BAR Brazilian Administration Review

ANPAD

Research Article

Integrated Social Media for Knowledge Sharing (INT-SM4KS): A Framework Based on the Affordance Theory

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How to cite: Silva, R. A. C., Chaves, M. S., & Pedron C. D. (2024). Integrated Social Media for Knowledge Sharing (INT-SM4KS): A framework based on the affordance theory. *BAR-Brazilian Administration Review, 21*(3), e220172.

DOI: https://doi.org/10.1590/1807-7692bar2024220172

Keywords:
social media; affordances; knowledge sharing; project management; IT projects

JEL Code:
M10

ABSTRACT

Objective: this study investigates the use of integrated social media (SM) technologies to support knowledge-sharing (KS) processes in information technology (IT) projects. Its main objective is to develop a framework to assist project managers in solving problems such as selecting or replacing social media tools, developing KS processes, and creating guidelines. **Methods:** the affordance theory was the theoretical lens adopted to explore the relationship between using technology (SM) and organizational change processes (KS). The design science research (DSR) was adopted as a prescriptive method. The work adds to the body of knowledge and provides a support tool designed and validated specifically for practitioners and researchers. A literature review served as the basis for creating the framework, and 18 interviews with IT project members helped assess and refine it. **Results:** the resulting framework consists of three components based on affordance perception, materialization, and effect. It is presented from both component and integrative complementary views and has the potential to contribute to solving problems identified in the literature and in practice. **Conclusions:** the successful application of the framework in IT projects can promote the benefits of KS, potentially increasing management effectiveness and positively influencing outcomes.

Received:
December 02, 2022.
This paper was with the authors for two revisions.

Accepted:
August 09, 2024.

Publication date:
August 27, 2024.

Funding:
This work has been partially supported by the CNPq project SMARTER: Knowledge Sharing and Social Media Affordances in Intra-organizational Information Technology Projects (Process number: 421729/2018-0). The authors thank the CNPq under grant #310709/2022-9 (Productivity Scholarship of Cristiane Pedron), CAPES, Brazil, and FCT, I.P., the Portuguese national funding agency for science, research and technology, under Project UIDB/04521/2020.

Conflict of Interests:
The authors have stated that there is no conflict of interest.

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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, the internet of things (IoT), artificial intelligence (AI), and others are influencing the reshaping of businesses (Marnewick & Marnewick, 2019; Zin et al., 2018). Such circumstances have brought about a special interest in improving IT projects, making their management a key concern (Koriat & Gelbard, 2019).

In this organizational scenario, such intangible resources as knowledge contribute to the organization's competitive advantage and directly affect its achievements (Koriat & Gelbard, 2019). Knowledge sharing (KS) is the most important knowledge management process (KM), because most 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). Human interactions like these to share knowledge can reduce costs and increase productivity by yielding such benefits as preventing mistakes from being repeated, avoiding knowledge re-creation, reducing the loss of expertise, leveraging existing knowledge, and supporting decision-making (Chaves et al., 2018; Kinder, 2020).

Information technology is a major enabler of KS activities and processes (Panahi et al., 2012). The technology chosen and the way it is used are important to improving KS (Stray et al., 2019). Therefore, the competence to leverage such support becomes a key point (Daemi et al., 2020; Sarka & Ipsen, 2017). In this respect, SM applications like wikis, social networks, instant messengers, 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 tool difficulties concerning KS in IT projects, such as selecting or replacing SM tools and technologies (Babenko et al., 2019); creating guidelines for tool use (Eriksson & Chatzipanagiotou, 2021); planning and developing training (Stray et al., 2019); or designing 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 solving various 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 by introducing a class of collaborative tools called '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 indicates that they can support KS procedures effectively in project management (Eriksson & Chatzipanagiotou, 2021). However, despite integrating platforms within project teams, it remains hard to know how to best interact with other team members to share knowledge and benefit everyone (Eriksson & Chatzipanagiotou, 2021). Consequently, 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 fill this theoretical and practical gap, we adopt a theoretical approach using the affordance lens to explore the relationship between the use of technology (SM) and organizational change processes (KS). The affordance perspective allows for being specific about technology while incorporating social and contextual elements, including the interactions between organizational actors and technical capabilities (Stray et al., 2019; Thompson, 2018; Volkoff & Strong, 2017). We address the following research question: "How can integrated social media tools support knowledge-sharing processes in information technology projects?"

We approach this subject by applying a prescriptive method to create a framework, an artifact that provides the basic structure of something and aids in problem solving or decision-making (Cambridge, n.d; Merriam-Webster, n.d.). The framework created helps IT project managers solve some of the existing KS difficulties stated above. The framework approach considers people, processes, and technology when addressing human interactions in KS processes that are mediated by integrated SM features.

THEORETICAL BACKGROUND

Social media, knowledge sharing, and project management

Social media are "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" (Carr & Hayes, 2015, p. 8). 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 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 organizational phenomena and processes such as communication, collaboration, and knowledge management (Leonardi & Vaast, 2017; Sarka & Ipsen, 2017; Sun et al., 2019).

Within organizations, knowledge is a body 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 improvement (Navimipour & Charband, 2016). Among KM processes, sharing has been recognized as the most important, upon which most initiatives depend (Anwar et al., 2019). At this point, we 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). In this context, KS 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 viewpoint, effective KS creates relationships between members, improving performance and allowing 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: (a) user-generated content; (b) peer-to-peer communication; (c) networking; (d) multimedia-oriented; and (e) 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, a lack of intention to share knowledge, a 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). As a 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 open communication among individuals and work teams (Koriat & Gelbard, 2019), and technology plays an important role in supporting these processes throughout the 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 (Daemi et al., 2020; Sarka & Ipsen, 2017). SM thus emerges as a valuable instrument to support project management by 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).

Information technology projects and virtual teams

"Organizations undertake IT projects to transform and grow" (Daemi et al., 2020, p. 6) at least since the mid-1960s to achieve strategic objectives and create competitive advantage (Foote & Halawi, 2018), so much so that the improvement in 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 and technologies, comprising new products, services, or processes such as software development,

information systems, and the deployment of IT infrastructure (Babenko et al., 2019). In this context, according to Babenko et al. (2019), 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 or technologies in conditions of uncertainty regarding development technologies, customer requirements, and customer needs" (p. 630).

Despite the new concepts, methodologies, and software tools, IT projects have been notorious for failures, due to factors such as a continuously 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). In addition, management complexity and difficulty are increased because IT projects may last for years, involving personnel from several countries with various languages and cultures (Foote & Halawi, 2018). In parallel, products and service delivery are incorporating IT components, 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, the internet of things, and artificial intelligence (Rai, 2016). Each industry, organization, and project faces different challenges (Project Management Institute [PMI], 2021). As a result, the value added to the business by IT projects is gaining more dimensions, the complexity is increasing, and failures are becoming multi-dimensional ones (Rai, 2016).

Considering this scenario, 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 toward 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 by 'tailoring' the 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 approaches that mix traditional procedures with agile concepts (McGrath & Kostalova, 2020).

In addition to changes in management approaches, flexible and distributed teamwork has been increasingly demanded as organizations have become more project-oriented and project complexity has increased (Lansmann et al., 2019). As a result, IT project teams have grown increasingly virtual and decentralized, and project management has become more virtualized with collaborative information and communications technologies (ICT) 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., 2009).

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

Despite the challenges created, COVID-19 has proven to be a catalyst for the use of various technology solutions to assist remote working (Kolluru et al., 2021). 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 predicting an increase in global-scale projects and in the number of online project teams (Ozguler, 2020).

Knowledge sharing and integrated social media tools in information technology projects

In this context, thanks to advances in information technology, projects can be effectively managed from anywhere without the 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 on

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 use of SM platforms provides better opportunities for rapid knowledge flow between 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 that they are internet-based, allowing knowledge to be created, shared, and used both in co-located and distributed project environments. Moreover, studies regarding different success criteria indicate the positive impact of SM use for KS on IT project success as perceived in virtual and co-located project teams, both in the private and public sectors.

In this regard, Sarka and Ipsen (2017) affirmed that using SM to share knowledge can effectively help software developers achieve project objectives; Nabelsi et al. (2017) reported project performance benefits from wiki usage in knowledge sharing 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 to develop higher quality software; Chowdhury and Lamacchia (2019) presented a collaborative framework where social media tools make it easier for employees to share knowledge, contributing to successful digital transformation projects.

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).

As a result, academic research has investigated the use 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 individual, independent 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 the unique set being used, meeting individual desires for ease of use and accessibility, rather than becoming 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.'

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 to add 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 active monthly users in July 2021 (tecmundo.com.br/software/221981-alta-microsoft-teams-chega-250-milhoes-usuarios.htm).

The use 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 sharing (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 suggests that integrated SM platforms can support KS procedures effectively in project management, facil-

itating 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).

Affordances as the theoretical lens of this study

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 independently of the users, but the affordances do not, for they have unique meanings related to how 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 practice with perception, presenting the idea that people do not perceive an object as a set of inherent physical features, that is, its materiality, but in terms of how that object can be used to meet specific goals (Volkoff & Strong, 2017). Later, 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).

In this context, 'affordance' refers to the potential for action that technologies provide to users (Leonardi, 2011). In its turn, 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). Describing technological artifacts as a set of affordances allows 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). Therefore, the concept of affordances could possibly be employed to explore the relationship between technology and organizational change, improving the design of technological artifacts and user engagement with the activities it mediates (Treem & Leonardi, 2013).

Researchers have increasingly adopted the affordance perspective to study the use and influence of IT artifacts in organizational contexts. As to the specific areas where it has become 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 (Stray et al., 2019). Rather than examining the technology, the affordance theory allows us to look also at the behaviors offered by SM-integrated collaborative tools with a finer-grain lens (Waizenegger et al., 2020).

The affordance concept provides a powerful lens for understanding the relationship between social media and KS from a socio-technical perspective that allows for being 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 socio-technical 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 in how SM affords 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 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 employee creativity from the perspective of knowledge acquisition and provision.

Regarding the different classifications identified in the literature, Treem and Leonardi (2013) proposed four SM affordances that could influence organizational processes like socialization, knowledge sharing, and power relations. Other authors proposed different classifications, such as Majchrzak et al. (2013), Oostervink et al. (2016), Pee (2018), and Sun et al. (2019). Furthermore, Sun et al. (2019) carried out a systematic literature review in which they identified relevant studies on organizational SM affordances and their influence on KS, consolidating different classifications, as presented in Table 1.

Table 1. Affordance summarized categorization.

Affordance	Description	Related affordance	Original research
Reviewability (Faraj et al., 2011)	Involves how 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 be 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)	This means the possibility of modifying content both before and after it is made available. Other people can make contributions. Users can join or manage, as well as control and duplicate content.	Editability	Treem and Leonardi (2013)
		Recombinability	Faraj et al. (2011)
		Experimentation	Faraj et al. (2011)
		Selectivity	Gibbs et al. (2013)
		Replicability	Boyd (2010)
Association (Treem & Leonardi, 2013)	This is related to establishing connections between users and users, users and content, and content and content, and to engaging in ongoing conversation relying on the presence of others, 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)	This refers to users being notified when particular events happen and responding to conversations only when they want. It allows 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 to ubiquity. It means that users can communicate with others nearly anywhere, at any time, in order to seek and share knowledge.	Pervasiveness	Rice et al., 2017
		Ubiquity	Kane (2017)

Note. Based on Sun, Y., Zhou, X., Jeyaraj, A., Shang, R. A., & Hu, F. (2019). The impact of enterprise social media platforms on knowledge sharing: An affordance lens perspective. *Journal of Enterprise Information Management*, *32*(2), 233–250. https://doi.org/10.1108/JEIM-10-2018-0232

METHODOLOGY

This research has an essentially qualitative nature, and its main objective is the proposition of a new artifact, a framework to support KS in IT projects, addressing a problem at the intersection of information technology and organizations. In this regard, we consider frameworks as a "real or conceptual guide to serve as support or guide" (Vaishnavi et al., 2021, p. 16). The scientific approach used in the research as a whole was the abductive method, which is a creative process of studying phenomena or situations and proposing theories to explain them (Dresch et al., 2015). When the researcher analyzes a problem, it is appropriate to propose potential solutions. A prescriptive methodological approach was used, and the research was conducted within the design science (DS) paradigm using the design science research (DSR) method (Dresch et al., 2015; Van Aken, 2005). Table 2 presents the methodological choices.

Table 2. Methodological choices.

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 project teams and stakeholders
Data collection	Literature review and interviews
Data analysis	Qualitative analysis and content analysis

Note. Developed by the authors.

DSR Method

Research supported by the social or natural sciences typically aims to describe, explain, and forecast situations, which is not always sufficient to be used in professionals' routines. In contrast, authors in the field of management usually seek solutions to specific problems or design and produce artifacts that can solve problems faced in the real world. These observations highlight the necessity for research that not only broadens the understanding of managerial endeavors but also has the capacity to prescribe solutions to real problems (Dresch et al., 2015).

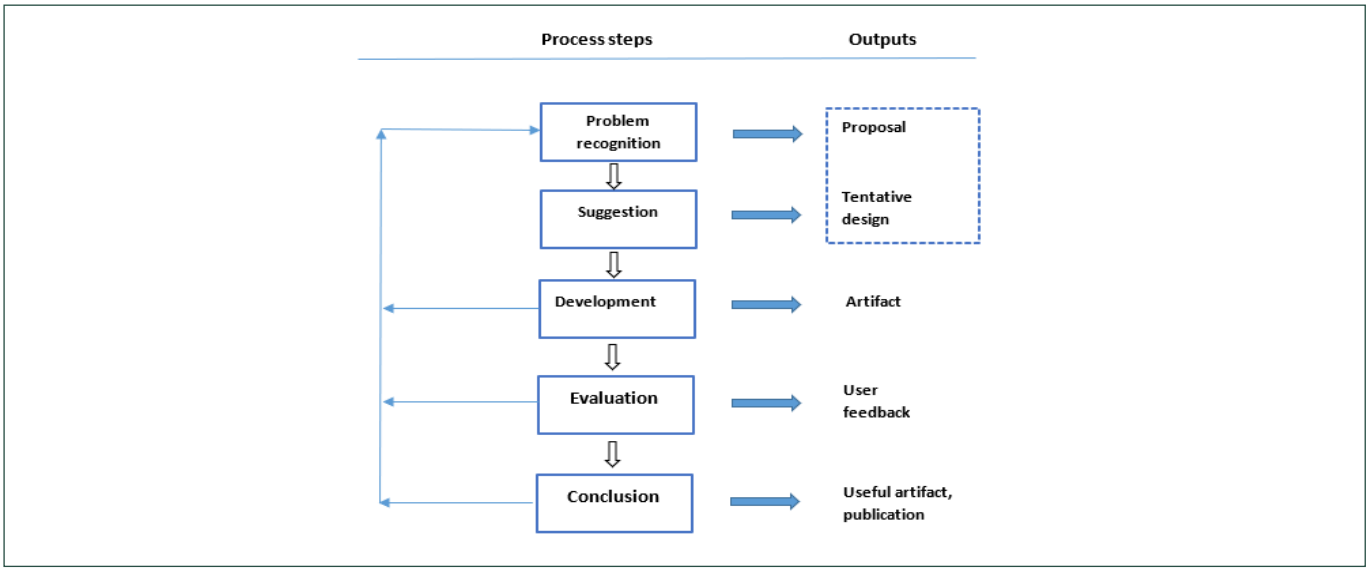
In this regard, design science research is a form of scientific knowledge production oriented toward solving problems whose primary goal is to prescribe. Its prescriptive nature becomes evident in its emphasis on developing practical solutions as well as feasible alternatives that can be immediately used in order to enhance particular domains of interest (Dresch et al., 2015). Researchers understand the problem addressed and the feasibility of their approach to its solution while constructing and exercising innovative artifacts, and simultaneously make a kind of prescriptive scientific contribution (Dresch et al., 2015; Hevner et al., 2004).

DSR aims to use the scientific mode of research to address practical issues (Van Aken, 2005) as well as being aligned with practitioners' interests and needs (Shapiro et al., 2007). DSR creates artifacts that fulfill human needs, seeking to support solutions to current challenges by drawing on the human experience in organizations (Peffers et al., 2007). According to this

viewpoint, an artifact is something that has not yet appeared in nature and is new. Examples include models, frameworks, approaches, and strategies that humans have developed for use in real-world situations (Hevner & Chatterjee, 2010).

The DSR method involves a rigorous process for researching and investigating the artificial and its behavior, both from an academic and organizational point of view (Dresch et al., 2015). In this regard, 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., 2021). We chose this process, like Bergström et al. (2021), because it is consistent with previous research in the IT context and because the steps and related activities of the model are adequately described. Additionally, it has been used in research where the goal is to address a real problem and offer a useful, prescriptive contribution to the field of management while maintaining theoretical and methodological rigor, such as the ones by Francisco and Klein (2020) and Porto and Oliveira (2020).

As illustrated in Figure 1, the model consists of five basic steps and permits iterating some of them if the results obtained provide opportunities for improvement: (a) problem recognition, (b) suggestion, (c) development, (d) evaluation, and (e) conclusion.



Source: Based on Vaishnavi, V., Kuechler, W., & Duraisamy, S. (2021). *Design Science Research in Information Systems*. http://www.desrist.org/design-research-in-information-systems/

Figure 1. Development process model.

The first step, problem recognition, involves identifying a problem in business, society, or science and justifying the study's relevance (Vaishnavi et al., 2021). In this research, data from a review of academic literature revealed that ensuring efficient SM technologies integration 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 a preliminary version of a potential 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 first two steps, proposal and tentative design, indicates that they are closely connected (Vaishnavi et al., 2021). The knowledge resources required up to this point are the understanding of the problem and the existing solutions in the literature, which are described in the Theoretical Background section. The tentative design is refined and developed in the third step, Development. The literature review served as the foundation for the development of the framework in this phase, as with the evolution of the outputs from the preceding phase (Vaishnavi et al., 2021). The fourth step comprises the evaluation of the artifact's expected behavior and impacts, which involves collecting evidence that the current version meets the required goals (Venable et al., 2016). The framework developed up to this point was presented to project team members and stakeholders in semi-structured interviews to obtain their feedback and solicit suggestions for improvements. In the fifth and final phase, conclusion, the research effort may be completed if the findings are 'good enough,' or, if not, iteration to a prior step may be necessary (Vaishnavi et al., 2021). As a conclusion of a work, the problem recognition, the proposed solution, and the resultant artifact must be disclosed to researchers and practitioners in this phase, with a clear understanding of the knowledge contributions.

Data collection

An exploratory literature review was conducted, especially on recent research, to provide an overall picture of the subject area and generate ideas, insights, and clarifications, as recommended by Petticrew and Roberts (2008). Some gaps were found during this investigation, and new information also emerged that helped define the research problem and raised the idea of employing affordances as a theoretical research lens. As a result, the research problem focused on the difficulties IT project managers faced in ensuring the integration of social media technologies to support knowledge sharing in their projects in a scenario where the COVID-19 pandemic's effects were getting worse, the demand for using virtual teams was rising, project management methodologies were constantly changing, and new technologies and integration tools were emerging. In addition, the literature review served as the foundation for the development of the lists of affordances and KS activities that are described in Tables 4 and 5, respectively.

Searches were conducted in the Google Scholar database, and the set of academic publications retrieved was reviewed. Search strings included ('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 using the backward reference method to select complementary papers.

Besides the data collected in the literature review, the semi-structured interview was the source of primary data used to evaluate and refine the framework. Between November 2021 and March 2022, 18 Brazilian IT project team members and stakeholders from distinct business sectors using agile or hybrid approaches were interviewed. Interviews 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. Table 3 presents the interviewee profiles.

Table 3. Interviewee 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. Developed by the authors.

The number of interviews was not determined in advance. Eighteen participants were interviewed until data saturation, i.e., when information and opinions started to repeat. In this regard, more participants were invited until no additional data could be uncovered or tended to be redundant from the data already collected (Fusch & Ness, 2015). The interview protocol's open-ended questions were formulated to gain meaningful knowledge, based on a detailed literature review. Interviews were conducted and recorded using Skype, Teams, and Zoom. The average length of each interview was 60 minutes. Before starting, interviewees were assured of privacy and confidentiality. They also received a brief explanation of the theme and purpose of the interview, as well as a review of the concepts of social media and the framework's social media tools.

Data analysis

Content analysis is a research technique for making replicable and valid inferences from written texts (often) to the contexts of their use (Krippendorff, 2018). The three-phase method outlined by Bardin (2011)

was used to conduct the content analysis of the interviews: (a) pre-analysis, which involves reading through the transcripts in their entirety; (b) exploration of the collected material, which is grouped and categorized; and (c) treatment of results, inference, and interpretation of the manifest and latent contents of the categorized material. The analysis was supported by ATLAS.ti, version 7.5.4, which was used to automate coding and store transcriptions and results.

RESULTS

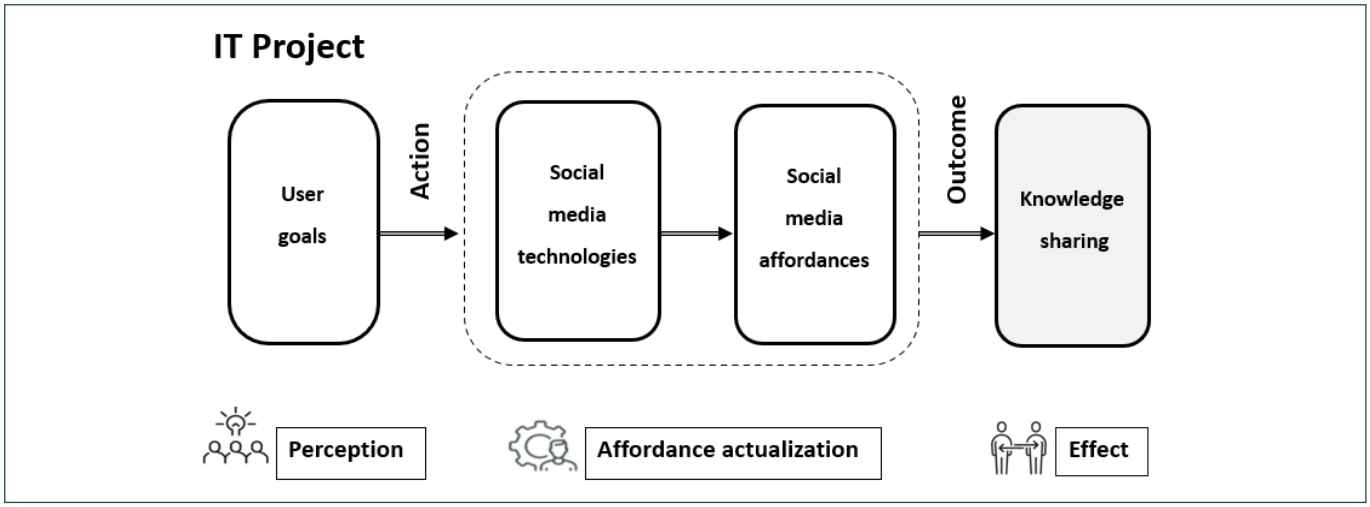
Problem recognition

The results of the problem recognition and suggestion steps are the basis for further development in the initial proposal and the tentative design for the framework, which come next. Initially, problem recognition was anchored in the extant literature. SM tools have typically only been 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 collaborative 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 this scenario into consideration, the initial problem was stated as "IT project managers lack an artifact to guide them on the integration of SM to support KS in their projects, particularly in virtual teams." We therefore defined the class of problems as the integration of SM to support KS in projects. In consequence, the resulting proposal that came out of this step was the development of a framework integrating SM-mediated interactions to support KS.

Suggestion

An early version of the to-be-developed artifact is designed during the suggestion phase of the creative process, based on an original configuration of existing or new and existing elements (Vaishnavi et al., 2021). In this step, the work was anchored in the literature and is supposed to evolve in the next steps. With the use of the affordance approach, we were able to be specific about technology while incorporating social and contextual elements, considering the interactions between organizational actors and technical capabilities (Sun et al., 2019; Volkoff & Strong, 2017). 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 affordance actualization, where the user turns possibility into action, making use of the perceived potential to support his goals. Finally, in the effect step, the actualization will produce immediate concrete outcomes for achieving KS goals. The framework's tentative design proposal is shown in Figure 2.

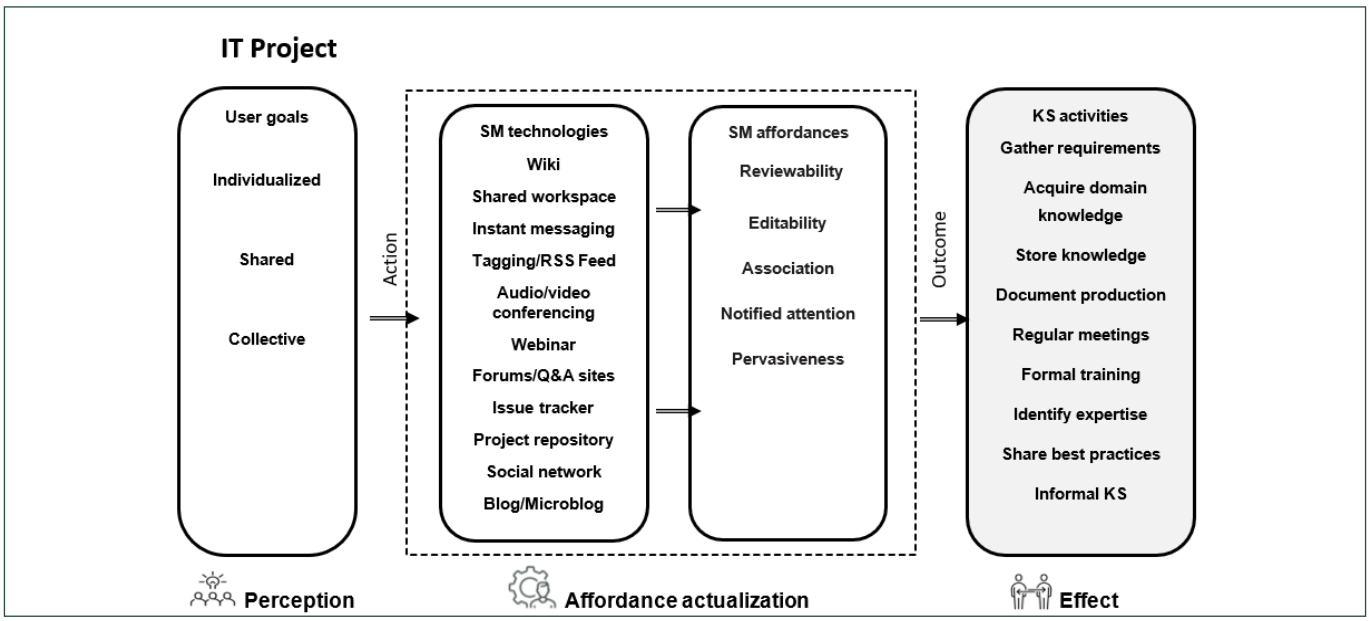


Source: Developed by the authors.

Figure 2. Tentative design.

Framework development

From the tentative design's initial conceptual proposition, the components of the theoretical framework were extended to develop the three steps of the framework based on the literature and practitioners' knowledge. Figure 3 illustrates the overall proposal and presents the developed framework.



Source: Developed by the authors.

Figure 3. Framework proposal.

People perceive technology's materiality as offering distinct possibilities, or 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). These three steps will be described in detail as follows.

Step 1 - Perception (user goals)

Different social forces arising from the context in which actors operate within the organization affect user behavior since many actions are performed collaboratively or are influenced by the actions of others (Volkoff & Strong, 2017). Therefore, when considering an organizational context, the presence of different people with similar goals working to actualize the affordances of the same or different SM tools must be addressed (Volkoff & Strong, 2017). Therefore, the categorization of affordances into individualized, shared, and collective seems appropriate to reflect multi-level intent and the different types of goals that lead users to trigger SM affordance 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; 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; and collective affordances involve individuals performing different aggregated tasks to achieve a common goal, producing something that otherwise they could not, e.g., discussing a problem in a Slack or MS-Teams channel (Leonardi, 2013; Volkoff & Strong, 2017).

Step 2.1 - 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 taken into consideration 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 found in the systematic literature review by Camara et al. (2021) and unveiled in interviews with senior Brazilian project managers (Silva & Chaves, 2021). The correlation was significant, and a final categorization of 11 key technologies was defined.

According to the IT managers interviewed, the five most significant technologies are wikis, shared workspaces, instant messaging, videoconferencing, and issue trackers, which account for 80% of the mentions. The list of SM tools also includes tagging/RSS feeds, webinars, forums/Q&A sites, blogs/microblogs, social networks, and code hosting environments. Table 4 highlights relevant aspects of the most common uses of these technologies in the knowledge-sharing process.

Table 4. Social media technologies.

Technology	Mentioned products	Technology use in knowledge-sharing process
Wiki	Confluence, Azure, corporative wikis	They primarily serve as a repository for project technical and management knowledge and documents. They are rich and powerful structured data repositories for preserving knowledge about lessons learned, project history, training material, problem resolution, bug fixing, software version upgrades, tool configuration optimization, project management processes, and best practices. They are also used for collaborative document creation.
Shared workspace	SharePoint, Google Drive, Dropbox, OneDrive	Preserve project knowledge by saving process documentation, templates, and manuals, which are particularly important for training new personnel. They allow for collaborative editing, reducing the time required for project document production.
Instant messaging	WhatsApp, Telegram, Facebook Messenger, Teams	Used individually or in groups to solve problems and share technical and project management knowledge. Immediate connection with the team is possible, allowing for disseminating critical and urgent knowledge. Informal knowledge is shared and stored through personal interactions with colleagues.
Video conferencing	Skype, Skype for Business, WebEx, Google Meets, Hangout, Zoom, Teams	Videoconferences enable people to interact throughout the organization and with clients from different places. They are held to report project status, show presentations, train, discuss project issues, aggregate knowledge to solve problems and share and reuse previously stored knowledge.
Issue trackers	Redmine, Jira	Aside from tracking issues, they are a knowledge base for many teams. They are used to save sprint documents, lessons learned reports, videos, technical information, and project knowledge. Team members use this content to solve doubts, examine lessons learned, look for known problem solutions, and conduct self-training. Discussions about problem control and bug solving are reused. They keep the whole service history, providing knowledge to solve the customer's problems.

Note. Based on Silva, R. A. C. da, & Chaves, M. S. (2021). Use of social media collaborative tools to support knowledge sharing in it projects workplace: A Senior Practitioners' Perception. *XLV Encontro ANPAD 2021.* http://anpad.com.br/uploads/articles/114/approved/fb3f76858cb38e5b7fd113e0bc1c0721.pdf

Step 2.2 Affordance actualization (SM affordances)

The classification presented by Sun et al. (2019) was adopted for the composition of the second element in the affordance actualization step. These authors carried out a systematic literature review and identified enterprise SM affordances and their influence on KS. Thirty-eight affordances from ten different classifications were analyzed, consolidated, and reclassified into five affordances: association, editability, notified attention, reviewability, and pervasiveness. Table 5 provides an overview of the five resulting consolidated affordances, together with their related affordances provided in prior literature classifications.

Table 5. 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 or out 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 the presence of others, profiles, content and activities, e.g., adding a tag, commenting, responding to a question, 'liking,' etc.
	A40 — Obtain and use other people's 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 the information of others 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 information or updates of others.
	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, whenever 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. Developed by the authors.

Step 3 - Effect (Knowledge-sharing activities)

The fourth step of the framework, which categorizes KS activities, was similarly put together using professional and academic sources. Regarding using SM to support KS, we also drew on data from interviews with 15 senior Brazilian IT project managers (Silva & Chaves, 2021). The activities mentioned by the practitioners were classified and categorized as key processes to support KS in both traditional and agile project management approaches. A literature synthesis elaborated by Thompson (2018), on the use of SM in project management activities related to knowledge transformation processes, was also used. The final categorization shown in Table 6 was determined by comparing and correlating these two sets of KS activities from professional and academic sources. The list 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 references to the academic publications where they were found.

Table 6. 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 & 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 right people who are knowledgeable about a subject or can help 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. Developed by the authors.

Framework evaluation

After the development of the framework proposal, it was validated and refined following the process model. Eighteen interviews were carried out with practitioners, stakeholders, and members of virtual and hybrid IT project teams. To evaluate the framework's adherence to their daily work, project members were asked about KS activities, SM collaborative tools, and integrated tool use.

Perception (user goals)

Interviewee responses confirmed the three categories of user goals proposed by Leonardi (2013), and no other forms were mentioned, therefore validating the framework's perception step. In this regard, individual, shared, and collective KS actions were reported. Users take individual KS actions, such as tagging teammates to notify them about a topic in an online meeting, or searching a wiki for previous project technical knowledge; they also take shared KS actions, such as working together on the creation of a requirement list or updating the "who knows what" spreadsheet in the knowledge repository; and they also take collective KS actions, such as finding a solution to a problem by creating a temporary channel, inviting specialists, discussing in a group, and storing the knowledge produced.

Affordance actualization (SM technologies)

Interviewee responses uncovered differences 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 whose functionality is used differently to usual were highlighted. Considering that, the affordance actualization (SM technologies) step of the framework was validated and refined.

Several interviewees, such as I04, I05, I09, I10, I12, I14, I15, and I17, mentioned using canvas tools in their projects. The canvas tool is a virtual environment not initially included in the framework and was thereby included. On the other hand, no interviewees mentioned using blogs, microblogs, social networks, Q&A sites, or webinars in their current or previous projects. Discussion forums were not mentioned either, and interviewees I01, I05, I08, I09, and I11 reported a replacement of their function by the communication channels and groups in the integrated SM platforms and instant messengers. In consequence, these technologies were

dropped from the framework. Additionally, I07, I08, I09, I10, I11, and I14 reported the use of Jira and Redmine issue trackers to store and share project knowledge, and the term 'issue tracker' was then replaced by 'product/project management' in the SM technologies component of the framework.

The canvas, project repositories, and tagging aspects were not highlighted during the development process, but they were significantly mentioned during the evaluation phase and included in the framework's final version. Table 7 illustrates the key features of these regularly utilized technologies in the knowledge-sharing process.

Table 7. Additional social media technologies.

Technology	Mentioned products	Technology use in knowledge-sharing processes
Canvas	Miro, Whiteboard, Fun Retrospective, Figma, Project Canvas, and Easy Retro	Allows synchronous and asynchronous collaboration. In agile projects, it is utilized in retrospectives, reviews, sprint planning, and sprint work. It can help in training, brainstorming, presentations, process and functionality design, requirement definition, lessons learned, best practices, document generation, knowledge sharing, and collaborative project story creation and refinement.
Project repository	GitHub, BitBucket, GitLab	Code repositories and collaborative software development platforms that enable developers to generate, store, manage, and share code while also enabling issue tracking, software feature requests, and task management for each project. When the project is simple, interviewees reported sharing knowledge directly in the code, as well as using it for training, sharing best practices, and code review.
Tagging	Character @ in Teams, WhatsApp and Slack	Tags are used for communication among users, by identifying people in chats such as Teams and WhatsApp, discussion forum posts, and regular meetings with team members and suppliers. Tagging is used in a variety of tasks, including gathering requirements, acquiring business knowledge, creating backlog, sharing best practices, training, lessons learned, and sprint work.

Note. Developed by the authors.

Affordance actualization (SM affordances)

The five categories of consolidated affordances and all their related affordances 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 20 additional affordances to be incorporated into the original set of related affordances. Table 8 presents the list of the new affordances.

Table 8. 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 notifications about audio/video conferences and other events	I03, I11
	N35 — Create automatic notifications 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. Developed by the authors.

Effect (Knowledge-sharing activities)

The effect/KS activities step was also considered validated, given that (a) all the KS activities proposed in the framework were recognized by the interviewees as occurring at certain moments during the execution of their projects; and (b) when asked if they could cite any

missing activity, all the interviewees answered negatively. Social media tools were mapped to the corresponding KS activities where they are used, according to the interviewees. Each cell in the spreadsheet shows the number of times the association between tool and activity was mentioned. For instance, the use of wikis to store knowledge was mentioned 13 times. It should be noted that more than one mention in a cell may have come from the same interviewee. Table 9 maps the use of SM tools in each project's KS activity.

Table 9. Mapping between SM tools use and KS activities.

	Audio/Video conferencing	Canvas	Project repository	Instant messenger	Product/ Project Management	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. Developed by the authors.

Social media tools integration

The interviewees were asked about the use of tool integration in their projects and often provided affirmative responses. They emphasized that it is both a trend (I03, I06) and a necessity, particularly in IT projects (I10), but it must be user-friendly (I10) and widespread within the organization (I01). I12 said that it was once important but is now indispensable, and I18 considers that it has become irreversible. On the other hand, I10 and I13 emphasized the significant cost of acquiring and maintaining such integrated tools, particularly the professional versions.

The integration was considered to facilitate communication and documentation (I07, I09, I13, I18). These activities are important for gaining agility (I13) and managing knowledge (I16, I18), thus contributing to increased project performance (I02, I03). I15 said that using only one integrated tool would make work easier. According to I18, as team members' participation and collaboration levels improve, they begin to have a more active voice and gain more empowerment.

All interviewees except I03, I09, I10, I15, and I18 reported using more than one integrated tool besides standalone tools. In this regard, several respondents reported problems arising from the lack of integration between tools (I01, I03, I04, I05, I06, I16). Multiple tool use results in rework (I12, I14, I15, I17), outdated versions of the same document (I16), and knowledge loss (I08, I12, I14).

All the interviewees reported using SM tool integration to share knowledge in their projects. Here, we consider integration using 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 for knowledge storage. Table 10 presents the mapping between integrated SM tools and KS activities.

Table 10. Mapping between integrated SM tools use and KS activities.

	Azure DevOps	Discord	Google Workplace	GoTo Meeting	Jira	Redmine	Slack	Teams	Trello	Webex	Totals
Acquire domain knowledge	1	0	1	1	0	0	0	9	0	1	13
Document 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. Developed by the authors.

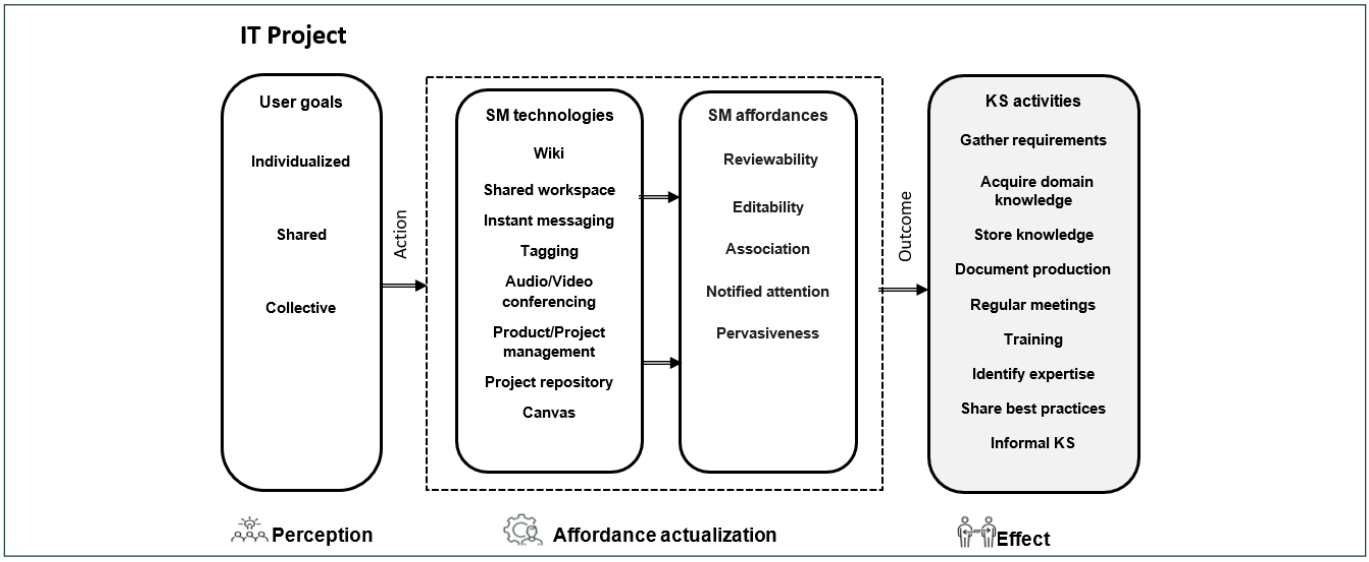
The INT-SM4KS framework

In this section, we present the updated framework, now denominated 'integrated social media for knowledge sharing' (INT-SM4KS) framework, which was refined with the contributions from the interviewees. Two framework views, the component view and the integrative view, are presented to provide a more comprehensive understanding of the artifact developed, considering people, processes, and technology.

The two perspectives are complementary, and this is how the framework describes the environment approached in this work. The main objective of the research is expected to be accomplished by project managers with the help of the analysis and application of the knowledge offered to solve the aforementioned problems.

The component view

The component view corresponds to the initial proposal shown in Figure 3, which has been revised to reflect and consider the improvements made during the development phase and described in the preceding sections. 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 technology integration. The component view is presented in Figure 4.



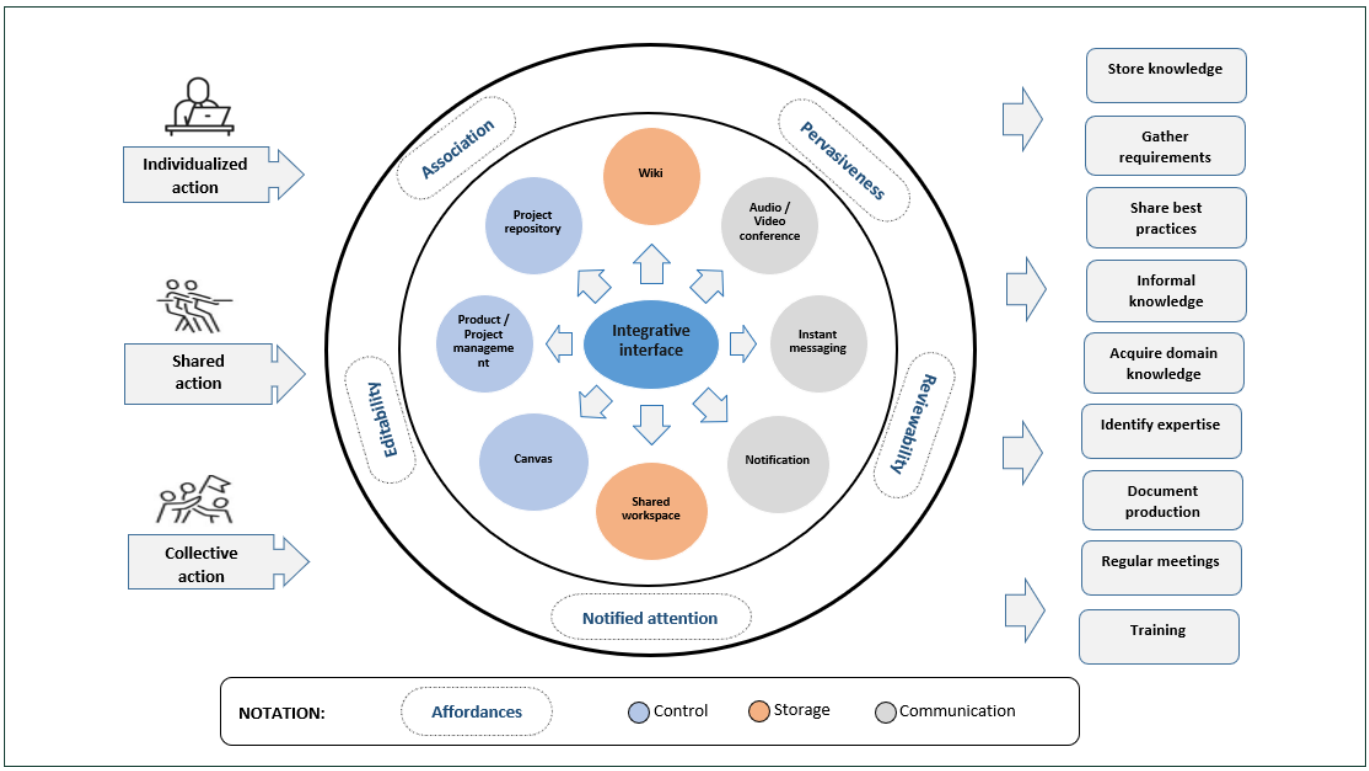
Source: Created by the authors.

Figure 4. Component view of the INT-SM4KS framework.

The integrative view

The integrative view keeps the same components and their respective elements but is presented differently. The goals and actions are still on the left, and the resulting KS activities are still on the right. However, the integration of social media technologies is highlighted in the central component of affordance materialization. The integrative view is presented in Figure 5.

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 are used mostly for storing knowledge, i.e., wikis and shared workspaces. On the right side, the technologies are used mostly for communication, i.e., audio/video conferences, instant messaging, and notifications. The outer circle contains the five groups of materializable affordances. This arrangement indicates that the set of affordances is related to all the technologies, that one technology can materialize one or many affordances, and that many technologies can materialize one or many affordances.



Source: Created by the authors.

Figure 5. Integrative view of the INT-SM4KS framework.

Conclusion of the development process

By conveying the findings of the work completed, this research can 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. Following the research model, this study was submitted to publication in a congress and a journal in order to communicate the work's results to researchers and practitioners.

FINAL REMARKS

This study investigates how to integrate various SM tools to support knowledge-sharing processes in IT projects. Its main objective is to develop a framework to assist IT project managers and contribute 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 tool use.

In this way, this paper adds an integrative framework (INT-SM4KS) to the literature. The affordance lens was adopted as a theoretical approach and a development process model proposed by Vaishnavi et al. (2021) was used. The framework was evaluated and refined by eighteen participants of agile projects, using semi-structured interviews. Its final version comprises three components, drawing on affordance perception, actualization, and effect. It is presented in two complementary perspectives: the components view and the integrative view.

Contributions and implications

By incorporating social media and knowledge-sharing procedures, the INT-SM4KS framework can impact the management, project management, and knowledge management communities. All project management tasks may be included in the potentially vast affected area. Additionally, the effective use of the framework made available for immediate use can add to the work of project managers the benefits of knowledge shared between project participants as well as among different projects; increase management efficiency; and positively influence its success, as indicated by authors like Sarka and Ipsen (2017), who claim that the use of SM can help IT project members achieve project goals.

According to Narazaki et al. (2020), using DSR enables the experience of combining theoretical foundations to create an artifact with its application in a real-world setting. Considering such a perspective, this paper will offer a deeper understanding of the topic at hand, benefiting the project management and knowledge management academic and practitioner communities in three ways: (a) 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; (b) a framework on the integrated use of SM in the dynamics of KS in IT projects will be available for practitioners; and (c) an empirical validation of this framework will be added to the literature.

If we take into consideration the fact that the framework was designed for IT project participants and validated by their peers, it has unique features. The process model in use considers not just the technical aspect but also the goals and requirements of the users and the organizational setting, all of which impact how extensively the provided resources are used (Sun et al., 2019). As a result, one may count on the framework's capacity to support KS activities in IT projects, a setting that is inherently exciting and conducive. It possibly enables the development of new knowledge and skills through collaboration and the sharing of expertise in IT projects, contributing to enhancing a culture of continuous learning and improvement within the project members and organization.

From an innovative viewpoint, using social media technologies fosters innovation and collaboration (Kerzner, 2015). In this sense, it is expected that using this artifact in a setting where collaboration is supported and encouraged can contribute to developing innovative products or services. Additionally, this sharing of knowledge between project teams, stakeholders, and customers may eventually result in potential cost reduction effects, such as preventing mistake repetition, avoiding knowledge recreation, reducing expertise loss, leveraging existing knowledge, and supporting decision-making (Chaves et al., 2018; Kinder, 2020).

Limitations and future research

The study's main limitation is that it involved only online interviews due to COVID-19 pandemic restrictions. However, the steady, systematic development process and the solid interviewee's background on the subject contribute to validating the results. Furthermore, due to the pandemic restrictions, the framework was not evaluated in a real-world environment where people would simulate or perform real tasks.

According to Pries-Heje and Baskerville (2008) and Dresch et al. (2015), the validity of a DSR must be established and rigorously demonstrated by the evaluation of the developed artifact, which must satisfy the necessary conditions to achieve the desired objectives. In this regard, within the DSR paradigm, the framework can also be evaluated in a real-world environment using the framework for evaluation in design science research (FEDS) proposed by Venable et al. (2016) to support the evaluation of design decisions in DSR.

We suggest evaluating and obtaining feedback from project managers on the framework using the following evaluation criteria: (1) Completeness — Characteristic of what is presented completely in its elements, without anything lacking or unnecessary. The following questions can be done: Would you add to or remove from the framework any user goal, SM tool, SM affordance, or KS activity? Which element(s) would you add or remove? Why? (2) Complexity — The quality or condition of being complex; the state of being confusing, or complicated, or difficult to understand. The following questions are to be considered: How do you assess the framework in terms of ease of understanding? Did you find it easy to understand the characteristics of both the component and integrative views? (3) Ease of use — Refers to how natural it is to operate something, or to the extent which something may be used to achieve a specific outcome or effect without applying significant effort. The following questions can be posed: How would you assess the simplicity of applying this framework in a project, based on your daily experience? (4) Impact — The force of impression of one thing on another: a significant or major effect or influence that something, especially something new, has on someone or on a situation. The following questions can be addressed: How much do you believe the framework would help managers share technical, management, organizational, and business knowledge in order to achieve project goals? These criteria are greatly dependent on the goals of the DSR project itself (Venable et al., 2016) and were defined as having in mind their relationship with the research question to be answered.

Future research can investigate the efficiency of the framework when used in a real-world project environment, evaluating its application in projects and other business areas, including the public sector. Moreover, research can be promoted on using the framework by different teams such as company employees, outsourced members, and mixed teams comprising members of these two groups. It is also interesting to validate the simplicity of use by using the framework in organizations that already have an established KS process.

Additionally, in line with the socio-technical nature of the research, the framework can be extended to include elements such as practices related to KS activities, enablers, and barriers to using SM to support KS, and affordances materialized by emerging technologies like IoT, AI, and cloud computing. 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.

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