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USO INTEGRADO DE MÍDIAS SOCIAIS NO SUPORTE AO COMPARTILHAMENTO DE CONHECIMENTO EM PROJETOS DE TECNOLOGIA DA INFORMAÇÃO SOB A PERSPECTIVA DOS AFFORDANCES

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THE USE OF INTEGRATED SOCIAL MEDIA TO SUPPORT KNOWLEDGE SHARING IN INFORMATION TECHNOLOGY PROJECTS FROM THE PERSPECTIVE OF AFFORDANCES

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Tese apresentada ao Programa de Pós-Graduação em Gestão de Projetos da Universidade Nove de Julho – UNINOVE, como requisito parcial para obtenção do grau de **Doutor em Administração**.

Orientadora: Profª. Drª Cristiane Drebes Pedron (UNINOVE)
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Ricardo Antônio Câmara da Silva

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DEDICATION

To my mother, for everything she did for me; for working hard to provide me with a good education and the opportunity to "be someone in life," and for always setting a positive example of work, responsibility, and commitment.

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ABSTRACT

In the organizational scenario, information technology (IT) has increasingly become a powerful conductor of business strategies and an essential asset, while intangible resources such as knowledge contribute to the competitive advantage and directly affect its achievement. In this regard, knowledge sharing is the most significant process of knowledge management, and in the project management domain, success requires sharing knowledge at all project stages. Matching IT with business processes is both an enabler and a facilitator of knowledge sharing, and social media technologies have emerged as a valuable element to support knowledge sharing in IT projects and are being increasingly adopted in organizations. This document describes a PhD thesis in multiple studies, consisting of three articles and a technological product. The main objective of the research is to propose and evaluate a framework for the integrated use of social media tools, INT-SM4KS, to support knowledge sharing in IT projects, making use of the affordance perspective. At the end, practitioners will be provided with a support tool specifically developed and validated for them. Affordances were chosen as the theoretical lens to analyze the relationship between the use of social media and knowledge sharing within organizations. The research is essentially qualitative with a prescriptive approach and was conducted using the Design Science Research method, following a process model in five steps. A literature review and interviews with senior project managers were conducted to identify the research problem; an initial solution was proposed and subsequently developed and refined, based on the literature and interviews with practitioners; the framework was evaluated by senior project managers in a focus group meeting. The final version of the framework comprises three components, drawing on the concepts of affordance perception, actualization, and effect. It is presented in two complementary perspectives: the Components view and the Integration view. The impact of the framework is potentially relevant, contributing to the solution of problems identified in the literature and in practice, such as selecting or replacing social media tools; developing knowledge sharing processes and training; and creating guidelines for tool use. Its efficient application in IT projects can assist project managers by improving the benefits of knowledge sharing between participants and between different projects, which can increase managerial effectiveness and have a favorable impact on its success. The impacted area is potentially large, encompassing all project management activities.

Keywords: Project management; Knowledge sharing; Information technology; IT projects; Social media; Affordances.

RESUMO

No cenário organizacional, a tecnologia da informação (TI) tem se tornado cada vez mais um poderoso condutor das estratégias de negócios e um ativo essencial, enquanto recursos intangíveis como o conhecimento contribuem para a vantagem competitiva e afetam diretamente a sua aquisição. Nesse sentido, o compartilhamento de conhecimento é o processo mais significativo da gestão do conhecimento e, no domínio do gerenciamento de projetos, o sucesso requer o compartilhamento do conhecimento em todas as suas etapas. A combinação de TI com processos de negócios é um facilitador do compartilhamento de conhecimento e as tecnologias de mídia social surgiram como um elemento valioso para apoiá-lo em projetos de TI, sendo cada vez mais adotadas nas organizações. Este documento descreve uma tese de doutorado em estudos múltiplos, composta por três artigos e um produto tecnológico. O objetivo principal da pesquisa é propor e avaliar, um framework para o uso integrado de ferramentas de mídia social, denominado INT-SM4KS, para apoiar o compartilhamento de conhecimento em projetos de TI, usando a perspectiva dos affordances.
Ao final, os profissionais receberão uma ferramenta de apoio desenvolvida e validada especificamente para eles. Affordances foram escolhidos como lente teórica para analisar a relação entre o uso das mídias sociais e o compartilhamento de conhecimento dentro das organizações. A pesquisa é essencialmente qualitativa, com abordagem prescritiva e foi realizada utilizando o método Design Science Research, seguindo um processo em cinco etapas. Uma revisão de literatura e entrevistas com gerentes de projeto seniores foram realizadas para identificar o problema de pesquisa; uma solução inicial foi proposta e posteriormente refinada, com base na literatura e em entrevistas com profissionais; o framework foi avaliado por gerentes de projeto sênior em um grupo focal. A versão final do framework é apresentada em duas perspectivas que se complementam: a visão de Componentes e a visão de Integração. O impacto do framework é potencialmente relevante, contribuindo para a solução de problemas identificados na literatura e na prática como selecionar ou substituir ferramentas de mídia social; desenvolver processos e treinamento; e criar diretrizes para uso de ferramentas. Seu uso efetivo pode agregar ao trabalho dos gerentes, aumentando os benefícios do compartilhamento de conhecimento, o que pode melhorar a eficácia gerencial e ter um impacto favorável no seu sucesso. A área impactada é potencialmente grande, abrangendo todas as atividades do gerenciamento de projetos.

Palavras-chave: Gerenciamento de Projetos; Compartilhamento de conhecimento; Tecnologia da Informação; Projetos de TI; Mídias sociais; Affordances.

LIST OF ACRONYMS

ACRONYM	MEANING
API	Application Programming Interfaces
AI	Artificial Intelligence
CAPES	Coordination for the Improvement of Higher-Level Personnel
CFG	Confirmatory Focus Group
COVID-19	Coronavirus Disease 2019
DS	Design Science
DSR	Design Science Research
DSD	Distributed Software Development
EnANPAD	Encontro da Associação Nacional de Pós-Graduação e Pesquisa em Administração
ERP	Enterprise Resource Planning
ESN	Enterprise Social Network
GSD	Global Software Development
ICT	Information and Communinication Technology
IOT	Internet of Things
ISSN	International Standard Serial Number
IT	Information technology
KM	Knowledge Management
KPM	Knowledge Process and Management
KS	Knowledge Sharing
OSS	Open-Source Software
PM	Project Management
Q&A	Question-And-Answer
RSS	Really Simple Syndication
SM	Social Media
SLR	Systematic Literature Review
UNINOVE	Universidade Nove de Julho
URL	Uniform Resource Locator
WFA	Work-From-Anywhere
WFH	Work-From-Home

LIST OF FIGURES

SUMMARY

1 INTRODUCTION

Information technology (IT) has increasingly become a powerful conductor of business strategies and an essential asset in the organization's competitive game plan (Koriat & Gelbard, 2019; Rai, 2016). Transformational forces like social media (SM), mobility, cloud computing, internet of things (IoT), artificial intelligence (AI), and others are influencing businesses' reshaping (Marnewick & Marnewick, 2019; Rai, 2016; Zin et al., 2018). When discussing the effects of this technological revolution, Porter and Heppelmann (2014, p. 4) notice that IT is now an integral part of the product itself, which "has become complex systems that combine hardware, sensors, data storage, microprocessors, software, and connectivity in myriad ways."

Products and services development, according to this innovative viewpoint, present new challenges for IT project managers (Koriat & Gelbard, 2019), as the business environment and product requirements change frequently and unexpectedly in a context of rapid technological development (Babenko et al., 2019; Rahmanian, 2014). Such circumstances have brought about a special interest in improving IT projects, making their management a current key concern (Gholami & Murugesan, 2011; Koriat & Gelbard, 2019; Rai, 2016).

In this organizational scenario, intangible resources such as knowledge contribute to the organization's competitive advantage and directly affect its achievements (Koriat & Gelbard, 2019; Marnewick & Marnewick, 2019). Knowledge is considered the root of strategic advantage (Blagov & Anand, 2022). It is critical for organizations that increasingly realize its role as a factor of production and understand the challenges to its acquisition and dissemination (Lindner & Wald, 2011; Krumova & Milanezi, 2015; Ersoy & Mahdy, 2015; Yuan et al., 2013).

Within organizations, multidisciplinary knowledge is created by gathering data from suppliers, customers, and the company itself, and should be shared with all the stakeholders (Ghimire et al., 2017; Marnewick & Marnewick, 2019). The management and sharing of this acquired knowledge play a fundamental role in reacting quickly to hastened problem solving and decision-making processes, which are common in the IT field (Koriat & Gelbard, 2019; Zin et al., 2018). This role comprises four processes: 1) creation, 2) storage, 3) sharing and 4) application of knowledge (Nonaka, 1994).

In this regard, knowledge sharing (KS) is the most significant process of knowledge management (KM), as it forms the foundation of most initiatives (Anwar et al., 2019; Krumova & Milanezi, 2015). At this point, we want to emphasize that, despite accepting the terminologies debate (Tangaraja et al., 2016), we will adhere to common practice and use the

terms knowledge transfer, knowledge sharing, and knowledge exchange interchangeably (Wald & Bjorvatn, 2021)

"Knowledge sharing occurs when individuals convey knowledge or acquire it from others" (Ahmed et al., 2019, p. 74). Particularly in the project management domain, success requires sharing knowledge at all project stages, as well as active collaboration to establish a mutual understanding among participants by coordinating and integrating multiple knowledge sources, which adds to the complexity (Nidhra et al., 2013). Such human interactions to share knowledge can lower costs and increase productivity, yielding benefits like preventing mistake repetition, avoiding knowledge recreation, reducing expertise loss, leveraging existing knowledge, and supporting decision-making (Chaves et al., 2018; Kinder, 2020). As a result, the ability to share technical, organizational, and professional knowledge among project members and across project teams has emerged as a critical concern in IT projects (Karlsen & Gottschalk, 2004).

Information technology is a major enabler of KS activities and processes (Panahi et al., 2012); the technology chosen and the way it is used is important to improving KS (Stray et al., 2019). In this respect, the use of social media (SM) presently pervades our society and organizational settings, so much so that its benefits and challenges can no longer be ignored (Ahmed et al., 2019; Sarka & Ipsen, 2017). Therefore, the competence to understand how to leverage such support becomes a key point (Nidhra et al., 2013). The concept of social media applies to a group of collaborative tools and services that foster social interactions in the digital domain, such as wikis, shared repositories, blogs, microblogs, social networks, and instant messenger applications (Ikemoto et al., 2017; Sarka & Ipsen, 2017).

The increasing potential of IT support and the constant pressure for innovation motivate organizations to leverage the use of SM to improve their performance, affecting organizational phenomena and processes (Sarka & Ipsen, 2017; Sun et al., 2019). Driven by new management trends and innovations, leading executives and researchers keep prospecting new uses to benefit from exploring SM in such diverse areas as product development, healthcare, information technology, academia, and government (Gholami & Murugesan, 2011; Kanagarajoo et al., 2019; Naeem, 2019; Sun et al., 2019).

Social media thereby emerges as a valuable platform to support IT projects, facilitating knowledge creation and sharing, networking, collaboration, and communication (Ahmed et al., 2019; Kanagarajoo et al., 2019; Koriat & Gelbard, 2019; Yuan et al., 2013). SM has been used in such project management areas as requirements, communication, knowledge, and collaboration, improving engagement and relationships (Daemi et al., 2020). Currently, SM

applications like wikis, instant messengers, and videoconference tools assist effective knowledge sharing among IT workers and IT work teams (Koriat & Gelbard, 2019; Nabelsi et al., 2017; Sarka & Ipsen, 2017; Zahedi et al., 2016).

The main advantage of SM tools, according to Portillo-Rodríguez et al. (2012), is that they are web-based, allowing knowledge to be created, shared, and used in both collocated and distributed project scenarios. Furthermore, studies considering various success criteria show that using SM for KS has a positive impact on the success of IT projects (Chowdhury & Lamacchia, 2019; Daniel & Stewart, 2016; Foote & Halawi, 2018; Nabelsi et al., 2017).

It is worth highlighting that IT project teams are growing more decentralized (Zin et al., 2018), and more flexible teamwork has been demanded as organizations have become more project oriented (Lansmann et al., 2019). In this context, any issue relating to the project management process is intensified, and only technology makes knowledge sharing possible (Wells & Kloppenborg, 2019). Team members are increasingly relying on technology and communication platforms to coordinate, communicate, and collaborate to put their work tasks together (Bissaliyev, 2017; Forsgren & Byström, 2018). To facilitate project activities, IT workers make use of various SM tools, but the simultaneous use of different tools competing with one another can lead to conflicts and redundancies (Forsgren & Byström, 2018; Karlsen & Gottschalk, 2004).

1.1 RESEARCH PROBLEM

The lack of integration among IT-based tools, whether information systems or SM tools, has long been seen as a challenge, forcing a lot of work to be done and hindering the way people do things (Niazi et al., 2015; Pirkkalainen & Pawlowski, 2014; Riege, 2005; Santos et al., 2012). The variety of competing tools incompatible with each other makes management more difficult (Niazi et al., 2015; Pirkkalainen & Pawlowski, 2014), so much so that ensuring SM tools' efficient and meaningful integration is an essential managerial task (Forsgren & Byström, 2018), notably in virtual teams (Manzoor, 2016).

This scene was amplified after the increase of project members' remote working caused by the outbreak of COVID-19 (Kinder, 2020); the IT industry shifted toward remote work or virtual workplaces, and Work-From-Home (WFH) or Work-From-Anywhere (WFA) became the "new normal" (Blagov & Anand, 2022; Kolluru et al., 2021). For example, in India, approximately 2.9 million IT industry employees were moved to work from remote locations, supported by an IT collaboration platform and cloud services to ensure projects' quality and delivery time to meet deadlines (Kolluru et al., 2021; Ramasamy, 2020).

Existing research shows that data integration from multiple SM tools contributes to the resolution of various types of problems in the KS domain (Ikemoto et al., 2017; Stray et al., 2019; Veronese & Chaves, 2016). On the other hand, theoretical and practical studies on this subject have identified some barriers to SM adoption and use, such as selecting or replacing SM tools and technologies in a context of rapid technological obsolescence (Babenko et al., 2019; Ranjbarfard et al., 2014; Vergara et al., 2020); developing or improving KS processes (Asrar-ul-Haq & Anwar, 2016; Zahedi et al., 2016); creating guidelines for tool use (Eriksson & Chatzipanagiotou, 2021); planning and developing training (Stray et al., 2019); or designing a structure to enable storing and retrieving knowledge (Dingsoyr & Smite, 2014; Kukko, 2013; Zahedi & Babar, 2014).

As a consequence, scholars have been looking into the usage of integrated SM tools in project management and knowledge management. Veronese and Chaves (2016) envisioned an integrated set of technologies to promote the application of lessons learned in projects. Ikemoto et al. (2020) proposed the SM4PM, a framework to guide the integrated use of SM in project management, focusing specifically on IT projects. In subsequent empirical studies, the SM4PM framework was instantiated to be evaluated in a private financial institution (Oliveira, 2018) and in a public security organization (Narazaki et al. (2020). These studies, however, relate to the integrated use of independent individual tools.

Considering a distinct perspective, Popescu (2014) highlighted the importance of unique platforms that would integrate a wide range of social media components to facilitate management by avoiding monitoring several dispersed tools. Corroborating, Ikemoto et al. (2017) postulated that social media technologies need to be integrated via a single interface to reach their full potential; Narazaki et al. (2020) advocated that social media tools should be integrated into a unique set being used, not become more tools to be managed.

In such a vein, recent solutions have been addressing this technology gap and responding to academic claims with the introduction of a class of collaborative tools referred to here as "integrated social media platforms." They include such products as Microsoft Teams, Slack, and Jira Software (Eriksson & Chatzipanagiotou, 2021; Mittal & Mehta, 2020; Stray et al., 2019). These current technological solutions are concerned with a unified user interface and a unique set of SM features. As a result, team members can access the range of services using different devices such as smartphones, tablets, desktops, and laptops (Bissaliyev, 2017). Additionally, the use of plugins and other components that connect to the integrated environment via Application Programming Interfaces (APIs) allows for the addition of other tools and applications (Silva & Chaves, 2021).

According to the research of Lansmann et al. (2019), these integrated SM platforms can improve knowledge management and productivity. Furthermore, empirical investigations show that they can effectively support KS procedures in project management (Eriksson & Chatzipanagiotou, 2021; Stray et al., 2019), as well as provide IT project practitioners with the simplicity of use and accessibility they desire (Narazaki et al., 2020; Silva & Chaves, 2021). Throughout the pandemic, these collaboration platforms were used to implement the remote work model, keeping employees engaged and productive, with Microsoft Teams standing out for its integration capabilities (Kolluru et al., 2021).

Despite the use of integrated platforms, however, within project teams it remains difficult to know how to best interact with other team members in order to share knowledge and benefit everyone (Eriksson & Chatzipanagiotou, 2021; Stray et al., 2019). Surprisingly, in the age of advanced SM platforms and cloud-based tools, the selection and use of appropriate tools to support project management processes such as KS is still an issue in virtual work environments (Nidhra et al., 2013; Ikemoto et al., 2020; Rozman, 2019). In this regard, a comprehensive assessment of the tools to be used and how to use them is required to meet the project's needs based on its characteristics (Ikemoto et al., 2020).

As a consequence, taking into consideration this scenario where academic literature and practitioners' experience coexist, the problem addressed in this research is the need for guidance on the integration of social media technologies to support IT project managers in sharing knowledge. Accordingly, in order to contribute to filling this practical and theoretical gap, we address the research question: "How to support knowledge sharing processes in information technology projects using integrated social media tools."

In terms of the theoretical approach, the affordance lens is used in this research to explore the relationship between the use of technology (SM) and organizational change processes (KS). Affordances have been productively applied in the domain of SM adoption and use (Volkoff & Strong, 2017), as evidenced by such studies as those undertaken by Treem and Leonardi (2013), Ellison et al. (2015), and Sun et al. (2019).

The affordance lens considers the socio-technical viewpoint, in contrast to the traditional deterministic view, which overlooks the complexity of human interaction in projects. The affordance perspective allows for technology specificity while incorporating social and contextual elements, such as interactions between organizational actors and technical capabilities (Sun et al., 2019; Thompson, 2018; Volkoff & Strong, 2017).

1.2 OBJECTIVES

1.2.1 MAIN OBJECTIVE

The main objective of this research is to propose and evaluate an artifact, a framework for the integrated use of social media tools to support knowledge sharing in IT projects, making use of the affordance perspective.

The artifact addresses human interactions in KS processes mediated by integrated SM features, considering that a framework is "a network of interconnected concepts that together provide a comprehensive understanding of a phenomenon or phenomena" (Jabareen, 2009, p. 51), and that it is used as a "real or conceptual guideline to serve as support or guide" (Vaishnavi et al., 2019, p. 16). The framework's development approach considers the three essential knowledge management pillars of people, process, and technology, which together constitute organizational performance (Chan, 2017).

1.2.2 SPECIFIC OBJECTIVES

i. Identify existing problems in the IT project domain to whose solution the use of social media to share knowledge can contribute.
ii. Propose a framework grounded on the integrated use of social media tools using the affordance perspective.
iii. Evaluate the definitive version of the framework proposed.
iv. Convey to scholars and practitioners the findings of the work completed.

1.3 JUSTIFICATION

This research is initially justified by the relevance of its three basic pillars in the contemporary organizational environment, both individually and collectively: IT projects; knowledge sharing; and integrated social media. To the best of our knowledge, at the beginning of this work, these themes had not been combined in previous research.

Organizations have undertaken IT projects to "transform and grow" (Daemi et al., 2020, p. 6) since the mid-1960s, at least, to achieve strategic objectives and create competitive advantage (Foote & Halawi, 2018). Business leaders and policy makers recognize that IT has become a vital component of a company's strategy and are willing to invest heavily to make technology an integral part of products and services (Chowdhury & Lamacchia, 2019; Wessel et al., 2021), so much so that global IT spending is expected to reach $4.45 trillion in 2022 (www.statista.com/statistics/203935/overall-it-spending-worldwide/).

Moreover, knowledge is considered the root of strategic advantage in this organizational context (Blagov & Anand, 2022), and the KS process forms the foundation of most initiatives in knowledge management (Anwar et al., 2019; Krumova & Milanezi, 2015), facilitated by team member coaction using collaborative SM tools (Koriat & Gelbard, 2019; Nabelsi et al., 2017; Sarka & Ipsen, 2017), which enables knowledge sharing, communication, and collaboration (Kanagarajoo et al., 2019). An increasing number of organisations are employing integrated SM platforms, with a growing impact on how collaboration is conducted and organized, improving knowledge management and productivity (Lansmann et al., 2019).

What has been exposed has motivated the interest in exploring the relationship between the three themes of IT projects, knowledge sharing, and integrated social media. Organizations have never before needed good communication, collaboration, knowledge sharing, and innovation as much as they do now, corroborating the current and future importance of conducting research in this relatively new field of study (Ikemoto et al., 2020; Naeem, 2019; Lansmann 2019).

Furthermore, studies on the impact of using social media to support knowledge sharing on IT projects, regarding different success criteria, have shown that positive contributions occur across a variety of project activities and processes, including documentation, lessons learned, requirements elicitation, and process learning. This influence has been observed in distributed and collocated projects as well as in the private and public sectors (Chowdhury & Lamacchia, 2019; Foote & Halawi, 2018; Nabelsi et al., 2017; Sarka & Ipsen, 2017). In light of this, we understand that the current study is timely and significant because it addresses users' wants and needs to produce knowledge that is solution-oriented in order to create a practical artifact aimed at resolving real-world problems (Shapiro et al., 2007; Van Aken, 2005) and potentially assisting in the success of IT projects.

Despite the benefits provided by social media technologies, however, it remains a challenge for project managers to obtain and integrate previous knowledge, such as lessons learned from different tools used in projects (Veronese & Chaves, 2016). The lack of data integration due to the use of different collaboration tools was a significant barrier in IT projects found in the systematic literature review and in the interviews with project managers carried out in this research (Camara et al., 2021; Silva & Chaves, 2021). The variety of competing tools and their incompatibility with each other makes knowledge management a hard task (Niazi et al., 2015; Pirkkalainen & Pawlowski, 2014). Accordingly, practitioners

suggest that the awareness of a common set of SM technologies and the understanding of their affordances represent a powerful instrument for project management (Ikemoto et al., 2020).

In this regard, we believe that the framework proposed in this study is an adequate artifact to guide the selection and utilization of the appropriate technologies in order to provide the necessary support to tasks and teams (Stray et al., 2019), considering that frameworks are sets of rules or ideas that provide the basic structure of something, providing support for dealing with problems or making decisions (Cambridge, n.d.; Merriam-Webster, n.d.). Such a framework can assist project managers in adopting and developing their personal technology strategy, identifying needs for intervention during the project lifecycle, and optimizing its use for knowledge sharing, for example, by providing guidelines or planning training (Eriksson & Chatzipanagiotou, 2021; Kinder, 2020).

Finally, it is worth highlighting the socio-technical dimension of the approach applied in the construction of the framework, which is reflected in the choice of affordances as the theoretical lens. There are few obvious theoretical lenses and frameworks like the affordances for understanding the ways that SM incorporates and affects organizational processes like KS (Leonardi & Vaast, 2017), and the work on affordances and team collaboration is limited (Waizenegger et al., 2020). From this perspective, using the affordances concept to explore the relationship between technology and organizational change can improve the design of technological artifacts and the users' engagement with the activities they mediate (Treem & Leonardi, 2013).

Moreover, in the context of constant changes in IT project environments, the use of the affordance perspective is much more likely to have staying power (Treem & Leonardi, 2013). Affordances generalize across applications through the use of several features, focusing on the types of practices they afford, whereas SM features are specific to applications that will not probably be the ones used in the future (Karahanna et al., 2018; Treem & Leonardi, 2013).

2 RESEARCH DESIGN

This thesis uses the model of articles or studies with a single method, where multiple connected studies are used to accomplish research objectives, as an alternative to the conventional model of a thesis in a single document. In this alternative structure, the study is considered as the component that identifies and gives uniqueness to scientific research for the doctorate; it is still to be submitted or, in some cases, has already been published or has been submitted for publication in peer-reviewed journals or arbitrated conference proceedings (Costa et al., 2019). The main methodological features employed to carry out the research are presented below.

2.1 RESEARCH METHOD

This research has an essentially qualitative nature, aiming to understand, interpret, and describe the human experience in organizations. Its main objective is the proposition of a new artifact, which is expected to support solutions to problems not previously addressed (Peffers et al., 2007; Van Aken & Romme, 2009). The methodological approach is prescriptive, aiming at applying the scientific mode of research to solve a real-world problem (Van Aken, 2005), as well as being aligned with practitioners' interests and needs (Shapiro et al., 2007).

In this way, taking the research as a whole into account, the abductive method will be the scientific approach used. The abductive method is a creative process that is considered the most indicated method for understanding a problem; it consists of studying phenomena or situations and proposing theories to explain them (Dresch et al., 2015); it is appropriate, for instance, when the researcher is studying a problem to propose possible solutions (Dresch et al., 2015). Figure 2.1 presents the methodological summary.

Figure 2-1 Methodological summary

Feature	This Research
Paradigm	Design Science
Method	Design Science Research (DSR)
Research Nature	Qualitative
Scientific Approach	Abductive
Methodological Approach	Prescriptive. Solution oriented and Design oriented
Unit of Analysis	IT Projects
Unit of Observation	IT Projects Teams and Stakeholders
Data Collection	Literature Review, Interview and Focus Groups
Data Analysis	Qualitative analysis and Content analysis

Note. Source: Created by the author

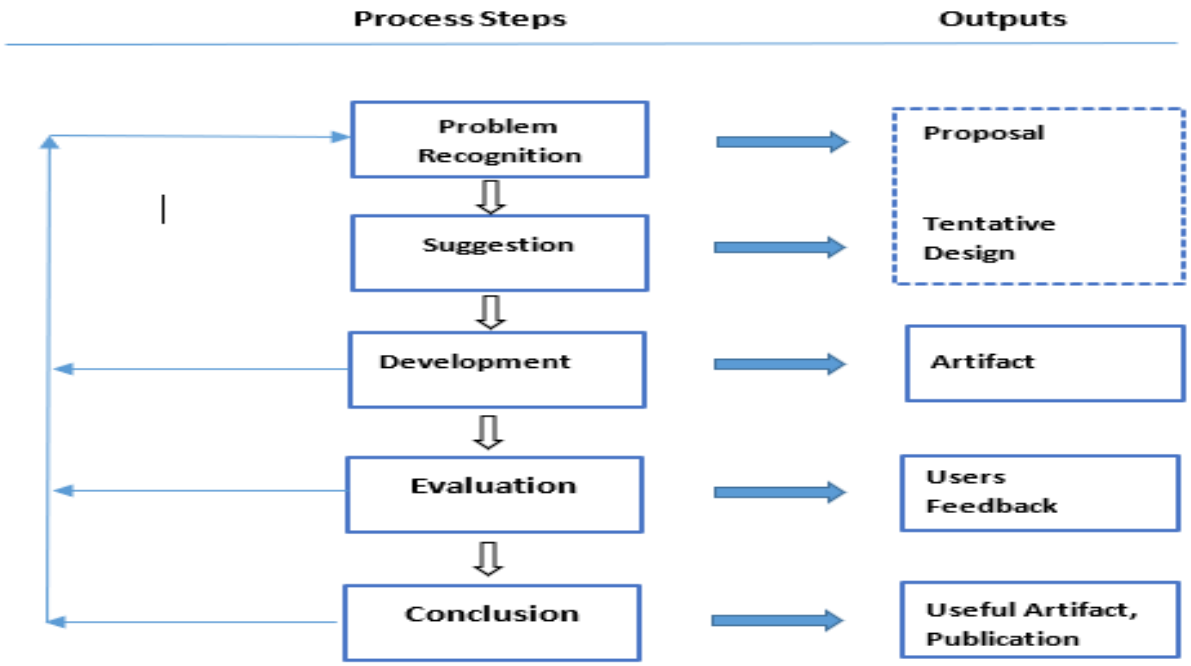
The research was conducted within the Design Science (DS) paradigm using the Design Science Research (DSR) method (Dresch et al., 2015; Van Aken, 2005). The Design Science Research method involves a rigorous process for researching and investigating the artificial and its behavior, both from an academic and organizational point of view, in a real or simulated environment (Dresch et al., 2015). DSR seeks to reduce the gap between theory and practice but maintains the necessary rigor to guarantee the reliability of the results while allowing for flexibility and freedom (Dresch et al., 2015; Hevner et al., 2004). DSR was chosen as an appropriate method because of its underlying characteristics of prescribing solutions, designing, and developing artifacts, as well as generating knowledge towards obtaining a satisfactory solution to specific problems (Dresch et al., 2015; Van Aken, 2005), which is in line with the purpose of this research.

From this perspective, an artifact is something new, not yet existing in nature, created by people for a practical purpose, such as models, frameworks, methods, techniques, notations, algorithms, and instantiations (Hevner & Chatterjee, 2010; Wieringa, 2014). In this regard, a framework is a particular set of rules or ideas that provide the basic structure of something, giving support to dealing with problems or making decisions (Cambridge, n.d.; Merriam-Webster, n.d.). Besides, we also see a framework as "a network of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena" (Jabareen, 2009, p. 51), used as a "real or conceptual guideline to serve as support or guide" (Vaishnavi et al., 2019, p. 16).

The DSR process model employed in this research was adapted from the one proposed by Takeda in 1990 and improved by Vaishnavi and Kuechler in 2004 (Vaishnavi et al., 2019). In agreement with Bergström et al. (2020), we also selected this process due to its consistency with past DSR research within the context of information technology and systems and because the model's phases and associated activities are adequately described.

Design science research (DSR) is based on the idea that scientific knowledge can be generated by means of constructing an artefact (Kristjánsson et al., 2012), and a key focus of this process and of design science research itself is the contribution of new knowledge. As illustrated in Figure 2.2, the process model consists of five basic steps and permits iterating some of them if the results obtained provide opportunities for improvement: i) Problem recognition; ii) Suggestion; iii) Development; iv) Evaluation; and v) Conclusion.

Figure 2-2 Development process model



Note: Adapted from Vaishnavi et al. (2019).

The first step, Problem recognition, involves identifying a problem in business, society, or science, and justifying the study's importance. The output for this step will be a proposal for the research effort. The second step, Suggestion, comprises the presentation of an early draft of a possible solution for the problem at hand, the Tentative Design, drawn from the existing knowledge/theory base for the problem domain (Vaishnavi et al., 2019). These two steps correspond to the first and second studies in this research, carried out to identify existing problems in the IT project domain to whose solution the use of SM to share knowledge can contribute. The dotted line surrounding the outputs of these two steps, proposal and tentative design, indicates the close connection between them.

In the third step, Development, the tentative design is further refined and developed. The techniques for development may vary for different artifacts since the novelty is primarily in the design, not in the construction itself (Vaishnavi et al., 2019). As an evolution of the previous step outputs, the development of the framework in this phase was also based on the literature and on interviews with practitioners.

The fourth step comprises the evaluation of the artifact's expected behavior and impacts, collecting evidence that the version in hand meets the required goals. The results of

the Evaluation step often involve additional research and new design to understand the reasons for eventual deviations from the expected behavior (Vaishnavi et al., 2019). The framework was evaluated by senior project managers in a focus group meeting. The Suggestion, Development, and Evaluation steps correspond to the third study carried out in this research.

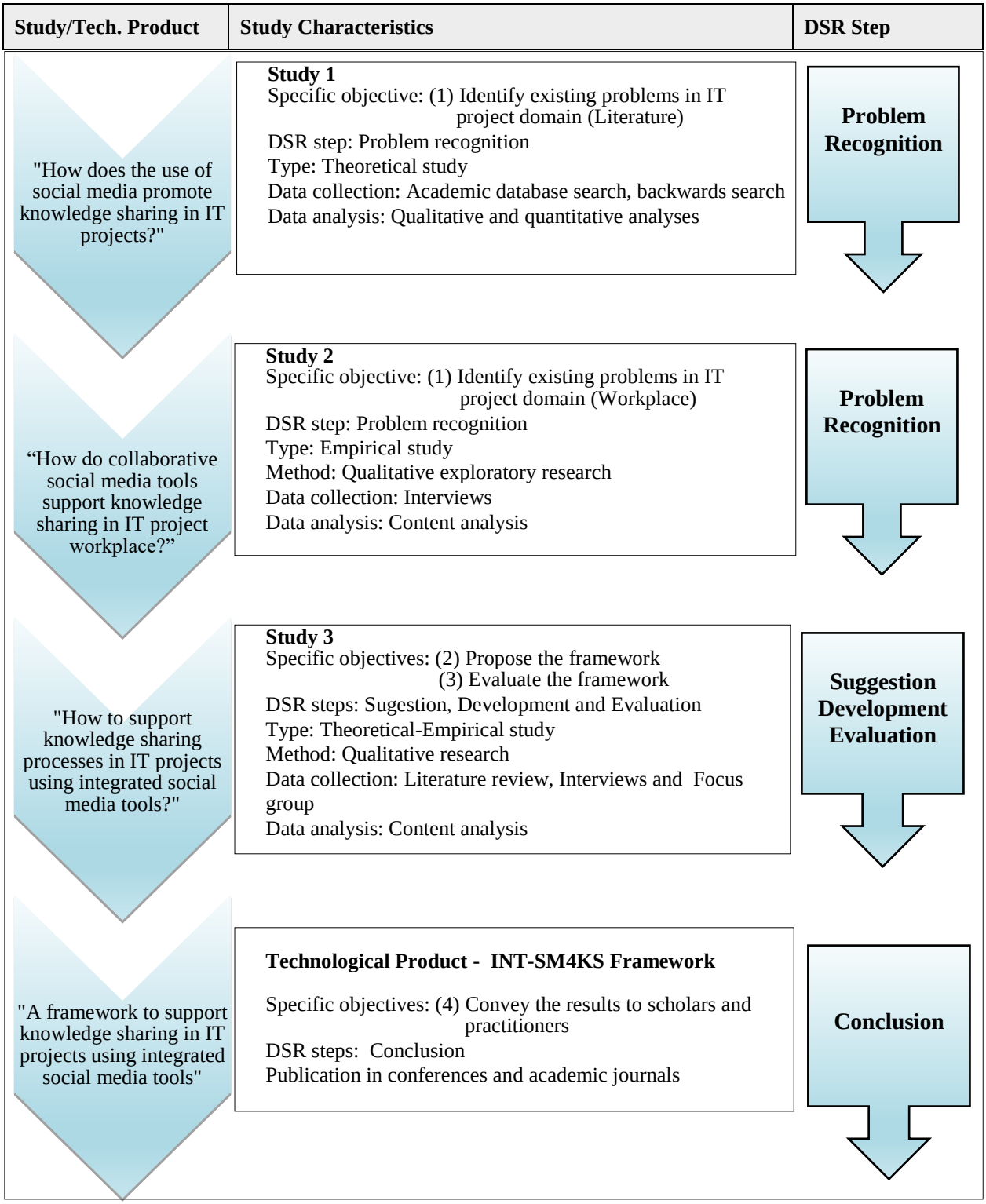
Finally, in the fifth step, Conclusion, the problem recognition, the proposed solution, and the resultant artifact must be communicated to researchers and practitioners. This step may indicate the end of the DSR project effort or simply the end of a research cycle with subsequent iteration to one of the previous steps (Vaishnavi et al., 2019). In this regard, a paper describing the work executed and the results accomplished will be produced and submitted for publication in journals and conferences.

2.2 THESIS OUTLINE

Although the studies are independent, they are sequentially connected, so much so that each study result contributes to the next. The first study establishes the basis for work development, compiling knowledge of recent academic literature on the subject being studied. The second study complements the previous one, approaching the subject from a practical perspective, seeking to identify difficulties related to the theme in IT project workplaces. In the third study, we make use of the knowledge acquired in the first two. The theory, practice, existing gaps, and IT project managers' needs are analyzed to propose the framework, specify its components, and carry out the artifact’s development and evaluation.

The thesis outline is presented in Figure 2.3. On the left side, emphasis is given to the sequence of the three research questions of the studies which comprise the thesis and the technological product proposed as a result. The study's characteristics are highlighted in the center, presenting the corresponding DSR steps, the research type, research method, data collection method, and data analysis method. On the right side, the DSR process model steps to which the study is related are shown.

Figure 2-3 Thesis outline



Note: Created by the author

3 THESIS STRUCTURE

The structure designed for this thesis comprises three studies. The first one aims to collect and summarize academic knowledge produced on the research subject from 2010 to 2019. A systematic literature review (SLR) was carried out to increase understanding and direct future research efforts. Forty-three papers on the use of social media to promote knowledge sharing in IT projects were analyzed to identify literature gaps and propose a research agenda.

The objective of the second study is to identify difficulties in knowledge sharing within different IT project workplaces where using collaborative social media tools can make a significant contribution. In order to gain a more in-depth and empirically grounded understanding of the problems in the research domain, interviews were carried out with fifteen Brazilian senior IT project managers from distinct business sectors.

In the third study, the development and evaluation of the framework are carried out and described. The development was based on a comprehensive literature review and on eighteen interviews conducted with participants of agile projects to validate and refine the framework. In addition, the completeness, the complexity, the ease of use, and the impact of the framework were evaluated by four senior project managers in a focus group meeting.

This section presents a summarized view of the thesis' structure in a matrix where essential information can be found, as illustrated in Figure 3.1, that presents an adaptation of the Methodological Mooring Matrix suggested by Costa et al. (2019). This matrix links the theoretical, methodological, and contributory elements of the multiple studies, connecting the different research or methods in the context of the thesis development, as proposed by Costa et al. (2019). The thesis matrix consists of four sections: i) header; ii) justifications; iii) studies; and iv) technological products.

Figure 3-1 Methodological Mooring Matrix

THESIS RESEARCH QUESTION
"How to support knowledge sharing processes in information technology projects using integrated social media tools?"
GENERAL OBJECTIVE
Propose and evaluate an artifact, a framework for the integrated use of social media tools to support knowledge sharing in IT projects, making use of the affordance perspective.
Justification for the studies

The initial study aims to collect and summarize academic knowledge produced on the subject of study from 2010 to 2019, to increase understanding and direct future research efforts. The objective of the second study is to identify, in different IT project workplaces, difficulties to whose solution knowledge sharing supported by collaborative social media tools can make a significant contribution. In the third study, the development and validation of a framework are carried out and described.
Justification for the interdependence of the studies
The first study establishes the basis for work development, compiling knowledge of recent academic literature on the subject being studied. The second study complements the previous one, approaching the subject from a practical perspective, seeking to identify difficulties related to the theme in IT project workplaces. In the third study, knowledge acquired in the first two studies is used. Theory, practice, existing gaps, and IT projects needs are analyzed to propose the artifact, specifying its characteristics, and carrying out the artifact's development and evaluation.

Study 1 - Using Social Media to Promote Knowledge Sharing in Information Technology Projects: A Systematic Literature Review	
Research Question	"How does the use of social media promote knowledge sharing in IT projects?"
General Objective	Investigate the role of social media in promoting KS in IT projects identifying research gaps and proposing a future research agenda.
Type	Theoretical.
Status	Accepted in ENADI 2020 Conference (August 2020) Accepted in SINGEP 2020 Conference (October 2020) Published in Journal of Management & Technology, (A3), v. 21, n.4, p.203-229, out./dez. 2021.
Research Method	Systematic Literature Review
Data Collection	Queries to SCOPUS and Web of Science databases. Additional, backward search. Articles from academic journals between 2010 and 2019.
Data Analysis	i) Design extraction form; ii) extract and store relevant data; iii) simple quantitative analysis; iv) qualitative analysis
Study 2 - Knowledge Sharing in Information Technology Projects: a Senior Practitioners' Perception on the Use of Collaborative Tools	
Research Question	"How do collaborative social media tools support knowledge share in IT project workplace?"
General Objective	Identify, difficulties in IT projects workplaces, to whose solution knowledge sharing supported by social media tools can contribute.
Type	Empirical.
Status	Accepted in EnANPAD 2021 Conference (October 2021) Submitted to the Journal Knowledge and Process Management (A2), in 2022/03/01.
Research Method	Qualitative exploratory research
Data Collection	Semi-structured interviews with 15 Brazilian IT project managers, following the guidelines of a seven stages systematic process.
Data Analysis	Content analysis was applied to analyze the transcript contents, supported by Atlas.ti software.
Study 3 - The Integration of Social Media Collaborative Tools To Support Knowledge Sharing in IT Projects: An Affordance-Based Perspective	
Research Question	"How to support knowledge sharing in IT projects using integrated social media tools?"
General Objective	Use the perspective of affordances to develop and evaluate a framework for

	the integrated use of social media tools to support knowledge sharing in IT projects.
Type	Theoretical-Empirical.
Status	Accepted in EnANPAD 2022 Conference. (September 2022)
Research Method	Design Science Research
Data Collection	Literature review, semi-structured interviews and focus groups.
Data Analysis	Content analysis was applied to analyze the transcript content, supported by Atlas.ti software.
Technological Product - Unpatentable Process / Technology or Product / Material. Products and /or technological processes that, due to legal impediments, do not have a formal protection mechanism in Brazilian territory, including any intellectual property assets.	
Description	Framework for the integration of interactions mediated by social media technologies, to support knowledge sharing in IT projects.
Adherence	High. The framework was developed as an activity of the graduate program, originated in its research lines, linked to an axis project within one of the lines, "Information Technology and Innovative Projects".
Impact	Potentially relevant, impacting knowledge sharing in IT projects. Its efficient application in IT projects can assist project managers by improving the benefits of knowledge sharing, which can increase managerial effectiveness and have a favorable impact on its success. Spontaneous demand and general objective previously defined.
Applicability	High. The framework will be available to the community of professionals involved in IT projects. Potential for growth in the use by project professionals from other areas and business sectors.
Innovation	Medium. The combination of technical knowledge used has already been established. Knowledge produced was related to the application, integration, and / or technological evolution of existing knowledge.
Complexity	Medium, resulting from the combination of pre-established and stable knowledge regarding the different actors who will participate in its development.

Note: Adapted from Costa et al. (2019).

The Header section in the matrix includes the thesis research question and the general objective. The two Justification sections contain a brief description of the objectives of each study as well as the way they are interdependent, i.e., how each one is connected to the others. The Studies section consists of a group of lines, each one summarizing one study of the thesis, where the corresponding topics are title, research question, main objective, type of study, publication status of the study, research method, data collection, and data analysis procedures.

Finally, the Technological products section comprises a group of lines, each of them summarizing a technological product to be developed and presented as a thesis result. In addition to the lines containing the name, type, and description of the product, this section also contains a line for each criterion considered by the Coordination for the Improvement of

Higher-Level Personnel (CAPES) to assess the product when evaluating the graduate program: i) adherence; ii) impact; iii) applicability; iv) innovation; and v) complexity.

4 STUDY 1 - USING SOCIAL MEDIA TO PROMOTE KNOWLEDGE SHARING IN INFORMATION TECHNOLOGY PROJECTS: A SYSTEMATIC REVIEW AND FUTURE RESEARCH AGENDA

Uso de mídias sociais para promover compartilhamento de conhecimento em projetos de tecnologia da informação: revisão sistemática e agenda de pesquisas futuras

Uso de las redes sociales para promover el intercambio de conocimientos en proyectos de tecnología de la información: una revisión sistemática y una agenda de investigación futura

Abstract

Objective of the study: This study investigates the use of social media to promote knowledge sharing in information technology projects, integrating the three concepts to identify literature gaps and propose a research agenda.

Methodology/Approach: With descriptive and exploratory purposes, a systematic literature review was

carried out, adopting a systematic process to define the research protocol.

Main results: Wikis, instant messengers and blogs concentrate the research focus. The number of peer-reviewed papers published is low and most of them address software development projects, tasks and processes, and developers. Literature gaps and research opportunities refer to studies in the public sector; the use of social media for knowledge sharing in project management practices and methodologies; sharing knowledge in hybrid and virtual teams; and the use of integrated social media and/or new technologies such as mobile, cloud computing and Internet of Things.

Theoretical/Methodological contributions: Besides adding to the literature and stimulate future research, findings can bring new insights on adopting or improving the use of social media to share knowledge in IT projects.

Originality/relevance: This study approaches an emerging and growing research field. It is innovative in bringing together the themes of social media, knowledge sharing, and IT projects, presenting an overview of the subject addressing the most used tools; tasks and processes supported; stakeholders involved; and tools contribution to knowledge sharing practices. To the best of our knowledge the integration of these themes has not been previously explored.

Keywords: Project management; Knowledge sharing; Information technology; IT projects; Social media.

Resumo

Objetivo do estudo: Investigar o uso de mídias sociais para promover compartilhamento de conhecimento em projetos de tecnologia da informação, integrando os três conceitos para identificar lacunas na literatura e propor uma agenda de pesquisa.

Metodologia/Abordagem: Com fins descritivos e exploratórios, uma revisão sistemática da literatura foi realizada, adotando um processo sistemático para definir o protocolo de pesquisa.

Principais resultados: Wikis, mensageiros instantâneos e blogs concentram as pesquisas. O número de artigos revisado por pares encontrado é baixo e a maioria aborda projetos, tarefas e processos de desenvolvimento de software e desenvolvedores. Lacunas na literatura e oportunidades de pesquisa referem-se a estudos no setor público; uso de mídias sociais para compartilhar conhecimento em práticas e metodologias de gerenciamento de projetos; compartilhamento de conhecimento em equipes híbridas e virtuais; uso integrado de mídia sociais e/ou novas tecnologias como celular, computação em nuvem e Internet das Coisas.

Contribuições teórico-metodológicas: Além de agregar à literatura e estimular pesquisas futuras, os achados podem trazer *insights* sobre a adoção ou aprimoramento do uso das mídias sociais para compartilhar conhecimento em projetos de TI.

Originalidade/relevância: Este estudo aborda um campo de pesquisa emergente e crescente. Inova reunindo os temas de mídia social, compartilhamento de conhecimento e projetos de TI, apresentando um panorama que aborda as ferramentas mais utilizadas; tarefas e processos suportados; partes interessadas; e contribuição de ferramentas para práticas de compartilhamento. Até onde sabemos, a integração destes temas é inexplorada.

Palavras-chave: Gerenciamento de projetos; Compartilhamento de conhecimento; Tecnologia da Informação; Projetos de TI; Mídias sociais.

Resumen

Objetivo del estudio: Investigar el uso de las redes sociales para promover el intercambio de conocimiento en proyectos de tecnología de la información, integrando los tres conceptos para identificar vacíos en la literatura y proponer una agenda de investigación.

Metodología/Enfoque: Con fines descriptivos y exploratorios, se realizó una revisión bibliográfica sistemática, adoptando un proceso sistemático para definir el protocolo de investigación.

Principales resultados: Wikis, mensajería instantánea y blogs concentran la investigación. El número de artículos revisados por pares encontrados es bajo y la mayoría cubre proyectos, tareas y procesos de desarrollo de software. Las lagunas en la literatura y las oportunidades de investigación se refieren a estudios en el sector público; uso de las redes sociales para compartir conocimientos sobre prácticas y metodologías de gestión de proyectos; intercambio de conocimientos en equipos híbridos y virtuales; uso integrado de redes sociales y/o nuevas tecnologías como dispositivos móviles, computación en la nube e Internet de las cosas.

Contribuciones teórico-metodológicas: Además de contribuir a la literatura y estimular la investigación futura, los hallazgos pueden aportar ideas sobre la adopción o mejora del uso de las redes sociales para compartir conocimientos en proyectos de TI.

Originalidad/relevancia: Este estudio aborda un campo de investigación emergente y en crecimiento. Innova al reunir los temas de las redes sociales, el intercambio de conocimientos y los proyectos de TI, presentando una visión general que abri-las las herramientas más utilizadas; tareas y procesos soportados; partes interesadas; y contribución de herramientas para compartir prácticas. Hasta donde sabemos, la integración de estos temas está inexplorada.

Keywords: Gestión de proyectos; El intercambio de conocimientos; Tecnología de la informacion; Proyectos de TI; Redes sociales.

4.1 CONTEXT AND BACKGROUND

Information technology (IT) has become an essential asset to the competitive strategy in contemporary organizations and the relevance of knowledge has grown in IT projects (Koriat & Gelbard, 2019). In our knowledge-based society, there is an increase recognition of knowledge as a factor of production and of the importance of collaboration and social interaction (Krumova & Milanezi, 2015). Particularly in IT projects domain, collaborative behaviors such as knowledge sharing (KS) are the basis for successful teamwork while an open communication is one of the requirements to share knowledge (Koriat & Gelbard, 2019), demanding more emphasis on tools and techniques to enhance project team collaboration (Lee, 2021). Social media (SM) technologies and services emerged as a valuable element to facilitate KS and communication and have been increasingly adopted in organizations (Ahmed et al., 2019; Leonardi & Vaast, 2017). SM enable different formats of social interactions where users create and share content collaboratively, leading to new and more complex knowledge (Ngai et al., 2015; Leonardi & Vaast, 2017).

4.1.1 SOCIAL MEDIA

SM are described by Carr and Hayes (2015, p. 8) as "Internet-based channels that allow users to opportunistically interact and selectively self-present, either in real-time or asynchronously, with both broad and narrow audiences who derive value from user-generated content and the perception of interaction with others". This definition applies to a collection of interactive technologies and services, encompassing tools such as wikis, blogs, microblogs, social networks and instant messenger applications (Gholami & Murugesan, 2011). The advent and use of SM have been modifying the technological landscape, affecting human interactions, facilitating intra- and inter-organizational collaboration and content sharing between peers, customers, business partners, and other organizations (Ngai *et al*., 2015).

Presently, the use of SM tools pervades our society and organizational settings so much so that its benefits and challenges can no longer be ignored (Ahmed *et al*., 2019; Sarka & Ipsen, 2017). The increasing potential of IT support and the constant pressure for innovation motivate organizations to leverage the use of SM to improve their performance, affecting organizational phenomena and processes (Sarka & Ipsen, 2017; Sun et al., 2019). Driven by new management trends and innovations, leading executives and researchers keep prospecting new uses to benefit from exploring SM in such areas as product development, sales and

marketing, healthcare, IT, academia, and government (Gholami & Murugesan, 2011; Kanagarajoo et al., 2019; Naeem, 2019; Sun et al., 2019).

SM tools have been used in such project management (PM) areas as requirements, communication, knowledge and collaboration, improving engagement and relationships (Daemi et al., 2020). Zin et al. (2018) suggest that these collaborative tools tend to gain more attention as teams become increasingly delocalized with Information and Communication Technology (ICT) supporting virtual work. Furthermore, the recent consequences of the COVID-19 pandemic led to a great expansion of virtual project work supported by collaborative tools in the IT industry (Ozguler, 2020) .

4.1.2 KNOWLEDGE, KNOWLEDGE SHARING AND SOCIAL MEDIA

Currently, organizational competitiveness derives mostly from intangible resources, such as tacit and explicit knowledge, whose processes set the foundation for ensuring operational effectiveness, employee creativity and high-performance standards (Navimipour & Charband, 2016; Sun *et al*., 2019). Tacit knowledge is embedded in mind, based in action and experience, being difficult to be communicated, shared or transferred between projects (Nidhra et al., 2013; Panahi et al., 2012; B. Rowe, 2014). In contrast, explicit knowledge is formal and systematic, shared in the form of specifications, manuals, books, procedures, papers, etc. (Nidhra et al., 2013; Panahi et al., 2012; B. Rowe, 2014).

As the most important knowledge management process, sharing knowledge quickly and efficiently has become imperative (Krumova & Milanezi, 2015; Naeem, 2019; Sun et al., 2019). Doronin et al, (2020, p. 1063) define knowledge sharing as “an individually intentioned process of disseminating and transferring individually possessed tacit and explicit knowledge, completed in order to produce an increase of knowledge within the recipient or recipients (individuals, group of individuals, organizations, or communities)”.

Regarding an organizational environment, Wang and Noe (2010, p. 117) assert that KS relates to “the provision of task information (knowledge) and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies or procedures”. Thus, through effective KS, organizations are able to integrate expert critical knowledge, skills and abilities to carry out complex work and innovation (Navimipour & Charband, 2016).

Information technology is a main enabler of KS processes (Panahi et al., 2012) and SM tools foster effective KS through social interaction and collaborative practices at individual, group, and organizational levels (Naeem, 2019). In this context, organizations seek to inspire and

exploit it by expanding technologies and practices (Gaál *et al*. 2015). Leaders, consultants and researchers increasingly try to intensify SM tools adoption to support KS, however it is usually complex and complicated (Gaál *et al*., 2015; Naeem, 2019).

Panahi *et al*., (2012) describe five SM features likely to encourage, support and enable people to share knowledge easily and efficiently: i) user-generated content; ii) peer to peer communication; iii) networking; iv) multimedia oriented; and v) user friendly. In contrast, Naeem (2019) points out SM limitations as a technological support to enhance KS, such as fear of losing power, lack of intention to share knowledge, lower level of motivation and resistance toward technology. He claims that organizations must understand and manage these situations to use SM efficiently and effectively.

4.1.3 KNOWLEDGE SHARING AND PROJECT MANAGEMENT

An effective sharing of learning experience is an organizational key factor contributing to successful projects (Koriat & Gelbard, 2019; Mueller, 2015). As project management (PM) practices evolve, knowledge is shared through processes, tools, documents, meetings and training (B. Rowe, 2014), favoring new knowledge, new skills and enhancing new ideas (Naeem, 2019). Within project workplaces, KS links individuals and the team, increasing performance, reducing costs and improving innovation capability (Chaves et al., 2018; Navimipour & Charband, 2016; Sarka & Ipsen, 2017).

Project managers are continuously looking for ways to accomplish KS, facing the challenge of effectively leading their teams in knowledge creation and sharing processes (Mueller, 2015; B. Rowe, 2014). Mueller (2014, 2015) suggests that organizations must focus on sharing knowledge within team boundaries and support individual activities, so as to fully exploit team potential and meet stakeholders' knowledge needs, achieving better results. Mueller (2015) adds that since team members usually belong to different departments, focus on KS across organizational boundaries and between project teams is also imperative.

4.1.4 IT PROJECT MANAGEMENT

"Organizations undertake IT projects to transform and grow" (Daemi et al., 2020, p. 6), so much so that IT project management is a key concern, leading to a special interest in its improvement (Rai, 2016). However, despite the new concepts, methodologies, and tools, IT project management is still notorious for failures, due to such factors as rapidly changing

environment, increased demands, complex systems development and complex infrastructure required (Babenko et al., 2019; Gholami & Murugesan, 2011).

Along with information technology, IT projects have gone through a radical change and enterprises are being reinvented under the influence of SM, mobility, cloud computing, internet of things (IOT), artificial intelligence (AI) and other transformational forces (Rai, 2016). Multidisciplinary knowledge must be collected and disseminated (Marnewick and Marnewick, 2019). The management and sharing of this knowledge play a fundamental role in reacting quickly to hasten problem solving and decision-making processes in the IT field (Koriat and Gelbard, 2019; Zin *et al*., 2018).

Technological advancement and the increased use of SM tools have transformed the practice within project teams (Auinger et al., 2013) and the context in which team members operate (Storey et al., 2014), including IT projects. Such management and development tools support KS processes, allowing users to share information and knowledge on technical and professional issues (Koriat and Gelbard, 2019) also supporting project teams remote work, facilitating collaboration with partners in different locations, which is a challenge in contemporary organizations (Kanagarajoo et al., 2019; Portillo-Rodríguez et al., 2012).

As to the impact of SM support to KS on IT projects success, Sarka and Ipsen (2017) affirm that using SM to share knowledge effectively helps software developers to achieve project objectives; Nabelsi *et al*. (2017) report benefits in project performance from wiki use in KS within the context of IT projects in the public sector; Foote and Halawi (2018) point out SM tools that aided team members to develop higher quality software; and Chowdhury and Lamacchia (2019) present a framework where SM tools facilitate KS in successful digital transformation projects.

4.1.5 OBJECTIVE AND RESEARCH QUESTION

Although the perceived relevance of the three themes approached here, both individually and altogether, several studies indicate a need for further research. Accordingly, Leonardi and Vaast (2017) assert that organizational scholars have been slow to explore SM use in the workplace, despite the claims, and several studies corroborate it. Gholami and Murugesan (2011) report the sparse academic literature linking the management of distributed IT projects and SM tools; Navimipour and Charband (2016) report that comprehensive and systematic research on KS mechanisms between project teams is rare; Naeem (2019) reports finding limited literature available exploring SM role in enhancing KS practices. From this perspective, Sarka and Ipsen (2017) suggest that SM support to KS in IT projects is an

emerging and growing field of research, remaining reasonably new to academia. As such, practitioners and researchers demand common references and a valid general knowledge database.

In light of the above, to contribute on the understanding of the integration of these three concepts, a Systematic Literature Review (SLR) was carried out on the current knowledge to investigate the role of SM in promoting KS in IT projects. Aiming to identify literature gaps and propose a further research agenda on the subject, the study addresses the research question *"How does the use of social media promote knowledge sharing in IT projects?"*.

A systematic literature review was the chosen method to carry out this work because SLRs adopt a well-defined process to map out knowledge areas, enabling findings on what research has been done, what the new and emerging developments are and where new studies are needed (Guide, 2006; Kitchenham & Charters, 2007; F. Rowe, 2014).

The remainder of this paper is structured in four additional sections: Section 2 describes the method used to select and retrieve papers to review, as well as the analyses carried out. Section 3 discusses the main results found in this review, notably the answers to the research question and the future research agenda. Section 4 presents the conclusion.

4.2 METHODOLOGY

In the context of the objective proposed, this review is both descriptive and exploratory. As a descriptive review, it aims to organize what is known about a recent or emerging technology, service or practice (Rowe, 2014b), and as an exploratory review it aims to provide an overall picture of the subject area, generating ideas, insights, and clarifications, as the first step of a broader investigation (Petticrew & Roberts, 2008).

To ensure the rigor, we draw on Kitchenham and Charters (2007) adopting five steps of the systematic process they propose to design a research protocol: i) research question formulation, ii) search strategy, iii) database screening, iv) study selection and v) data extraction and analysis. These steps will be described in the next subsections.

4.2.1 RESEARCH QUESTION FORMULATION

When the need was identified, the next step consisted of delineating the focus and the scope of the review, which has been set out in the previous section.

4.2.2 SEARCH STRATEGY

Two leading academic databases were searched for papers, Scopus and Web of Science. To ensure rigor, only peer-reviewed journal articles were considered in the result set. Additionally, manual searches were carried out using the technique of backward reference. The search string defined comprises three sections: “Social media”, “Knowledge sharing” and “IT project management”. Along with these terms, other keywords with similar meanings were used to avoid omitting studies. Figure 4.1 presents the search string used.

Figure 4-1 Search string used

Section	Search String
Social Media and correlated terms	*("social media" OR "web 2.0" OR "social software" OR "social network*" OR "social comput*" OR wiki* OR blog* OR microblog* OR "instant messenger*" OR forum*)*
Knowledge Sharing and correlated terms	*AND ((knowledge OR "lesson* learned") AND (sharing OR disseminat* OR transfer* OR exchang*)*
IT Project Management and correlated terms	*AND (project* OR "project manage*" OR agil* OR "information technology" OR "information system*" OR "computer system*")*

Note: Created by the author.

4.2.3 DATABASE SCREENING

The search on the two databases was conducted in December 2019 and January 2020. The search engine was configured to select only articles and reviews published in journals, to filter by subject area/category and to look for the search string in titles, abstracts, and keywords. The search was limited to the timeframe of 2010–2019. Figure 4.2 presents a summary of the database screening step.

Figure 4-2 Summary of the database screening

Database Screening

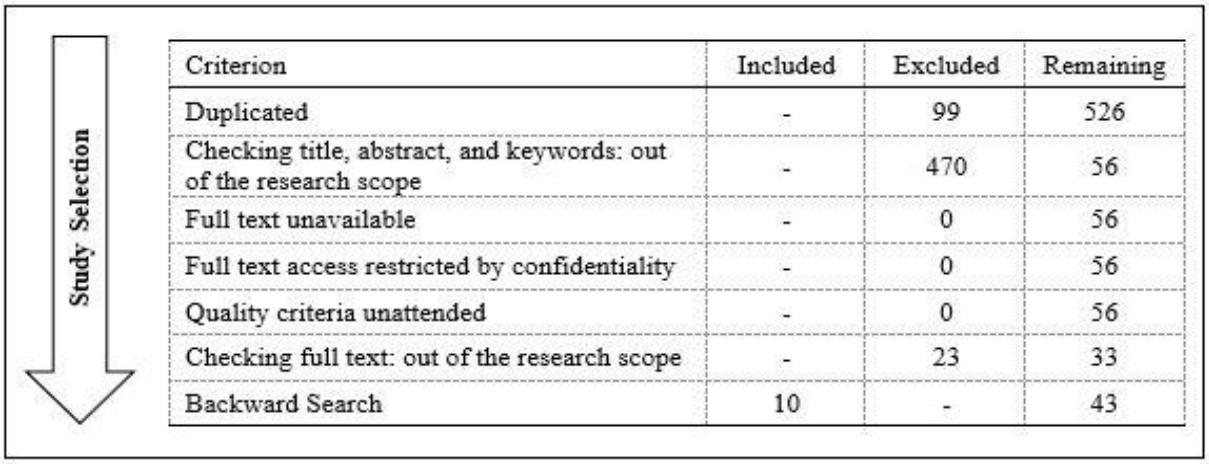
Database	Subject areas / Categories / Constraints	Included
Scopus	Business, Management and Accounting; Computer Science.	370
Web of Science	Management; Computer Science Information Systems; Business; Computer Science Software Engineering; Computer Science Interdisciplinary Application; Public Administration.	255
Both databases	Articles or reviews; published in journals; timeframe 2010-2019; search in titles, abstracts, keywords.	625

Note: Created by the author

4.2.4 STUDY SELECTION

Inclusion and exclusion criteria were applied to the result set retrieved from the databases, to select adequate studies to answer the research question. The final set is composed of 43 papers. A summary for this process is presented in Figure 4.3.

Figure 4-3 Summary of the study selection



Criterion	Included	Excluded	Remaining
Duplicated	-	99	526
Checking title, abstract, and keywords: out of the research scope	-	470	56
Full text unavailable	-	0	56
Full text access restricted by confidentiality	-	0	56
Quality criteria unattended	-	0	56
Checking full text: out of the research scope	-	23	33
Backward Search	10	-	43

Note: Created by the author

After the selection, the papers were sorted by publication year and name and assigned a unique identification number. Figure 4.4 presents the complete list of the selected papers.

Figure 4-4 List of the selected papers

Id No.	Title	Authors	Year
P01	Analysis of virtual communities supporting OSS projects using social network analysis	Toral, S.L., Martínez-Torres, M.R. & Barrero, F.	2010
P02	Knowledge repository to improve agile development processes learning	Amescua, A., Bermón, L., García, J. & Sánchez-Segura, M.-I.	2010
P03	Qualitative Analysis of Semantically Enabled Knowledge Management Systems in Agile Software Engineering	Rech, J., & Bogner, C.	2010
P04	Design guidelines for software processes knowledge repository development	Javier García, Antonio Amescuaa, María-Isabel Sánchez & Leonardo Bermón	2011
P05	Global IT Project Management Using Web 2.0	Gholami B. & Murugesan S.,	2011
P06	Global Software Development and Collaboration: Barriers and Solutions	Noll, J., Beecham, S., & Richardson, I.	2011
P07	Antecedents of collaborative behavior in companies: An analysis of the use of corporate blogs	Fernández-Cardador, P., Agudo-Peregrina, Á.F. & Hernández-García, Á.	2012

Id No.	Title	Authors	Year
P08	Knowledge management: A Solution to requirements understanding in global software engineering	Khan, H., Ahmad, A. & Alnuem, M.A.	2012
P09	Tools used in Global Software Engineering: A systematic mapping review	Portillo-Rodríguez, J., Vizcaíno, A., Piattini, M. & Beecham, S	2012
P10	Wiki as a corporate learning tool: Case study for software development company	Milovanović, M., Minović, M., Štavljanin, V., Savković, M., Starčević, D.	2012
P11	Assessing technical candidates on the social web	Capiluppi, A., Serebrenik, A. & Singer, L.	2013
P12	Empirical studies on the use of social software in global software development-A systematic mapping study	Giuffrida, R. & Dittrich, Y.	2013
P13	Interactive knowledge asset management: Acquiring and disseminating tacit knowledge	Heredia, A., Garcia-Guzman, J., Amescua, A. & Sanchez-Segura, M.-I.	2013
P14	Knowledge transfer challenges and mitigation strategies in global software development – A systematic literature review and industrial validation	Nidhra, S., Yanamadala, M., Afzal, W., & Torkar, R.	2013
P15	Network ties and the success of open-source software development	Peng, G., Wan, Y. & Woodlock, P.	2013
P16	The use of different information and communication technologies to support knowledge sharing in organizations: From e-mail to micro-blogging	Yuan, Y Connie, Zhao, Xuan, Liao, Qinying & Chi, Changyan	2013
P17	Microblogging in open-source software development: The case of Drupal and Twitter	Wang, X., Kuzmickaja, I., Stol, K.-J., Abrahamsson, P. & Fitzgerald, B.	2014
P18	Organizational learning networks that can increase the productivity of IT consulting companies. A case study for ERP consultants	Bologa, R. & Lupu, A.R.	2014
P19	Study of factors influencing the adoption of agile processes when using Wikis	Heredia, A., Garcia-Guzman, J., Amescua-Seco, A. & Serrano, A.	2014
P20	Understanding the attitudes, knowledge sharing behaviors and task performance of core developers: A longitudinal study	Licorish, Sherlock A. & MacDonell, Stephen G.	2014
P21	An Analysis of Problem-Solving Patterns in Open-source Software	Koo, H.-M. & Ko, I.-Y.	2015
P22	Automatic Mapping of User Tags to Wikipedia Concepts: the Case of a Q&A Website - StackOverflow	Joorabchi, A., English, M., & Mahdi, A. E.	2015
P23	Empirical investigation of the challenges of the existing tools used in global software development	Niazi, M., Mahmood, S., Alshayeb, M. & Hroub, A.	2015

Id No.	Title	Authors	Year
	projects		
P24	TagCombine: Recommending Tags to Contents in Software Information Sites	Wang, X. Y., Xia, X., & Lo, D.	2015
P25	Utilizing online serious games to facilitate distributed requirements elicitation	Ghanbari, H., Similä, J. & Markkula, J.	2015
P26	A systematic review of knowledge sharing challenges and practices in global software development	Zahedi, Mansooreh, Shahin, Mojtaba & Babar, Muhammad Ali	2016
P27	Knowledge Sharing on Enterprise Social Media: Practices to Cope With Institutional Complexity	Oostervink, N., Agterberg, M. & Huysman, M.	2016
P28	Network dynamics and knowledge transfer in virtual organizations	Gandal, N. & Stettner, U.	2016
P29	Open-source project success: Resource access, flow, and integration	Daniel, Sherae & Stewart, Katherine	2016
P30	Producing Just Enough Documentation: An Optimization Approach Applied to the Software Architecture Domain	Díaz-Pace, J.A., Villavicencio, C., Schiaffino, S. & Nicoletti, M. & Vázquez, H.	2016
P31	Semantic tagging and linking of software engineering social content	Bagheri, E., & Ensan, F.	2016
P32	A semantic wiki approach to enable behavior driven requirements management	Marques-Lucena, C., Agostinho, C., Sarraipa, J. & Jardim-Goncalves, R.	2017
P33	Documenting and sharing software knowledge using screencasts	MacLeod, L., Bergen, A. & Storey, M.-A.	2017
P34	Increasing the Impact of Wikis on Project Performance: Fine-tuning Functional Quality and Knowledge Sharing	Nabelsi, Veronique, Gagnon, Stephane & Brochot, Damien	2017
P35	Innovation In The Management Of Lessons Learned In An IT Project With The Adoption Of Social Media	Winter, Roberto & Chaves, Marcirio Silveira	2017
P36	Knowledge sharing via social media in software development: A systematic literature review	Sarka, P. & Ipsen, C.	2017
P37	Motivators for adopting social computing in global software development: An empirical study	Niazi, M., Mahmood, S., Alshayeb, M., Baqais, A.A.B. & Gill, A.Q.	2017
P38	The Role of Task Uncertainty in IT Project Team Advice Networks	Keith, Mark, Demirkan, Haluk & Goul, Michael	2017
P39	The structure and dynamics of knowledge network in domain-specific Q&A sites: a case study of stack overflow	Ye, D., Xing, Z., & Kapre, N.	2017
P40	Use of social media in IT project management: a literature review based on hermeneutics and a research agenda	Ikemoto, M. N., Gantman, S., & Chaves, M. S.	2017

Id No.	Title	Authors	Year
P41	Accountability in Brazilian Governmental Software Project: How Chat Technology Enables Social Translucence in Bug Report Activities	Tenrio, Nelson & Pinto, Danieli & Bjorn, Pernille	2018
P42	A topological analysis of communication channels for knowledge sharing in contemporary GitHub projects	Tantisuwankul, J., Nugroho, Y.S., Kula, R.G., Hata, H., Rungsawang, A., Leelaprute, P. & Matsumoto, K.	2019
P43	Towards a reduction in architectural knowledge vaporization during agile global software development	Borrego, G., Morán, A.L., Palacio, R.R., Vizcaíno, A. & García, F.O.	2019

Note: Created by the author

4.2.5 DATA EXTRACTION AND ANALYSIS

The papers were carefully analyzed, relevant information was extracted and stored in a spreadsheet previously designed. The extracted fields were title, keywords, abstract, authors, year of publication, journal, database, h-index, number of citations, objectives, research question(s) or hypotheses, project type, findings/results, contributions, future research, most used SM, project phases/processes/events, and stakeholders involved. The resulting spreadsheet has been preserved.

Descriptive statistics was used to analyze contextual attributes: SM used, project phases/processes/events affected, and stakeholders involved. Specifically, to discuss the contribution of SM use we drew on the six themes categorized by Zahedi *et al*. (2016). Qualitative analyses were used to conduct this discussion, to identify gaps in literature and propose a research agenda. To ensure reliability, an individual viewpoint on a topic was only accepted when discussed and agreed on by all the researchers.

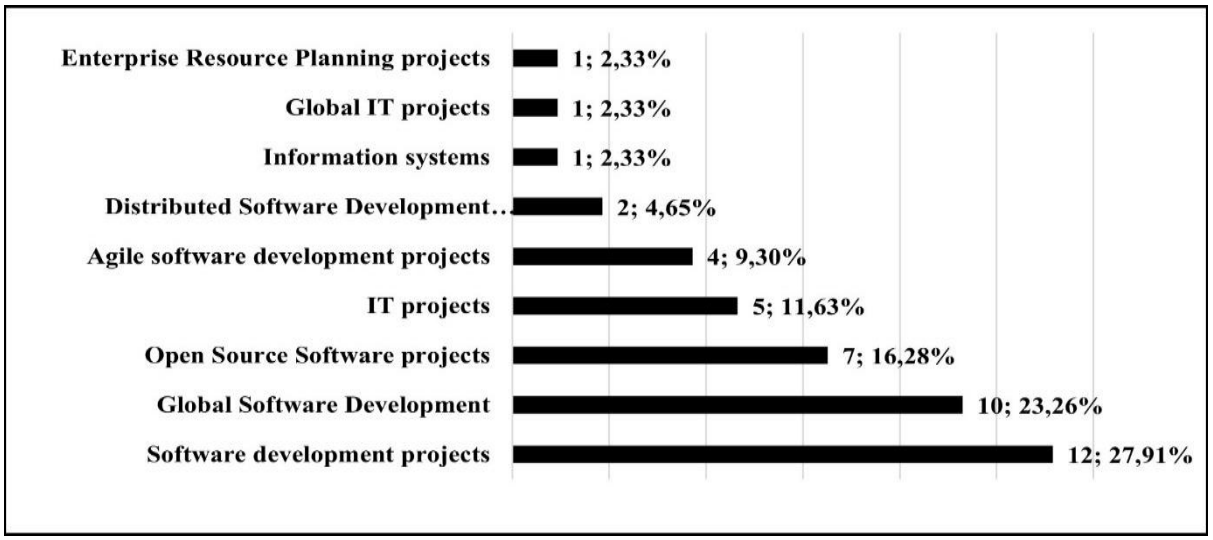
4.3 RESULTS AND DISCUSSION

Initially, it is relevant to point out the low number of publications found. The same applied to other SLRs addressing a correlated theme, such as P06, P09, P12, P14, P23, P26, and P36, where the majority of the papers refer to congresses and conferences. This fact confirms the importance of this study and is consonant with the need for further research on the integration of the themes addressed here, claimed by Gholami and Murugesan (2011), Zahedi and Babar (2014), Navimipour and Charband (2016), Sarka and Ipsen (2017), and Naeem (2019). After this clarification, we proceed with the results.

4.3.1 TYPES AND DENOMINATIONS OF IT PROJECTS

Although IT domain encompasses different types of projects, regarding the development of products, services, or processes such as software, information systems, software implementation, and deployment of IT infrastructure (Babenko et al., 2019) all but one papers address software development projects. Only P18, addresses *Enterprise Resource Planning* (ERP) projects. Figure 4.5 presents the types of IT projects found.

Figure 4-5 Types and denominations used in IT projects



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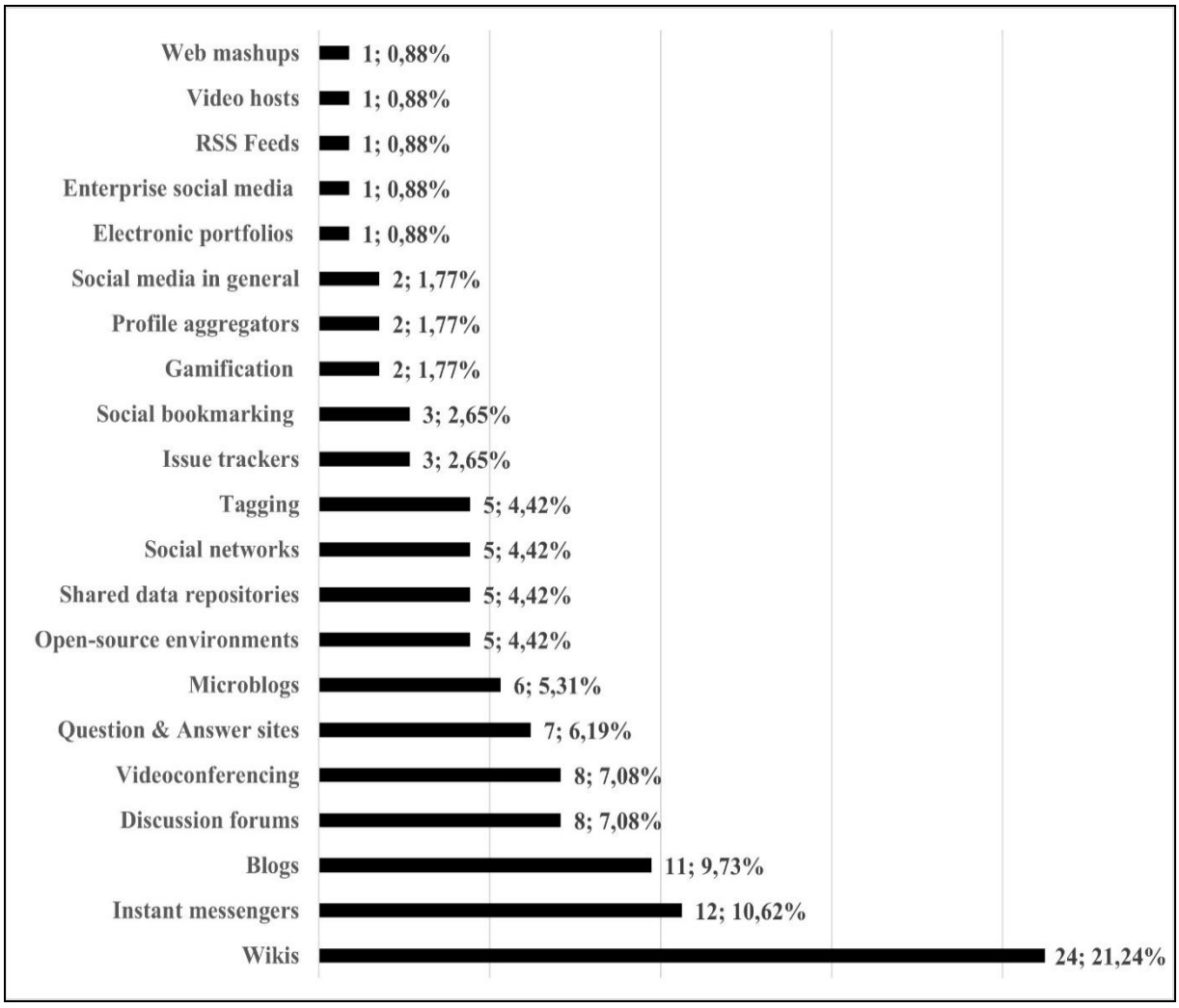
Software projects developed by collocated teams are addressed in 22 studies, or 51.16%, but the relevance of software developed by distributed teams stand out. They are addressed in 20 studies, or 46.51%. This fact suggests the importance of the relationship between team location and adequate KS practices for the effective management of software development projects, as suggested by Noll *et al*. (2010). It is also noticeable that only five studies address agile methods, four referring to distributed teams and only one to collocated teams. It suggests low interest in research on IT project management methodological approaches.

Among collocated teams, the denomination “software development project” is used 12 times and “IT project” is used 5 times. The term “agile software development” is used 4 times, and the term “information system” only once. In the group of the distributed teams, 7 studies address Open-Source Software (OSS) projects; 10 address Global Software Development projects, one of them being Agile (2.33%); two of the studies address Distributed Software Development projects; and one uses the term Global IT Project.

4.3.2 WHAT ARE THE MOST USED SOCIAL MEDIA TO PROMOTE KNOWLEDGE SHARING IN IT PROJECTS?

There were 113 mentions to SM tools in the 43 papers. Wikis, instant messengers and blogs, received 41.6% of all mentions. An intermediate group composed by discussion forums, internet conferencing tools, question-and-answer (Q&A) sites, microblogs, open-source environments, shared data repositories, social networks and tagging received 43.4% of the mentions. The remaining tools received 15.04% of the mentions, where two studies mention SM in general. This result is presented in Figure 4.6 and highlights the importance of their use and suggests that researchers are increasing investigation on their contribution to KS.

Figure 4-6 Most used social media tools to support knowledge sharing in IT projects



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These numbers echo other systematic reviews results, particularly those regarding global software development (GSD) projects. Giuffrida and Dittrich (2013), in P12, found that instant messengers are the most used tool. Portillo-Rodríguez *et al*. (2012), in P09, report that

wikis, blogs and shared data repositories are the main support for knowledge acquisition, sharing and distribution. Zahedi *et al*. (2016), in P26, report the comprehensive and increasing use of the same three tools. In a broadened scope, considering software projects in general, Sarka and Ipsen (2017), in P36, also found that wikis are the most used tool.

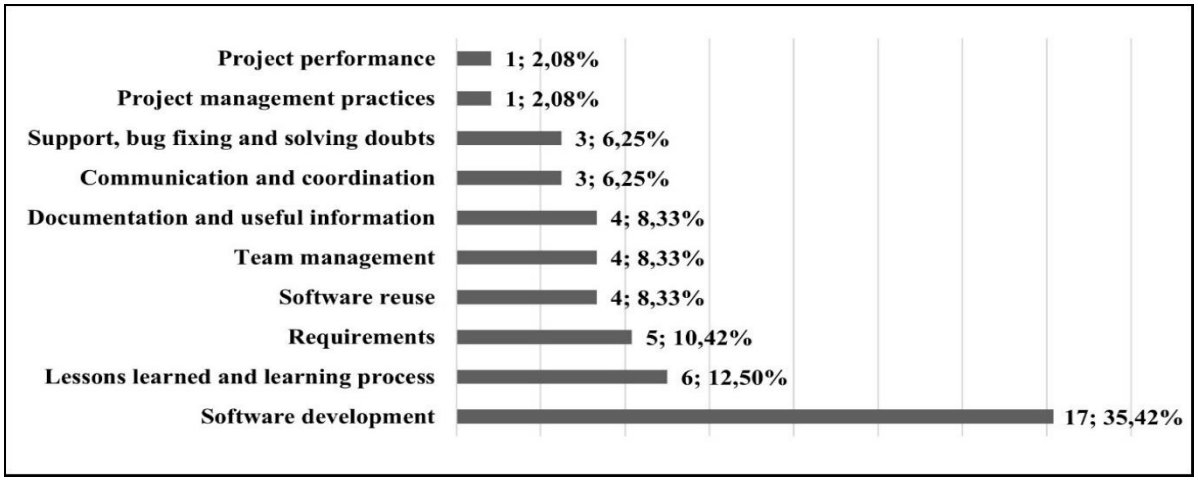
Along with commonly used SM tools, such as wikis and blogs, it is significant that tools strongly related to software development are among the most mentioned. Discussion forums, open-source environments, issue trackers and Q&A sites, mentioned in P22, P29, P39, P42, for example, are popular among software developers.

4.3.3 PROJECT TASKS AND PROCESSES WHERE SOCIAL MEDIA SUPPORT KNOWLEDGE SHARING

A significant number of studies refer to software development topics where the use of SM to support KS is pervasive throughout the project. P06, P07, P09, P14, P15, P16, P17, P22, P23, P24, P26, P27, P29, P31, P36, P39, and P42 belong in this group.

Additionally, studies P05, P08, P25, P32 and P42 focus on requirement elicitation and management; P02, P04, P13, P19, P28, and P35 refer to lessons learned and learning processes; P12, P20 and P37 refer to project coordination and communication; P03, P04, P13 and P21 refer to software reuse; P10, P30, P33, and P43 refer to documentation and useful information; P01, P38, and P41 report contributions to support, bug fixing and clarifying doubts; P05, P11, P18, and P20 refer to team management. P03 refer to PM practices in general and, finally, P34 addresses the overall project performance. Tasks and processes are presented in Figure 4.7.

Figure 4-7 Tasks and processes where social media knowledge sharing.



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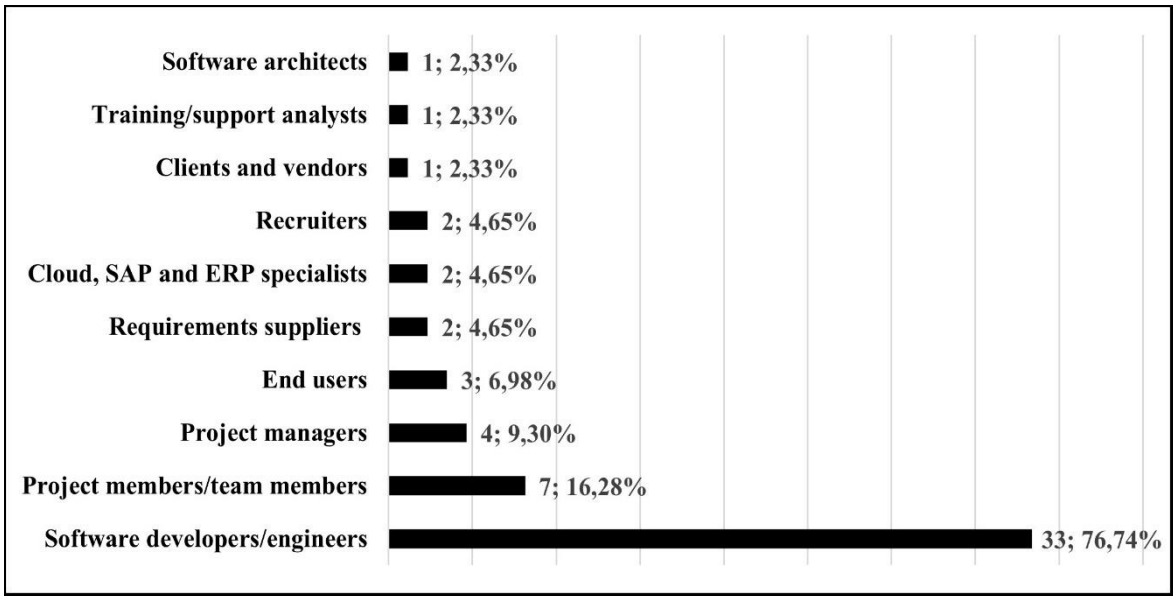
4.3.4 STAKEHOLDERS INVOLVED IN USING SOCIAL MEDIA TO SHARE KNOWLEDGE

Internal and external stakeholders involved are presented in Figure 4.8. Consonant with the prevalence of software development projects, software developers and software engineers are the main class of stakeholders involved in sharing knowledge. They are mentioned in 33 studies: P01, P02, P03, P04, P05, P08, P09, P10, P11, P13, P14, P15, P16, P17, P19, P20, P21, P22, P23, P24, P25, P27, P28, P29, P31, P32, P33, P35, P36, P39, P41, P42, and P43.

Figure 4-8 Stakeholders involved in knowledge sharing processes



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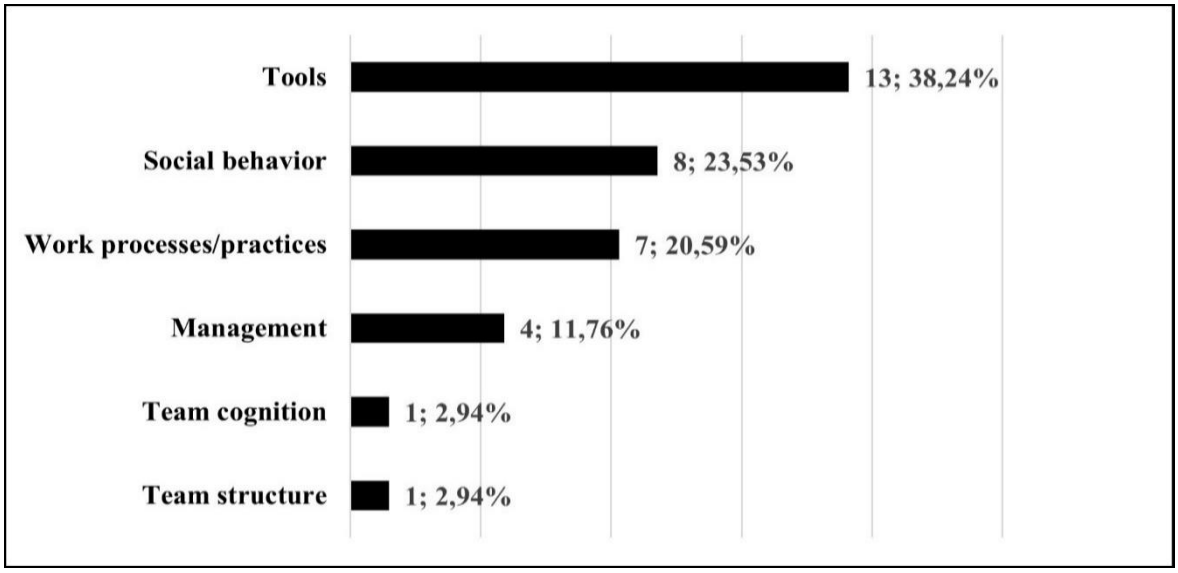
Additionally, there are reports on the involvement of project managers in P03, P05, P16, and P41, or 9.3% and of end-users in P01, P32, and P43, or 6.98%. Cloud computing specialists, SAP and ERP consultants are mentioned in P18 and P27, recruiters in P11 and P20 and requirement suppliers in P32 and P25, or 4.65% each. Clients and vendors are mentioned in P41, software architects in P30, training analysts and support analysts in P35, or 2.33% each. All the project members or team members are mentioned in P06, P12, P26, P34, P37, P38, and P40, or 16.28%.

4.3.5 THE CONTRIBUTION OF SOCIAL MEDIA USE TO PROMOTE KNOWLEDGE SHARING IN IT PROJECTS

To discuss this topic, the categorization of six high-level themes proposed by Zahedi *et al.* (2016) was adopted: i) management; ii) team structure; iii) work processes/practices; iv)

team cognition; v) social behavior; and vi) tools/technologies. Their SLR addressed GSD projects, but they suggest that these categories constitute a basic standard for other types of IT projects. Figure 4.9 presents the contribution of SM use to promote KS.

Figure 4-9 Contribution of social media use to promote knowledge sharing



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4.3.5.1 MANAGEMENT

KS practices under this category are those associated with project manager responsibilities, actions, and strategies. The studies in this group address project results. P29 highlights software developers' participation in discussion forums to leverage knowledge and motivate contributions to project success. P18 identifies how social networks catalyze KS process in an IT company so as to design a learning community that increases productivity. P34 reports how project performance benefits from wikis in KS, within the context of IT projects in the public sector. P05 addresses team management, discussing awareness and use of SM to enable more efficiency and effectiveness.

4.3.5.2 TEAM STRUCTURE

Practices in KS related to establishing project team structure were found in P11, where guidelines are proposed to assist the selection of software developers using SM platforms LinkedIn and StackOverflow as knowledge bases to assess candidates' abilities.

4.3.5.3 WORK PROCESSES/PRACTICES

P10 is about wiki usage as a corporate learning tool by the software development team in a multinational company. P33 analyzes the use of screencasts hosted on YouTube to document and share software knowledge. P41 analyzes the use of instant messengers for

software bug fixing activities between client and vendors. In P08, KS practices supported by audio/video conferencing and discussion forums are investigated as solution for challenges on requirement understanding. P25 raises a discussion on how the use of online serious games can improve requirement elicitation. P39 examines how URL diffusion in Q&A sites enables more effective sharing, use, representation, and search of knowledge in software engineering. P42 identifies the relevance of wikis and bug trackers as communication channels to capture, share, and update knowledge in GitHub.

4.3.5.4 TEAM COGNITION

KS practices under this category refer to comprehensiveness and understandability, to prevent knowledge gaps, for instance (Zahedi *et al*., 2016). In this regard, authors of study P27 investigate the influence of institutional complexity on the use of Enterprise SM to facilitate or frustrate KS. They examined how users deal with this new technology, developing specific practices to cope with organizational tensions and ambiguity.

4.3.5.5 SOCIAL BEHAVIOR

Zahedi *et al*. (2016) highlight the influence of such factors as social ties, credibility, and trust to enable faster and more extensive KS. Studies under this category address these individual or collaborative social interactions. P01 discusses how the role played by developers in discussion forums can stimulate or decrease participation, co-learning and KS in projects. P07 characterizes and measures collaborative behavior in an Information Systems department, identifying factors influencing the use of corporate blogs. P15 examines network ties and co-membership among teams in a data repository to reveal the impact of KS on project success. P16 addresses the contribution of SM in handling KS difficulties in a software company, related to awareness of expertise distribution, motivation for sharing, and network ties. P17 analyzes interactions, concluding that Twitter is useful in projects when tacit knowledge is externalized, saved persistently, and made publicly available. P20 analyzes instant messenger and discussion forums data from a corporate repository to study developers' attitudes, KS behaviors and task performance correlated to team success. P28 examines data from a software repository to study how changes in social network structures can foster knowledge transfers across distinct projects. P38 investigates IT projects teams in times of uncertainty, showing that blogs and wikis motivate and increase the importance of advice networks in KS.

4.3.5.6 TOOLS/TECHNOLOGIES

Thirteen reviewed studies propose novel tools, techniques and solutions, or describe artifact validation. P02 presents a wiki designed and developed to foster process development learning in agile software projects. P03 describes a wiki-based tool to facilitate knowledge acquisition and retrieval as well as support reuse in agile software engineering environments. P04 proposes a guideline to develop and implement a wiki to store software engineering best practices, supporting agile software process learning and use. P13 presents an artifact for acquiring and disseminating tacit knowledge to help manage and improve software processes, using wikis for persistence, business logic, and user interface. P19 presents a framework based on SM to examine factors influencing the adoption of new software engineering processes to support collaborative learning through KS. P21 presents an ontological model to formally represent reuse-related problems in open-source software and build a knowledge base for the most common problems. P22 describes a tool to automatic mapping user tags to Wikipedia concepts and improve knowledge stored and enhance its sharing possibilities in a Q&A website. P24 proposes an automatic method to recommend efficient tags and avoid synonyms problem in software information sites, helping in learning. P30 implements a data repository using a wiki to enable communication and KS between software architecture stakeholders. P31 presents a practical implementation of a framework using automatic semantic tagging suggestions to support users on software engineering content finding and content dissemination. In P32 a requirement engineering methodology is proposed, based on behavior driven features and concretized in a wiki-based tool for requirement management. P35 presents the validation of Target, a model supported by a wiki platform to manage lessons learned in IT projects. P43 proposes a tool to capture and tag relevant knowledge from objects in software information sites, along with a search mechanism to make KS easier and improve software development performance.

4.3.6 FURTHER RESEARCH

Some insights for future research arose from the analysis carried out. In this section, research gaps regarding the use of SM to support KS in IT projects are uncovered. Suggestions for the conduction of new research include:

4.3.6.1 ADDRESSING IT PROJECT MANAGEMENT PRACTICES.

The first reflection regards the low number of papers addressing the management of the project itself, focusing on project manager activities, for example. A knowledge gap

exists on how to make effective use of SM to promote KS within IT project management practices. Only few papers contribute to improving project life cycle phases such as planning or controlling, thus echoing Chadli et al., (2016) who reviewed tools used in GSD and suggest that some PM areas need more attention from tool developers, so as to cover project whole life cycle.

4.3.6.2 ADDRESSING IT PROJECT MANAGEMENT METHODOLOGIES.

In the same context, few studies address PM methodology approaches, such as agile, waterfall or hybrid. This is a pertinent gap, considering the growing number of ICT organizations interested in adopting a more flexible PM approach, applying or moving to agile methods or integrating traditional procedures with agile concepts (Cram & Marabelli, 2018; Paterek, 2018). In this vein, we highlight Sweetman and Conboy's (2018) assertion that agile approaches have been used in some way by 95% of software development teams. Additionally, Cram and Marabelli (2018) found evidence in the literature that KS processes are conducted differently depending on the PM approach adopted.

4.3.6.3 CONDUCTED IN THE PUBLIC SECTOR.

The low number of studies conducted in the public sector is also noteworthy, confirming Karagoz et al. (2020) assertion that KS in ICT project environment is under-researched within that context. Only two papers, P41 and P07, address research in governmental organizations. This evidence corroborates both Ahmed et al. (2019) and Sun et al. (2019), who suggest that organizations in the public sector are just beginning to take full advantage of SM use for KS. Nabelsi et al. (2017) also report a research gap on new collaboration and knowledge management technologies in the public sector. On the other hand, Asrar-ul-Haq and Anwar (2016) detected a growing academic interest in KS in public sector after 2010, although they also report a lack of understanding of knowledge management in the public sector.

4.3.6.4 ON KNOWLEDGE SHARING IN VIRTUAL AND HYBRID PROJECT TEAMS.

Approximately half of the studies focus on projects developed by distributed teams, highlighting the importance of the relationship between team location and KS processes (Noll et al., 2011), confirming the increasing delocalization of project teams and the growing importance of collaboration tools to support virtual project workers to put their work activities together (Forsgren & Byström, 2018; Zin et al., 2018). Additionally, the recent COVID-19

pandemic led many project members to work from home and forecasts indicate an increase in global scale projects and the growth of distributed project environments (Ozguler, 2020). These facts intensify the interest in research on improving collaboration in IT projects developed by virtual or hybrid teams.

4.3.6.5 ON THE USE OF DIFFERENT AND INTEGRATED SOCIAL MEDIA TOOLS.

The reviewed papers evidence the predominance of wikis, blogs, discussion forums and instant messengers, suggesting a research gap regarding the use of other SM tools. Besides, SM tools have been predominantly used in an isolated way. Chadli et al. (2016) found that 77% of standalone tools in their review. In this context, data integration transferred from each tool to another one to support KS has been a challenge for IT project managers and future research on the use of integrated SM tools can facilitate KS, benefiting academics and practitioners, as suggested by Stray et al. (2019), and Eriksson and Chatzipanagiotou (2021). In this regard, recent solutions such as Microsoft Teams, Slack and Jira, comprising a set of integrated SM tools have been introduced. Initial studies suggest that they provide effective support to KS in PM (Eriksson & Chatzipanagiotou, 2021; Stray et al., 2019), but new research is needed.

4.3.6.6 ON THE INTEGRATION OF SOCIAL MEDIA AND NEW TECHNOLOGIES.

Besides SM, other technologies have reached maturity and are now part of organizational life. Mobile technology permits knowledge to be created and shared in real-time and cloud computing is increasing efficiency and economy by moving IT services to the internet (Nach, 2016). Also, machine learning, AI, IOT, and other digital technologies are radically changing IT projects, generating multidisciplinary knowledge in real time, to be managed and disseminated (Ghimire et al., 2017; Marnewick & Marnewick, 2019; Rai, 2016). Information is stored, processed, and retrieved using data-driven tools and SM will access it from watches, pens and vehicles via IOT (Carr & Hayes, 2015). Thus, new research is needed on the integration of these improvements with SM, in novel and useful artifacts.

4.4 CONCLUSION

A systematic literature review was carried out in this study, aiming to present an overview of the use of SM to promote KS in IT projects. A systematic process in five steps was adopted to design the research protocol. The 43 studies covered by this SLR were published in academic journals between 2010 and 2019.

Results show that wikis are the most used tools, followed by instant messengers, blogs, discussion forums, and videoconferencing tools. Other general-purpose tools, particularly those related to software development are significantly mentioned. Tools support to KS is pervasive throughout the project life cycle in such activities as requirement elicitation, lessons learned, coordination, communication, documentation, bug fixing, learning, training, and software reuse. Software development projects, tasks and processes are the most studied. Likewise, studies highlight software developers and engineers as the main class of stakeholders involved in sharing knowledge followed by far by project managers and end users.

SM tools and technologies contribution to promote KS was identified in artifacts to store and retrieve project knowledge, manage lessons learned, and requirement elicitation. Authors use primary and secondary data sources to analyze communication channels and project member networks; benefits, influence factors and motivators of SM use; individual behaviors concerning the use of SM in KS; the importance and influence of project members collaboration; and direct interaction mediated by SM tools.

Several possibilities for future research have arisen, regarding the possibility of continuing any of the works reviewed. Besides, some gaps and new research opportunities emerged, such as conducting studies in the public sector; addressing IT project management methodologies or project manager activities; KS in virtual and hybrid project teams; and on the integration of SM tools and/or new digital technologies such as mobile, cloud computing, machine learning and IOT.

The main limitation of the current study is the somewhat low number of peer-reviewed papers selected and analyzed. However, this fact corroborates the perception of SM use for KS in IT projects as a reasonably new field of investigation as well as the scarcity of literature concerning the integration of the three constructs, indicating the relevance of the research. Additionally, this limitation may stimulate new studies on the same subject, searching in other academic databases, considering conference papers, and investigating the gray literature.

This study can contribute to strengthening research in the area, helping to present the state of current research and serving as a reference for future works. By deepening the understanding of the subject addressed, the study can also benefit the communities of researchers and professionals in IT project management and knowledge management. New studies addressing the challenges and suggestions discussed here will possibly increase knowledge within the field and benefit researchers and practitioners. Besides, findings can bring new insights on adopting or improving the use of SM to share knowledge in IT projects.

4.5 REFERENCES

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5 STUDY 2 - KNOWLEDGE SHARING IN INFORMATION TECHNOLOGY PROJECTS: A SENIOR PRACTITIONER PERCEPTION OF THE USE OF COLLABORATIVE TOOLS

Abstract: Collaborative tools support knowledge sharing (KS) processes in Information Technology (IT) projects, allowing users to create and share technical and professional knowledge. In this paper, we investigate how the usage of collaborative social media (SM) tools can contribute to sharing knowledge in IT projects. We adopt a qualitative approach, by interviewing fifteen IT senior project managers. Results show usage reported by the interviewees concentrated in just a few tools: wikis, instant messengers, videoconferencing, shared repositories, and issue trackers. In addition, the use of e-mails and file system directories is still intense for storing and sharing knowledge. Interviewees also mention individual, organizational and technological barriers influencing the lack of interest and resistance of team members in sharing knowledge by social media tools. Our contribution to the literature is a better understanding of collaborative tool use to support knowledge sharing, which will benefit researchers and knowledge workers.

Keywords: Knowledge sharing; Information technology; IT projects; Social media; Project management.

5.1 INTRODUCTION

Business leaders and policy makers recognize the need for change catalyzed by digital technologies and are ready to invest heavily to make technology an integral part of product and service delivery (Chowdhury & Lamacchia, 2019; Wessel et al., 2021). Value added to business by Information Technology (IT) projects is gaining more dimensions, increasing in complexity and turning project failures into multi-dimensional failures (Rai, 2016). In this organizational context, knowledge is considered the root of strategic advantage (Blagov & Anand, 2022). The creation and use of knowledge needed for a project is different for each organization (Foote & Halawi, 2018), thus multidisciplinary knowledge must be collected and disseminated among the stakeholders (Marnewick & Marnewick, 2019).

Collaborative behaviors, for example knowledge sharing (KS), are the basis for effective and successful teamwork and the IT domain requires open communication between individuals and teams to create new, innovative knowledge and share that which already exists (Koriat & Gelbard, 2019). Such human interactions encompass group membership,

comments and collaboration, which can reduce costs and increase productivity by yielding such benefits as preventing mistake repetition, avoiding knowledge recreation, reducing the loss of expertise, and leveraging existing knowledge (Chaves et al., 2018; Kinder, 2020).

Therefore, knowing how to share knowledge across teams and between project members is a central concern in IT projects (Karlsen & Gottschalk, 2004). Scholars like Koriat and Gelbard (2019), Nabelsi et al. (2017), Sarka and Ipsen (2017), and Zahedi et al. (2016), agree that KS is crucial for an organization's competitive achievements, facilitated by team member coaction using collaborative social media (SM) tools like wikis, blogs, instant messengers, and videoconferencing tools. This set of internet-based tools enables knowledge creation and sharing, communication, and collaboration (Kanagarajoo et al., 2019).

As project teams become increasingly delocalized, information and communication technologies support the work (Zin et al., 2018) and collaborative tools tend to gain more attention. Users can share information and knowledge on technical and professional issues using collaborative management and development technologies, which support KS processes in IT projects (Koriat & Gelbard, 2019). In consequence, executives and consultants are continually attempting to increase the use of such tools to promote KS practices, although it is usually a complex and complicated task (Gaál et al. 2015; Naeem, 2019).

When it comes to the impact of SM use on IT projects, studies regarding different success criteria have been addressed since the beginning of the 2010's. Recently, Daniel and Stewart (2016) highlighted the importance of discussions in forums to leverage knowledge and contribute to project success; Sarka and Ipsen (2017) affirmed that using SM to share knowledge can effectively help software developers to achieve project objectives; Nabelsi et al. (2017) reported project performance benefits from wiki usage in KS within the context of IT projects in the public sector; Foote and Halawi (2018) pointed out the different SM tools that aided the team members in developing higher quality software; Chowdhury and Lamacchia (2019) presented a digital framework where collaborative tools facilitate employee KS in successful digital transformation projects.

However, while considering such a positive impact, it seems there have not been enough studies on this subject. In this regard, Naeem (2019) found limited literature available on the role of SM applications to enhance KS practices, while Sarka and Ipsen (2017) assert that KS via SM in software development is a novel and emerging field, where practitioners and researchers demand common references and a valid general knowledge database.

As to the use of SM in organizations, Ozguler (2020) highlights the increased adoption of SM tools and services in project workplaces caused by the COVID-19 pandemic. Many

organizations have shifted toward online work, work from home, or virtual workplace (Blagov & Anand, 2022). Digital project management solutions have received a significant expansion and expert forecasts indicate an increase in global scale projects and in the number of online project teams (Ozguler, 2020). At the same time, in different contexts, including IT projects, KS barriers have been identified in the literature, interlinked factors that reduce the propensity of individuals to effectively share knowledge, highlighting the importance of identifying these problems and their impact (Karagoz et al., 2020; Marouf & Khalil, 2015).

As a result of the above, we advocate that the three themes approached here are significant today, both individually and together. Since it is a reasonably new field of investigation, there is present and future interest for research on KS in the IT project domain, focused on the use of collaborative SM tools. Therefore, considering this context, aiming to contribute by filling a knowledge gap, we investigate IT project settings from the practitioner perspective to answer the research question "how do collaborative social media tools support knowledge sharing in the IT project workplace?"

By interviewing fifteen senior project managers, we examine how the usage of collaborative SM tools contributes to KS in IT projects. Within this rather underexplored field of knowledge, we expect to identify existing problems and gather helpful information to find ways to solve some of them.

5.2 THEORETICAL BACKGROUND

5.2.1 KNOWLEDGE SHARING AND SOCIAL MEDIA

According to Wang and Noe (2010, p. 117) KS involves "the provision of task information (knowledge) and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies or procedures". Thus, effective KS processes can benefit organizations in accomplishing complex and innovative work by allowing the integration of expert critical knowledge and abilities (Navimipour & Charband, 2016). Within organizations, KS plays an essential role in social interaction and collaborative behaviors, so much so that conveying knowledge quickly and efficiently has become a need (Naeem, 2019; Sun et al., 2019). In consequence, sharing knowledge becomes a key challenge for contemporary organizations, be they profit, nonprofit, or governmental (Yuan et al., 2013).

Doronin et al, (2020, p. 1063) describe knowledge sharing as "an individually intentioned process of disseminating and transferring individually possessed tacit and explicit knowledge, completed in order to produce an increase of knowledge within the recipient or recipients

(individuals, group of individuals, organizations, or communities)". In this regard, the use of information technology is a key enabler for materializing KS processes (Panahi et al., 2012) and SM tools support effective KS at individual, group, community and organizational levels, encouraging participation, conversation, openness, creation, and socialization among the users (Naeem, 2019; Panahi et al., 2012). Being aware of this, organizations seek to expand their technologies and practices and inspire managers to exploit the need, providing opportunities and stimulating groups of people to share knowledge (Gaál et al., 2015).

Panahi et al. (2012) categorized five SM tool features which are relevant to encourage and enable people to share knowledge easily and efficiently. In combination with their associated tools, these features support communication and KS processes, helping people get connected, building relationships, and developing trust: i) user-generated content; ii) peer to peer communication; iii) networking; iv) multimedia-oriented; and v) user friendly.

In contrast, Naeem (2019) points out that SM has limitations as a technological support to enhance KS, such as fear of losing power, lack of intention to share knowledge, lower level of motivation and resistance to technology. He highlights the importance of understanding and managing these limiting situations to enhance the use of SM tools efficiently and effectively within organizations.

5.2.2 KNOWLEDGE SHARING AND IT PROJECT MANAGEMENT

"Organizations undertake IT projects to transform and grow" (Daemi et al., 2020, p. 6). To this end, they have been using IT projects to achieve strategic objectives, create competitive advantage and other sources of value since the mid-1960s, at least (Bredillet, 2010). Currently, information technology projects can be defined as the design, development, and implementation of artifacts of information systems/technology forms, comprising new products, services, or such processes as software development, information systems, and deployment of IT infrastructure. (Babenko et al., 2019; Karlsen & Gottschalk, 2004).

As project management practices evolve, knowledge is shared through processes, tools, documents, meetings and training (Rowe, 2014). Content and connections grow organically in response to the collective activity of the users (Murphy & Salomone, 2013). In collaborative project activities, KS efforts complement skills and generate synergy, allowing members to increase their strengths and decrease their weaknesses (Davis, 2009; Hsu et al., 2011). The practice of project management has been transformed by technological advancement and the increased use of SM (Auinger et al., 2013). The adoption of SM tools

allows the creation of a project environment characterized by decentralization, collaboration and innovation, an effective alternative to traditional management methods (Filev, 2008). In this context, SM technologies enable KS in project teams, allowing knowledge to be created and shared in collocated and distributed environments (Portillo-Rodríguez et al., 2012).

Technological support from different tools is therefore a facilitator and an enabler for successful KS and how to leverage such a tool support becomes a key point in a project work environment (Nidhra et al., 2013). Due to the COVID crisis, many organizations have shifted toward online work, work from home, or virtual workplace (Blagov & Anand, 2022), using web-based SM tools to effectively support remote work, facilitate collaboration with other partners and in different locations, which is a challenge in contemporary organizations (Kanagarajoo et al., 2019; Portillo-Rodríguez et al., 2012). Collaboration tools such as the currently well-known Trello, Jira, Slack, Zoom, Microsoft Teams, and Google Drive will become more and more important for projects in the coming years (Walker & Lloyd-Walker, 2019). For project managers it is an opportunity and a challenge to go beyond traditional tools and exploit the potentiality of social media (Nach, 2016).

On the other hand, managing IT projects has become more and more challenging for project managers. The rapid changes in technology, the design of the project team, the complexity of the project and the goal make IT projects different, also considering that they may continue for a number of years, involve people from different countries, and with different languages and cultures (Foote & Halawi, 2018). In this context, KS behaviors are frequently influenced by interlinked factors that reduce the propensity of individuals to effectively share knowledge, so much so that it is important to identify these barriers and their impact (Marouf & Khalil, 2015).

Knowledge sharing barriers can be categorized into three core domains, making it easier to understand the whole: individual/personnel, organizational/project, and technological, (Anwar et al., 2019; Karagoz et al., 2020; Kukko, 2013; Marouf & Khalil, 2015; Nidhra et al., 2013; Riege, 2005). These KS barriers are connected and support one another under each dimension (Sharma & Singh, 2013). The individual level is where knowledge resides, reflecting the characteristics and capabilities of individual employees involved; the organizational level is where knowledge obtains its economic and competitive value, considering organization and project-related issues; and the technological level plays the role as facilitator, providing tools for KS (Kukko, 2013; Nidhra et al., 2013).

5.3 METHODOLOGY

This research adopted a qualitative method with an exploratory approach, materialized by conducting semi-structured interviews to cover state-of-practice regarding the use of SM collaborative tools to share knowledge in IT projects. Qualitative research is appropriate for studies like this, which intends to approach social phenomena from the real work environment by analyzing experiences related to individuals' professional practices (Kvale, 2008).

The semi-structured interview is often the most effective and convenient means of gathering information. It proves to be particularly useful for understanding how the interviewees make sense of the social world under study, for example how project managers perceive their jobs and their work environment (Qu & Dumay, 2011). In this study, the interview design adheres to the guidelines of a seven-stage systematic process proposed by Steinar Kvale (Kvale, 2008) consisting of the following elements:

Thematizing - Involved formulating the purpose and the theme of the investigation before starting the interviews. Here, the theme defined for the investigation was the use of SM collaborative tools to share knowledge within the context of IT projects.

Designing - The interview protocol was designed; a list of SM and project management collaboration tools was produced; and an informed consent form was created. Fifteen senior IT project managers from distinct business sectors, five women and ten men, with at least 10 years of work experience in the IT sector and in IT project management, accepted the invitation and were interviewed. Participation was voluntary, and the interviews were scheduled to suit interviewee availability. Figure 5.1 presents the interviewees profiles.

Figure 5-1 Interviewees' profiles

Interviewee	Occupation	Business Sector	Years in IT Sector	Years in IT Project Management
I01 - RC	Project Manager	Municipal Government	35	15
I02 - RK	Project Manager	State Government	25	25
I03 - RS	Project Director	Multinational Company	20	14
I04 -MA	Project Coordinator	Telecom	20	20
I05 - SC	Project Manager	Multinational Company	27	10
I06 -RP	Project Manager	Multinational Consulting	25	12
I07 - AF	Project Manager	Consulting Company	20	20
I08 - JI	Project Manager	Consulting Company	24	10
I09 - SC	Project Manager	Multinational Company	10	10
I10 - SV	Project Manager	Multinational Consulting	23	10
I11 - VV	Operational Manager	Consulting Company	30	22

I12 - LA	Project Manager	Multinational Company	18	8
I13 - VB	Project Manager	Multinational Bank	16	11
I14 - JQ	Research Manager	Multinational Company	26	10
I15 - TC	Project Manager	Multinational Company	11	10

Note. Source: Created by the author

Interviewing - The interviews were all conducted and recorded using Skype, each one lasting 60 minutes on average. The list of social media and project management collaboration tools had previously been sent by email. Before starting, interviewees were assured of privacy and confidentiality and received a brief explanation of the theme and the aim of the interview. Figure 5.2 presents the interview questions.

Figure 5-2 Interview questions

Code	Question
Q01	What social and / or collaborative media tools do you use in the projects you work on? In what activities / events?
Q02	Among the tools you mentioned, which ones do you consider most important? Why?
Q03	In what activities / events do you use these tools on of the projects you work ?
Q04	Are there other social media or collaborative tools, used or not in your company / organization, that you would like to use in your projects? What tools? What for?
Q05	Among the project management tools in the list you have received, which ones do you know or have heard of? Which ones do you use or would like to use in your projects? What for?
Q06	Among the non-specific project management tools in the list you have received, which ones do you know or have heard of? Which ones do you use or would like to use in your projects? What for?
Q07	How does knowledge management usually take place in the projects your organization works on?
Q08	How does the knowledge acquisition process take place? Are there social or collaborative media tools used? Which?
Q09	Within the company, what has facilitated / facilitates / would facilitate the implementation, dissemination, and constant use of knowledge acquisition activities?
Q10	Within the company, what has hindered / hinders / would hinder the implementation, dissemination, and constant use of knowledge acquisition activities?
Q11	How does the knowledge storage process take place? Are there social or collaborative media tools used? Which?
Q12	What is stored: audio, video, presentations, spreadsheets, text…?
Q13	Where is it stored? File system, databases, external servers, cloud?
Q14	Within the company, what has facilitated / facilitates / would facilitate the implementation, dissemination, and constant use of knowledge storage activities?
Q15	Within the company, what has hindered / hinders / would hinder the implementation, dissemination, and constant use of knowledge storage activities?
Q16	How does the knowledge dissemination process take place? Are there social or collaborative media tools used? Which?
Q17	Within the company, what has facilitated / facilitates / would facilitate the implementation and constant use of knowledge dissemination activities?
Q18	Within the company, what has hindered / hinders / would hinder the implementation and constant use of knowledge dissemination activities?
Q19	How does the knowledge application process take place? Are there social or collaborative media tools used? Which?

Q20	Within the company, what has facilitated / facilitates / would facilitate the implementation, dissemination, and constant use of knowledge application activities?
Q21	Within the company, what has hindered / hinders / would hinder the implementation, dissemination, and constant use of knowledge application activities?

Note. Source: Created by the author.

Transcribing - Involved the transcription of the recorded material from oral speech to written text. The software Audipo was used to help in transcribing the interviews. The resulting text was compared to the recordings and corrected when necessary.

Analyzing - The interview content analysis was carried out using the technique proposed by Bardin (2011), comprising three phases: i) pre-analysis, in which the general reading of the transcribed material took place; ii) exploration of the collected material, which was grouped by theme; and iii) treatment of results, when the categorized content was interpreted. The software ATLAS.ti version 7.5 was used to support the analysis, by automating coding and storing transcriptions and results.

We draw on Cram and Marabelli (2018) to categorize knowledge-sharing processes. Those authors updated a conceptual framework by Chau et al. (2003), which identifies the characteristics of eight key processes to support knowledge sharing, comparing traditional and agile project management approaches. Figure 5.3 presents the resulting summary.

Figure 5-3 Knowledge sharing support in project management dimensions

Knowledge Sharing Process	Knowledge sharing support	
	Traditional Approach	Agile Approach
Competence Management refers to identifying what team members know or do not know, as well as making each one aware of knowledge holders that might be relevant to their work.	Formal status reports, assigned responsibilities based on document ownership, direct managerial oversight.	Ongoing communication between stakeholders to establish a shared understanding and to discuss progress. Collective ownership allows team members to monitor their colleagues' work.
Continuous Learning, by reusing previous knowledge to raise, discuss and deal with success factors and obstacles.	Postmortem reviews and lessons-learned processes at the end of project stages, at major milestones or at project completion.	Person-to-person interactions using techniques such as pair programming and feedback sessions. Retrospective activities at the end of sprints.
Use of **Documentation** referring to knowledge about the requirements and designs of the product, the development process, the business domain, and the project status.	Extensive documentation, consisting of artifacts such as requirement definition, design specifications, and development plans.	Lean, mean and "just enough" documentation, which may include techniques such as user stories and user acceptance tests.
Use of infrastructure as **Knowledge Repositories** to facilitate the capture and storing of knowledge, making it accessible to the entire organization.	Explicit knowledge stored in documents within formal repositories.	Reliance on tacit knowledge, trial and error, and communication between team members. Use of lightweight, informal knowledge repositories
Gathering **Requirements and Domain Knowledge** by using techniques to determine and plan the	Formalized requirements captured before initiation of design and development.	Active stakeholders and user participation; high readiness for change. Requirements are estimated

features that must be implemented.	Preinitiation of design and development; As-needed interaction between project team and customers.	for workload, prioritized, and contextualized as stories or test cases.
Team Composition refers to grouping distinct roles in project teams and their influences on knowledge flow.	Clearly defined, role-based teams.	Cross-functional teams; team members play multiple roles throughout the project.
Training refers to disseminating management, process, and technical knowledge to the team.	Formal, facilitated training sessions, often using static training materials.	Informal training practices such as pair programming and daily meetings.
Trust and Care refers to the development of organizational and individual trust in the team and between the team and the customer. The key for KS here is the voluntary interaction.	Low reliance on trust. Formal policies including processes that mandate periodic management reviews.	High empowerment and trust within the team foster interactions between members, built from techniques such as collective ownership, standup meetings, and collaborative workspaces.

Note. Source: Adapted from Cram and Marabelli (2018).

Verifying - The continuous validation of the seven process stages followed here adds to the assurance that results are consonant with the objectives of the interviews held. Reliability includes the analysis and interpretation of the interviewees' answers, discussed further in section 4. The results may not be generalized to all types of projects, but the added value provided by the interviewees' backgrounds enables generalizations to similar realities.

Reporting -. The methods applied in this study are described in this section 3 and the findings are presented in section 4. The paper resulting from this work will be submitted for presentation at a congress and for publication in a journal.

5.4 RESULTS AND DISCUSSION

The relationship between knowledge sharing processes and SM tools was mapped and is presented in this section. Afterwards, we highlight and discuss details of the interviewee answers considered relevant to building the knowledge pursued in the research.

5.4.1 COLLABORATIVE TOOLS USAGE AND KNOWLEDGE SHARING PROCESSES SUPPORTED

Throughout the analysis of the interviews, the collaborative tools were classified as categories and the mentions of tool usage to support KS processes were taken into consideration as codes. Figure 5.4 presents the mapping between SM tools and the knowledge sharing processes they support, according to the interviewee's answers.

Each tool was mapped to the KS processes it supports, or to possible uses identified by the interviewees, as shown in the table. Each spreadsheet cell contains the number of citations regarding the relationship between line and column. The use of microblogs for

competence management, for example, was mentioned once, while there are no columns showing Team Competence KS process because no tools supporting it were mentioned. More than one citation may have come from the same interviewee. Totals and percentages are presented by tool and by process.

Figure 5-4 Mapping between tools usage and KS processes supported

	Competence Management	Continuous Learning	Documentation	Domain Knowledge and Requierments	Knowledge Repository	Training	Trust and Care	#Total	%
Canvas						1		1	0.55
Microblog	1							1	0.55
Q&A site						1		1	0.55
Videoshare						1		1	0.55
Blog					1	1		2	1.09
Code hosting					2			2	1.09
Forum							2	2	1.09
Learning platform						2		2	1.09
Podcast		1	1			1		3	1.64
Tagging	1	1					2	4	2.19
Social Network		2			4		3	9	4.92
Webinar				1		8		9	4.92
Issue tracker	1	2		1	2		5	11	6.01
Instant messenger	3			1		5	14	23	12.57
Videoconference	4	2		1		8	8	23	12.57
Shared Repository	1		7		17	1	4	30	16.39
Wiki	1	6	10		34	5	3	59	32.24
#Total	**12**	**14**	**18**	**4**	**60**	**34**	**41**	**183**	
%	6.56	7.65	9.84	2.19	32.79	18.58	22.40		100.00

Note. Source: Created by the author.

A small number of tools concentrated most of the use, in spite of the number of different tools mentioned. From the list presented to the project managers before the interview, RSS feeds and vodcasts received no use reports, and only one participant knew all the tools in the list. Only five tools, 29.41%, were mentioned more than ten times, but represent 80% of the mentions: wikis, shared repositories, videoconference tools, instant messengers, and issue trackers. The first two technologies suggest that storing and producing documents are perhaps the most relevant uses of SM tools, as knowledge repository and documentation KS processes received 42.63% of the mentions. In this respect, Portillo-Rodríguez et al. (2012) found that wikis and shared repositories were among the three main supports for such organizational activities as knowledge sharing, whereas Zahedi et al. (2016) reported the comprehensive and increasing use of these same tools. The number of mentions of videoconferencing and instant messenger reflects a growing need for these technologies,

especially in the current COVID-19 pandemic scenario. There is an increasing number of distributed IT project environments as well as IT project members who work from home and use such technologies to perform their work activities (Forsgren & Byström, 2018; Ozguler, 2020). Foote and Halawi (2018) also pointed out that instant messengers and videoconferencing tools aided team members in developing higher quality software in an insurance company, keeping the number of defects to a minimum. Issue track use is related to software development technical activities such as bug tracking and issue control, but curiously the answers revealed that it also serves as a knowledge base for lessons learned and informal knowledge, as well as an instrument for interaction with customers.

Along with the use of SM tools, the respondents reported a significant use of traditional file system directories and emails to store and share knowledge, produced mostly in such applications as PDF, Word, Excel, PowerPoint, and Project. There were reports on the difficulties in searching these unstructured repositories. Most of the interviewees reported the use of internal, institutional stand-alone tools, usually data repositories. Some of them were developed in the organization itself and are used to store and share project knowledge. In addition, interviewees mentioned Google as a first knowledge repository frequently used by team members to acquire general project knowledge.

Details on the use of the most cited tools i.e., wikis, shared data repositories, videoconferencing, instant messengers, and issue trackers are as follows:

Wikis. All the interviewees except I12 mentioned the use of wikis in their organizations, mostly as a repository for technical and project management knowledge and documentation. Wikis were reported to be rich and powerful repositories of structured data, storing knowledge related to different subjects such as lessons learned, project history, training material, problem solving and bug fixing, software version updates, software code, sprint documentation, tools configuration optimization, project management processes, status reports, and project best practices. Besides corporate wikis, project team members also consult public ones, like Wikipedia (I02), and provider's wikis made available for a period (I02, I03). Interviewees consider wikis an effective and dynamic source of structured knowledge, whose resources facilitate searching. In this regard, besides knowledge repository and documentation, they also reported wiki use to support KS processes such as training, lessons learned and even trust and care, when project members and stakeholders collaborate in the production of technical documents, and best project practices.

Shared data repositories. Seven interviewees (I04, I07, I08, I10, I11, I12, and I15) mentioned the importance of these repositories in the organization to preserve project

knowledge, by storing process documents, templates, and manuals. These documents are used particularly to train newcomer employees. The capability of permitting collaborative edition was also highlighted because of the time reduction for project document production it provides. SharePoint, Google Drive, Dropbox, and OneDrive were mentioned.

Videoconferencing. Eight interviewees (I01, I04, I05, I09, I10, I12, I13 and I14) conduct videoconferences to report project status, show presentations, give training, discuss project issues, and aggregate knowledge to solve problems. Project managers reported diverse situations such as videoconferencing becoming the official tool for Project Management Office (PMO) meetings only after the COVID-19 pandemic (I01); the use of unofficial tools because some of the team members cannot access some environments from home (I14); project issue discussion with customers and meetings at the beginning of projects to share previous knowledge (I08); online workshops to promote the reuse of stored knowledge (I13); and people interaction throughout the organization, even in different countries, by means of a videoconference tool (I10 and I13). The videoconferencing applications mentioned were Skype, Skype for Business, WebEx, Google Meets, Hangout, Zoom and Teams.

Instant messengers. All the interviewees highlighted the intense use of instant messengers in their projects. Team members and project managers usually take part in a substantial number of groups, so much so that for some of them it becomes a problem. In some cases, (I06, I08 and I12), the interviewees have to join groups with customers, although this is forbidden for official use in their organizations. Instant messengers are used for sharing knowledge in projects individually or in groups, to resolve issues, and share technical and project management knowledge. Only I05 said that instant messengers are not used for sharing knowledge in his projects. Mentions of instant messenger use are particularly related to sharing and storing informal knowledge in the course of personal interaction with colleagues. One of the most appreciated and mentioned features is the possibility of immediate communication with the team, used by I01, I09, and I14 to disseminate urgent, recent, and important knowledge. WhatsApp, Telegram, Facebook Messenger, and Teams were mentioned.

Issue trackers. Five interviewees (I01, I08, I09, I14 and I15) reported the use of an issue tracker tool. Redmine and Jira were the issue trackers mentioned. The discussions stored during bug solving and other activities related to issue control are reused almost like lessons learned. One interviewee (I09) said that he and his team interact with customers within Jira, so the entire service history and knowledge base to solve the customer's problem remains

stored there. Different project teams can consult the stored knowledge to clarify doubts and look for known problem solutions.

5.4.2 INTEGRATED TOOLS

In addition to the use of standalone tools, the majority of the interviewees mentioned a class of collaborative tools that we will refer to as "integrated" in this article. This group of tools refers to an environment with a uniform interface that includes a set of SM tools. There, new applications and tools can be added via plugins, i.e., components that interact with the integrated environment using Application Programming Interfaces (APIs)-.

Some of the project managers interviewed are using integrated tools on an experimental basis and the evaluation has been positive. Other have been using them in a normal basis, also reporting good results. Their answers show that these integrated technologies can provide support to all the knowledge sharing processes described in the framework used here and identified by the respondents.

Interviewees I03, I04, I05, I07, I09, I11, I12, I13, 114 and I15 reported the use of Microsoft Teams, where team members can find in the same place collaborative tools such as a wiki to store and consult documents, online forums, an instant messenger, a videoconference tool to carry out online meetings, webinars, and training. It is possible to integrate these features with other applications such as a social network, project control tools and learning platforms. I04, for example, said that “Teams is a powerful collaborative tool that many companies are adopting”, precisely because of the power of bringing people together. “At this moment that we are living, with the coronavirus and so on”, he says, “up to now, this tool has been useful for companies to be able to conduct their daily activities”

In this regard, I07 said that “in my project, Teams was used (…) as a repository, (…) as a chat, (…) for meetings, and everybody loved it. “At the company where I work, we only used Teams, and I loved to use it for everything.”; I15 said that he “migrated the entire operation to Teams, and the advantage is that I have all the tools there. If I want, I can manage 100% of my project within it, without having physical contact with anyone.”; and I03 commented that “Teams (…) is becoming more and more (adopted), (…) so I see that my company is using it a lot in the United States. (…) I use it a lot and now my boss (…) is replicating it for the local team here, for the people, to start using Teams and explore this ability (…) to have everything in one place.”

Besides Teams, I06 and I08 also mentioned Microsoft Team Foundation Servers (TFS), an integrated tool that covers the entire software development life cycle, which is now called Azure DevOps Server. They use it for gathering requirements, as a knowledge repository and for project documentation. I06 relates that "instead of using four, five collaborative tools, one with each customer, the adoption of TFS, a platform with all the tools integrated was (..) a case of success". I13 and I14 use Jira and its plugins, especially Confluence and Bitbucket, as an integrated tool for project and knowledge management. The integration of social media with new technologies such as cloud computing was also mentioned as a positive feature by I15 who said that "everything is saved in a cloud environment, so, (…) if one day your machine crashes, which is not difficult to happen, (…) you don't lose it, you just change your machine and recover everything".

These reports seem to indicate that integrated tools tend to gain more attention in the current pandemic scenario, where a great number of team members is working from home. Project workers increasingly depend upon technology to communicate, collaborate, and coordinate to put work activities together (Forsgren & Byström, 2018). Accordingly, virtual project work and digital project management solutions had a significant expansion, while forecasts indicate an increase in global scale projects and growth of distributed project environments (Ozguler, 2020).

5.4.3 BARRIERS TO PROMOTING KNOWLEDGE SHARING IN IT PROJECTS

To provide a better understanding of the subject approached, IT project managers also answered questions about problems they face in promoting KS in their projects, especially those related to SM support. Their answers corroborate Marouf and Khalil (2015), who found that project member behaviors are frequently influenced by interlinked factors that reduce the propensity of individuals to share knowledge effectively. Figure 5.5 summarizes the major issues found in literature, grouped into four subclasses. The table also includes issue core domains and literature references.

Figure 5-5 Barriers to knowledge sharing in IT projects

Subclass	Barrier	(I)ndividual, (O)rganizational, (T)echnological	Literature References
Familiarity and	Lack of familiarity or experience using tools	I	Ghobadi and Mathiassen, 2016; Riege, 2005.

suitability of KS tools	Lack of suitable SM tools	O, T	Anwar et al., 2019; Asrar-ul-Haq and Anwar, 2016; Kukko, 2013; Ranjbarfard et al., 2014.
	Lack of specific SM tools	I, O	Anwar et al., 2019; Ghobadi, 2015.
	Lack of internal disclosure	I, O	Karagoz et al., 2020; Niazi et al., 2015; Riege, 2005.
	Inability to locate the knowledge source	O	Anwar et al., 2019; Hysa and Spalek, 2019; Zahedi et al., 2016.
	Lack of awareness of tool features	O	Karagoz et al., 2020; Niazi et al., 2015; Riege, 2005.
	Lack of compatibility with work routines	O, T	Foote and Halawi, 2018; Riege, 2005; Santos et al., 2012; Zahedi et al., 2016.
Acquisition, infrastructure, and maintenance of KS tools	Cost of licenses and other KS practices	O	Ahmed et al., 2019; Anwar et al., 2019; Niazi et al., 2015; Hysa and Spalek, 2019; Zahedi and Babar, 2014; Daemi et al., 2020.
	Too much bureaucracy	O	Anwar et al., 2019; Nidhra et al., 2013.
	Low investment in technology	O	Anwar et al., 2019; Ghobadi, 2015; Nidhra et al., 2013.
	Lack of strong infrastructure and technical support	O,T	Daemi et al., 2020; Nidhra et al., 2013; Ranjbarfard et al., 2014; Riege, 2005; Sharma and Singh, 2013.
	Changes in technology	O, T	Asrar-ul-Haq and Anwar, 2016; Babenko et al., 2019; Ranjbarfard et al., 2014; Vergara et al., 2020.
Limitations on the use of KS tools	Search difficulties	I, T	Dingsoyr and Smite, 2014; Kukko, 2013; Zahedi et al., 2016.
	Excessive content	I, O, T	Dingsoyr and Smite, 2014; Kukko, 2013; Ranjbarfard et al., 2014.
	Access difficulties and constraints	I, O, T	Kukko, 2013; Zahedi et al., 2016; Mueller, 2015; Dingsoyr and Smite, 2014.
	Lack of tool integration	I, T	Pirkkalainen and Pawlowski, 2014; Niazi et al., 2015; Riege, 2005; Santos et al., 2012; Ikemoto et al., 2020; Narazaki et al., 2020.
	Fear of losing productivity	I, O	Daemi et al., 2020; Hysa and Spalek, 2019; Ramasamy, 2020.
	Security risks	I, T	Beier and Wagner, 2016; Daemi et al., 2020; Hysa and Spalek, 2019; Zhang and Gupta, 2018.
Knowledge management	Cultural factors	I	Riege, 2005; Noll et al., 2011; Anwar et al., 2019.
	Language differences	I, O	Anwar et al., 2019; Ghobadi and Mathiassen, 2016; Kukko, 2013; Noll et al., 2011.
	Lack of recognition and reward	O, I	Anwar et al., 2019; Kukko, 2013; Ranjbarfard et al., 2014; Riege, 2005; Zahedi et al., 2016; Asrar-ul-Haq and Anwar, 2016.
	Lack of KS processes / strategies / plans	O	Asrar-ul-Haq and Anwar, 2016; Dingsoyr and Smite, 2014; Zahedi et al., 2016.

Lack of defined templates and guidelines	O	Eriksson and Chatzipanagiotou, 2021; Ghobadi and Mathiassen, 2016; Stray et al., 2019.
Lack of support and training on tool use for KS	O	Eriksson and Chatzipanagiotou, 2021; Foote and Halawi, 2018; Stray et al., 2019.
Lack of time for KS	I, O	Anwar et al., 2019; Daemi et al., 2020; Ranjbarfard et al., 2014.

Note. Source**:** Created by the author.

Four subclasses of barriers were identified from the analysis of the responses: i) familiarity and suitability of KS tools; ii) acquisition, infrastructure, and maintenance of KS tools; iii) limitations on the use of KS tools; and iv) knowledge management. These barriers belong to the class of problems of knowledge sharing in IT projects. Some of them have existed since information systems were used for knowledge sharing. They can be categorized into three core domains, making it easier to understand the whole: individual/personnel, organizational/project, and technological (Anwar et al., 2019; Karagoz et al., 2020; Kukko, 2013; Marouf & Khalil, 2015; Nidhra et al., 2013; Riege, 2005). According to Sharma and Singh (2013), these issues are connected and support one another under each dimension. Below, we discuss details on each subclass's issues.

5.4.3.1 FAMILIARITY AND SUITABILITY OF KS TOOLS

The lack of suitable collaboration tools potentially hinders the successful sharing of knowledge, since information technology facilitates data collection to generate and share knowledge (Anwar et al., 2019; Asrar-ul-Haq & Anwar, 2016; Ranjbarfard et al., 2014), leading project managers to stimulate behaviors to minimize this risk (Ghobadi, 2015). In this regard, the project managers interviewed reported, for example, the lack of a repository to centralize knowledge (I07, I11, I12), as pointed out by Zahedi et al., 2016.

The mismatch between individual needs, tools and work routines also restricts KS practices (Foote & Halawi, 2018; Riege, 2005; Santos et al., 2012; Zahedi et al., 2016). Interviewees reported that they had to adapt or use inadequate and unofficial tools to store and share knowledge (I04, I13), particularly in the public sector (I01, I02). Ranjbarfard et al. (2014) affirm that inappropriate technology can also result in resistance on the part of the employees. In this regard, I07 said that "when the first team member becomes discouraged (…) due to using inappropriate tools, (…) that person starts to influence the others, (…) affecting many processes such as knowledge sharing".

The lack of familiarity or experience with available collaboration technologies may also negatively impact effective knowledge sharing, as people are reluctant to use the tools

(Ghobadi & Mathiassen, 2016; Riege, 2005). A possible cause could be that “some of the tools were not very well disclosed, when they appeared” (I05). Difficulties were also reported on the use of a complex customized version of a tool (I13) and on the use of specific unfamiliar SM tools required by customers (I07).

Inefficient disclosure of available tool location and advantages can lead to inadequate knowledge sharing due to the lack of awareness of what tool features support projects (Hysa & Spalek, 2019; Karagoz et al., 2020; Niazi et al., 2015; Riege, 2005). Anwar et al. (2019), Zahedi et al. (2016). Accordingly, project managers I05 and I10 said that some team members made use of collaboration tools rarely or not at all “because they were unaware of their benefits or did not even know they were available”.

5.4.3.2 ACQUISITION, INFRASTRUCTURE, AND MAINTENANCE OF KS TOOLS

Regardless of the size of the firm, the lack of infrastructure, technical support and immediate maintenance can obstruct work routines and hinder effective knowledge sharing practices and opportunities (Daemi et al., 2020; Ranjbarfard et al., 2014; Riege, 2005; Sharma & Singh, 2013). The availability of reliable electrical supply, internet connection infrastructure, and bandwidth, as well as alternative power sources, are of equal importance, since it was observed that problems with communication had a negative impact on knowledge transfer (Nidhra et al., 2013). In this sense, I07 mentioned the need of “powerful technological infrastructure support to ensure that this intellectual capital be exchanged, (…) that the sum of the knowledge produced by people be maintained and protected.”.

However, investments in these areas are frequently under-budgeted, under-allocated, or under-defined prior to the start of the project (Anwar et al., 2019; Nidhra et al., 2013). In this regard I07 emphasizes the importance of the prioritization of maintening knowledge repositories and I02 mentions political difficulties for investments in public sector organisations. The bureaucracy is criticized by I09 and I15, who label it as “a great bottleneck that slows down the entire process of advancement and innovation, that results in a rigid and lengthy acquisition process”.

In this same context, the costs associated with knowledge sharing practices in projects are also a barrier to KS (Ahmed et al., 2019; Anwar et al., 2019; Daemi et al., 2020; Zahedi & Babar, 2014). Respondents I04, I07, and I12 corroborated Niazi et al. (2015) and Hysa and Spalek (2019), pointing out the high cost of corporate SM tool licenses, which sometimes impede the use of needed tools. Moreover, I08 reports a “loss of control regarding who

accesses the product", because "the licensing fee is determined by the number of users and only a few generic licenses are purchased".

Change in technology also hinders knowledge sharing practices (Asrar-ul-Haq & Anwar, 2016). IT projects are carried out in a context of rapid obsolescence and the maintenance of knowledge bases is critical (Babenko et al., 2019). However, it becomes difficult to maintain this legacy over time (Ranjbarfard et al., 2014) and tools commonly have to be replaced (Vergara et al., 2020), impacting negatively on KS. The respondents reported that although it is important that "knowledge remains officially active, as a part of the project legacy and of the company legacy" (I07) sometimes the migration process is not completed, due to the complexity and the cost, highlighting that usually "accesses are different, the repository structure is different, the context of the projects too, and, unfortunately, the company loses knowledge" (I12).

5.4.3.3 LIMITATIONS ON THE USE OF KS TOOLS

The negative impact of using SM in project management is perceived in relation to the security of the project and loss of sensitive project data (Hysa & Spalek, 2019). Potential security issues have become increasingly serious, especially for virtual, remote projects (Beier & Wagner, 2016; Zhang & Gupta, 2018) and the risk of losing control over information and security is the main barrier to the implementation and use of SM in projects (Daemi et al., 2020; Hysa & Spalek, 2019). In this regard, interviewees mentioned the "prohibition of using instant messengers to carry out official project acts" (I03); the reluctance in adopting a wiki tool to "eliminate folders and lots of spreadsheets, because I still haven't convinced them that it's safe to use a wiki" (I09), and the prohibition regarding the use of any tool that stores data out of the corporate servers, especially cloud tools (I04, I05, I13, I15).

The lack of confidence in the appropriate use of tools also hinders the adoption of SM (Hysa & Spalek, 2019). Project managers and company leaders are worried that personnel would waste time on non-project related matters, causing a fall in productivity (Daemi et al., 2020; Hysa & Spalek, 2019; Ramasamy, 2020). In this regard, interviewees highlighted the impact of the COVID-19 pandemic on the use of SM tools, including for KS. Before the pandemic "there was a reluctance to release employees to work from home, perhaps for fear of reducing productivity", said I05. However, I01, I04 and I05 reported that the pandemic scenario led their organizations to rethink their policies and implement more intensive use of teleworking, adopting collaborative SM tools. For instance, I01 reported that prior to the

pandemic, online project meetings were not approved by the senior management; nevertheless, all status reports meetings are now held via videoconference.

There were also reports on the difficulties with unstructured data in SM repositories related to poor or ineffective search mechanisms and/or excess of content, which make retrieving a difficult task, impacting on the use of SM to share knowledge (Dingsoyr & Smite, 2014; Kukko, 2013; Ranjbarfard et al., 2014; Zahedi & Babar, 2014). Interviewees reported the use of unfriendly tools with a lot of stored data and problematic searches, in such a way that people avoid searching and it is not known if knowledge is really being reused (I10). In this regard, I12 mentioned the great number of results received when searching the internal knowledge repository in his organization: "and then, we have the point (…) where you are searching for a topic and everything comes, (…), 1700 items, great, and which of them are you going to use?".

Some tools configuration separate project data, thus prohibiting KS between projects, particularly across remote sites (Dingsoyr & Smite, 2014; Mueller, 2015). Project knowledge stored in unshared repositories across workplaces are mentioned by Dingsoyr and Smite (2014) while Zahedi et al. (2016) report access restrictions to knowledge sources in the client. In this respect, interviewees I07, I10, I11 and I14 stated that difficulties with access rights for sharing knowledge across projects requires extra effort to create, store, and share knowledge, hence increasing project cost.

The lack of integration of IT-based tools has long been considered a barrier to KS, from system information to social media tools, causing a lot of work to be carried out and impeding the way people do things (Pirkkalainen & Pawlowski, 2014; Riege, 2005; Santos et al., 2012; Ikemoto et al., 2020; Narazaki et al., 2020). In this regard, interviewees said that "when it comes to knowledge management or communication by social media, people would like to have a single tool to do everything" (I07), particularly in distributed teams (I06, I07). Additionally, they say that "integrated tools are more powerful" (I06) and that the use of different standalone tools means rework (I06, I09), discourages people (I06) and brings "a lot of difficulties in guaranteeing interaction between my knowledge and that of my colleagues." (I15). In the implementation of a new standalone tool, I09 realized that "the worst part (…) is that it is an extra system, it's one more thing that you have to do, it's one more item that you have to work on. And it's hard to convince people that they have to write all that again". In his turn, I06 reported that when the team "started working with different tools we noticed that, for some reason, it ended up discouraging people. So, that was also a failure factor for us."

5.4.3.4 KNOWLEDGE MANAGEMENT

Project managers also mentioned existing organizational aspects that hamper knowledge management processes and the lack of others that could facilitate it. Obstacles relating to culture and language are especially important when organizations rely on knowledge sharing procedures across foreign subsidiaries (Anwar et al., 2019; Noll et al., 2011; Riege, 2005). In this regard, interviewees from various kinds of organizations reported the lack of interest, even resistance from team members, in sharing knowledge by means of SM tools. The attempt to retain knowledge by outsourced employees (I12), the conservativeness of public employees and the difficulty with changes among the Latin-Americans were mentioned as causes.

I05 and I15 pointed out the use of the same tool to store and share project knowledge is much more intensive in the United States and Europe than in Brazil. I15 estimates that in her company, “about only 5% of the recordings are from Latin America”. Interviewees I01 and I02 mention organizations in the public sector where outsourced workers and employees coming from the private sector are more willing to share knowledge in projects. As to language barriers, I04 observes people’s inhibition "when participating in forums, due to their difficulties to express themselves in English"; I15 sometimes notices limitations in KS “because the subject is written in English”; and I14 complains that it is frequently “ difficult to understand the strong accent of my French colleagues speaking in English”.

The lack of incentive to share knowledge within and between projects were reported. In this respect, Riege, (2005) claims that knowledge sharing may be more efficient when a reward system is in place to promote it, while Anwar et al. (2019) and Asrar-ul-Haq and Anwar (2016) observed the lack of incentives and rewards hindering motivation to share knowledge and the lack of recognition reducing KS between software developers. Such situations were reported by I01, I04, I05, I07, I12, I13 and I14, who mention the need for corporate and project manager initiatives to disclose the benefits, incentivize, train, manage and reward the collaborative use of the existing tools to share knowledge.

Additionally, Asrar-ul-Haq and Anwar (2016) observed the lack of a clear institutionalized process with emphasis on KS practices, just like I10 and I11 did; Zahedi et al. (2016) noted lack of strategies/plans for applying existing tools; Stray et al., (2019) claim for training to improve the learning curve of any tool, and Eriksson & Chatzipanagiotou (2021) for training or guidelines on what should be saved. Interviewees I05, I06, I07, I08, I09, I10, I11, and I12 corroborate some of these findings. In I05’s company “there is no process to use previous knowledge when starting new projects”; I08 misses a process defining

when and how to use the existing tools to sharing knowledge; I07 regrets that “storing and sharing the acquired knowledge is the great process that we do not have (...)”, estimating that about 80% (or more) of knowledge is lost, the greatest part remaining only in people's minds.

Researchers also verified that getting engaged in KS activities becomes difficult when heavy workload causes a lack of available time (Asrar-ul-Haq & Anwar, 2016; Qureshi & Evans, 2015). Project managers interviewed reported that they also face this problem, corroborating studies defending that there should be enough time available to use KS methods and tools if the organization intends to operate with knowledge creation and sharing (Anwar et al., 2019; Daemi et al., 2020; Ranjbarfard et al., 2014). In this regard, I05 complains that there are few people available for KS, I06 blames the pressure of tight schedules, and I07 reports that he needed to cut down on KS processes to satisfy pressing client needs.

5.5 CONCLUSION

This study demonstrates how the usage of collaborative tools can contribute to KS in IT projects. Results show that just a small number of tools concentrate most of the usage reported in the interview answers: wikis, shared repositories, instant messengers, videoconferencing tools, instant messengers, and issue trackers. The increasing importance of integrated tools to support KS processes was identified. Knowledge Repository, Trust and Care and Training are the KS processes that collaborative SM tools support the most.

This study also contributes to the literature on knowledge management by uncovering organizational, individual and technological KS barriers in the specific context of IT projects. Four subclasses were identified in the “problems of KS in IT projects” class: i) familiarity and suitability of KS tools; ii) acquisition, infrastructure, and maintenance of KS tools; iii) limitations on the use of KS tools; and iv) knowledge management.

Interviews revealed that project managers do not have much information about some SM tools; the cost of sharing knowledge is high; the use of e-mails and file system directories to store and share knowledge is still intense; cultural factors influence the lack of interest and resistance shown by project team members when it comes to sharing knowledge by means of SM tools; the lack of management support, of available time for KS, of an institutionalized process, of reward and recognition, are other barriers to using SM tools for knowledge sharing; the COVID-19 pandemic forced organizations to adopt collaborative SM tools and implement more intensive use of teleworking.

The main limitation of this study is the somewhat low number of interviews conducted and analyzed. This limitation, however, does not invalidate the findings, because the work

follows a steady systematic investigation process and the interviewees' backgrounds related to the object of study is solid.

As SM use for knowledge sharing in IT projects is still a reasonably new field of investigation, there is present and future interest in research in the area. It is worth noting the relevance of investigating the practice in this universe, to construct solution-oriented knowledge, and to develop practical artifacts directed towards supporting practitioners, thus contributing to solving existing problems.

The findings of this study will provide information on and insights into the definition and development of artifacts to support KS in IT projects. Once such an artifact is developed and made available, its use could possibly contribute to benefitting the communities of researchers and professionals in project management and knowledge management, both increasing efficiency and influencing the success of IT projects.

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6 STUDY 3 - THE INTEGRATION OF SOCIAL MEDIA COLLABORATIVE TOOLS TO SUPPORT KNOWLEDGE SHARING IN INFORMATION TECHNOLOGY PROJECTS: AN AFFORDANCE-BASED PERSPECTIVE

Abstract:

This study investigates the use of integrated social media tools to support knowledge-sharing processes in IT projects. Its main objective is the development of a framework to assist project managers, contributing to resolve problems such as selecting or replacing social media tools, developing knowledge sharing processes, and creating guidelines. The research is qualitative, using a prescriptive approach. The Affordance Theory was the theoretical lens adopted and a systematic process model was used. The framework development was based on a comprehensive literature review, and interviews were conducted with participants of agile projects to evaluate and refine it. Interviewees validated the framework and reported that such tools as blogs, social networks, and webinars are not used in their projects, whereas the canvas tool is increasingly being used to facilitate knowledge sharing. Additionally, twenty other affordances were mentioned and incorporated into the framework. A focus group meeting evaluated framework's completeness, complexity, ease of use and impact. Suggestions were made to increase focus on practice. The framework's effective application can add to IT projects the benefits of knowledge sharing, increasing management efficiency, and positively influencing success. Future research can investigate the efficiency of the framework when used in a real-world project environment.

Keywords: Project management; IT projects; Knowledge sharing; Integrated social media; Affordances; Virtual project teams.

6.1 INTRODUCTION

Information technology (IT) has increasingly become a powerful conductor of business strategies and an essential asset in the organization's competitive game plan (Koriat & Gelbard, 2019). Transformational forces like social media (SM), mobility, cloud computing, internet of things (IoT), artificial intelligence (AI), and others are influencing businesses reshaping (Marnewick & Marnewick, 2019; Zin et al., 2018). Such circumstances have brought about a special interest in improving IT projects, making their management a current key concern (Koriat & Gelbard, 2019).

In this organizational scenario, intangible resources such as knowledge contribute to the organization's competitive advantage and directly affect its achievements (Koriat & Gelbard, 2019). Knowledge sharing (KS) is the most important process of knowledge management (KM), because most of the initiatives depend upon it (Anwar et al., 2019). Particularly in the project management domain, success requires sharing knowledge at all project stages, as well as active collaboration to establish a mutual understanding among participants by coordinating and integrating multiple knowledge sources, which adds to the complexity (Nidhra et al., 2013). Such human interactions to share knowledge can reduce costs and increase productivity by yielding such benefits as preventing mistakes repetition, avoiding knowledge recreation, reducing the loss of expertise, leveraging existing knowledge, and supporting decision making (Chaves et al., 2018; Kinder, 2020).

Information technology is the main enabler of KS activities and processes (Panahi et al., 2012). The technology chosen and the way it is used are important to improve KS (Stray et al., 2019). Therefore, the competence to understand how to leverage such support becomes a key point (Nidhra et al., 2013). In this respect, SM applications such as wikis, blogs, social networks, instant messengers, discussion forums, and videoconference tools can assist KS among IT workers, and IT work teams (Koriat & Gelbard, 2019; Sarka & Ipsen, 2017).

In this context, theoretical and practical studies have identified some SM tools barriers concerning KS in IT projects, such as selecting or replacing SM tools and technologies (Babenko et al., 2019); creating guidelines for tools use (Eriksson & Chatzipanagiotou, 2021); planning and developing training; or design a structure to enable storing, accessing, and retrieving knowledge (Dingsoyr & Smite, 2014). Furthermore, other researchers advocate that data integration from multiple SM tools contributes to the resolution of various types of problems in the KS domain (Ikemoto et al., 2017; Veronese & Chaves, 2016) while also providing IT project practitioners with the simplicity of use and accessibility they desire (Narazaki et al., 2020; Silva & Chaves, 2021).

Recent solutions have been addressing this technological gap and responding to academic claims with the introduction of a class of collaborative tools we refer to as "integrated social media platforms". They offer a unified user interface and a unique set of SM features, as well as allowing the addition of other applications and tools using plugins and components (Silva & Chaves, 2021). These platforms include Microsoft Teams, Slack, and Jira Software (Eriksson & Chatzipanagiotou, 2021; Mittal & Mehta, 2020; Stray et al., 2019).

Existing studies suggest that these integrated SM platforms can improve knowledge management and productivity (Lansmann et al., 2019), and empirical research indicate that

they can support KS procedures effectively in project management (Eriksson & Chatzipanagiotou, 2021). Despite the use of integrated platforms, however, within project teams it remains difficult to know how to best interact with other team members to share knowledge and benefit everyone (Eriksson & Chatzipanagiotou, 2021). Therefore, a comprehensive assessment of the tools to be used and how to use them is required to meet the project's needs based on its characteristics (Ikemoto et al., 2020).

Therefore, to contribute to filling this practical and theoretical gap, we address the research question: "How to support knowledge sharing processes in information technology projects using integrated social media tools?"

In terms of the study's theoretical approach, the affordance lens is used to explore the relationship between the use of technology (SM) and organizational change processes (KS). The affordance perspective permits to be specific about technology while incorporating social and contextual elements, including the interactions between organizational actors and technical capabilities(Sun et al., 2019; Thompson, 2018; Volkoff & Strong, 2017).

6.2 THEORETICAL BACKGROUND

6.2.1 SOCIAL MEDIA, KNOWLEDGE SHARING, AND PROJECT MANAGEMENT

Social media are described by (Carr & Hayes, 2015, p. 8) as “internet-based channels that allow users to opportunistically interact and selectively self-present, either in real-time or asynchronously, with both broad and narrow audiences who derive value from user-generated content and the perception of interaction with others”. This definition applies to a group of collaborative products and services that foster social interactions in the digital domain, such as wikis, shared repositories, blogs, microblogs, social networks and instant messenger applications (Ikemoto et al., 2017; Sarka & Ipsen, 2017).

Social media facilitate intra- and inter-organizational activities among peers, customers, business partners, and other organizations, enabling interactions where users create and share their own content collaboratively leading to new and more complex knowledge (Leonardi & Vaast, 2017). A large and growing number of employees are currently using SM in the workplace, affecting such organizational phenomena and processes as communication, collaboration and knowledge management (KM) (Leonardi & Vaast, 2017; Sarka & Ipsen, 2017; Sun et al., 2019).

Within organizations, knowledge is a meaning set of continuously created information transformed by personal experience, beliefs, and values (Nidhra et al., 2013). It is one of the

intangible organizational resources whose processes and practices set the foundation for ensuring operational effectiveness, employee creativity and high-performance standards (Navimipour & Charband, 2016; Sun et al., 2019), which are essential to creating and maintaining a competitive advantage (Gaál et al., 2015). Thus, KM refers to the organizational processes that facilitate knowledge identification, organization and flow between individuals, who retrieve, process, and apply knowledge to achieve some kind of improvement (Navimipour & Charband, 2016).

Among KM processes, sharing has been recognized as the most important, upon which the majority of initiatives depend (Anwar et al., 2019). "Knowledge sharing occurs when individuals convey knowledge, or acquire it from others" (Ahmed et al., 2019, p. 74). Within organizations, knowledge sharing refers to "the provision of task information and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies or procedures" (Wang & Noe, 2010, p. 117). From this point of view, effective KS creates relationships between members, improving their performance and enabling the integration of experts' key knowledge and abilities to complete complex and innovative work (Navimipour & Charband, 2016).

Panahi et al. (2012) identified five SM tool characteristics that support communication and KS processes, helping people connect, create relationships, and develop trust: i) user-generated content; ii) peer to peer communication; iii) networking; iv) multimedia oriented; and v) user friendly. On the other hand, Naeem, (2019) recognized limitations to the efficient and effective use of SM in organizations, such as fear of losing power, lack of intention to share knowledge, lower level of motivation, and resistance toward technology.

Particularly in the project management domain, success requires sharing knowledge at all project stages, as well as active collaboration to establish mutual understanding among participants (Nidhra et al., 2013). Knowledge sharing initiatives complement skills and create synergy to improve project members' strengths while reducing their weaknesses (Hsu et al., 2011). Within project settings, KS creates a link between individuals and teams, enhancing performance, lowering costs, and expanding innovative capabilities (Navimipour & Charband, 2016; Sarka & Ipsen, 2017). In consequence, project managers are constantly looking for ways to lead their teams through processes that share knowledge effectively (Mueller, 2015).

One of the basic requirements to create and share knowledge is the open communication among individuals and work teams (Koriat & Gelbard, 2019) and technology plays an important role in supporting these processes along project life cycle (Eriksson &

Chatzipanagiotou, 2021). Matching IT with business processes is an enabler and a facilitator of successful KS activities (Nidhra et al., 2013; Panahi et al., 2012). In this context, there are many SM alternatives to support collaborative practices that enhance KS in organizations (Eriksson & Chatzipanagiotou, 2021) and figuring out how to leverage such support becomes a key point (Nidhra et al., 2013). Thus, social media emerge as a valuable instrument to support project management, facilitating knowledge creation and sharing, collaboration, and communication (Ahmed et al., 2019; Kanagarajoo et al., 2019; Koriat & Gelbard, 2019), motivating leaders to increase SM adoption, although it is typically seen as a challenging process (Gaál et al. 2015; Naeem, 2019).

6.2.2 IT PROJECTS AND VIRTUAL TEAMS

"Organizations undertake Information Technology projects to transform and grow" (Daemi et al., 2020, p. 6) since the mid-1960s, at least, to achieve strategic objectives and create competitive advantage (Foote & Halawi, 2018), so much so that the improvement of IT project management is currently a key concern (Koriat & Gelbard, 2019; Rai, 2016). IT projects encompass the design, development, and implementation of artifacts of information systems/technologies form, comprising new products, services, or processes such as software development, information systems, and deployment of IT infrastructure (Babenko et al., 2019). In this context, according to Babenko et al. (2019, p. 630), IT project management is "a time-limited and resource-based set of interrelated actions aimed at achieving an intellectually intangible non-material result in the form of information systems/technologies in conditions of uncertainty regarding development technologies, customer requirements and customer needs".

Despite the new concepts, methodologies, and software tools, IT projects have been notorious for failures, due to such factors as continuous changing environment, increased demands, complex system development, the complex infrastructure required, frequent technology changes, project team design, and goal complexity (Babenko et al., 2019; Foote & Halawi, 2018). Besides, management complexity and difficulty are increased because IT projects may last for years, involving personnel from various countries, with various languages and cultures (Foote & Halawi, 2018).

In parallel, products and service delivery are incorporating IT parts, combining hardware, sensors, data storage, software, and connectivity in multiple ways (Chowdhury & Lamacchia, 2019). In line with this technological revolution, IT projects have gone through a fundamental change, while businesses are reshaped under the influence of transformational forces such as

mobility, cloud computing, internet of things, and artificial intelligence (Rai, 2016). Each industry, organization and project face different challenges (PMI, 2021). As a result, the value added to business by IT projects is gaining more dimensions, the complexity is increasing, and failures are becoming multi-dimensional ones (Rai, 2016).

In light of this, organizations have been looking for new methods of effective project management to deal with complexity and improve planning and execution in a highly uncertain and changing environment (Martínez Montes et al., 2021). To improve project success rates, speed and agility are required from project teams and project managers, while project management bodies of knowledge, standards, methodologies and methods are in constant change (Martínez Montes et al., 2021). Orientation is moving towards results and benefits, not deliverables; principles, not processes; project performance domains, not knowledge areas(Martínez Montes et al., 2021; PMI, 2021).

Constant change and uncertainty are being managed through “tailoring” project management approach, governance, and processes to the realities of the given environment (McGrath & Kostalova, 2020; PMI, 2021). Agile techniques, which advocate a flexible and adaptable approach to project management throughout the project life cycle are becoming more widely adopted (Martínez Montes et al., 2021). Many organizations have been using or planning to use agile methods, as well as hybrid methods that combine traditional procedures with agile concepts (McGrath & Kostalova, 2020).

In addition to changes in management approaches, flexible and distributed teamwork has been increasingly demanded as long as organizations have become more project-oriented and project complexity has increased (Lansmann et al., 2019). As a result, IT project teams have grown more and more virtual and decentralized, and project management has become more virtualized, with collaborative ICT technologies supporting them (Martínez Montes et al., 2021; Zin et al., 2018). We refer to virtual project teams as groups of workers who are geographically and temporally separated but are brought together through technology to complete their interdependent organizational tasks, working as if they were co-located (Gupta et al., 2019).

The trend for virtual team collaboration was amplified due to the increase in remote working caused by the outbreak of COVID-19 (Kinder, 2020). Many countries imposed social distancing policies, like Germany, which sent home one-third of its workforce to reduce the infection risk at the beginning of the pandemic (Mattern et al., 2021). As consequence, IT industry shifted toward remote work or virtual workplaces, and Work-From-Home (WFH) or Work-From-Anywhere (WFA) became the "new normal" (Blagov & Anand, 2022; Kolluru et

al., 2021). In India, for example, IT industry moved about 2.9 million employees to work from remote locations, supported by an IT collaboration platform and cloud services to ensure projects' quality and delivery time to meet (Kolluru et al., 2021; Ramasamy, 2020).

Despite the challenges created, the COVID-19 has proven to be a catalyst for the use of various technology solutions to assist remote working (Kolluru et al., 2021). According to (Ozguler, 2020), the pressing need to adopt collaborative solutions has made existing barriers disappear and minds have opened to the benefits of SM platforms. Virtual project work and digital project management solutions have seen a major growth in demand, with experts' forecasts indicating an increase in global-scale projects and the number of online project teams (Ozguler, 2020).

6.2.3 KNOWLEDGE SHARING AND INTEGRATED SM TOOLS IN IT PROJECTS

In this context, thanks to advances in information technology, projects can be effectively managed from anywhere with no need for face-to-face meetings between project managers and virtual teams (Gupta et al., 2009; McGrath & Kostalova, 2020). These geographically dispersed teams and personnel increasingly depend upon technology to communicate, collaborate, and coordinate (Forsgren & Byström, 2018; Martínez Montes et al., 2021). As a result, in the context of virtual teams, any issue relating to the project management process is intensified and only technology makes KS possible (Wells & Kloppenborg, 2019).

In this light, the usage of SM platforms provides better opportunities for rapid knowledge flow among people working across different geographical locations than traditional technologies such as search engines or databases could offer (Ahmed et al., 2019). Complementing this viewpoint, Portillo-Rodríguez et al. (2012) state that the main advantage of SM tools is being internet-based, allowing knowledge to be created, shared, and used both in collocated and distributed project environments. Moreover, studies regarding different success criteria indicate the positive impact of SM use for KS on IT projects' success, perceived in virtual and co-located project teams as well as in private and public sectors (Chowdhury & Lamacchia, 2019; Foote & Halawi, 2018).

Project management practices are used to organize and plan the work of IT projects, but it remains a challenge to manage KS within the project team and with stakeholders from various departments, backgrounds, institutional environments, and organizational hierarchies (Eriksson & Chatzipanagiotou, 2021; Martínez Montes et al., 2021). Theoretical and practical studies have pointed out barriers concerning KS via SM in IT projects. These interlinked

factors reduce the propensity of individuals to effectively share knowledge, highlighting the importance of identifying their impact (Karagoz et al., 2020). When it comes to using technology to support KS in projects, the lack of integration among IT-based tools has long been seen as one of these challenges, forcing a lot of work to be done and hindering the way people do things (Pirkkalainen & Pawlowski, 2014; Riege, 2005).

In consequence, academic research has looked into the usage of integrated SM tools in project management and knowledge management. Veronese and Chaves (2016) envisioned an integrated set of technologies to promote the application of lessons learned in projects. Ikemoto et al. (2020) proposed the SM4PM, a framework to guide the integrated use of SM in project management, focusing specifically on IT projects. The SM4PM framework was instantiated in a subsequent empirical study by Narazaki et al. (2020) within a public security organization to be evaluated regarding project knowledge management support. All these studies, however, relate to the integrated use of independent individual tools.

Considering a distinct perspective, Ikemoto et al. (2017) postulated that social media technologies need to be integrated via a single interface to reach their full potential and Narazaki et al. (2020) advocated that social media tools should be integrated into an unique set being used, meeting individuals desire for ease of use and accessibility, not becoming more tools to be managed. In such vein, recent solutions have been addressing this technology gap and responding to academic claims with the introduction of a class of collaborative tools referred here as "integrated social media platforms".

These current technological solutions are concerned with a unified user interface and a unique set of SM features. Thus, team members can access the range of services using such different devices as cell phones, tablets, PCs, and laptops (Bissaliyev, 2017). It is also possible the addition of other applications and tools using plugins and components that interface with the integrated environment via Application Programming Interfaces (APIs) (Silva & Chaves, 2021). These platforms include Microsoft Teams, Slack, and Jira Software (Eriksson & Chatzipanagiotou, 2021; Mittal & Mehta, 2020; Stray et al., 2019).

Among them, Microsoft Teams seems to be the most popular, where team members can find such collaborative tools as wikis, forums, instant messengers, and video calls all in one place. The platform had 250 million monthly active users in July 2021 (tecmundo.com.br/software/221981-alta-microsoft-teams-chega-250-milhoes-usuarios.htm). The usage of Microsoft Teams in remote work during the COVID-19 pandemic stood out for its integration capabilities (Kolluru et al., 2021). The Slack platform is popular among startup companies and big enterprises, enabling instant messaging, video calls, and file share (Stray et

al., 2019). The use of Jira Software and its plugins such as Confluence and Bitbucket is also popular as a platform of tools to support project and knowledge management in agile software development (Mittal & Mehta, 2020).

Throughout the pandemic, these integrated collaboration platforms were used to implement the remote work model, keeping employees committed and productive (Kolluru et al., 2021). Moreover, empirical research suggest that integrated SM platforms can support KS procedures effectively in project management, facilitating the resolution of integration problems (Eriksson & Chatzipanagiotou, 2021; Stray et al., 2019), as well as providing IT project practitioners with the simplicity of use and accessibility they desire (Narazaki et al., 2020; Silva & Chaves, 2021).

6.2.4 AFFORDANCES AS THE THEORETICAL LENS OF THIS STUDY

There are few obvious theoretical lenses and frameworks for understanding the ways that SM incorporates and affects organizational processes like KS (Leonardi & Vaast, 2017) and the work on affordances and team collaboration is limited (Waizenegger et al., 2020). Leonardi and Vaast (2017) suggest that a lens focusing attention on the organizational activities that SM afford users to do or constrain them from accomplishing would provide an effective framework to understand the role of SM in organizations. Corroborating, Waizenegger et al. (2020) assert that the performance can be enhanced if virtual team processes are adapted for the affordances offered by the technology.

Affordances can be defined as relationships between the properties of an object and the capabilities of the individual that determine how it can be used (Norman, 1988). In this conception, the different features of the object exist independent of the users, but the affordances do not, for they are unique meanings related to the particular way in which each actor perceives and uses the object (Leonardi & Vaast, 2017; Treem & Leonardi, 2013).

The psychologist James Gibson introduced the concept of affordance in 1977. In the original principles of the Affordance Theory, Gibson connected action with perception, presenting the idea that people do not perceive an object as a set of inherent physical features, its materiality, but in terms of how that object can be used to meet specific goals (Volkoff & Strong, 2017). As such, an “affordance” refers to the potential for action that technologies provide to users (Leonardi, 2011). In its turn, a technology provides an affordance when individuals perceive that the properties of its material features transcend the context of use and allow them to perform certain actions (Leonardi & Vaast, 2017).

After Gibson's original ideas were proposed, researchers in different fields started to adopt the concept in contradictory ways, but the functional perspective became dominant, focusing on what potential actions intend to achieve, afforded by the technology-user relationship (Treem & Leonardi, 2013; Volkoff & Strong, 2017). Later on, the affordance research focus moved from the individual to the organizational use of artifacts, and the study of individual actors engaging with individual objects switched to groups of organizational actors engaging with more complex technological objects (Volkoff & Strong, 2017).

Describing artifacts as a set of affordances allow us to understand how people can use different technologies in similar ways or use the same technology in different ways, as long as a person can make use of an opportunity to different degrees or even refuse it (Gibbs et al., 2013; Treem & Leonardi, 2013). In this way, the concept of affordances can be possibly employed to explore the relationship between technology and organizational change, improving the better design of technological artifacts and the users' engagement with the activities it mediates (Treem & Leonardi, 2013).

Researchers have increasingly adopted the affordances perspective to study the use and influence of IT artifacts in organizational contexts. As to the specific areas where it became useful, the adoption and use of SM is a domain where the affordance lens has been used productively (Volkoff & Strong, 2017). Social media technologies may both enable and hinder KS by affording different user behaviors dependent on artifacts, individual goals and organizational context (Sun et al., 2019). Rather than examining the technology as a whole, Affordance Theory allows us to look also at the behaviors offered by SM integrated collaboration tools with a finer grain lens (Waizenegger et al., 2020). It is more valuable to study the relationship between knowledge sharing and affordances than between knowledge sharing and specific social media features (Karahanna et al., 2018), to cope with the issue of replacing an SM tool, for example.

The affordance concept provides a powerful lens for understanding the relationship between social media and KS from a socio-technical perspective that permits to be specific about technology while incorporating social and contextual elements, considering the interactions between organizational actors and technical capabilities together (Sun et al., 2019; Volkoff & Strong, 2017). In this respect, (Ellison et al., 2015) consider that an affordance-based approach permits theorizing about sociotechnical systems like SM in a way that comprehends both the human mediation and the materiality of technology without being entirely technological or social.

In the context of academic research, there has been increased interest on how SM afford changes in KS for organizations (Leonardi & Vaast, 2017). Treem and Leonardi (2013) used the affordance lens to examine how social media use within organizations can affect such processes as KS; (Majchrzak et al., 2013) showed how four different affordances associated with the use of social media changed KS engagement in the workplace, from centralized, intermittent and repository-based to decentralized, continuous and emergent; Ellison et al. (2015) investigated how the affordances of Enterprise Social Network (ESN) sites shape KS practices within an organizational context; Oostervink et al. (2016) studied the influence of institutional complexity on how affordances of social media are engaged, facilitating or frustrating KS; Pee (2018) described social media affordances that can lessen the perceived effort of sharing domain-specific and complex knowledge; Sun et al. (2019) identified the affordances of enterprise social media affected by individual goals and by organizational context, as well as how they influence KS; In addition, Sun et al (2020) empirically validated a model to investigate the effect of social media affordances on employees creativity, from the perspective of knowledge acquisition and provision.

In terms of the different classifications identified in the literature, Treem and Leonardi (2013) proposed four SM affordances that could influence organizational processes like socialization, KS and power relations. Other classifications of SM affordances were proposed by such authors as Majchrzak et al. (2013), Oostervink et al. (2016), Pee (2018), and Sun et al. (2020). Furthermore, a systematic literature review was carried out by Sun et al. (2019); they identified relevant studies about organizational social media affordances and their influence on KS, consolidating the different classifications found, as illustrated in Figure 6.1.

Figure 6-1 Affordance summarized categorization.

Affordance	Description	Related Affordance	Original Research
Reviewability (Faraj et al., 2011)	Involves the ways in which narrative content is viewed and retrieved over time. Content is always available to users, it has a high potential for visibility, it can be accessed through search, and it can made visible to others	Persistence	Treem and Leonardi (2013)
		Scalability	Boyd (2010)
		Searchability	Boyd (2010)
		Visibility	Treem and Leonardi (2013)
		Reviewability	Faraj et al. (2011)
		Leaky pipe	Leonardi et al. (2013)
Editability (Treem & Leonardi, 2013)	Means the possibility of modifying content both before and after it is made available. Other people can make contributions. Users can join or control groups, as well as control and duplicate	Editability	Treem and Leonardi (2013)
		Recombinability	Faraj et al. (2011)
		Experimentation	Faraj et al. (2011)
		Selectivity	Gibbs et al. (2013)

	content.	Replicability	Boyd (2010)
Association (Treem & Leonardi, 2013)	Related to establishing connections between users and users, users and content, content and content, and to engaging in ongoing conversation relying on other's presence, profiles, content and activities.	Association	Treem and Leonardi (2013)
		Network-informed association	Majchrzak et al. (2013)
		Social lubricant	Leonardi et al. (2013)
		Echo chamber	Leonardi et al. (2013)
		Meta voicing	Majchrzak et al. (2013)
Notified Attention (Oostervink et al., 2016)	Refers to users being notified when particular events happen and respond to conversations only when they want. Allow users to control information overload.	Signal availability	Gibbs et al. (2013)
		Triggered attending	Majchrzak et al. (2013)
		Display updates	Gibbs et al. (2013)
		Signaling	Rice et al. (2017)
Pervasiveness (Rice et al., 2017)	Related with ubiquity. It means that users can communicate with others in nearly everywhere, at any time, in order to seek and share knowledge	Pervasiveness	Rice et al. (2017)
		Ubiquity	Kane (2017)

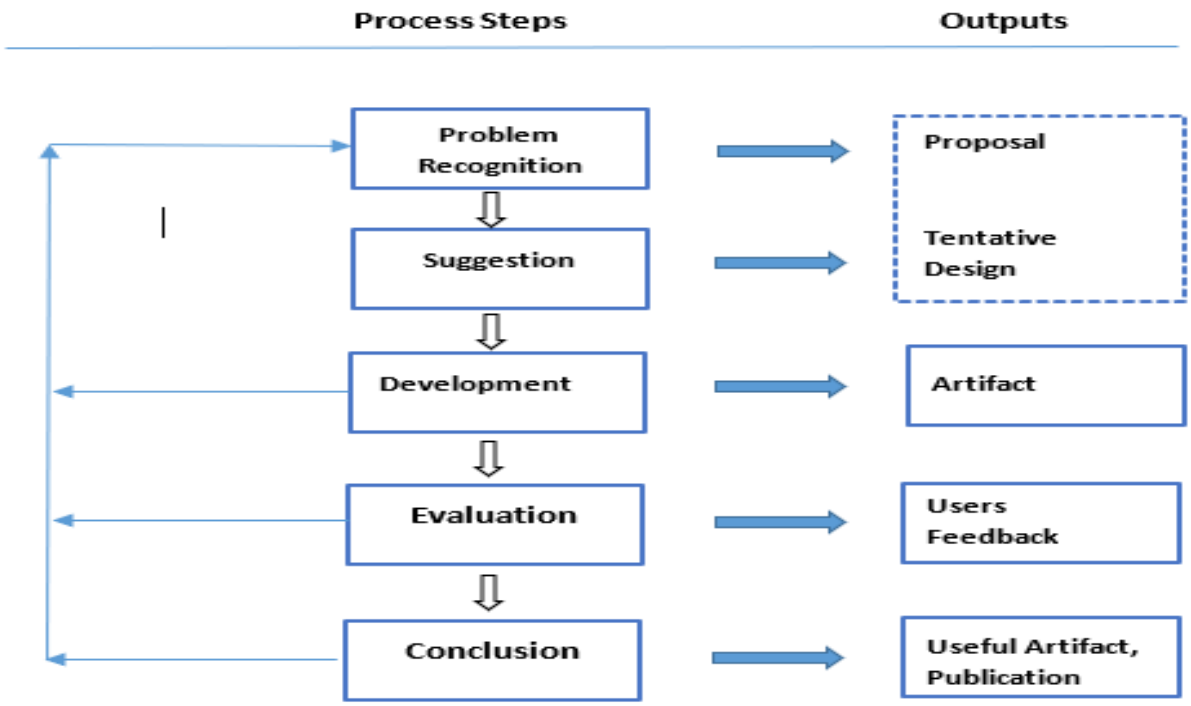
Note: Adapted from Sun et al. (2019).

6.3 METHODOLOGY

Qualitative research is appropriate when it is intended to address social phenomena from the real-world environment by analyzing individual professional practices (Kvale, 2008). Therefore, this qualitative research aims at understanding and describing the human experience in organizations to develop an artifact, a framework, to support solutions to existing problems (Peffers et al., 2007). The methodological approach is prescriptive, aiming to apply the scientific mode of research to solve a real-world problem (Van Aken, 2005). From this perspective, an artifact is something new, not yet existing in nature, such as models, frameworks, methods, and techniques, created by people for a practical purpose (Hevner & Chatterjee, 2010).

In this study, a framework to support KS in IT projects was developed and evaluated, considering that frameworks are "real or conceptual guidelines to serve as support or guide" (Vaishnavi et al., 2019). The process model employed was adapted from the one proposed by Takeda in 1990 and improved by Vaishnavi and Kuechler in 2004 (Vaishnavi et al., 2019). As illustrated in Figure 6.2, the model consists of five basic steps and permits iterating some of them if the results obtained provide opportunities for improvement: i) Problem recognition; ii) Suggestion; iii) Development; iv) Evaluation; and v) Conclusion.

Figure 6-2 Development process model



Note: Adapted from Vaishnavi et al. (2019).

The first step, "Problem Recognition", involves identifying a problem in business, society, or science, and justifying the study importance (Vaishnavi et al., 2019). In this research, data from an academic literature review indicated that ensuring efficient integration of SM technologies to support KS in IT virtual and hybrid project teams is an important managerial task and a relevant theme for research (Camara et al., 2021).

The second step, “Suggestion”, comprises the presentation of an early draft of a possible solution for the problem at hand, the Tentative Design, in the form of a framework from an affordance standpoint. The dotted line surrounding the outputs of the two first steps, Proposal and Tentative Design, indicates that they are closely connected (Vaishnavi et al., 2019). The understanding of the problem and the existing solutions in the literature, which are described in the Theoretical Background section, are the knowledge resources required up to this point.

In the third step, "Development", the Tentative Design is further refined and developed. As the evolution of the previous step outputs (Vaishnavi et al., 2019), the framework development in this phase was also based on the literature review. Furthermore, semi-structured interviews were carried out with project team members and stakeholders to obtain their feedback and solicit suggestions for improvements.

The fourth step comprises the "Evaluation" of the artifact's expected behavior and impacts, collecting evidence that the version in hand meets the required goals (Venable et al., 2016). In an exploratory focus group, the framework produced thus far was presented to project managers in order to gain feedback and suggestions for changes. Additional research and new design may be necessary, to understand the reasons and correct eventual deviations from the expected behavior (Vaishnavi et al., 2019).

Finally, the fifth step, "Conclusion", can mean the end of the research effort, if the results are "good enough," or the iteration to one of the previous steps, if not (Vaishnavi et al., 2019). In this phase, as a conclusion of a work, the problem recognition, the proposed solution, and the resultant artifact must be communicated to researchers and practitioners, with a clear understanding of the knowledge contributions.

6.3.1 DATA COLLECTION

A literature review was initially carried out to investigate the use of social media to promote KS in IT projects and identify gaps. Searches were conducted in Google Scholar database and the set of academic papers retrieved was reviewed. Several search strings were used, such as ("project management", "social media"), (“social media”, “IT project”), ("social media", "knowledge sharing"), (“social media, “affordance”), and (“virtual teams”, “knowledge sharing”). Titles, abstracts and keywords were examined to select papers for a more detailed analysis. Additionally, manual searches were carried out to select complementary papers using the technique of backward reference. Different gaps and some insights arose from the analysis.

6.3.1.1 INTERVIEWS

In the Development step, besides data collected in the literature review, the semi-structured interview was the source of primary data used and refine the framework, targeting project managers, stakeholders and members of IT project teams. For this study, Brazilian IT project team members and stakeholders were invited from distinct business sectors and were interviewed, between November 2021 and March 2022.

Contacts in the researcher's network, particularly in WhatsApp groups, were used to identify potential participants. They were invited to participate and asked to recommend other persons in their networks whose profiles fulfilled the established criteria for interview participation. The majority of the participants had previously worked on projects using the traditional approach, but all were currently working on projects using the agile approach and the SCRUM method, so the answers were primarily based on these projects, though there were references to facts from previous projects as well. Figure 6.3 presents the interviewees' profiles.

Figure 6-3 Interviewees' profiles

Interviewee	Role	Business Sector	Team Location	Years in IT Projects
I01	Scrum Master	Consulting	Hybrid	23
I02	Project Manager	Multinational Company	Hybrid	21
I03	Scrum Consultant	Consulting	Virtual	29
I04	Project Owner	Consulting	Hybrid	20
I05	Technical Leader	Bank	Virtual	15
I06	Developer	Consulting	Virtual	3
I07	Scrum Master	State Government	Virtual	38
I08	Development Manager	Consulting	Virtual	20
I09	Project Manager	Multinational Company	Virtual	22
I10	Agile Coach	State Government	Hybrid	20
I11	Scrum Master	Bank	Hybrid	18
I12	Developer / Agile Leader	Financial	Virtual	5
I13	Scrum Master	Financial	Virtual	35
I14	Project Manager / Scrum Master	Insurance	Virtual	11
I15	Project Manager	Insurance	Hybrid	35
I16	Quality Manager	State Government	Virtual	14
I17	Agilist	Startup	Hybrid	5
I18	Project Coordinator	Telecom	Hybrid	24

Note: Created by the author.

The number of interviews was not determined in advance. New interviews were conducted until data saturation, which refers here to the process of inviting more participants until no additional data are being found or new data tend to be redundant to data already collected (Fusch & Ness, 2015). Eighteen people were then interviewed until data saturation was reached, when information and opinions started to repeat.

The questions in the interview protocol are open-ended, formulated to gain meaningful knowledge, based on a detailed review of the literature. All the interviews were conducted and recorded using videoconference tools. Skype, Teams and Zoom tools were used. Each interview lasted 60 minutes on average. Before starting, interviewees were assured of privacy and confidentiality. They also received a brief explanation of the theme and the objective of the interview, as well as a review of the concepts of social media and the social media tools included in the framework. The interview protocol established can be found in Appendix A

6.3.1.2 FOCUS GROUP

In the Evaluation step, the focus group was the source of primary data used to evaluate the framework. They provide a natural environment and encourage people interaction, which is valuable to develop shared understandings while allowing for individual differences of

opinion to be expressed (Tremblay et al., 2010). The number of participants invited was based on Tremblay et al. (2010) who suggest between four and twelve people for focus groups, highlighting that in design research it may be problematic to have more than six participants, because the subject matter is usually more complex; they also suggest that participants should be familiar with the application context for which the artifact was developed, so as to properly inform its refining and evaluation. So, a focus group meeting was carried out with four senior project managers in May 2022. Figure 6.4 presents the participants profiles.

Figure 6-4 Focus Group participants profiles

Participant	Role	Business Sector	Last Degree	Years in Project Management
P01	Project Manager	Government	Master	13
P02	Project Manager	Consulting	Master	15
P03	Project Manager	Consulting	Master	13
P04	Project Manager	Consulting	Master	15

Note: Created by the author.

Tremblay et al. (2010), propose two different kinds of focus groups for design research: exploratory (EFG), which is used to develop and refine an artifact, and confirmatory (CFG), which is used as a confirmatory proof of an artifact's utility in the field. In this sense, the focus group that was conducted in this research had both confirmatory and exploratory aspects. Four open-ended questions were formulated and proposed to the participants in order to evaluate four dimensions of the framework: completeness, complexity, ease of use and impact. The two first dimensions focused on the characteristics that make up the artifact and the latter two focused on its use. These questions are detailed in Figure 6.5.

Figure 6-5 Framework's evaluation criteria

Criterion	Description	Question
Completeness	Characteristic of what is presented completely in its elements, without anything lacking or unnecessary.	Would you add to or remove any user goal, social media tool, affordance or KS activity from the proposed framework? Which one(s)?
Complexity	The quality or condition of being complex; the state of being confusing, or complicated, or difficult to understand.	In your opinion, how easy it is to understand the framework?
Ease of use	Refers to degree which something can be used to achieve a particular result or effect without applying much effort.	How would you rate the likelihood of this framework being easily used in a project, considering your daily activities?
Impact	Refers to what extent the framework will help managers to share knowledge in order to achieve its goals	How well do you believe the framework will achieve its goals of assisting managers in sharing organizational, technical, managerial, or business knowledge?

Note: Created by the author.

Contacts in the researcher's network, particularly in WhatsApp groups, were used to identify potential participants and invited to participate. Those who accepted, received a web link to a 20-minute video presentation of the framework published on You Tube. The meeting was conducted and recorded using Skype videoconference tool and lasted about two hours. The researcher took on the role of moderator. As well as in the interviews, participants were assured of privacy and confidentiality at the start of the meeting.

6.3.2 DATA ANALYSIS

Content analysis is a research technique for making replicable and valid inferences from written texts (most frequently) to the contexts of their use (Krippendorff, 2018). The interviews and focus group content analysis was carried out according to the technique proposed by (Bardin, 2011), comprising three phases: i) pre-analysis, in which the general reading of the transcribed material takes place. ii) exploration of the collected material, which are grouped and categorized; and iii) treatment of results, inference, and interpretation of the manifest and latent contents of the categorized material.

The interviews and the focus group were recorded to ensure a more accurate account of the conversations and to prevent data loss. Files were labeled and the recorded material was transcribed from oral speech to written text, with software support. The software ATLAS.ti, version 7.5.4, was used to support the analysis, by automating coding and storing transcriptions and results.

6.4 RESULTS

6.4.1 PROBLEM RECOGNITION

The results of the first two steps, Problem Recognition and Suggestion, are taken as a basis for the further development in the next steps, comprising the initial Proposal and a Tentative Design for the framework.

Initially, problem recognition was anchored in the extant literature. It was noticed that SM tools have been mostly used in isolation, suggesting that research on the use of integrated SM tools to support KS needs should benefit both researchers and practitioners (Camara et al., 2021; Ikemoto et al., 2020). On the other hand, the literature review uncovered the lack of data integration among different collaboration tools as a challenge for project managers so much so that ensuring the efficient integration of these technologies became an essential managerial task (Forsgren & Byström, 2018; Veronese & Chaves, 2016).

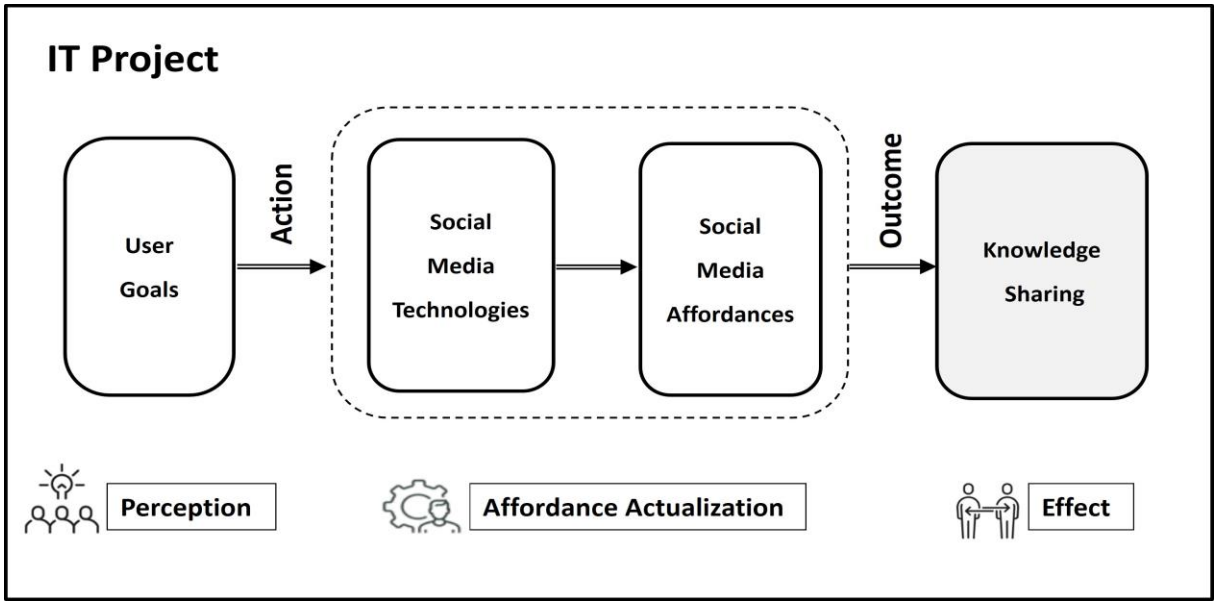
Taking into consideration this scenario, the initial problem statement was “IT project managers lack an artifact to guide them on the integration of SM to support KS in their projects,

particularly in virtual teams". In consequence, the resulting proposal from this step was the development of a framework integrating SM mediated interactions to support KS.

6.4.2 SUGGESTION

The suggestion is a creative phase in which an initial version of the artifact to be developed is designed, based on an original configuration of existing or new and existing elements (Vaishnavi et al., 2019). In this step, the work was anchored in the literature and is supposed to evolve along with the next steps. The affordance perspective adopted allowed us to be specific about technology while incorporating social and contextual elements, considering the interactions between organizational actors and technical capabilities together (Sun et al., 2019; Volkoff & Strong, 2017). Figure 6.6 presents the Tentative Design proposal.

Figure 6-6 Tentative Design



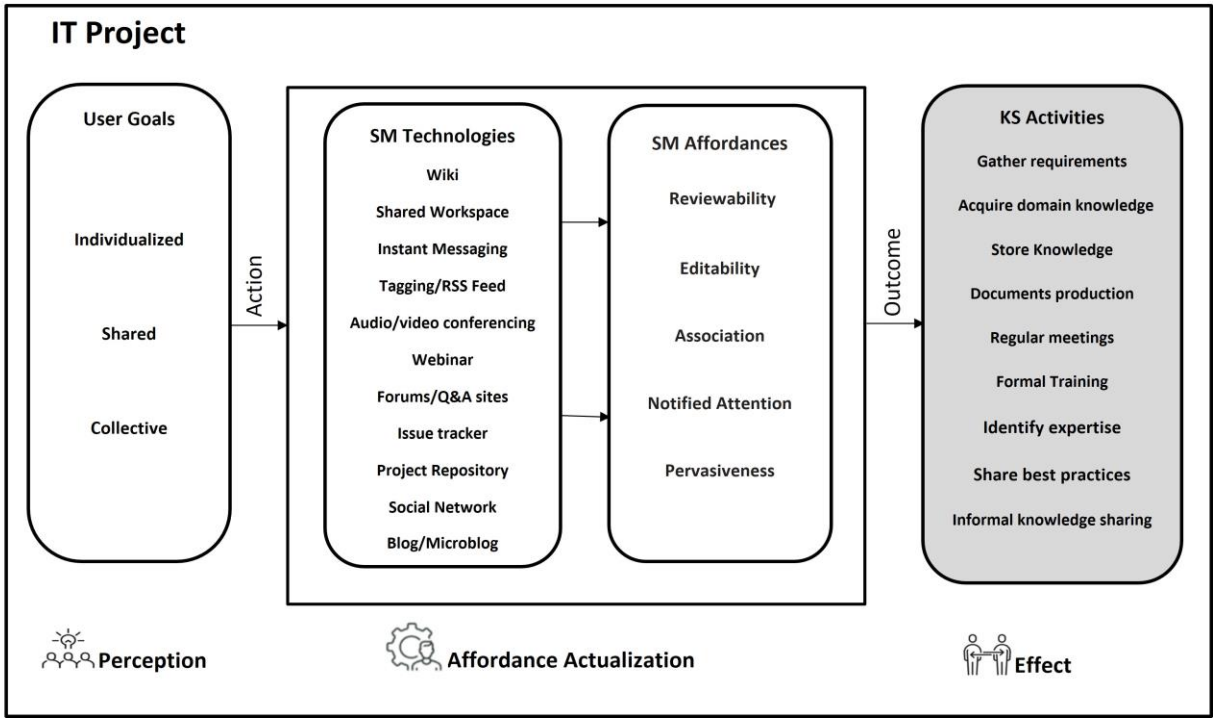
Source: Created by the author.

The design of the theoretical framework drew on the concepts of affordance perception, affordance actualization and affordance effect (Bernhard et al., 2013; Volkoff & Strong, 2017). The first step involves the perception process where the goal-oriented users perceive the social media affordances and the opportunities to perform actions. The second comprises the affordance actualization, where the user turns possibility into action, making use of the perceived potential to support his goals. Finally, in the third step, the affordances actualization will produce an effect of immediate concrete outcomes for achieving KS goals.

6.4.3 FRAMEWORK DEVELOPMENT

From the initial conceptual proposition of the Tentative Design, the components of the theoretical framework were extended to develop the three steps of the framework, based on the literature and on the practitioners' experience. Figure 6.7 illustrates the overall proposal, presenting the developed framework.

Figure 6-7 Framework proposal



Note: Created by the author.

People perceive technology materiality as offering distinct possibilities, the affordances, to carry out their different goals (Bernhard et al., 2013). As affordances are just potentials for action, not the actions themselves, they need to be triggered by a goal-oriented actor, reflecting the human will to employ an affordance to achieve an outcome (Bernhard et al., 2013). As a result, it becomes necessary to make a clear distinction between the possibilities for goal-directed action (perception), the actions taken (affordance actualization), and the consequence of these actions (effect) (Volkoff & Strong, 2017). The three steps will be described in detail in the next topics.

6.4.3.1 PERCEPTION/USER GOALS

Different social forces arising from the context in which actors operate within the organization affect users' behavior, since many actions are performed collaboratively or are influenced by others' actions (Volkoff & Strong, 2017). Teams may perceive the usefulness of technology in achieving their goal even if it was not originally designed to be used in that way (Leonardi, 2013) and the presence of different people with similar goals acting to

actualize affordances of the same or of different SM tools must be addressed when considering an organizational context (Volkoff & Strong, 2017), since. Thus, the categorization of affordances into individualized, shared and collective seems appropriate to represent multi-level intent, the different types of goals that leads users to trigger SM affordances actualization in a project context (Leonardi, 2013).

Individualized affordances are actualized by individuals acting independently and may not be available to everyone in the workgroup, e.g., granting access permissions or creating groups; collective affordances involve individuals performing different aggregated tasks to achieve a common goal, producing something that otherwise could not, e.g., discussing a problem in a Slack or MS-Teams channel; shared affordances are actualized by many people using similar patterns and are available to everyone in the group, e.g., updating a wiki page or producing collaboratively a document (Leonardi, 2013; Volkoff & Strong, 2017).

6.4.3.2 AFFORDANCE ACTUALIZATION/SM TECHNOLOGIES

To extend the first element in the affordance actualization step, both professional and academic sources have been used to build the list of SM technologies. Considering the professional perspective and empirical studies from the academic literature regarding social collaboration in project work, Thompson (2018) developed a taxonomy of nine types of SM technologies. The five SM types considered by Sun et al. (2019) complemented the list, reflecting collaborative and interactive features to share knowledge.

This partial list was then compared with relevant SM technologies to support KS processes mentioned by the Brazilian project managers (Silva & Chaves, 2021) and found in the systematic literature review by Camara et al. (2021). The match was significant, and a final categorization of key technologies was then defined comprising the following wikis, shared workspaces, instant messaging, tagging/RSS feed, videoconferencing, webinars, forums/Q&A sites, issue trackers, blogs/microblogs, social networks and project repositories environments.

6.4.3.3 AFFORDANCE ACTUALIZATION/SM AFFORDANCES

The affordances classification presented by Sun et al. (2019) was adopted to the composition of the second element in the affordance actualization step. Those authors carried out a systematic literature review and identified enterprise SM affordances and their influence on KS. Ten different classifications, encompassing thirty-eight affordances were analyzed and consolidated, resulting in a reclassification consolidated into five groups of related affordances: Association, Editability, Notified Attention, Reviewability, and Pervasiveness.

The five resulting groups of affordances and their related affordances, offered in prior literature classifications, are summarized in Figure 6.8.

Figure 6-8 Social media affordances

Affordance	Related affordances
Association	A10 - Find information I already knew or was aware of. In or out of the project.
	A15 - Find people I already know or am aware of. In and or of my project.
	A20 - Find new information I did not know or wasn't aware of. In or out of the project.
	A25 - Form relationships with other users, e.g., friending, following, etc.
	A30 - Join individual conversations, groups or online communities.
	A35 - Consult and react online to others' presence, profiles, content and activities, e.g., adding a tag, commenting, responding a question, "like", etc.
	A40 - Obtain and use others' files, documents, photos, or other information.
	A45 - Share files, documents, photos, videos, links, and other information with others.
	A50 - Direct public messages to and receive public messages from a specific individual or group.
	A55 - Enrich the text through the use of graphical icons, photographs, etc.
Editability	E10 - Edit others' information after they have posted it.
	E15 - Edit my information after I have posted it.
	E20 - Collaboratively create or edit content, e.g., documents and posts.
	E25 - Select or subscribe to specific groups and content.
	E30 - Duplicate content.
	E35 - Manage groups. Create groups. Control who can participate in groups.
Notified Attention	N10 - Receive notifications about others' information or updates
	N15 - Receive notifications about information or updates referring to a specific content of interest.
	N20 - Indicate presence/absence status
	N25 - Check if other users are accessible.
Pervasiveness	P10 - Get quick responses to my requests from others.
	P15 - Communicate with others from any place, while moving, commuting, or traveling.
	P20 - Communicate with others at any time.
	P25 - Communicate with infrequent or less important work relationships.
Reviewability	R10 - Find information about previous projects
	R15 - Users are able to view and reuse knowledge after posted, at anytime they need
	R20 - Conversations may be searched, browsed, replayed, annotated, visualized, and restructured
	R25 - Search for information or people by entering search words.
	R30 - Learn about who knows what in the organization, identifying experts in relevant fields
	R35 - Search for information or people by following links between contents.
	R40 - Search for tags or keywords that someone else has added to content.
	R45 - See other people's answers to other people's questions.
	R50 - Include information, photos, and other content on media that present my personal identity
	R55 - Adjust my media profile to my preferences and abilities
	R60 - Participants can use the interaction between team members, which is automatically preserved

Note: Created by the author.

6.4.3.4 EFFECT/KNOWLEDGE SHARING ACTIVITIES

Both professional and academic sources have also been used to categorize KS activities and compose the fourth step of the framework. In this step, we also draw on data from the interviews with fifteen senior Brazilian IT project managers addressing the use of SM to support KS (Silva & Chaves, 2021). The activities mentioned by the practitioners were classified and categorized as key processes to support KS in traditional and agile project management approaches.

A literature synthesis elaborated by Thompson (2018) on the use of social media in project management activities related to knowledge transformation processes was also used. Both sets of KS activities, from professional and academic sources, were then compared and correlated to define a final categorization presented in Figure 6.9.

The list in Figure 6.9 presents the set of activities identified in the literature review related to KS among the members of an IT project, as well as a brief description of how each activity occurs and also the references to the academic studies where they were found.

Figure 6-9 Knowledge-sharing activities

KS Activities	Definition	References
Acquire domain knowledge	Acquire knowledge about the business areas with end users, customers and other stakeholders.	Cram and Marabelli (2018); Silva and Chaves (2021)
Gather requirements	Capture functional and non-functional project requirements with end users, customers and other stakeholders, to describe and plan the project features.	Cram and Marabelli (2018); Silva and Chaves (2021)
Document production	Produce documentation regarding knowledge about requirements, process, development plans, business domain, metrics, project status, etc.	Cram and Marabelli (2018); Silva and Chaves (2021);
Store knowledge	Make use of the storage infrastructure as a repository for capturing and disseminating knowledge across the organization.	Cram and Marabelli (2018); Silva and Chaves (2021); Thompson (2018);
Regular meetings	Conduct/attend regular meetings that are part of the project's development process and allow for the exchange of project knowledge.	Thompson (2018); Daemi et al. (2020); Stray et al. (2019); Eriksson and Chatzipanagiotou, (2021);
Training	Carry out formal project team events, such as training and webinars, held to disseminate project-related knowledge.	Cram and Marabelli (2018); Silva and Chaves (2021);
Share best practices	Apply techniques to disseminate and reuse existing knowledge, discussing success factors, obstacles and lessons learned.	Cram and Marabelli (2018); Silva and Chaves (2021); Daemi et al. (2020); Thompson (2018);
Identify expertise	Identify the proper people who are knowledgeable about a subject or can help to solve an issue, as well as making each one aware of knowledge holders.	Cram and Marabelli (2018); Leonardi (2015); Buunk et al. (2017); Stray et al. (2019);

Informal knowledge sharing	Outside of formal meetings, provide or receive knowledge about problems, solutions, ideas or opportunities, individually or in groups, at any time.	Cram and Marabelli (2018); Silva and Chaves (2021); Tromer (2021); Thompson (2018);

Note: Created by the author.

6.4.4 FRAMEWORK VALIDATION AND REFINEMENT

Following the process model, once the framework proposal was developed, the next step was its validation and refinement. Eighteen interviews were then carried out, where the framework was presented to practitioners, stakeholders and members of virtual and hybrid agile IT project teams. To assess the framework adherence to their daily work, they were asked about KS activities, SM collaborative tools and tools integrated use. The results are presented and discussed in the next topics.

6.4.4.1 PERCEPTION/USER GOALS

The three categories of user goal proposed by Leonardi (2013) were identified in the interviewees' answers and no different types of user goals were mentioned, therefore validating the framework's Perception step. In this regard, users take individualized KS actions, such as tagging another team member to notify about a topic in an online meeting, enabling permissions to external participants in internal videoconferences or searching a wiki for previous project technical knowledge; users also take shared KS actions such as collaborating on the creation of a requirement list, designing a new functionality on canvas tool or updating the "who knows what" spreadsheet in the knowledge repository; and users also take collective actions such as solving a problem by creating a temporary channel, inviting specialists, discussing possible solutions and storing the knowledge produced.

6.4.4.2 AFFORDANCE ACTUALIZATION/SOCIAL MEDIA TECHNOLOGIES

The interviewees' responses uncovered some contrasts between the findings of the literature presented in the framework and the actual work environment of practitioners in a project context. Tools that are not used, that are not included in the framework, or that have the functionality used in a manner other than the traditional were highlighted. Therefore, the framework's Affordance Actualization/SM Technologies step was validated and refined.

No interviewees mentioned the use of blogs, microblogs, social networks, Q&A sites, RSS Feeds or webinars in their current or previous project. So, these technologies were removed from the framework. Discussion forums were not mentioned either, but their function was replaced by the communication channels in integrated SM platforms, groups in instant messengers or issues in issue trackers, as reported by I01, I05, I08, I09 and I11.

Additionally, I07, I08, I09, I10, I11 and I14 reported that Jira and Redmine, initially considered only as issue trackers, were also used to store and share product and project management knowledge. Hence, the term "issue tracker" was replaced by "product/project management" in the SM Technologies component of the framework.

On the other hand, several interviewees mentioned activities facilitated by the canvas tool, a virtual environment not initially included in the framework that permits synchronous and asynchronous collaboration. Canvas tools can be used in activities such as training, brainstorms, presentations, process design, functionality design and requirement specification. Such products as Miro, Whiteboard, Fun Retrospective, Figma, Project Canvas and Easy Retro are used by I04, I05, I09, I10, I12, I14, I15 and I17 in their projects. Canvas tool was thereby included in the Components step of the framework.

Corroborating the findings of Silva and Chaves (2021), respondents reported the significant use of traditional instruments such as file system directories and emails to store and share knowledge, created mostly in PDF, Word, Excel, PowerPoint, and Project, as mentioned by I02, I03, I04, I08, I09, I10, I15, I16 and I18. Besides that, corporate wikis (I05, I07, I13, I14) and corporate discussion forums (I09, I12) were also mentioned as SM collaborative tools used by project team members and available to all the organization areas.

6.4.4.3 AFFORDANCE ACTUALIZATION/SOCIAL MEDIA AFFORDANCES

The five classes of consolidated affordances and all of their related affordances, as proposed in Figure 6.8, were identified in the interviewees' answers, validating the framework's Affordance Actualization/SM Affordances step. Additionally, there was also a refinement of this step because respondents mentioned twenty additional related affordances to be incorporated to the original set. The list of the new affordances identified in the development process is presented in Figure 6.10.

Figure 6-10 Additional related affordances

Affordance	New Related Affordance	Mentioned by…
Editability	E40 - Control access to group stored conversation	I12
	E45 - Remove groups and their content	I17
	E50 – Control content update permission	I10
	E55 - Manage content storage and consultation	I12
	E60 - Control suitability of included or changed content	I13
Notified Attention	N30 – Send notification about audio/video conferences and other events	I03, I11
	N35 - Create automatic notification about audio/video conferences and other events	I12, I14
	N40 – Send notification about content to another user	I01, I02, I03,

		I05, I08
	N45 - Notify request for permission to speak in a video conference	I12
Association	A60 – Control file sharing enabling.	I04, I08
	A65 – Control chat enabling to internal and/or external users.	I01, I08
	A70 – Share screen in video events	I01, I05, I08, I10
	A75 – Control internal/external participation permission in audio/video events	I08, I15
	A80 - Create audio/video conference rooms	I13
	A85 - Communicate between audio/video conference rooms	I13
Reviewability	R 65 - Store and make available files, documents, photos, videos, audios and other information.	All
	R70 - Search for files, documents, photos, videos, audios and other project content.	All
	R75 – Record and preserve audio/video content.	I01, I05, I08, I09, I10, I17
	R80 – Transcribe and preserve audio/video content.	I09, I17
	R85 - List the audio/video event participants	I01, I18

Note: Created by the author.

6.4.4.4 EFFECT/KNOWLEDGE SHARING ACTIVITIES

The Effect/KS Activities step was also considered validated, given that i) all of the KS activities proposed in the framework were recognized by the interviewees as occurring in certain moments along the execution of their projects; and ii) when asked if they could cite any missing activity, all the interviewees answered negatively. To illustrate that, the use of SM tools in each project KS activity was mapped and is presented in Figure 6.11.

Figure 6-11 Mapping between SM tools use and KS activities

	Audio/Video Conferencing	Canvas	Project Repository	Instant Messenger	Product / Project Mgmt	Shared Workspace	Tagging	Wiki	TOTALS
Acquire Domain Knowledge	16	1	0	6	0	3	2	0	28
Document Production	4	9	0	0	3	6	0	0	22
Gather Requirements	15	1	0	6	2	1	2	1	28
Identify Expertise	3	0	0	1	1	8	0	5	18
Informal Knowledge Sharing	13	1	1	22	1	2	2	1	43
Regular Meetings	18	0	0	12	1	2	8	0	41
Share Best Practices	11	6	1	4	1	3	2	0	28
Store Knowledge	6	3	1	5	24	33	1	13	86
Training	17	1	1	3	2	1	2	3	30
TOTALS	103	22	4	59	35	59	19	23	324

Note: Created by the author.

Social media tools were mapped to the corresponding KS activities where they are used, according to the interviewees' answers. Each spreadsheet cell contains the number of times the association between tool and activity was mentioned. The use of wikis to store knowledge, for example, was mentioned thirteen times. It should be noticed that more than one mention in a cell may have come from the same interviewee.

6.4.4.5 SOCIAL MEDIA TOOLS INTEGRATION

The interviewees were asked about the use of tool integration in their projects, and the majority answered positively. They emphasized that it is a trend (I03, I06) and a necessity, particularly in IT projects (I10), but it needs to be easy to use (I10), and capillarized within the organization (I01). I12 said that it used to be important but now it is indispensable and I18 considers that it became irreversible. The significant cost of acquiring and maintaining such integrated tools was emphasized by I10 and I13, especially the professional versions.

It was considered that the integration facilitates communication and documentation (I07, I09, I13, I18), which is important to gain agility (I13) and to manage knowledge (I16, I18), contributing to increase project performance (I02, I03). I15 said that using only one integrated tool would make his work easier. According to I18, as team members' participation and collaboration improves, they begin to have a more active voice and become more empowered. Figure 6.12 presents the mapping between integrated SM tools and KS activities.

Figure 6-12 Mapping between integrated SM tools use and KS activities

	Azure DevOps	Discord	Google Workspace	GoTo Meeting	Jira	Redmine	Slack	Teams	Trello	Webex	TOTALS:
Acquire Domain Knowledge	1	0	1	1	0	0	0	9	0	1	13
Documents Production	1	0	1	1	0	0	0	2	2	1	8
Gather Requirements	1	1	1	0	1	0	0	9	1	1	15
Identify Expertise	1	1	0	0	3	1	2	4	1	0	13
Informal Knowledge Sharing	1	1	2	0	1	0	3	17	0	0	25
Regular Meetings	0	1	2	1	0	1	0	8	0	1	14
Share Best Practices	1	0	1	0	0	1	0	8	1	0	12
Store Knowledge	4	0	2	0	12	7	2	18	8	0	53
Training	0	1	1	0	2	0	0	13	0	0	17
TOTALS	10	5	11	3	19	10	7	88	13	4	170

Note: Created by the author.

It is worth noting that all of the interviewees except I03, I09, I10, I15 and I18, reported the use of more than one integrated tool, in addition to standalone tools. In this regard, several respondents reported problems arising from the lack of integration between tools used in the organization (I01, I03, I04, I05, I06, I16). The use of multiple tools causes rework (I12, I14, I15, I17), outdated versions of the same document (I16) and loss of knowledge (I08, I12, I14).

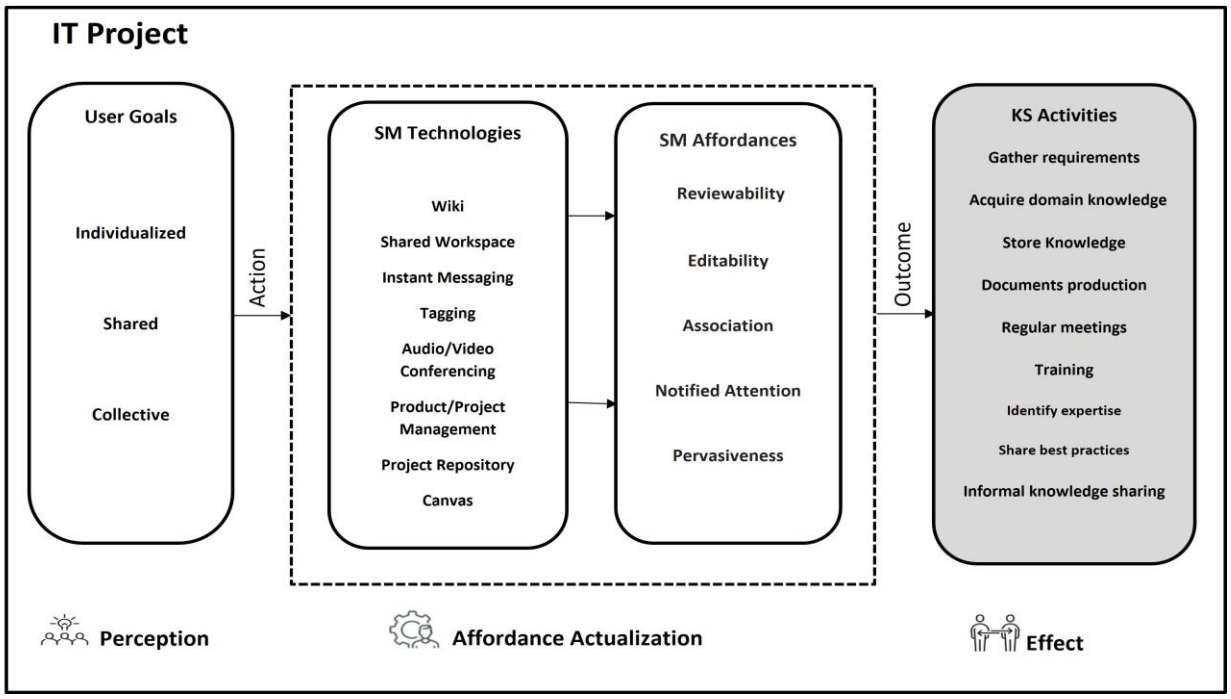
In their responses, all the interviewees mentioned the use of SM tools integration to share knowledge in their projects. Here, we consider integration as the use of more than one SM technology in the same tool or integrated platform. Microsoft Teams was the most mentioned, corroborating Kolluru et al. (2021). Azure DevOps, Jira, Trello, Redmine, and Google Workspace were also mentioned. Additionally, respondents reported the use of integration in all KS activities included in the framework, mostly to store knowledge.

6.4.4.6 THE INT-SM4KS FRAMEWORK

In this section, we present the version of the framework, refined with the contribution of the interviewees, from now on denominated Integrated Social Media for Knowledge Sharing (INT-SM4KS) framework. To provide a more comprehensive understanding of the artifact developed, considering people, processes, and technology, two views of the framework are presented, the Components view and the Integration view. The two perspectives are complementary, and this is how the framework describes the environment approached in this work. It is expected that the analysis and use of the knowledge presented will assist project managers in resolving the aforementioned problems and in achieving the research's major goal.

The Components view corresponds to the initial proposal updated to reflect the refinements described in the previous sections, made during the development step. In this view, one can observe the representation of the sequence of steps in which knowledge sharing occurs in the project, through human interactions enhanced by the affordances of social media tools. The Components view is presented in Figure 6.13.

Figure 6-13 Components view of the INT-SM4KS framework



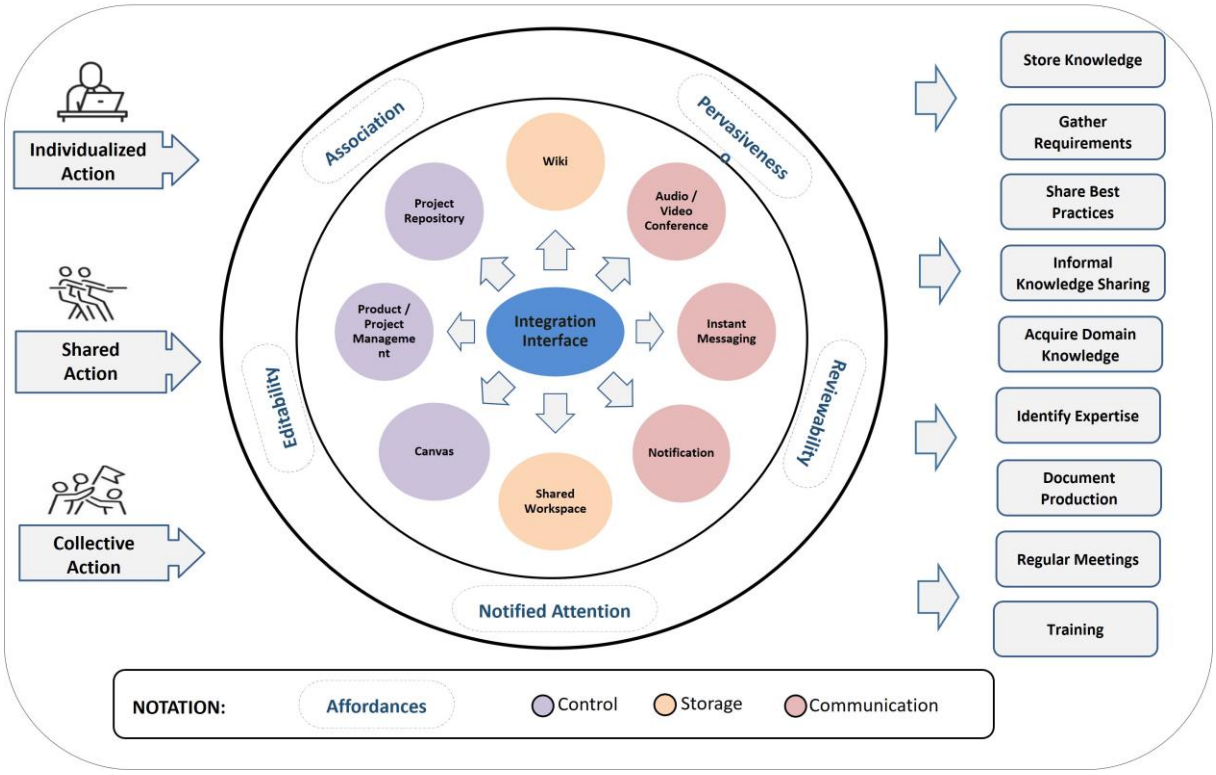
Note: Created by the author.

The Integration view keeps the same components and their respective elements, but they are presented differently. On the left side, the objectives and actions remain, and on the right side, the resulting KS activities also remain. In the component of affordances materialization, however, the integration of social media technologies is highlighted.

The inner circle represents the proposed set of tools integrated in the same interface, from which all of them can be activated. The different colors group the tools according to the main effect they have for carrying out knowledge sharing activities in the project, i.e., control, storage and communication. This categorization was found in the literature (Eriksson & Chatzipanagiotou, 2021; Ikemoto et al., 2020; Narazaki et al., 2020) and was corroborated by the interviewees' speech.

On the left side, we can see the technologies used mostly for control: project repositories, product/project management and collaborative canvas. In the center, the technologies used mostly for storing knowledge: wikis and shared workspaces. On the right side, the technologies used mostly for communication: audio/video conference, instant messaging and notifications. The Integration view is presented in Figure 6.14.

Figure 6-14 Integration view of the INT-SM4KS framework



Note: Created by the author.

The five groups of materializable affordances are located in the outer circle. This placement indicates that all the affordances relate to all the technologies, that one technology can materialize one or many affordances, and that many technologies can materialize one or many affordances.

6.4.5 FRAMEWORK EVALUATION FOCUS GROUP

The objective of the focus group was to obtain feedback from project managers on the characteristics and the utility of the framework that had been developed and refined, considering four dimensions: completeness, complexity, ease of use and impact. When accepted the invitation, the participants received a link for the 20-minutes video presenting the framework version, which had been previously published on You Tube (https://youtu.be/KDXHq38rFB4). The same presentation was used by the moderator to support him in conducting the meeting.

Initially, the participants were given a brief explanation about i) the main concepts used in the study: knowledge sharing, social media, virtual teams and affordances; ii) the research positioning; iii) the research problem; iv) the research main objective; and v) the framework objective. After that, the conceptual summary in Figure 6.15 was presented and described, in order to provide a broad overview and understanding of the framework. Then, the meeting

proceeded with the evaluation of the four dimensions that represent the framework's characteristics. Figure 6.15 presents a summary of the results.

Figure 6-15 Focus group results summary

Criterion	Consensus?	Accepted?	Evaluation
Completeness	Yes	Yes	No new elements to be included into or removed from the framework were suggested.
Complexity	Yes	Yes	Participants stated and demonstrated a general understanding of the framework .
Ease of Use	Yes	No	Recommendation for improving the framework to have a greater focus on practice.
Impact	No	N/A	P1, P3, and P4 considered that knowledge sharing is not particularly relevant in their projects P2 considers that it will be useful in the near future to build knowledge, improve other projects and the project itself. P3 said that the company's director where he leads a project does not want to integrate anything. P2 sees in this proposal a software that would integrate everything, and this will happen, as the players are working on it.

Note: Created by the author.

The Completeness and Complexity criteria were unanimously deemed adequate, with the moderator answering some of the participants' questions. The criterion Ease of Use obtained a unanimous review, but no acceptance; all agreed that a greater focus on the practical aspects of the framework was required to ensure that the user understood how to utilize it. The Impact criterion, on the other hand, did not receive unanimous approval; participants had differing opinions on the use of tool integration and knowledge sharing in their projects. Below is a more extensive discussion of how each criterion was assessed.

6.4.5.1 EVALUATING COMPLETENESS

Completeness is the characteristic of what is presented completely in its elements, without anything lacking or unnecessary. In this respect, the participants evaluated if the structure contains all of the necessary elements as well as the required interactions between them. They were asked if they would add to or remove from the proposed framework any user goal, SM tool, SM affordance, or KS activity, as well as which element they would add or remove.

Each component and respective elements was presented and discussed, together with their individual aspects, in order to capture this answer. No new elements to be included into or removed from the framework were suggested. P02 said that “the proposed framework is what I

see in practice. I think it is very complete. People use the tools; gather the best they have and use them to run the project. I have seen it working like this".

A suggestion for improving the presentation was made. Examples of market products representing each type of social media in the framework were referenced in the presentation. Participants recommended that additionally examples of integrated SM products, such as Teams or Azure DevOps, be also displayed in this regard.

6.4.5.2 EVALUATING COMPLEXITY

Complexity characterizes the quality or condition of being complex; the state of being confusing, or complicated, or difficult to understand. In this respect, the participants were asked about their perception of the framework in relation to its ease of understanding. In both the given perspectives, the components view and the integration view, they stated and demonstrated a general understanding of the framework and its characteristics.

The questions posed in response to this evaluation criterion were primarily aimed at comprehending the framework's objectives and scope, which were developed with a focus on projects rather than the entire company, considering the process of knowledge sharing mediated by SM technology. P3, for example, inquired about how to apply the framework to the company's strategic goals, while P1 and P4 questioned the framework's lack of explicit connection with Nonaka's knowledge construction process.

6.4.5.3 EVALUATING EASE OF USE

Ease of Use refers to how natural it is to operate something, to the degree which something can be used to achieve a particular result or effect without applying much effort. In this respect, the participants were asked how they considered the ease of using this framework in a project, considering their day-to-day experience.

This criterion received unfavorable feedback from the participants. P3 said that he didn't understand how to use the framework observing that "it doesn't mean I wouldn't use it; it's just that it's not ready for me to use yet." P4 added that it is necessary to "know how to take advantage of all this."

The moderator argued that the idea behind the framework is to support decisions by providing a description of a generic knowledge-sharing environment, to be analyzed by managers and tailored to their projects. However, the group did not think this sufficient and suggested that there should be an improvement in this area, recommending that the framework have a greater focus on practice. As a result, the creation of practical examples to demonstrate how to use the framework was considered, and the spreadsheet presented in Figure 6.16 was created.

Figure 6-16 - Selecting affordances x social media for Gathering Requirements

	Affordances	Storing and consulting documents	Chats and videoconferences	Sector groups discussions	Requirements gathering meetings	Functionality design
		Shrd Wksp	Notf	Inst Msng	A/V Conf	Canv
Ass	A15 - Find people I already know or am aware of. In and or of my project.		X	X		
	A30 - Join individual conversations, groups or online communities.			X		
	A50 - Direct to and receive public messages from a specific individual/group.			X		
	A75 – Control internal/external participation permission in audio/video events				X	
Edtb	E10 - Edit others' information after they have posted it.	X				X
	E20 - Collaboratively create or edit content, e.g., documents and posts.	X				X
	E35 - Create groups and control who can participate.			X		
	E50 – Control content update permission	X				X
Prv	P10 - Get quick responses to my requests from others.					
	P15 - Communicate with others from any place, while moving or traveling.			X	X	
	P20 - Communicate with infrequent or less important work relationships.			X	X	
Notf	N15 - Receive notifications about information or updates of a specific content.	X	X			
	N20 - Indicate presence/absence/do not disturb and other status		X	X	X	
	N35 - Create automatic notification about audio/video conferences and other events		X		X	
	N45 - Notify request for permission to speak in a video conference		X		X	
Revw	R10 - Find information about previous projects	X		X		X
	R15 - Users are able to view and reuse posted knowledge at anytime	X		X		X
	R25 - Search for information or people by entering search words.	X		X		X

	R75 – Record and preserve audio/video content.			X	X

Note: Created by the author.

In this example, a timetable for KS tasks associated to gathering requirements in an imaginary project is shown briefly. On the upper right, SM technologies and the purposes to which they'll be applied are positioned. A few affordances were chosen for use and are displayed on the left side; cells marked with an X in the same row of the affordance indicate the tools that will be triggered by users to materialize them. Inclusion of practices connected to KS activities and probable affordances associated with each tool are two further possibilities for future framework improvements.

In this project, requirements will be gathered via videoconferences, during which functionalities will be collaboratively defined on the canvas, documents will be produced in the same manner, and all will be saved in the shared workspace. At all times, the instant messenger will be available for group talks and discussions, as well as relevant notifications can be sent and received. Using this sort of mapping it is possible to specify the properties of tools for addition or replacement, define usage guidelines, prepare training content and manuals, and outline the activity's knowledge sharing process, for example.

6.4.5.4 EVALUATING IMPACT

In order to evaluate this criterion, the participants were asked to what extent they consider the framework will help managers share technical, management, organizational, and business knowledge in order to achieve its goals. The evaluation produced no consensus, and the majority of the responses were based on the fact that the organizational process addressed in the framework, i.e., knowledge sharing, was not particularly relevant in their projects.

P3 said that in his projects senior management determines the objectives and everyone must work to achieve them, regardless of sharing knowledge or not. He continued by stating that the idea of integration “is far from happening in the present project, because the company's director does not want to integrate anything”. For him, more than user requirements, for example, “the director wants to see a sheet or a slide regarding project demands” and activities such as identifying expertise do not occur in his projects. He said that “sharing knowledge is not something easy, it is not something that exists” in his daily life.

P1 and P4 agreed, and the latter added that that despite the lack of integration, he can now work with some of the framework's tools, which is a major challenge. He considers that perfect integration would be "the best of all worlds," but there are few products that meet these

requirements. Furthermore, he believes that the director's primary concern is the project's benefits, and he is unaware of how knowledge sharing might help in this regard.

P2 presented a different perspective, considering that it is an artifact that will be useful in the near future to build knowledge within the project, to improve communication, to improve the development of other projects and of the project itself. He sees in this proposal a software that would integrate everything, and this will happen, as the players are working on it. Today it still needs improvement, but it will eventually arrive. He sees it as something more advanced than a framework, as a necessity.

These findings revealed the necessity for a more detailed initial explanation of the concept of knowledge sharing, used as the foundation for the framework's development. It is clear that it does not entirely reflect the participants' perceptions of the subject; they do not regard information and know-how about business, managerial, technical, and organizational factors provided during the development of a project to be knowledge, as claim Wang and Noe (2010). "Perhaps it is our difficulty," P4 commented in this regard, "keeping in mind that knowledge is a wider thing, that it has a greater meaning than project information."

Furthermore, it appears that the work environment impacted the participants' evaluation of this criterion; most of them are consultants completing projects for customers, pressured by contract budgets and timetables, and subordinated to the needs of the use of various set of tools. A similar finding was confirmed in interviews conducted throughout the framework development phase, when respondents who completed projects in their own organizations indicated considerably more frequently the existence of knowledge sharing activities in their projects. This suggests that future uses of this framework will be more well-received and successful in organizations whose employees compose project teams.

6.4.6 CONCLUSION STEP

We consider that this subsection corresponds to the last step of the development process, Conclusion, because the development and evaluation steps are complete, and the framework is available to researchers and practitioners. Following the model, this study will be submitted to publication in congresses and journals in order to communicate the work results to researchers and practitioners.

6.5 CONCLUSION

This study aims at investigating how to use the integration of various SM tools to support knowledge-sharing processes in IT projects. Its main objective is the development of a framework to assist IT project managers, contributing to the solution of KS problems identified in the

literature and in practice such as selecting or replacing SM tools; developing KS processes and KS training; and creating guidelines for tools use.

The impact of the framework is potentially relevant. Its effective use in IT projects can add to the work of managers the benefits of knowledge shared between project participants as well as between different projects; increase management efficiency; and positively influence its success. The impacted area is potentially large, encompassing all project management activities.

The affordance lens was adopted as a theoretical approach and a development process model proposed by Vaishnavi et al. (2019) was used. The initial version of the framework was based on a comprehensive literature review and was evaluated refined by eighteen participants of agile projects, by means of semi-structured interviews.

The framework comprises three components, drawing on the concepts of affordance perception, actualization and effect. The first one involves the users' perception of the opportunities to perform actions; the second comprises turning possibilities into action; and the third will produce an effect of outcomes for achieving KS goals.

Interviewee's answers uncovered that blogs, microblogs, social networks, discussion forums, Q&A sites, RSS Feeds, and webinars are not used for KS in their current projects. In contrast, issue trackers are being used to store and share project and product management knowledge, while canvas tool has increasingly facilitated KS activities, thus both were included in the framework. Additionally, twenty affordances were identified and were also included.

The final version of the framework is presented in two perspectives that complement each other: the Components view and the Integration view. This version was evaluated in a focus group meeting with four senior project managers who assessed the Completeness, the Complexity, the Ease of Use and the Impact of the artifact.

The limitation is associated to conducting only online interviews and particularly online focus groups, for the framework's development and evaluation. Moreover, due to the research time limitations, it was not possible to conduct further focus groups, neither work on the necessary improvements identified in the evaluation. Also in this regard, holding more focus groups would allow for changes in the framework's presentation and in the way the meeting is conducted, in order to address some issues/difficulties identified in the application of the first one. Furthermore, constraints of time and location did not allow the framework to be instantiated in a real-world environment where people would simulate or perform real tasks.

Future research can investigate the efficiency of the framework when used in a real-world project environment, evaluating its application in various sorts of projects, and other business areas, including the public sector. Moreover, promoting research to the use of the framework with

different teams, such as company employees, outsourced and mixed; and validate the simplicity of use by using the framework in organizations that already have a defined KS process.

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6.7 APPENDIX A - INTERVIEW PROTOCOL

0 – Clarify the purpose of the interview, confidentiality, anonymity, recording, the possibility of interrupting at any time, the concept of knowledge sharing that will be addressed and the types of social media proposed in the framework.

1 – Interviewee's profile
- Name
- Experience in IT Projects
- Project's goal
- Team localization, distributed or hybrid
- Start date and End date.
- Project type, traditional, agile or hybrid
- Roles played in the project

2 – Exploring the framework
2.1) Introduce each knowledge sharing activity.

2.2) Ask how that activity happens in the interviewee's projects and how he/she participates in it. Explore the project phases and events where the activity happens, the knowledge shared and the way tools are used, especially integrated ones.

2.3) Explore the answer, seeking to obtain information about activities he/she mentions which are provided in the framework, as well as those mentioned and not foreseen in the framework.

2.4) Explore the answer, seeking to obtain information about tools he/she mentions which are provided in the framework, as well as those mentioned and not foreseen in the framework.

2.5) Explore the answer, seeking to obtain information about possible affordances he/she mentions which are provided in the framework, as well as those mentioned and not foreseen in the framework.

2.6) When exploring the answer, consider the two-way of knowledge sharing, the contribution and receipt of knowledge.

2.7) Ask about other activities, tools techniques and controls, that he/she carries out and considers that knowledge is shared. Ask for more details about it, regarding what tools are used and how they are used.

3 - General questions about tools integration

3.1) To what extent it is easy to you the use of tools to search for or storage data?

3.2) Are there situations when it is difficult to switch from one tool to another?

3.3) Are there tools which are difficult to use in order to accomplish your goals? Why?

3.4) What do you think about the significance of using integrated tools for your projects, and specifically for knowledge sharing?

7 TECHNOLOGICAL PRODUCT

As a part of the technological production of the Graduate Program in Project Management of Universidade Nove de Julho (UNINOVE), the results of this thesis will be considered in the evaluation of the program and must be developed according to the guidelines recommended by the Coordination for the Improvement of Higher-Level Personnel (CAPES), the federal government agency responsible for evaluating the *Stricto Sensu* Graduate Programs in Brazil.

In this regard, any technological production expected by CAPES must be a "tangible object with a high degree of novelty resulting from the application of new scientific knowledge, techniques, and expertise developed within the scope of research at the graduate program, used directly in solving problems of companies producing goods or in providing services to the population aiming at social welfare" (CAPES, 2019, p. 22).

In light of the definition of a framework as "a network of interconnected concepts that together provide a comprehensive understanding of a phenomenon or phenomena" (Jabareen, 2009, p. 51), and the use of a framework as a "real or conceptual guideline to serve as support or guide" (Vaishnavi et al., 2019, p. 16), the technological product proposed as a result of this thesis is an artifact, a framework for the integration of interactions mediated by social media technologies to support knowledge sharing in IT projects, denominated Integrated Social Media for Knowledge Sharing (INT-SM4KS).

The development approach takes people, processes, and technology into account to handle human interactions in KS processes mediated by integrated social media features. The framework was designed, developed, and evaluated throughout the research, using a five-step process model proposed by Vaishnavi et al. (2019). It is expected that the analysis and use of the supplied knowledge would aid project managers in overcoming the aforementioned problems concerning the use of integrated social media in IT projects.

The framework comprises three components, which conception was based on the notions of affordance perception, affordance actualization, and affordance effect (Bernhard et al., 2013; Volkoff & Strong, 2017). The first one involves the perception process in which goal-oriented users perceive the social media affordances and the opportunities to perform actions. The second one comprises affordance actualization, where the user converts possibility into action by exploiting the perceived potential to support his goals. Finally, in the

third component, the affordances actualization will result in immediate concrete outcomes for achieving the knowledge sharing goals.

The representation of the resulting artifact must be able to allow implementation and application in a real project environment (Hevner et al., 2004). So as to provide a more comprehensive understanding of the artifact developed, two views of the framework are presented: the Components view and the Integration view. The two perspectives are complementary, and this is how the framework describes the environment approached in this work. In the components view, one can observe the representation of the sequence of steps in which knowledge sharing occurs in the IT project through human interactions enhanced by the affordances of social media tools. The Integration view keeps the same components and their respective elements, but they are presented differently, highlighting the integration of social media technologies in the second component.

7.1 ANALYSIS OF THE ARTIFACT ACCORDING TO CAPES CRITERIA

In accordance with the CAPES' guidelines, a framework can be categorized as an "Unpatentable Process/Technology or Product/Material", which consists of "products and/or technological processes that, due to legal impediments, do not have a formal protection mechanism in Brazilian territory, including any intellectual property assets" (CAPES, 2019, p. 72). Therefore, the artifact to be produced, i.e., the framework, must comply with the set of criteria used by CAPES to assess it when evaluating the graduate program: adherence, impact, applicability, innovation, and complexity. The evaluation of the framework's compliance with each criterion is thus shown below.

The adherence of the framework is high, since it was developed as an activity of the graduate program, originated in the program research lines, and connected to an axis project within one of the lines, i.e., "Information Technology and Innovative Projects." As a consequence, we can assert that the thesis adheres completely to the graduate program (PPGP) and the research line of the advisor professor.

The impact is potentially relevant. The efficient application of the framework in IT projects can assist project managers by improving the benefits of knowledge sharing among project participants as well as between different projects. These benefits can increase managerial effectiveness and have a favorable impact on the success of IT projects carried out within an organization.

The demand was spontaneous, and the general objective of the work was already defined at the beginning of its execution, although the specification of its characteristics was

not, because it is an activity inherent to the project's work. The impacted area is potentially large, encompassing all the activities of IT project management; a more precise estimate of this extent depends on the use that will be made of the framework.

The applicability is potentially high, since the framework will be available to be used by the large community of professionals involved in IT projects. Besides, as KS processes and IT project execution are pervasive throughout organizations, there is good potential for growth in the use of the framework by project professionals from different business sectors.

According to CAPES' directions, the classification for the innovation criterion is based only on the generation of knowledge, not on the features of the technological product such as usability, complexity, or impact (CAPES, 2019). In this respect, the framework can be considered an innovative medium-content production because the combination of technical knowledge to be employed has already been established. Knowledge was created as a result of the framework's development; it was related to the application, integration, and/or technological evolution of existing knowledge.

In terms of the framework's complexity, it can be considered a medium-complex production resulting from the combination of pre-existing and stable knowledge regarding the various actors involved in its development. This criterion must be understood as "a feature associated with the diversity of actors, relationships, and knowledge required for product elaboration and development" (CAPES, 2019, p. 24).

7.2 THE USE OF THE INT-SM4KS FRAMEWORK

A gap between managerial research and managerial practices has been identified in academic discussion on the impact of management research on the private and public sectors, with business research in many fields becoming increasingly disconnected from the real-world practices (Faff et al., 2021). This gap has been viewed as a knowledge transfer and/or a knowledge production issue that could be addressed by more effectively converting research into publications, frameworks, and tools that managers can use in their work, as well as by more collaborative research initiatives between management scholars and practicing managers (Shapiro et al., 2007).

In this regard, this research is anchored in practitioners' information and suggestions, addressing users' wants and needs to produce knowledge that is solution-oriented in order to propose a practical artifact (Shapiro et al., 2007; Van Aken, 2005). The main objective of the work is the proposition of a framework for the integrated use of social media tools to support knowledge sharing in IT projects, to assist IT project managers in solving issues highlighted

by studies on SM adoption and use, such as selecting or replacing tools and technologies in a context of rapid technological obsolescence; developing or improving knowledge sharing processes; planning and developing training; and developing guidelines for tool use.

Thus, this section provides guidance on the application of the artifact in organizations, contemplating potential uses of the technological product in the workplace. Its goal is to help project managers with developing their personal technology strategy and optimizing technology use for knowledge sharing, by providing guidelines or planning training events, for example. In addition, an illustrative example is presented, in accordance with the recommendations made by the focus group participants, who took part in the framework evaluation and asked for detailed information about how to use the artifact.

Initially, we stress that the project manager must ensure that senior management agrees with the knowledge-sharing initiatives planned for the project. Organizations need to plan their investments and decide on different demands that consume resources and sharing knowledge may not always be a top priority. This is frequently true for projects developed by organizations that contract out the project work, where the contractor decides not to invest in KS in order to reduce costs. In this respect, Faff et al. (2021) include the identification and persuasion of the key stakeholders in the issue to be addressed as one of the three central dimensions in their engagement framework.

The project manager's next move is to explore the subject, becoming familiar with the tools, activities, affordances, and other framework components. This comes after securing the agreement of the key stakeholders for the investment. In this regard, Silva and Chaves (2021) identified that a lack of knowledge of social media tools is a barrier to their use in IT projects to share knowledge, corroborating Ghobadi and Mathiassen (2016) and Riege (2005), who assert that a lack of familiarity or experience with collaboration technologies may have a negative impact on effective knowledge sharing.

The knowledge of the framework elements will enable the manager to define how knowledge sharing will take place in his project, applying it to the situation of the problem he wants to address. Then he will be able to decide which objectives he wants to achieve and the means by which he would do it. At this point, he must also consult the mapping presented in Figure 7.1 to select which affordances match the knowledge sharing activities he wants to develop as well as the tools that will be used .

Figure 7-1 Mapping between affordances and SM tools

	Affordance	Wiki	Shrd Wksp	A/V Conf	Notf	Inst Msng	Canv	Pj/Pd Mgmt	Proj Rep
Association	A10 - Find information I already knew or was aware of. In or out of the project.	X	X				X	X	X
	A15 - Find people I already know or am aware of. In and or of my project.					X			
	A20 - Find new information I did not know or wasn't aware of. In or out of the project.	X	X				X	X	X
	A25 - Form relationships with other users, e.g., friending, following, etc.					X			
	A30 - Join individual conversations, groups or online communities.			X		X			
	A35 - Consult and react online to others' presence, profiles, content and activities, e.g., adding a tag, commenting, responding a question, "like", etc.	X		X	X	X	X	X	X
	A40 - Obtain and use others' files, documents, photos, or other information.	X	X	X		X	X	X	X
	A45 - Share files, documents, photos, videos, links, and other information with others.	X	X	X		X	X	X	X
	A50 - Direct public messages to and receive public messages from a specific individual or group.					X	X	X	X
	A55 - Enrich the text through the use of graphical icons, photographs, etc.	X	X			X	X	X	X
	A60 – Control file sharing enabling.		X	X		X	X	X	X
	A65 – Control chat enabling to internal and/or external users.					X	X	X	X
	A70 – Share screen in video events			X			X		
	A75 – Control internal/external participation permission in audio/video events			X					
	A80 - Create audio/video conference rooms			X					
	A85 - Communicate between audio/video conference rooms			X					
Editability	E10 - Edit others' information after they have posted it.	X	X				X		X
	E15 - Edit my information after I have posted it.	X	X			X	X	X	X
	E20 - Collaboratively create or edit content, e.g., documents and posts.	X	X				X		X
	E25 - Select or subscribe to specific groups and content.					X	X	X	
	E30 - Duplicate content.	X	X			X	X	X	X

	E35 - Create groups and control who can participate.			X		X	X	X	X
	E40 - Control access to group stored conversation					X	X	X	X
	E45 - Remove groups and their content					X			
	E50 – Control content update permission	X	X				X	X	X
	E55 - Manage content storage and consultation	X	X				X	X	X
	E60 - Control suitability of included or changed content	X	X						
Notified Attention	N10 - Receive notifications about others' information or updates								
	N15 - Receive notifications about information or updates referring to a specific content of interest.		X						
	N20 - Indicate presence/absence/do not disturb and other status			X		X	X		
	N25 - Check if other users are accessible.			X		X		X	
	N30 – Send notification about audio/video conferences and other events			X	X				
	N35 - Create automatic notification about audio/video conferences and other events			X	X				
	N40 – Send notification about content to another user	X	X	X	X		X	X	X
	N45 - Notify request for permission to speak in a video conference			X					
Pervasiveness	P10 - Get quick responses to my requests from others.					X			
	P15 - Communicate with others from any place, while moving, commuting, or traveling.	X	X	X	X	X	X	X	X
	P20 - Communicate with others at any time.	X	X	X	X	X	X	X	X
	P25 - Communicate with infrequent or less important work relationships.		X	X	X	X	X	X	X
Reviewability	R10 - Find information about previous projects	X	X			X	X	X	X
	R15 - Users are able to view and reuse knowledge after posted, at anytime they need	X	X			X	X	X	X
	R20 - Conversations may be searched, browsed, replayed, annotated, visualized, and restructured					X	X	X	X
	R25 - Search for information or people by entering search words.		X			X	X	X	X
	R30 - Learn about who knows what in the organization, identifying experts in relevant fields	X	X	X		X	X	X	X

R35 - Search for information or people by following links between contents.	X	X		X				
R40 - Search for tags or keywords that someone else has added to content.	X	X			X	X	X	
R45 - See other people's answers to other people's questions.				X	X	X	X	
R50 - Include information, photos, and other content on midia that present my personal identity	X			X	X	X	X	
R55 - Adjust my midia profile to my preferences and abilities				X	X	X	X	
R60 - Participants can use the interaction between team members, which is automatically preserved				X	X	X	X	
R65 - Include files, documents, photos, videos, audios and other project content.	X	X		X	X	X	X	
R70 - Search for files, documents, photos, videos, audios and other project content.	X	X		X	X	X	X	
R75 – Record and preserve audio/video content.			X	X				
R80 – Transcribe and preserve audio/video content.			X					
R85 - List the audio/video event participants			X					

Note: Created by the author.

It is recommended that the project team participate in this step in order to discuss the best tool features and select a set of tools that best fits project needs because the mismatch between individual needs, tools, and work routines also restricts KS practices (Foote & Halawi, 2018; Riege, 2005; Santos et al., 2012; Zahedi et al., 2016). After these definitions have been consolidated, market tools should be prospected to determine which ones best match the proposed solution, if necessary. In this context, if we define integration as the use of more than one SM technology in the same platform, Microsoft Teams, Azure DevOps, Jira, Trello, Redmine, and Google Workspace were the most often mentioned products by the practitioners who participated in this research.

Figure 7.2 provides a brief illustration of how the framework was used for the requirements gathering activity. By using a map like this one, one can, for instance, define usage guidelines, create training materials and manuals, specify tool characteristics for addition or replacement, or outline a knowledge sharing process.

Figure 7-2 - Selecting affordances x social media for Gathering Requirements

Affordances		Storing and consulting documents	Chats and videoconferences	Sector goups discussions	Requirements gathering meetings	Functionality design
		Shrd Wksp	Notf	Inst Msng	A/V Conf	Canv
Ass	A15 - Find people I already know or am aware of. In and or of my project.		X	X		
	A30 - Join individual conversations, groups or online communities.			X		
	A50 - Direct to and receive public messages from a specific individual/group.			X		
	A75 – Control internal/external participation permission in audio/video events				X	
Edtb	E10 - Edit others' information after they have posted it.	X				X
	E20 - Collaboratively create or edit content, e.g., documents and posts.	X				X
	E35 - Create groups and control who can participate.			X		
	E50 – Control content update permission	X				X
Prv	P10 - Get quick responses to my requests from others.					
	P15 - Communicate with others from any place, while moving or traveling.			X	X	
	P20 - Communicate with infrequent or less important work relationships.			X	X	
Notf	N15 - Receive notifications about information or updates of a specific content.	X	X			
	N20 - Indicate presence/absence/do not disturb and other status		X	X	X	
	N35 - Create automatic notification about audio/video conferences and other events		X		X	
	N45 - Notify request for permission to speak in a video conference		X		X	
Revw	R10 - Find information about previous projects	X		X		X
	R15 - Users are able to view and reuse posted knowledge at anytime	X		X		X
	R25 - Search for information or people by entering search words.	X		X		X
	R75 – Record and preserve audio/video content.			X	X	

Note: Created by the author.

This example shows a spreadsheet with tasks related to gathering requirements for a hypothetical project. Those responsible for the project used the framework to plot the affordances that will be employed (positioned on the left side) against the technologies they plan to integrate and the goals of their application (shown on the right side) . The cells in an affordance line marked with an X denote the tools that will be used to actualize it.

In our hypothetical project, the requirements would be gathered via videoconferences, at which time the functionality would be defined collaboratively in the canvas tool, the documentation would be produced in a similar manner, and everything would be stored in the shared repository. Instant messenger will always be accessible for individual chats and group discussions, as well as relevant notifications can be sent and received.

8 FINAL REMARKS

In this section, each study is revisited to describe how its results contributed to the achievement of these specific objectives and, ultimately, to answer the research question. Additionally, the main limitatons of the three studies and of the thesis as a whole are highlighted, as wel as the future research is suggested. To illustrate this, Figure 8.1 presents na adaptation of the Contributive Mooring Matrix suggested by Costa et al. (2019). Based on the findings from each study, it is expected that this item will produce an integrative analysis that explains how the studies collectively address the primary research question, and provide the thesis with originality (Costa et al., 2019).

Figure 8-1 Contributive Mooring Matrix

THESIS RESEARCH QUESTION	
"How to support knowledge sharing processes in information technology projects using integrated social media tools?"	
GENERAL OBJECTIVE	
Propose and evaluate an artifact, a framework for the integrated use of social media tools to support knowledge sharing in IT projects, making use of the affordance perspective.	
SPECIFIC OBJECTIVES	
1) Identify existing problems in IT project domain to whose solution the use of social media to share knowledge can contribute. 2) Propose a framework grounded on the integrated use of social media tools using the affordance perspective. 3) Evaluate the definitive version of the framework proposed. 4) Convey to scholars and practitioners the findings of the work completed.	
Study 1 - Using Social Media to Promote Knowledge Sharing in Information Technology Projects: A Systematic Literature Review	
Findings overview	Identify most used tools; tasks and processes supported; stakeholders involved; and tools contribution to KS practices. Identify research gaps.
Contribution to thesis' objectives	Identify emerging literature gaps related to knowledge sharing in virtual and hybrid project teams as well as on the use of integrated SM tools
Contribution to knowledge	Add to the literature on the subject, bringing new insights on adopting or improving the use of social media to share knowledge in IT projects.
Limitations	Number of peer-reviewed papers analyzed, 43, limiting the extent of knowledge retrieved to search for research gaps.
Future research	Studies related to the subject on the public sector; on the use in project management practices and methodologies; and on the use of new technologies.
Study 2 - Knowledge Sharing in Information Technology Projects: a Senior Practitioners' Perception on the Use of Collaborative Tools	
Findings overview	Adds to the literature by uncovering organizational, individual and technological barriers to knowledge sharing in the specific context of IT projects.
Contribution to thesis' objectives	Identify the increasing importance of integrated tools to support KS processes, providing pactitioners with simplicity of use and accessibility.
Contribution to	Better understanding of SM collaborative tool use to support knowledge

knowledge	sharing in IT projects workplace.
Limitations	Low number of interviews conducted, 15, thus reducing the chances of uncovering other problems.
Future research	Continue investigations on the subject to construct solution-oriented knowledge and to develop practical artifacts to aid solving existing problems.
Study 3 - The Integration of Social Media Collaborative Tools To Support Knowledge Sharing in IT Projects: An Affordance-Based Perspective	
Findings overview	Proposition of a framework to assist IT project managers, contributing to the solution of KS problems identified in the literature and in practice.
Contribution to thesis' objectives	Development and evaluation of the framework.
Contribution to knowledge	The development process adds to the knowledge base of design and an empirical validation of the framework added to the literature.
Limitations	Research time limitations hindered the conduction of further focus groups, and the work on the framework's improvements identified in the evaluation.
Future research	Investigate the efficiency of the framework when used in a real-world project environment.
INTEGRATIVE CONCLUSION	
By means of following the sequence of steps of the process model adopted, the set of studies produced in this thesis met all the specific objectives proposed. Studies 1 and 2 met the first objective; study 3 met the second and the third objectives; the publication of the studies the possible use of the framework in organizations met the fourth objective. As a result of achieving the four specific objectives, the primary objective and the research question were both addressed.	

Source: Adapted from Costa et al. (2019)

8.1 CONTRIBUTIONS AND IMPLICATIONS

The first study contributed to the first specific objective of the thesis, i.e., "identify existing problems in the IT project domain to whose solution the use of social media to share knowledge can contribute," by investigating the academic literature and uncovering emerging literature gaps related to knowledge sharing in virtual and hybrid project teams as well as on the use of integrated SM tools. The study presented a systematic literature review that was completed to identify research gaps on the research subject and propose a future research agenda by means of gathering and synthesising academic knowledge produced on the research subject between 2010 and 2019.

Moreover, the overview of the subject addressed the most used tools; tasks and processes supported; stakeholders involved; and tools' contribution to knowledge sharing practices; additional literature gaps and research opportunities referred to the lack of studies on the public sector; on the use of social media for knowledge sharing in project management practices and methodologies; and on the use of new technologies such as mobile, artificial intelligence, cloud computing, and Internet of Things.

The second study also contributed to the achievement of the first specific objective. Based on the research agenda outlined in the previous study, interviews were conducted with fifteen senior IT project managers from various business sectors in order to get a more in-

depth and empirically grounded understanding of the difficulties in project workplaces. In this regard, a number of problems were uncovered, as well as the fact that most interviewees mentioned the usage of social media integrated tools, particularly in distributed teams, and emphasized the importance of usability and accessibility.

Social media tool usage reported by the interviewees concentrated on just a few tools: wikis, instant messengers, videoconferencing, shared repositories, and issue trackers. In addition, it was also reported that the intense use of traditional tools such as emails and file system directories for storing and sharing knowledge. The study contributed to the literature on knowledge management by providing a better understanding of collaborative tool use to support knowledge sharing and by uncovering organizational, individual, and technological knowledge sharing barriers in the specific context of IT projects. Four subclasses were identified and described in the class of "problems of KS in IT projects": i) familiarity and suitability of KS tools; ii) acquisition, infrastructure, and maintenance of KS tools; iii) limitations on the use of KS tools; and iv) knowledge management.

The findings of the first two studies motivated the choice of the research problem to be addressed: the need for guidance on the integration of social media technologies to support IT project managers in sharing knowledge. In this regard, it was decided to develop and evaluate a framework that could contribute to the problem solution. This was done and described in the third study, to accomplish the second and third specific objectives.

Based on a comprehensive literature review and eighteen interviews conducted with participants of agile projects, the second specific objective was achieved, i.e., "Propose a framework grounded on the integrated use of social media tools using the affordance perspective." Additionally, the completeness, the complexity, the ease of use, and the impact of the framework were evaluated by four senior project managers in a focus group meeting, when the third specific objective, "evaluate the definitive version of the framework developed," was completed.

The application of DSR enables the experience of joining theoretical foundation to develop an artifact with its application in a real-world environment (Narazaki et al., 2020). Considering such a perspective, this thesis will provide a deeper understanding of the addressed subject, bringing benefits to the communities of researchers and practitioners in project management and knowledge management in three aspects: i) the process of developing the artifact, using the DSR method and the theoretical lens of affordances, will contribute to improving the knowledge base of design; ii) a framework on the integrated use

of SM in the dynamics of KS in IT projects will be available for practitioners; and iii) an empirical validation of this framework will be added to the literature.

From the innovative point of view, the framework developed has original features if we consider that it is an artifact specifically created for IT project participants and validated by their peers. In the process model applied, not only is the technical point of view considered, but users' objectives and needs are also considered, as well as the organizational context, influencing the extent of use of the resources offered (Sun et al., 2019). Therefore, one can count on the potential of using the framework to facilitate KS activities in an environment that is in itself stimulating and conductive, potentially enabling the generation of new knowledge and skills through collaboration and sharing of knowledge in IT projects.

Additionally, the version of the framework to be made available for immediate use can add to project managers' work the benefits of knowledge shared and potentially contribute positively to the good results of IT projects, as indicated by authors like Sarka and Ipsen (2017), who claim that the use of SM can help IT project members, such as software developers, to share knowledge about their needs to achieve project goals.

When it comes to the economic aspect, making a free SM artifact available should contribute to reducing costs in the organizations where it is adopted. Knowledge sharing resulting from the use of the artifact between project teams, stakeholders, and customers, for example, can possibly generate benefits with a potential cost reduction effect with time, such as preventing mistake repetition, avoiding knowledge recreation, reducing expertise loss, leveraging existing knowledge, and supporting decision-making (Chaves et al., 2018; Kinder, 2020). Besides, the adoption of INT-SM4KS adds no cost to the organization.

The fourth and last specific objective, "Convey to scholars and practitioners the findings of the work completed.", corresponded to the last phase of the work process followed. It was achieved with the submission of the studies in this research to conferences and journals. Moreover, this research will promote the dissemination of academic knowledge in organizations, assisting managers and other professionals who wish to introduce or manage the use of integrated SM in their workplace, especially if they are unsure of how it can be done. Furthermore, it is expected that employees of the firms using the framework will have a better awareness of the advantages offered by SM to support the dynamics of KS in IT projects. In this light, we argue that all the objectives of this thesis have been met.

8.2 LIMITATIONS

In the first study, the limitation is related to the selection of only papers published in journals. On the one hand, this increased the rigor of the results; on the other hand, it failed to select a substantial number of conference papers. Another limitation was that the search for articles for the SLR was carried out a few months before the effects of the pandemic of COVID-19 became evident, thus not being able to reach publications related to the issue. These facts limited the extent of knowledge retrieved in the area being researched to find gaps and establish an agenda for the future.

In the second study, the main limitation was the relatively small number of interviews conducted. Although the fifteen interviewees had great experience in IT projects and IT project management, having a larger group of them from different business areas would possibly allow for more observation diversity and practices of sharing knowledge via SM in their organizations. This would increase the chances of uncovering other problems and other classes of problems.

Still, in the second study, the pandemic was also a limiting factor. Because some of the interviews were conducted before the pandemic began and others in its early months, the first group of interviews did not capture the pandemic's effects, while the second group only captured the initial effects. As a consequence, the pandemic's unfolding was missed, a period of significant changes in IT project practices, particularly in KS, prompted by the needs related to the large increase in the number of virtual teams.

In the third study, the limitation is associated with conducting only online interviews and particularly online focus groups, for the framework's development and evaluation. Moreover, due to the research time limitations, it was not possible to conduct further focus groups or work on the necessary improvements identified in the evaluation, mainly in the area of ease of use. It would be beneficial to the research results if additional examples of use were developed.

In terms of the limitations of the research as a whole, we highlight the lack of further focus groups with participants who worked for the organization where the project is being implemented. In the first focus group, it was noticed that the use and acceptance of the framework by these practitioners should be stronger than among personnel in consultancies that execute projects for clients. Also in this regard, holding more focus groups would allow for changes in the framework's presentation and in the way the meeting is conducted, in order to address some issues or difficulties identified in the application of the first one. Furthermore, the framework was not instantiated in a real-world project or in a laboratory

setting where people would simulate or perform real KS tasks. Constraints of time and location did not allow people to gather in the same place.

8.3 FUTURE RESEARCH

In terms of future research that can be developed from this work, in line with the socio-technical nature of the research, the framework can be supplemented to include factors such as practices related to KS activities, individual, organizational, and technological enablers, and barriers to using SM to support KS. Also, to make the artifact easier to use, an electronic structure can be created, such as a database containing framework elements like practices, affordances, tools, and issues, as well as their relationships, accessible through a user-friendly interface running on websites and mobile apps.

In accordance with the recommendation for future research made in the first study, work focused on incorporating into the framework affordances materialized by new technologies such as IOT, artificial intelligence, and cloud would be a timely endeavor. In order to complete and expand the framework's reach with additional components, it is still beneficial to increase discussion on potential variations in the sharing of knowledge between agile and traditional projects.

Additionally, future research can investigate the efficiency of the framework when used in a real-world project environment, evaluating its application in various sorts of projects and other business areas, including the public sector. Moreover, promoting research into the use of the framework with different teams, such as company employees, outsourced and mixed teams, and validating the simplicity of use by using the framework in organizations that already have a defined KS process will help.

8.4 CONCLUSION

This thesis research was completed by carrying out three studies and proposing a technological product. Its main objective was the development of an artifact — a framework for the integrated use of social media to support knowledge sharing in IT projects. Each study that was conducted made significant contributions to the development of the major theme addressed. Despite being independent studies, the three are interconnected and interdependent in such a way that the outcomes of each one contribute to the completion of the next.

Four specific objectives were defined in order to respond to the main objective of the thesis. The first two studies contribute to achieving the first specific objective of identifying the research problem. Study 1 establishes the basis for work development, compiling knowledge of recent academic literature on the subject being studied. Study 2 complements

the previous one, approaching the subject from a practical perspective, seeking to identify difficulties related to the theme in IT project workplaces.

The second and the third specific objectives were achieved in Study 3, by complementing the knowledge acquired in the previous ones to develop and evaluate the intended artifact. The theory, practice, existing gaps, and IT project managers' needs are analyzed to design the framework, specify its components, and carry out the development and evaluation.

As to the fourth specific objective, conveying the knowledge produced, the submission and publication of the three studies in conferences and journals, as well as the possible use of the framework in IT projects' workplace, will promote the dissemination of academic knowledge to scholars and practitioners.

By means of following the sequence of steps of the process model adopted, the set of studies produced in this thesis met all the specific objectives proposed. As a result of achieving the four specific objectives, the primary objective and the research question were both addressed.

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