2006 and 2010. In 2018 and 2020, the number of publications increased considerably again. Most of the journals and conference papers have only one article published. However, it is important to highlight the "Journal of Knowledge Management", the journal with more published articles (five).

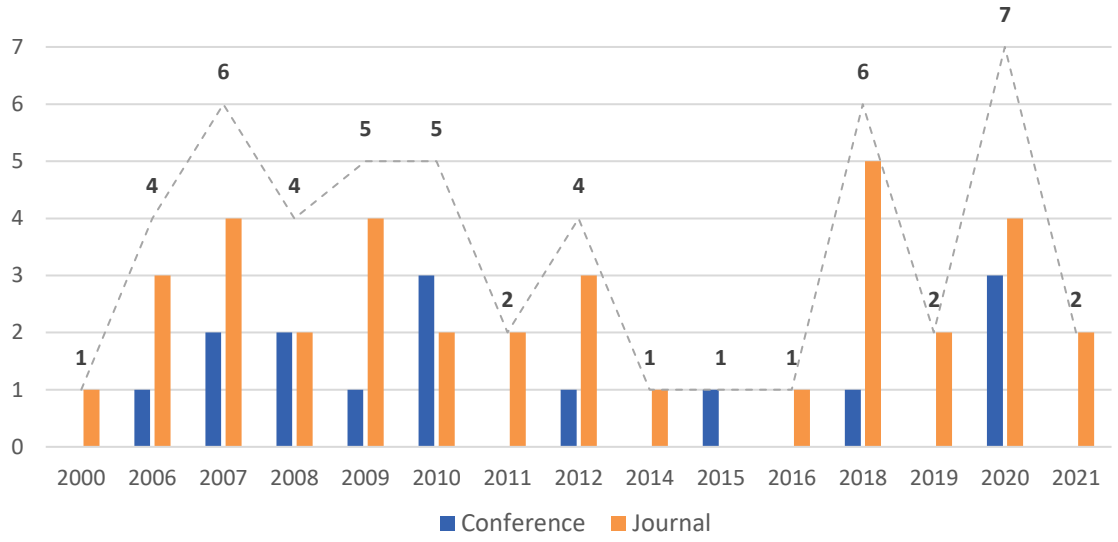

Figure 4: Papers Distribution Over Time

Regarding the methodology used (Figure 5), quantitative studies are most common, followed by qualitative studies. Generally, the studies applying quantitative methodology use questionnaires to collect data, processing it with statistical techniques such as descriptive analysis, factor analysis, multiple regressions, among others. In terms of qualitative methodology, the most used techniques are interviews with experts and case studies. Additionally, conceptual studies focus on the development of conceptual frameworks and have no empirical content.

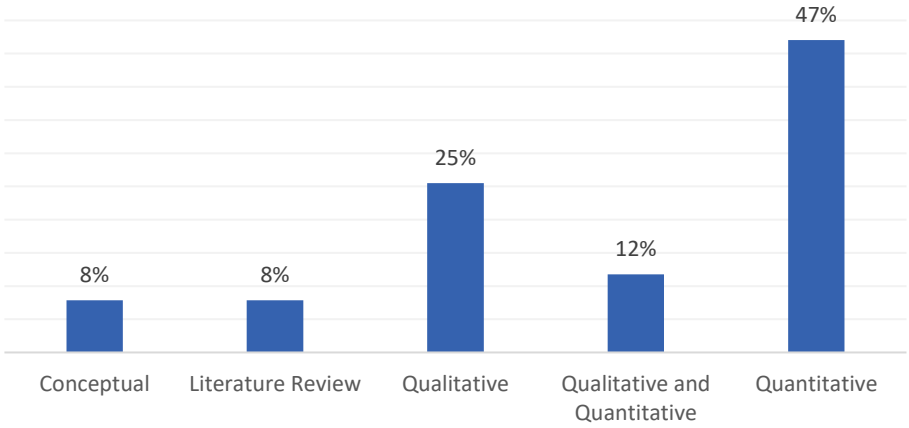

Figure 5: Papers Distribution by Methodology used

4.2 Main CSFs Identified

Through the analysis of the 51 articles, it was possible to extract 524 critical factors. To facilitate the analysis of these factors, 4 iteration stages were performed (figure 6).

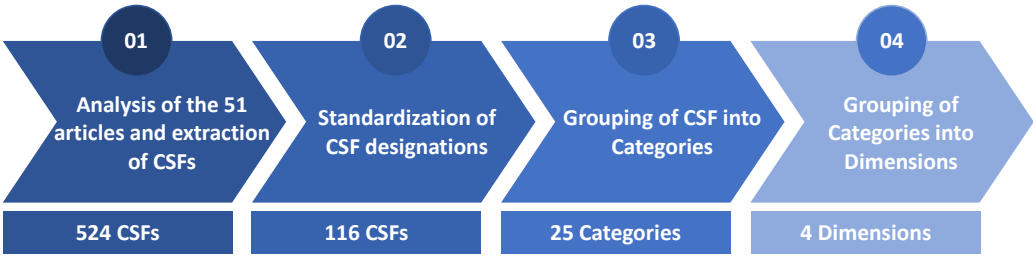

Figure 6: Steps for CSF Compilation

After the extraction of 524 CSFs, the authors removed duplicated factors and standardized the designations, using generic terms that represent synonyms. Some factors are present in several articles, with the same meaning but using different terms. For example, to refer the "alignment between KM strategy and business needs" factor, Mathew & Rodrigues (2019) presented "KM strategy aligned with organizational strategy" and du Plessis (2007) referred as "linking KM strategy to the business strategy". In addition, some authors presented the factors in more detail than others - for example, Ghomi & Barzinpour (2018) presented "Culture" as a CSF in a general way, unlike Alsadhan, Zairi, & Keoy (2008) which referred "Trust", "Openness", "Collaboration" and "Acceptance of Knowledge Sharing & Reuse" as CSF related to Culture. Other authors presented 2 factors in only 1 item – for example, Damodaran & Olphert (2000) presented "appropriate communication, training and support" as a unique factor, but for Xiong & Deng (2008), "effective communication" and "training" are two separate factors. With this first iteration, it was possible to standardize the 524 CSFs in 116 different factors.

The next step was to group similar factors into categories. In providing names for each category, the authors took care to ensure that these names were representative of the factors in question as much as possible. A total of 25 categories were obtained. Some factors did not have any similar factors and therefore some categories refer to only one factor (e.g. Benchmarking).

Finally, due to the high number of categories, the 25 categories were grouped into 4 dimensions. Figure 7 shows the dimensions and respective categories created, as well as the number of papers that cited each category, which provides valuable information about the popularity of these factors. There are more important factors than others, or at least, cited more frequently in the literature. Indeed, factors related to the organization are the most relevant, especially the organizational culture, which is the most cited category. Categories such as KM Strategy, Top Management Support and Leadership and Training should also be highlighted. In addition, regarding the technology dimension, IT Application was also one of the most cited categories in the literature.

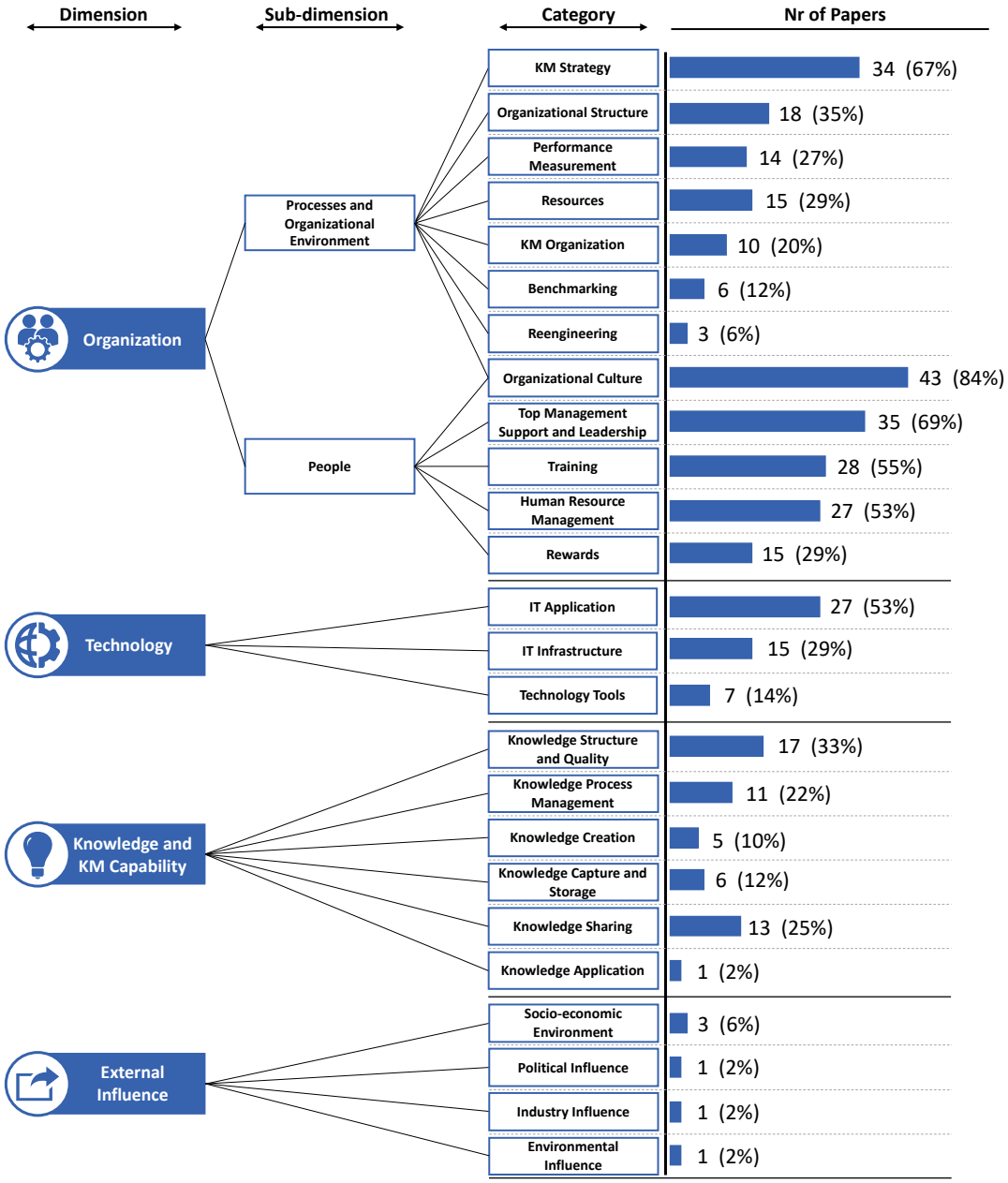

Figure 7: CSFs of KM: Dimensions and Categories

An overview of each CSF category is provided below.

4.2.1 CSFs: Organization Dimension

This dimension presents all categories directly related to the organization and is divided into two sub-dimensions: i) processes and organizational environment and ii) people.

Processes and organizational environment contain factors related to the structure of the organization, which must be flat and flexible, KM strategy, resources and processes carried out in the implementation of the KM program. People sub-dimension includes people-related factors, such as motivational or personal development factors, essential for the development of KM initiatives. The organizational culture category, despite being related to the organization, may belong to both sub-dimensions. Culture is related to people, as they think and act, but also belongs to the environment of the organization as a whole.

Table I presents all the critical success factors identified in the literature for each category belonging to the Organization dimension.

Table I: Critical Success Factors of KM: Organization Dimension

Category	Critical Success Factors	Citations
KM Strategy	**1.** Alignment between KM strategy and business needs; **2.** Clearly articulated KM Strategy; **3.** Communication and Marketing; **4.** Holistic approach; **5.** KM Strategy; **6.** KM Value Proposition; **7.** Integration with other initiatives and work practices; **8.** Strategic Planning; **9.** Pilot; **10.** User Orientation; **11.** Enterprise-wide and business unit specific needs	(Damodaran & Olphert, 2000; Ahmed & Hegazy, 2006; Artail, 2006; Akhavan, Jafari, & Fathian, 2006; Butler & Murphy, 2007; R. S. Chen & Hsiang, 2007; Jafari et al., 2007; du Plessis, 2007; Peszynski, Cooper & Molla, 2008; Xiong & Deng, 2008; Alsadhan, Zairi & Keoy, 2008; Bishop et al., 2008; Chang et al., 2009; Lo & Chin, 2009; Mohammadi, Khanlari & Sohrabi, 2009; Aggestam & Persson, 2010; Kant & Singh, 2010; Yang, Yeh & Lee, 2010; Altaher, 2010; Theriou, Maditinos & Theriou, 2011; Arif & Shalhoub, 2014; Tessier & Dalkir, 2016; Al-Hakim & Hassan, 2016; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Nazarizade & Azizi, 2018; Othman et al., 2018; Koloniari, Vraimaki & Fassoulis, 2018; Mathew & Rodrigues, 2019; Heryanto, Aulawi & Munthe, 2020; Yap & Toh, 2020; Zain & Latief, 2020; Romero-Hidalgo et al., 2021)
Organizational Structure	**12.** Organizational structure; **13.** Flat structure; **14.** Flexible structure; **15.** Formalization; **16.** Centralization; **17.** Decentralization	(Akhavan, Jafari, & Fathian, 2006; Jafari et al., 2007; Alsadhan, Zairi & Keoy, 2008; Mohammadi, Khanlari & Sohrabi, 2009; Xu, Zhao & Wang, 2009; Akhavan, Hosnavi & Sanjaghi, 2009; Yang, Yeh & Lee, 2010; Sadovykh & Sundaram, 2015; Al-Hakim & Hassan, 2016; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Nazarizade & Azizi, 2018; Koloniari, Vraimaki & Fassoulis, 2018; Mathew & Rodrigues, 2019; Biloslavo, Kljajić-Dervić & Dervić, 2019; Artini, Wati & Afrizal, 2020; Yap & Toh, 2020; Aldehayyat, Almohtasb & Alsoboa, 2021)
Performance Measurement	**18.** Performance Measurement; **19.** Financial performance; **20.** Non-financial performance; **21.** KM progress tracking and measurement; **22.** Business performance	(Ahmed & Hegazy, 2006; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Xu, Zhao & Wang, 2009; Chang et al., 2009; Akhavan, Hosnavi & Sanjaghi, 2009; Yang, Yeh & Lee, 2010; Kant & Singh, 2010; Arif & Shalhoub, 2014; Nazarizade & Azizi, 2018; Othman et al., 2018; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Mathew & Rodrigues, 2019)
Resources	**23.** Availability of resources; **24.** Financial resources; **25.** Free time and space; **26.** Use of consultants; **27.** Customer and knowledge supplier relationships	(Artail, 2006; Chen & Hsiang, 2007; Jafari et al., 2007; Alsadhan, Zairi & Keoy, 2008; Lo & Chin, 2009; Chang et al., 2009; Kant & Singh, 2010; Nazarizade & Azizi, 2018; Othman et al., 2018; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Mathew & Rodrigues, 2019; Artini, Wati & Afrizal, 2020; Heryanto, Aulawi & Munthe, 2020; Barua, 2021)
KM Organization	**28.** Chief Knowledge Officer; **29.** KM Champions and Leaders; **30.** KM Department; **31.** Specialized KM team; **32.** KM roles and responsibilities; **33.** Clearly defined knowledge ownership; **34.** Knowledge communities; **35.** Network of experts	(Butler & Murphy, 2007; Slagter, 2007; Jafari et al., 2007; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Bishop et al., 2008; Xu, Zhao & Wang, 2009; Akhavan, Hosnavi & Sanjaghi, 2009; Ghomi & Barzinpour, 2018; Mathew & Rodrigues, 2019)
Benchmarking	**36.** Benchmarking	(Alsadhan, Zairi, & Keoy, 2008; Akhavan, Hosnavi & Sanjaghi, 2009; Kant & Singh, 2010; Gunasekera & Chong, 2018; Othman et al., 2018; Barua, 2021)
Reengineering	**37.** Reengineering	(Akhavan, Jafari & Fathian, 2006; Butler & Murphy, 2007; Jafari et al., 2007)

Category	Critical Success Factors	Citations
Organizational Culture	**38.** Organizational Culture; **39.** Collaboration; **40.** Trust; **41.** Common vision and goals; **42.** Knowledge creating and sharing culture; **43.** Knowledge-centered culture; **44.** Learning culture; **45.** Learning from failure; **46.** Teamwork; **47.** Transparency; **48.** Openness; **49.** Readiness to accept the new system; **50.** Risk-taking climate	(Damodaran & Olphert, 2000; Ahmed & Hegazy, 2006; Artail, 2006; Lin & Lin, 2006; Akhavan, Jafari, & Fathian, 2006; Butler & Murphy, 2007; R. S. Chen & Hsiang, 2007; Slagter, 2007; Jafari et al., 2007; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Peszynski, Cooper & Molla, 2008; Xiong & Deng, 2008; Chang et al., 2009; Lo & Chin, 2009; Mohammadi, Khanlari & Sohrabi, 2009; Xu, Zhao & Wang, 2009; Akhavan, Hosnavi & Sanjaghi, 2009; Aggestam & Persson, 2010; Altaher, 2010; Kant & Singh, 2010; Yang, Yeh & Lee, 2010; Theriou, Maditinos & Theriou, 2011; Atanda, Dominic & Mahmood, 2012; Cardoso, Meireles & Peralta, 2012; Lee, Gon Kim & Kim, 2012; Arif & Shalhoub, 2014; Sadovykh & Sundaram, 2015; Al-Hakim & Hassan, 2016; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Nazarizade & Azizi, 2018; Othman et al., 2018; Koloniari, Vraimaki & Fassoulis, 2018; Ganapathy, Mansor & Ahmad, 2019; Mathew & Rodrigues, 2019; Biloslavo, Kljajić-Dervić & Dervić, 2019; Artini, Wati & Afrizal, 2020; Heryanto, Aulawi & Munthe, 2020; Nyame & Qin, 2020; Vyas, Bhalla & Najneen, 2020; Yap & Toh, 2020; Zain & Latief, 2020; Romero-Hidalgo et al., 2021)
Top Management Support and Leadership	**51.** Top management support; **52.** Leadership	(Damodaran & Olphert, 2000; Ahmed & Hegazy, 2006; Artail, 2006; Lin & Lin, 2006; Akhavan, Jafari, & Fathian, 2006; Butler & Murphy, 2007; Chen & Hsiang, 2007; Slagter, 2007; Jafari et al., 2007; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Peszynski, Cooper & Molla, 2008; Xiong & Deng, 2008; Bishop et al., 2008; Lo & Chin, 2009; Mohammadi, Khanlari & Sohrabi, 2009; Altaher, 2010; Kant & Singh, 2010; Yang, Yeh & Lee, 2010; Theriou, Maditinos & Theriou, 2011; Lee, Gon Kim & Kim, 2012; Arif & Shalhoub, 2014; Al-Hakim & Hassan, 2016; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Nazarizade & Azizi, 2018; Othman et al., 2018; Koloniari, Vraimaki & Fassoulis, 2018; Ganapathy, Mansor & Ahmad, 2019; Mathew & Rodrigues, 2019; Biloslavo, Kljajić-Dervić & Dervić, 2019; Artini, Wati & Afrizal, 2020; Heryanto, Aulawi & Munthe, 2020; Nyame & Qin, 2020; Yap & Toh, 2020; Zain & Latief, 2020; Aldehayyat, Almohtasb & Alsoboa, 2021; Barua, 2021)
Training	**53.** Training	(Damodaran & Olphert, 2000; Ahmed & Hegazy, 2006; Artail, 2006; Akhavan, Jafari, & Fathian, 2006; Butler & Murphy, 2007; Slagter, 2007; Jafari et al., 2007; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Xiong & Deng, 2008; Chang et al., 2009; Lo & Chin, 2009; Mohammadi, Khanlari & Sohrabi, 2009; Jafari et al., 2010; Kant & Singh, 2010; Yang, Yeh & Lee, 2010; Cardoso, Meireles & Peralta, 2012; Arif & Shalhoub, 2014; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Nazarizade & Azizi, 2018; Othman et al., 2018; Koloniari, Vraimaki & Fassoulis, 2018; Mathew & Rodrigues, 2019; Heryanto, Aulawi & Munthe, 2020; Yap & Toh, 2020; Zain & Latief, 2020; Romero-Hidalgo et al., 2021)

Category	Critical Success Factors	Citations
Human Resource Management	**54.** Human Resource Management; **55.** Human Resources; **56.** Employee commitment; **57.** Employee empowerment; **58.** Employee involvement; **59.** Employee motivation; **60.** Employee retention; **61.** Human capital; **62.** Job security	(Ahmed & Hegazy, 2006; Butler & Murphy, 2007; R. S. Chen & Hsiang, 2007; Hsu et al., 2007; Alsadhan, Zairi & Keoy, 2008; Mohammadi, Khanlari & Sohrabi, 2009; Akhavan, Hosnavi & Sanjaghi, 2009; Jafari et al., 2010; Kant & Singh, 2010; Chen et al., 2011; Theriou, Maditinos & Theriou, 2011; Atanda, Dominic & Mahmood, 2012; Cardoso, Meireles & Peralta, 2012; Arif & Shalhoub, 2014; Al-Hakim & Hassan, 2016; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Nazarizade & Azizi, 2018; Othman et al., 2018; Ganapathy, Mansor & Ahmad, 2019; Mathew & Rodrigues, 2019; Biloslavo, Kljajić-Dervić & Dervić, 2019; Artini, Wati & Afrizal, 2020; Yap & Toh, 2020; Zain & Latief, 2020; Aldehayyat, Almohtasb & Alsoboa, 2021; Barua, 2021)
Rewards	**63.** Incentives and rewards	(Ahmed & Hegazy, 2006; Lin & Lin, 2006; Butler & Murphy, 2007; Chen & Hsiang, 2007; Slagter, 2007; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Bishop et al., 2008; Mohammadi, Khanlari & Sohrabi, 2009; Xu, Zhao & Wang, 2009; Yang, Yeh & Lee, 2010; Ganapathy, Mansor & Ahmad, 2019; Mathew & Rodrigues, 2019; Biloslavo, Kljajić-Dervić & Dervić, 2019; Yap & Toh, 2020)

4.2.2 CSFs: Technology Dimension

Technology is considered one of the critical enablers of KM (Theriou, Maditinos & Theriou, 2011; Mathew & Rodrigues, 2019). This dimension includes the application of information technology in general, technology tools to be used in the KM system, as well as some important factors related to the effectiveness and security of the system infrastructure.

Table II presents the critical success factors identified for each category of the Technology dimension.

Table II: Critical Success Factors of KM: Technology Dimension

Category	Critical Success Factors	Citations
IT Application	**64.** IT Application; **65.** Balance between people and IT; **66.** Technology; **67.** Learner-focused technology; **68.** Alignment between business and technology; **69.** Friendly and easy to use KM system; **70.** KM system design	(Damodaran & Olphert, 2000; Artail, 2006; Lin & Lin, 2006; Butler & Murphy, 2007; R. S. Chen & Hsiang, 2007; Jafari et al., 2007; du Plessis, 2007; Bishop et al., 2008; Chang et al., 2009; Xu, Zhao & Wang, 2009; Altaher, 2010; Yang, Yeh & Lee, 2010; Theriou, Maditinos & Theriou, 2011; Atanda, Dominic & Mahmood, 2012; Lee, Gon Kim & Kim, 2012; Sadovykh & Sundaram, 2015; Al-Hakim & Hassan, 2016; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Nazarizade & Azizi, 2018; Othman et al., 2018; Koloniari, Vraimaki & Fassoulis, 2018; Mathew & Rodrigues, 2019; Biloslavo, Kljajić-Dervić & Dervić, 2019; Heryanto, Aulawi & Munthe, 2020; Zain & Latief, 2020; Barua, 2021)
IT Infrastructure	**71.** Effective IT infrastructure; **72;** Access to network infrastructure and hardware; **73.** Security	(Ahmed & Hegazy, 2006; Artail, 2006; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Lo & Chin, 2009; Mohammadi, Khanlari & Sohrabi, 2009; Aggestam & Persson, 2010; Arif & Shalhoub, 2014; Othman et al., 2018; Artini, Wati & Afrizal, 2020; Heryanto, Aulawi & Munthe, 2020; Nyame & Qin, 2020; Yap & Toh, 2020; Aldehayyat, Almohtasb & Alsoboa, 2021; Romero-Hidalgo et al., 2021)
Technology tools	**74.** Collaborative tools; **75.** Effective KM tools; **76.** Functions of KMS; **77.** Knowledge repository	(Damodaran & Olphert, 2000; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Jafari et al., 2010; Mathew & Rodrigues, 2019; Heryanto, Aulawi & Munthe, 2020; Romero-Hidalgo et al., 2021)

4.2.3 CSFs: Knowledge and KM Capability Dimension

This dimension includes factors related to the structure and quality of knowledge to be used, the knowledge processes management in general and also the KM processes capability, which in turn is related to the efficiency of each KM process in the organization.

The critical success factors of this dimension are summarized in table III.

Table III: Critical Success Factors of KM: Knowledge and KM Capability Dimension

Category	Critical Success Factors	Citations
Knowledge Structure and Quality	**78.** Flexible knowledge structure; **79.** Knowledge structure and map; **80.** Knowledge architecture; **81.** Nature of knowledge; **82.** Quality of information; **83.** Variety of knowledge sources	(Akhavan, Jafari, & Fathian, 2006; Jafari et al., 2007; du Plessis, 2007; Alsadhan, Zairi & Keoy, 2008; Chang et al., 2009; Mohammadi, Khanlari & Sohrabi, 2009; Xu, Zhao & Wang, 2009; Akhavan, Hosnavi & Sanjaghi, 2009; Aggestam & Persson, 2010; Yang, Yeh & Lee, 2010; Atanda, Dominic & Mahmood, 2012; Arif & Shalhoub, 2014; Gunasekera & Chong, 2018; Othman et al., 2018; Mathew & Rodrigues, 2019; Artini, Wati & Afrizal, 2020; Nyame & Qin, 2020)
Knowledge Process Management	**84.** KM processes and procedures; **85.** KM processes easy to follow; **86.** Knowledge process management; **87.** Managing explicit and tacit knowledge; **88.** Managing knowledge throughout its lifecycle; **89.** Mechanism to approve activities; **90.** Precise KM processes	(Lin & Lin, 2006; du Plessis, 2007; Chang et al., 2009; Lo & Chin, 2009; Jafari et al., 2010; Ghomi & Barzinpour, 2018; Gunasekera & Chong, 2018; Nazarizade & Azizi, 2018; Othman et al., 2018; Zain & Latief, 2020; Romero-Hidalgo et al., 2021)
Knowledge Creation	**91.** Knowledge Creation; **92.** Innovation	(Ahmed & Hegazy, 2006; Kant & Singh, 2010; Yang, Yeh & Lee, 2010; Nyame & Qin, 2020; Romero-Hidalgo et al., 2021)
Knowledge Capture and Storage	**93.** Knowledge capture; **94.** Knowledge storage; **95.** Knowledge identification	(Ahmed & Hegazy, 2006; Akhavan, Jafari, & Fathian, 2006; Akhavan, Hosnavi & Sanjaghi, 2009; Chang et al., 2009; Zain & Latief, 2020; Romero-Hidalgo et al., 2021)
Knowledge Sharing	**96.** Knowledge Sharing; **97.** Multiple channels for knowledge sharing; **98.** Specialized meetings, conferences and seminars; **99.** Procedural design needs to help to establish a loop of knowledge-sharing	(Ahmed & Hegazy, 2006; Artail, 2006; Akhavan, Jafari, & Fathian, 2006; R. S. Chen & Hsiang, 2007; Jafari et al., 2007, 2010; du Plessis, 2007; Chang et al., 2009; Yang, Yeh & Lee, 2010; Kant & Singh, 2010; Atanda, Dominic & Mahmood, 2012; Gunasekera & Chong, 2018; Yap & Toh, 2020)
Knowledge Application	**100.** Knowledge Application	(Yang, Yeh, & Lee, 2010)

4.2.4 CSF: External Influence Dimension

This dimension focuses on factors that are beyond the organization's control, allowing organizations to identify threats and opportunities and map them to their strengths and weaknesses in projects execution (Gunasekera & Chong, 2018). It includes socio-economic, political, industry and environmental influence factors.

Table IV presents the critical success factors of external influence.

Table IV: Critical Success Factors of KM: External Influence Dimension

Category	Critical Success Factors	Citations
Socio-economic Environment	**101.** Socio-economic environment; **102.** Economic climates; **103.** Economic stability; **104.** People affected because of the project activities; **105.** People benefiting from the project; **106.** Sound economic policy; **107.** Surrounding neighbours affected because of the project activities	(Sadovykh & Sundaram, 2015; Gunasekera & Chong, 2018; Othman et al., 2018)
Political Influence	**108.** Sources of finance; **109.** Confidence of politicians; **110.** Regulations; **111.** Adaptability to amendment of project plans	(Gunasekera & Chong, 2018)
Industry Influence	**112.** Availability of external resources; **113.** Subcontractors and suppliers; **114.** Market prices of materials and labour	(Gunasekera & Chong, 2018)
Environmental Influence	**115.** Ground conditions of projects; **116.** Weather conditions	(Gunasekera & Chong, 2018)

4.3 KM Processes

The authors also identified which KM processes were used and/or highlighted throughout the articles under study. As previously mentioned, this research focuses on four main KM processes. It should be noted that some authors identified other very similar processes that fit into the four initial processes (e.g. knowledge transfer was considered as knowledge sharing, due to the similarities of these processes in the literature). Additionally, knowledge storage was also widely cited and, for this reason, was grouped into "Knowledge Capture and Storage", since the capture process can be defined as the inclusion of knowledge into the existing knowledge base of an organization (Nielsen, 2006). Figure 8 summarizes the frequency of citations of the KM processes identified.

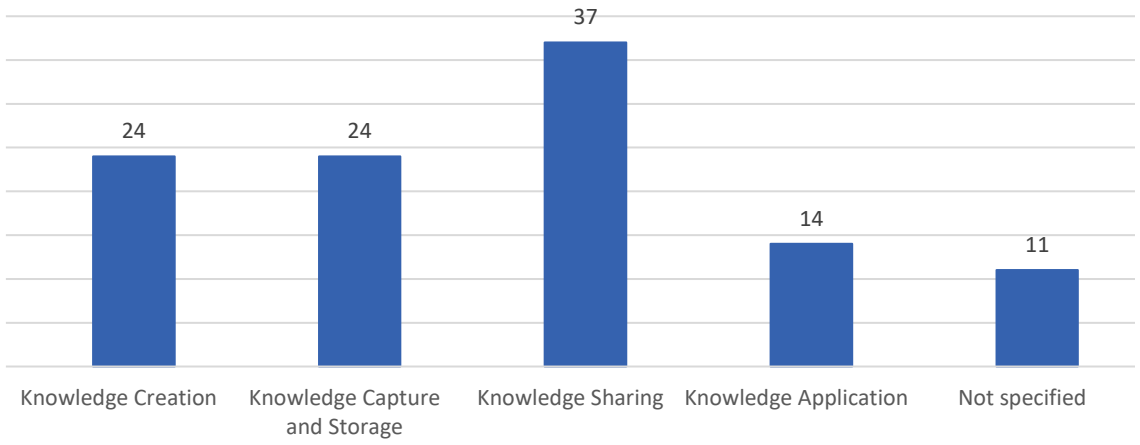

Figure 8: KM Processes Citations

Figure 8 shows that Knowledge Sharing is the most cited process, where there is more focus when implementing KM practices, followed by Knowledge Capture and Storage and Knowledge Creation. In fact, organizations also look for methods and techniques for knowledge creation and capture, with the subsequent objective of being shared among the organization.

Knowledge Application was explicitly mentioned only 14 times, but it does not mean that this process is less relevant. Although KM processes are almost always mentioned in the literature review section of the articles, not all papers focus on the processes most used in the KM strategies - 12 articles did not highlight any specific KM process.

It should be noted that, in general, when presenting the CSFs, the authors of the articles did not relate them to just one particular KM process, but to the KM initiative or strategy as a whole.

5. Discussion and Conclusions

As has been mentioned previously, knowledge management is a complex field, increasingly sought by organizations that want to improve processes and ensure the use of useful knowledge to gain long-term competitive advantage. Although there are several methodologies, there is no single comprehensive or integrated approach to implement KM projects, therefore it is crucial to look at what other organizations have done, their main results and lessons learned.

This research proposes a comprehensive investigation of the CSFs of KM implementations in organizations. Through the synthesis of 51 articles, 25 CSFs categories were extracted, forming a support base for organizations that are implementing KM initiatives.

The results show that factors related to the organization are the most important for KM. Firstly, because this is the dimension with the largest number of CSF categories identified, and secondly, because these categories are the most cited in the literature. In particular, organizational culture is the most important factor for the success of KM, as also concluded by other authors (Mathew & Rodrigues, 2019; Theriou, Maditinos & Theriou, 2011).

Promoting a culture of sharing and creating knowledge, trust, respect and collaboration is crucial and a prerequisite for KM - if people are not motivated and willing to share knowledge, the initiative will fail.

In addition, the implementation of KM in an organization is not an easy process, so it is fundamental to have a well-defined and concise strategy, with concrete goals to achieve success. This strategy must be aligned with the organizational strategy and be communicated to the organization, with a vision that inspires others to participate in KM initiatives.

In general, the results suggest that people-related factors have the greatest impact in KM adoption. Besides organizational culture, mentioned above, factors such as top management support and leadership, training, HRM and rewards have been frequently mentioned in the literature. Since most of the organizational knowledge resides in people and they are the main conveyor of knowledge (Igbinovia & Ikenwe, 2018), the significance of these factors becomes evident. It is crucial to adopt mechanisms and procedures that support and motivate people to participate in KM initiatives.

On the other hand, any KM practice should also be based on Technology and Processes (Igbinovia & Ikenwe, 2018). There is no doubt that IT facilitates KM, which can also be observed through the results of this study - 27 papers presented factors related to the IT application as critical to the success of KM. However, technology cannot be seen as a single facilitator to KM, as it will never work by itself. Therefore, it serves as support to people and processes involved, as perceived by Igbinovia & Ikenwe (2018).

In terms of knowledge processes, some authors identified the capability of these processes as CSFs to KM implementation, however, this aspect is not consensual. Most researchers identify CSFs to KM implementation indirectly contemplating KM processes in general, and not the processes in particular. Nevertheless, 11 papers identified knowledge process management as a CSF.

In any case, within the CSFs, the ability to share knowledge stands out from other processes, which is supported by the second part of the results. Most companies begin to implement KM practices with the main objective of knowledge sharing within the organization, since one of the main problems is knowledge residing only in the mind of employees. However, almost no author has related CSFs to a particular KM process, but to the KM initiative in general. It was not possible to relate CSF to specific KM processes. This leads to the conclusion that for KM initiatives to be successful, it is important to integrate all processes, not just share knowledge, for example.

Finally, it should be noted that only 3 articles mentioned external influence factors (Sadovykh & Sundaram, 2015; Gunasekera & Chong, 2018; Othman et al., 2018). The unpopularity of these topics can be explained by the concept of context which, although it has been increasing weight in the literature, there are still many authors who consider the role of context irrelevant for organizations seeking to promote KM practices (Sadovykh & Sundaram, 2015). Besides, the results show that external influence factors are related to the sector of the organization, such as the construction sector demonstrated by Gunasekera & Chong (2018). Thus, the authors conclude that external factors are less referred to in the literature since KM depends a lot on factors inherent to the organization, such as people, processes and technology. Except for certain situations, factors that are outside the control of organizations are not critical to the success of KM implementations, however, they should not be totally ruled out.

In summary, this study is comprehensive enough and its findings are relevant for all organizations intending to implement KM initiatives, regardless of size and sector. It is expected from a theoretical perspective to contribute to the area of KM through the compilation, categorization and classification of a set of critical success factors reported in the literature. From a practical perspective, these results can contribute as a consultative tool to support the preparation of strategies in this area by organizations wishing to implement KM initiatives. The identification of these CSFs facilitates organizations to understand which areas should be improved and what are the main measures to take in order to succeed in the KM implementation, creating an important decision instrument for organizations. However, it should be noted that each organization is different and therefore its current state of KM implementation should be well reflected, as well as which success factors will best fit its context.

This research also has limitations. The present study focuses on specific KM processes, and since there is still a lot of divergence in the literature regarding the main processes (or concepts), it may not have covered all KM processes and critical success factors. Future research may focus on identifying CSFs covering all KM processes, or none at all, since KM implementation includes the entire cycle of KM.

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Role of Training for Successful Use of Audit Software

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Abstract: This study examined the antecedent variables of using audit software tools to assist the auditor in completing tasks. Data were collected by distributing 303 questionnaires to auditors in Indonesia, while the technology acceptance model was used as the basis for constructing the required hypothesis. The returned questionnaires were tested for validity and reliability at the trial stage and after data collection. The data collected was analyzed using SmartPLS Ver.3.2.9 software, a structural equation modeling approach. The result showed that thirteen hypotheses were tested, of which four were rejected and nine were accepted. Furthermore, auditors' acceptance of new information systems depends on anxiety level, ease of use, and understanding of the application's usefulness. Hence, parties interested in using the audit software must conduct intensive introduction and training, which are critical to its successful implementation. Training reduces anxiety and increases computer intellectual capital and ease of use, which are important for the possible acceptance of a new system. Appropriate training reduces auditors' anxiety about using new applications and increases their intellectual capital. It will reduce paradox in conditions where investment in information systems is expensive but has low returns. The three-stage Sobel test concludes anxiety and intellectual capital are intervening variable, therefore, implementing the application in a hurry will reduce its actual usage.

Keywords: actual use, anxiety, auditor, computer intellectual capital, ease of use, usefulness

1. Introduction

Public accounting firms must build sustainable competitive advantage by developing or acquiring computer intellectual capital, a major source of capability and economic resource. This implies that firms must collect and utilize knowledge effectively because it is a major source of competitive advantage. Integrating academic knowledge and information technology is a significant factor in winning the business competition.

The auditor profession is inseparable from technological developments, hence they must respond to adaptability to avoid issues associated with data-based cloud auditing. Changing patterns and instruments of business transactions pose transformational challenges for auditors, therefore, they must have the ability to audit with computers, cloud-based technology, and big data. The development of technology-based is needed to reduce audit risk, improve performance and enhance monitoring effectiveness. Hence, auditors must have digital competence to fulfill these competencies.

The ability of public accounting firms to collect and utilize knowledge effectively is a major source of organizational competitive advantage. Intellectual capital is essential for accounting firms to manage their resources and capabilities. Employee competence and mastery of technology are part of intellectual capital, which means a lack of knowledge and training impacts the adequacy of auditors' competence. Several preliminary studies show that auditors do not take advantage of the latest auditing technology because they do not have the ability (Veerankutty, Ramayah, and Ali, 2018). This makes the implementation of audit work inefficient.

Knowledge management is one of the critical factors for public accounting firms to achieve effectiveness and excellent performance (Valacherry and Pakkeerappa, 2021). Employees' ability to balance technology skills leads to organizational productivity.

In 2018, the Indonesian Institute of Certified Public Accountants launched the audit tool and linked archive system (ATLAS) developed regarding risk-based auditing. ATLAS is generally used in audits due to its ability to process, cycle, document, and report audits, thereby increasing auditors' quality of work.

New information systems often create gaps in knowledge, attitudes, and skills. According to Kaya and Erkut (2018), public accounting firms must respond by transferring from implicit to explicit knowledge and vice versa by conducting socialization, articulation, and internalization. Training is an activity to reduce the gap by transferring new knowledge to maintain and develop the auditor's ability (Jridi and Chaabouni, 2021). It can help auditors improve their cognitive, affective, and conative skills.

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The presence of ATLAS requires knowledge transfer for it to be widely accepted and used for audit assignments. Previous studies on accepting new information systems have shown inconsistent results (Rahmawati and Narsa, 2019; Kustono, 2020; Nanggala, 2020). Therefore, this empirical study aims to ensure the acceptance of ATLAS in Indonesia and determine the success factors to prevent the productivity paradox. This research aims to determine (1) the factors of accepting the audit software, (2) the role of behavioral aspects, such as anxiety, ease of use, usability, and intention aid in its successful acceptance, and (3) the role of training in reducing anxiety and improving the auditor's computer intellectual capital.

2. Literature review and hypotheses development

The emergence of new technology is always associated with reactions in its interaction with users (Kamaja et al., 2016; Kustono and Valencia, 2017). Individuals accept or refuse to use the new information system based on their psychological and behavioral intention (Mohammadi and Isanejad, 2018).

The use of the audit tool is still voluntary, raising questions about its implementation's success. Some auditors do not use the application based on voluntary intention, hence the need to implement information system evaluation to prospective users.

Public accounting firms are faced with the challenge of reducing the gap in new system acceptance by transferring knowledge to increase the auditor's computer intellectual capital. One of the alternative actions in the process is training, which helps determine how auditors accept the new information system.

Several models have been developed to measure the acceptance of information systems. One of them is the Technology Acceptance Model (TAM), which explains that the two main variables affecting the approval of information technology are usefulness and ease of use (Liao et al., 2018; Tucker and Kotnour, 2022). Usefulness is the extent to which a person believes certain technologies will improve performance. At the same time, ease of use is the level where someone considers that information systems are not difficult to utilize.

2.1 Training

Training programs to increase staff knowledge are indispensable to cultivating assets capable of raising the profitability of public accounting firms. These activities are usually linked to organizational goals and are intended to achieve specific outcomes, such as shared knowledge, improved performance, or higher levels of innovation (Russo, 2016). Training is a series of individual activities systematically carried out to increase employees' skills and knowledge in their various professional fields. It is a learning process that allows employees to carry out their current work according to standards while achieving high predetermined outcomes. Furthermore, it is intended to enhance the mastery of various skills and techniques for implementing specific detailed and routine performances. The training process is focused on carrying out the work and applying understanding and knowledge to obtain a result capable of improving skills.

The development of the business environment requires efforts to increase competence. This can be done through training, a systematic process for changing the ability of employees to achieve specific goals (Jridi and Chaabouni, 2021). This orientation helps employees achieve particular skills and abilities to carry out their jobs, significantly influencing company development (Mannila, Nordén, and Pears, 2018).

An employee who has received training is proven to be better able to run new applications, and this capability provides an adequate response in both feature selection and connection problems. It enables them to understand technical terms quickly and how to use them to solve existing problems. Mastery of technology can reduce anxiety levels in communicating with individuals, changing their cognitive and practical abilities.

Information systems training can affect auditors' performance, enabling them to understand the audit tool, its usage, and available features. Knowledge of this can improve usage skills (Sabar, Masitoh, and Bachri, 2018), reduce the fear of rejection (Muller et al., 2015), enable quick operation (Mannila, Nordén, and Pears, 2018), and receive the benefits of the application (Venkatesh and Bala, 2008).

H1: Training negatively affects the anxiety levels of the audit software.
H2: Training positively affects the computer intellectual capital of the audit software.
H3: Training positively affects the ease of audit software use.

H4: Training positively affects the usefulness of the audit software.

2.2 Computer intellectual capital

Public accounting firms should utilize and apply knowledge management as a competitive advantage. This is because knowledge is a long-lasting competitive advantage when an organization knows more about something than its competitors. Unlike other reducible traditional resources, the more frequently used knowledge, the greater its value to the organization.

Knowledge management has interrelated people and processes, which technology supports to improve organizational performance (Schutte and Barkhuizen, 2014; Robu and Lazar, 2021). Computer intellectual capital is anything intangible, including assets, knowledge, and the ability to operate computers, creating a competitive advantage to achieve organizational goals (Christensen, 2018).

Computer intellectual capital (CIC) is a person's ability to demonstrate competency using a computer. People are proficient in its usage when they possess the knowledge, skills, and abilities to understand and use computer applications. Computer intellectuals encourage the zeal to learn something new, affecting individual self-confidence (Liao et al., 2018). Those with high computer intellectual always try to improve their knowledge and are not anxious when implementing a new system. Knowledge of new applications is an internal factor influencing audit software acceptance, making it easier to complete the task.

Njeru and Omondi stated that computer intellect consists of users' skills, abilities, and attitudes. The increase in one's ability leads to a change in metaphors for developing information systems. Several studies have shown that ability is associated with decreased anxiety (Mastuti and Handoyo, 2019) and increased ease of computer use (Huang, Liu, and Chang, 2012). Others prove that someone with computer intellectual capital uses it more often as a tool to complete tasks (Terentiev and Kleshchov, 2018). Along with the application of audit software, the proposed hypotheses are as follows:

H5: Computer intellectual capital negatively affects anxiety about the audit software.
H6: Computer intellectual capital positively affects the ease of using audit software.
H7: Computer intellectual capital positively affects the intention to use the audit software.

2.3 Anxiety

Every environmental change has detrimental or beneficial impacts on objects (Müller, Buliga, and Voigt, 2018; Mastuti and Handoyo, 2019). People react differently to the implementation of a new system. For instance, optimistic individuals accept this as an opportunity, challenge, and change for better performance, while pessimistic perceive it as a threat, inconvenience, or harm.

The application of new technology instills different fears in people, which are usually influenced by various statements, such as can I hope I have not made a mistake, and I hope the new system was not implemented because of my poor performance. These statements trigger anxiety and lead to poor concentration. The feeling of something new is challenging and lowers confidence.

The individual's choice influences anxiety about the use of audit software. Several studies have shown the effect of the anxiety variable on perceived ease of use, with numerous auditors avoiding its usage (Mastuti and Handoyo, 2019; Nanggala, 2020). Individuals prefer technology that can produce the expected results, and when they feel anxious, the developing information systems fail.

H8: Anxiety negatively impacts the ease of audit software use.

2.4 Ease of use

Ease of use (EOU) is the belief that using the system does not require an extra workforce, therefore, if someone believes that information technology is simplified, they will use it and vice versa. The more frequently used systems, the greater the comfort in operating and usage.

This factor drives interest in using information technology because it encourages users to take advantage of the system and its usefulness, which increases work performance. The perceived comfort has a positive impact on

use, hence the higher it is, the more positive the user's attitude. Information systems are created for users because they help complete their tasks and jobs. Oturakci (2018) and Nanggala (2020) stated that a significant positive relationship exists between perceived ease of use and the usefulness of a system.

Ease of use is an antecedent of intention to use information technology and a potential catalyst to increase use behavior. It has a positive and significant effect on the intention to use the audit software, therefore, auditors will use the software assuming it is easy to use and learn. This is in accordance with the research by He, Chen, and Kitkuakul (2018), stating that an increase in ease of use leads to a rise in the intention to use the information system and vice versa.

H9: Ease of use positively affects the usefulness of audit software.
H10: Ease of use positively affects the intention to use the audit software.

2.5 Usefulness

The perceived usefulness (USE) influences the intention to use (INT) a new system. Employees tend to use a system assuming it is considered beneficial in decision-making. People who believe in the benefits of technology use it more often due to increased performance.

Preliminary studies have shown that usefulness positively affects the intention to use information systems (Baki, Birgoren, and Aktepe, 2018; Bhullar and Gill, 2019). Therefore, they concluded an increase in usefulness leads to a rise in the intention to use information systems and vice versa. Auditors evaluate audit tools in terms of their functions and use because their benefit can be predicted due to the knowledge of existing features and facilities. The greater its usefulness, the higher the frequency of usage (Tucker and Kotnour, 2022).

H11: Usefulness positively affects the intention to use the audit software.
H12: Usefulness positively affects the actual audit software use.

2.6 Intention to use

Auditors who believe that the audit software improves their performance in terms of planning, fieldwork, and opinion-making always decide to use the application. This belief affects the actual use in auditing work, which is often identified by measuring the frequency and duration of technology use. An individual will be satisfied using a system assuming they believe it increases their productivity, similar to the use of the audit software (Bhullar and Gill, 2019).

Intention (INT) is the user's desire to continue using a particular technology and can be a predictor of technology acceptance. An auditor who is attracted by its benefits is motivated to use the software. Auditors feel facilitated in the planning, fieldwork, and reporting processes. Auditors intend to use audit software because they feel the system can speed up their activities. After all, usefulness positively and significantly affect actual use (Siegel, Acharya, and Sivo, 2017; Nagy, 2018). They concluded that convenient technology was often used to help get their work done.

H13: Intention to use positively affects the actual audit software use.

3. Research design

A questionnaire was developed in various stages to capture the phenomenon of using ATLAS. The first stage adopted the questionnaire in the previous TAM research, and its training construct consisted of five items (Arunachalam A.S and Velmurugan, 2018), three on anxiety (Kustono, 2021), four on computer intellectual capital (Namvar et al., 2010), and TAM variables (Venkatesh et al., 2003). A pilot test with six experts examined the test results. After being revised according to the recommendations of the statistical validity ($r > 0.6$, $p = 0.05$) and Cronbach's alpha (> 0.7) scores, a new questionnaire was distributed.

It consists of seven constructs, namely training, CIC, anxiety, EOU, USE, INT, and AUA, distributed using Google Forms with its link provided to Indonesian auditors using snowball techniques. The distribution period was from February to May 2021, and all items are on a five-point Likert scale, with 1 (strongly disagree) and 5 (strongly agree). The questionnaire's statement refers to the level of acceptance of the respondents regarding the use of ATLAS as audit software.

3.1 Population and sample

The target population is auditors at public accounting firms in Indonesia who use ATLAS. The purposive accidental method with a returned questionnaire was selected and used for data collection. The adequacy of the sample size of 4000 people was calculated using Slovin's formula (Asih and Dwiyanti, 2019). Slovin's procedure is explained as follows:

$$n = \frac{N}{1+Ne^2} \qquad (1)$$

with:
n = number of samples
N = population
e = percentage of allowance inaccuracy due to tolerable sampling error.

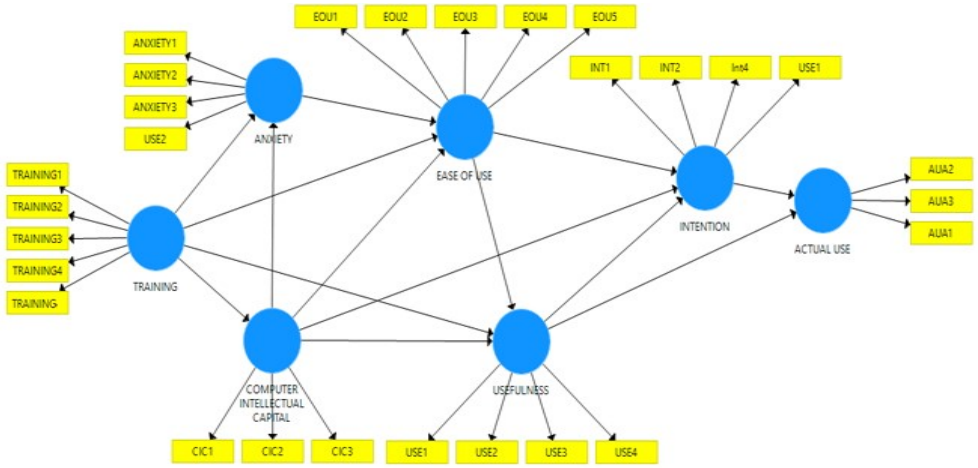
The accepted error uses the 10% limit, and based on this formula's calculations, the minimum sample size is 98 people.

3.2 Data analysis method

Hypothesis testing was conducted using Structural Equation Modeling with SmartPLS Ver 3.2.9 software. The analysis is carried out based on the following:

1. Outer Model Analysis. This determines the relationship between unobserved variables and their indicators through convergent, discriminant, and composite validities.
2. Inner Model Analysis. The inner model analysis determine whether exogenous variables influence the endogenous.

The research framework linking exogenous and endogenous variables is shown in Figure 1.



CIC, EOU, USE, INT, and AUA denote computer intellectual capital, ease of use, usefulness, intention to use, and actual audit software usage

Figure 1: Research Framework

4. Results and discussion

This study aims to examine the role of training in increasing the actual ATLAS use with behavioral factors as a mediating variable. Data were collected through a questionnaire filled out and returned using the Google form. The snowball technique was used to determine the sample size of the Indonesian Institute of Certified Public Accountants. From the distributed questionnaires, only 303 were returned and filled out completely.

The validity and reliability test examines the construct's factor analysis and describes the measurement of the dimensions that make up the latent variables. It consists of 7 and 28 unobserved and observed variables as their dimensions. The confirmatory analysis aims to test the validity of each latent variable's dimensions and will be used to ascertain whether the observed variables can reflect the analyzed factors. Table 1 showed that these

items had high estimates, except for the fourth, which had an estimated score of 0.18 and was therefore excluded from the analysis.

Table 1: Validity test results

Item-item	Training	CIC	Anxiety	EOU	USE	INT	AUA
Item 1	0.56	0.82	0.91	0.56	0.78	0.59	0.80
Item 2	0.79	0.86	0.92	0.49	0.63	0.80	0.93
Item 3	0.64	0.87	0.80	0.79	0.75	0.77	0.95
Item 4	0.79		0.18	0.79	0.88	0.85	
Item 5	0.66			0.81			

Source: Processed data, 2021

The reliability test of the training variables produced an alpha coefficient, CIC, anxiety, usefulness, ease of use, behavioral intention, and actual use of 0.811, 0.699, 0.701, 0.796, 0.742, 0.730, 0.760, and 0.755.

Descriptive analysis was used to determine how respondents answered the research variables. This analysis calculates the value of the theoretical and empirical range, as well as the mean and standard deviation. The descriptive data of respondents is shown in Table 2.

Table 2: Descriptive statistics

Variables	Minimum	Maximum	Mean	Std. Deviation
TRAINING	14	25	18.74	3.064
CIC	6	15	12.19	1.721
ANXIETY	8	15	11.19	1.583
EOU	11	23	18.88	2.500
USE	13	25	19.57	2.728
INT	9	20	15.50	2.071
AUA	6	15	11.48	1.625

Source: Processed data, 2021

Table 2 shows the quality of the data distribution, with the poorest being training. The standard deviation is the widest, with a mean value of 3,064. The best data distribution is anxiety, with the mean coinciding with the median value. Therefore, to avoid the problem of abnormal data distribution, the Partial Least Square analysis is used to test the hypothesis. The path analysis results were observed from the magnitude of the structural path coefficient and the t value for the prediction model's significance. The technique used is the bootstrap with a maximum of 50 iterations and 300 subsamples.

Table 3: Path coefficients

Variable Relationship	Original Sample	*t* statistic	*p* values	Hypothesis	Conclusion
TRAINING→ANXIETY	-0.315	3.828	0.000	H1	Accepted
TRAINING→CIC	0.572	9.423	0.000	H2	Accepted
TRAINING →EOU	0.121	2.620	0.009	H3	Accepted
TRAINING →USE	0.163	1.793	0.074	H4	Rejected
CIC→ANXIETY	-0.554	5.833	0.000	H5	Accepted
CIC → EOU	0.478	3.660	0.001	H6	Accepted
CIC→INT	-0.312	1.207	0.228	H7	Rejected
ANXIETY → EOU	-0.408	2.534	0.012	H8	Accepted
EOU→USE	0.720	8.550	0.000	H9	Accepted
EOU→INT	-0.295	1.075	0.283	H10	Rejected
USE→INT	1.173	1.477	0.000	H11	Accepted
USE → AUA	-0.074	0.489	0.625	H12	Rejected
INT→AUA	0.774	4.833	0.000	H13	Accepted

Source: Processed data, 2021

Path analysis determines how much influence exogenous variables have on the endogenous. Table 3 shows the magnitude of the structural path coefficient and the *t* value for the prediction model's significance. The test results indicate that the nine hypotheses, namely H1, H2, H3, H5, H6, H8, H9, H11, and H13, are accepted. Meanwhile, H4, H7, H10, and H12 with p > .05, are rejected.

4.1 Discussion

Training has a negative effect on anxiety levels of ATLAS, which means that a qualified person has an adequate understanding of the application. Therefore, employees need to acquire additional knowledge and skills to increase their knowledge of the application. On the other hand, these skills make it easy to run applications, and this result is in line with previous research by Muller et al. (2015). Training provides unprocessed technical expertise and reduces a person's anxiety.

The training variable has a positive and significant effect on computer intellectual capital and significantly impacts the ease of running the ATLAS. According to Sabar, Masitoh, and Bachri (2018), training is a way of updating employees' knowledge and skills in using applications. Post-training performance increases, thereby enabling the fulfillment of the task. Training encourages the improvement of one's competence and abilities.

It positively affects the ease of ATLAS use and provides additional skills related to a running application. These offer experiences that impact the belief that auditors do not need additional effort when running the application. This convenience can ease learning, use in work and assignments, and solve application problems (Mannila, Nordén, and Pears, 2018). The more a person participates in training, the greater the ease of use.

The different outcome from the predictions regards employees' immediate effect on usefulness, which is not directly affected by perceived usefulness. Someone who uses the new application can feel the benefits. The initial transfer of skills is an essential prerequisite for perceived usefulness in the workplace and indirectly affects its usefulness (Axtell, Maitlis, and Yearta, 1997). Training should enhance the perceived usefulness of a particular application because it helps users gain knowledge on its use. The training materials should also be related to developing adequate actions, knowledge, and skills.

Computer intellectual capital has a negative effect on anxiety about the ATLAS audit software and directly reduces anxiety. It relates to a person's skills in using computers, sufficient knowledge, and attitudes to continue learning applications. According to Mastuti and Handoyo (2019), anxiety arises because of incomplete knowledge or inadequate skills.

The intellectual capital of the computer positively influences the ease of use of ATLAS. Implementing the new system is made to make work easier, which is in line with the research by Huang, Liu, and Chang (2012), stating that employees with high computer skills complete their tasks. Auditors with sufficient expertise can operate it without difficulty, which motivates them to use and have a positive attitude towards the application.

Statistically, there is no proven direct effect of computer intellectual capital on the intention to use this application. Therefore, subjective abilities need to be explained using self-efficacy to analyze behavioral impulses (Mankad and Loechel, 2020).

Anxiety has a negative effect on the ease of ATLAS, as shown in the negativity effect. In implementing a new information system, some individuals may feel pessimistic about these developments. These fears include not using, talking, and thinking about computers, which leads to adverse effects.

A collection of negative feelings about employees' inability to use specific devices to achieve the desired performance is also known as anxiety. Therefore, the more anxious the auditors, the greater their feeling of insecurity and reluctance to use the software. This anxiety is influenced by the auditors' ability to accept or reject the level of ATLAS. According to preliminary studies, anxiety has a negative effect on ease of use (Mastuti and Handoyo, 2019; Kustono, Winarno, and Nanggala, 2021). When individuals feel anxious and refuse to implement the new information system, their ability to use it decreases.

Ease of use positively affects the perceived usefulness of ATLAS, provides more benefits, and improves performance (He, Chen, and Kitkuakul, 2018). The ease use shows that its features are easy to use and useful for auditors. This application feature requires general skills possessed by auditors because it improves performance. Audit planning is better, the implementation in the field is more orderly, and conclusions are drawn to provide accurate opinions. The ease of use identifies that ATLAS does not require a high ability to be free from physical and mental efforts (Oturakci, 2018). Auditors who efficiently use this application reported that it increases work effectiveness and productivity.

Ease of ATLAS use does not affect the auditor's intention because it is a belief with free attempts to use the application without difficulties. It refers to an individual's idea that the application does not require extra effort before it starts running. Furthermore, the test results showed that the ease of ATLAS use allows individuals to work effectively within limited timeframe. The application must be useful for auditors in completing their professional work. This means that when they do not feel the benefits of a system, the individual does not intend to use it, even when the application is easy to use. Kahar, Wardi, and Patrisia (2019) stated that employees are not guaranteed sustainability when there is no relationship between ease of use and intention to use.

These results are different from previous studies (He, Chen and Kitkuakul, 2018; Kang, Choi and Kim, 2021). They found that if respondents rated the information system as easy to use, it would positively impact their intention to use the application. This difference is possible because of the existence of the usefulness variable as a mediator for the two. The relationship between ease of use and intention to use becomes an indirect effect.

Usefulness positively affects the intention to use ATLAS because it affects the auditors. Usefulness is people's belief that using technology will improve their job performance. The intention to behave is the basis of the behavior carried out by individuals that an information system is functional with an increase in their intention to use. Conversely, when someone believes that the information system is less useful, they will not be interested in its usage.

Auditors' perceived usefulness leads to an incentive to use the application, believing that their work will lead to intention to use of technology. ATLAS is considered to help get the job done more quickly and effectively. The planning, fieldwork, and reporting processes have become more systematic with ATLAS (Silva, 2016; Baki, Birgoren, and Aktepe, 2018). Users have the intention to use technology when they feel it is useful.

The usefulness does not affect the actual ATLAS use because it is an individual's belief to increase performance quality when using this application. Technology can increase auditor productivity, performance, and efficiency. Result testing shows that usefulness does not necessarily increase the frequency of use, rather, a usage application indicates their liking. Many applications allow the auditor to use only the selected feature and demonstrate that the user does not necessarily increase its actual use.

This result aligns with previous research (Ismail, 2016; Rahmawati and Narsa, 2019). Empirical evidence suggests that usefulness has no direct effect on actual use. Rahmawati and Narsa (2019) found that if the regulator's obligations cause the use of an information system, its use does not affect its actual use. However, it is different from other researchers (Siegel, Acharya, and Sivo, 2017; Nagy, 2018). They show that usefulness strongly determines information systems use, adoption, and behavior. Intention to use may be a variable that changes the direct effect to indirect. This possibility is because both aspects of individual behavior are challenging to measure as predictors. The perceived usefulness must trigger an intention and eventually become its actual use.

The intention positively affects the actual ATLAS use, which shows the auditor's intention to use the application, which controls their behavior. Intention comes from accepting something new hence this attitude is influenced by the individual's perception of its benefits and the ease of using the new thing. Suppose the new system provides benefits and is easy to use by users, it will affect the employees' interest in utilizing this technology to complete their tasks.

The intention to use is the tendency to apply technology continuously, which encourages productivity. Brusso (2015, p.102) stated that the features provided by the application can improve the quality of planning, implementation, and reporting.

4.2 Indirect effects

Training is crucial for the successful implementation of ATLAS due to the possible indirect association between the two variables. The test results show three potential pathways for training to influence the application's actual use.

Table 4: Indirect effects

Indirect effect	Original sample	*T* value	*P*-value
Training→CIC→ANXIETY→EOU→USE→INT→AUA	0.085	2.0551	0.040*
Training→CIC→EOU→USE→INT→AUA	0.179	2.866	0.004**
Training→EOU→USE→INT→AUA	0.654	4.713	0.000**

Source: Data processed, 2021

The mediation effect testing was focused on two variables, namely CIC and anxiety. CIC has the possibility of an intervening variable in the relationship between training and anxiety variables. Meanwhile, anxiety is an intervening variable in the relationship between training-EOU and CIC-EOU. Figure 2 shows the potential of the two variables.

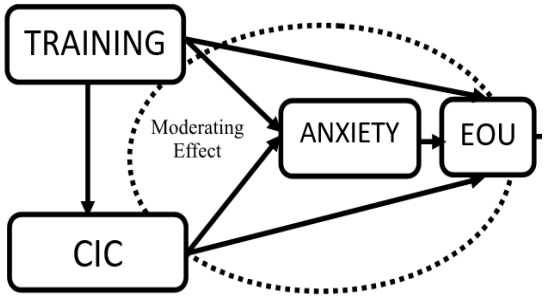


Figure 2: The possibility of mediating effect

Mediation testing determines the strongest training association pathways and their proper uses. The first testing phase was conducted to test whether CIC is an intervening variable between training and ease of use using the Sobel test with Z and *p* values of - 3.10 and 0.000. Calculations show that computer intellectual capital is an intervention variable between training and ease of use.

The second Sobel test was performed on the CIC variable as a mediation between training and anxiety. The results showed that Z and *p* have values of -2.65 and 0.004. Subsequently, the third test examines the anxiety variable as an intervening factor between computer intellectual capital and ease of use to obtain Z and *p values of* -2.49 and 0.006 at a significance level above 0.05. Anxiety is the variable that mediates the relationship between computer intelligence and ease of use.

The three-stage Sobel test concluded that the most robust pathway in the relationship between training and actual *ATLAS* use was training → CIC → anxiety→ ease of use → usefulness → intention to use → actual use. Training is important for the acceptance of the new system. Individual acceptance of something new depends on lowered anxiety levels, ease of use, and understanding of the application's benefits. It encourages personal interest to use it repeatedly because it is generally a transfer of knowledge, skills, and software features. Auditors who receive hands-on training can operate, understand software facilities, and solve problems, which leads to increased computer intellectual capital, thereby decreasing anxiety.

Training is an environment for auditors to achieve competence in changing knowledge, attitudes, and skills. Adding knowledge about ATLAS changes attitude, which is accompanied by a readiness to act according to the object. The knowledge gained during the training increase CIC by applying what has been gained. The training is to equip auditors with the knowledge and skills to operate ATLAS needed to work on field assignments. It also enables the use of information systems as an auditor's tool significantly impacting CIC (Alhejji et al., 2016).

This training is measured by covering the method, instructor, and material dimensions. The training method relates to the suitability of the curriculum with its objectives. Instructor deals with teaching, technical and communication skills, while material refers to the substance of the knowledge taught. The training dimension test indicates that the method dominates in leveraging CIC. Table 5 shows the two variables' direct effect regression results.

Table 5: Regression results of the exercise dimension

	Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
	B	Std. Error	Beta		
(Const)	5.33	1.79		3.39	.00
Method	0.64	0.19	0.37	3.69	.00
Instructor	0.36	0.16	0.26	2.22	.04
Material	0.22	0.18	0.18	2.17	.05

Source: Data processed, 2021

Training is an effort to increase understanding in a particular job. When the auditor undergoes training on the use of audit software, the dimensions of the training variables affected is the CIC. A comparison of R^2 on the direct relationship of each training dimension to CIC shows that the method, instructor, and material have R^2 values of 0.05, 0.16, and 0.09. This additional test demonstrates the instructor's dominance in increasing the effect of training on CIC.

The effectiveness of training methods plays a significant role in the ATLAS simulation techniques that focus on practice rather than theory. Instructors also play an important role in the smoothness and success of the training program to support the smooth running, which has helped in its implementation. The three dimensions of training help transfer knowledge on the positive effect of increasing CIC.

5. Conclusion and suggestion

In conclusion, four hypotheses were rejected from the TAM model of preliminary studies, and nine others were accepted. Training has been shown to reduce anxiety with increased computer intellectual capital and ease of use. However, it failed to demonstrate its effect on usefulness with a decrease in anxiety and a rise in ease of use. Anxiety has a negative effect on ease of use, which affects usefulness but is not empirically proven to influence intention to use, which positively impacts actual usage.

Training is essential for successfully implementing audit software due to the possibility of an indirect relationship between the two variables. The Sobel test concluded that the most robust pathway in the relationship between training and actual audit software use is increasing CIC, decreasing anxiety, raising ease of use, improving perceived usefulness, and encouraging intention to use. Training related to software techniques and features enables auditors to increase intellectual capital and reduce anxiety. The variables' impact on the intervening test shows a vital role as an explanatory relationship between training and ease of use.

5.1 Implications

This research has implications for knowledge management to overcome the acceptance of the new system. The training process can manipulate and control individual behavioral factors determining acceptance. Aggregate training changes tacit and explicit knowledge, which is needed to develop CIC to achieve the organization's objective and strategic vision. For practitioners, these findings provide insight into how implementing a new system requires users' acceptance. User readiness with low anxiety can be achieved assuming CIC is adequate with superior management capable of conducting intensive training with appropriate methods, instructors, and materials.

5.2 Limitation

This study is limited to the use of auditors who work in public accounting firms in Indonesia and the generalizability of differences in organizational culture from other countries. However, when the characteristics are similar, then the possibility becomes small. Training measurements do not separate the types of methods and materials; hence, they tend to ignore their effects. Future research needs to compare auditors in different countries and improve the measurement of the training variable to obtain a more comprehensive conclusion. We use a quantitative method intending to capture the average effect of training on aspects of auditor behavior and its impact on the use of audit software. The findings cannot explain the mechanism of the influence of training on behavior change because it does not explore each behavior. However, the distribution and adequacy of the sample are sufficient to guarantee generalization to auditors in Indonesia.

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