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

Autoria

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Resumo

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, eleven affordances were identified and incorporated in the framework. The framework's effective application can add to IT projects the benefits of knowledge sharing, increasing management efficiency, and positively influencing success. The main limitation is the small number of interviews conducted. However, the research will proceed with more interviews to complement and strengthen the findings. In the end, practitioners will be provided with a support tool specifically developed and validated for

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

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?" To answer this question, the main objective of the study is the development of a framework, an artifact that provides the basic structure of something, giving support to dealing with problems or making decisions (Cambridge, n.d.; Merriam-Webster, n.d.). The framework supports IT project managers, contributing to the solution of some of the existing KS problems mentioned above. The framework approach addresses human interactions in KS processes mediated by integrated SM features, considering people, processes, and technology.

In terms of the study's theoretical approach, the affordance 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).

2 THEORETICAL BACKGROUND

2.1 SOCIAL MEDIA, KNOWLEDGE SHARING, AND PROJECT MANAGEMENT

Social media 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 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).

Knowledge is a meaning set of continuously created information in organizations, 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). Within organizations, 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 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 the main enabler and a decisive 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, SM 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).

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., 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). 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).

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).

2.4 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 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 practice 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).

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 & 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 1.

Figure 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 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)	Related to establishing connections between usres 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)
		Metavoicing	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).

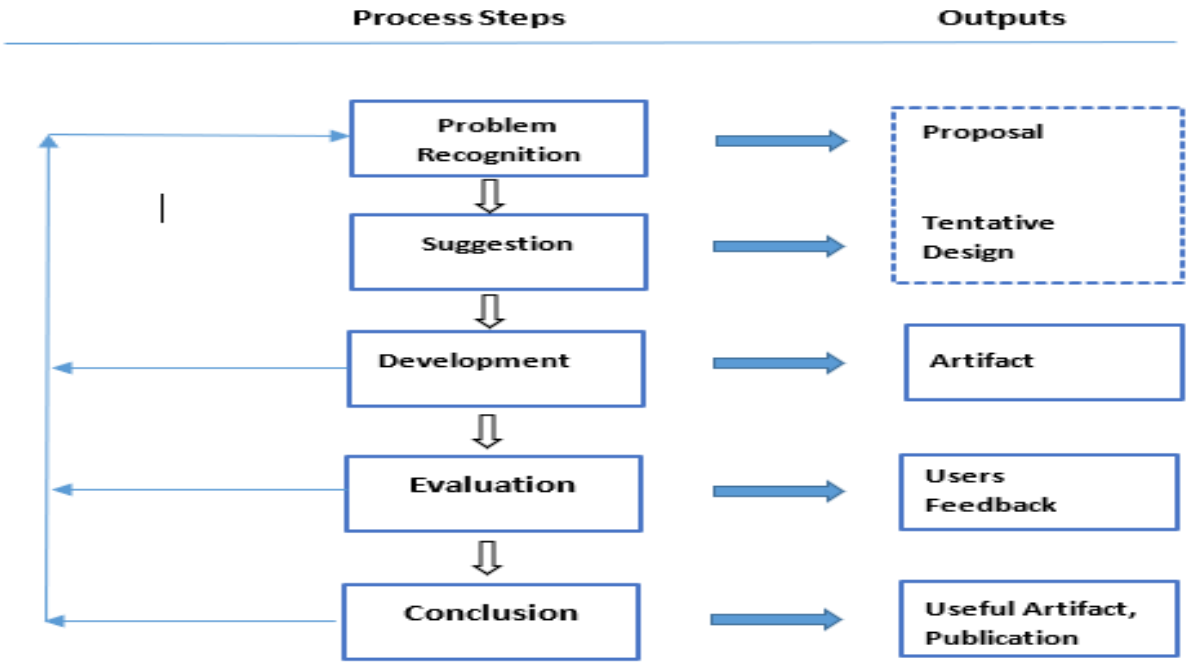
3 METHODOLOGY

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 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 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 development of the framework in this phase was also based on the literature review.

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). The framework developed so far was presented to project team members and stakeholders in semi-structured interviews, to obtain their feedback and solicit suggestions for improvements.

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). As a conclusion of a work, in this phase 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.

3.1 DATA COLLECTION

A literature review was carried out to investigate the use of social media to promote KS in IT projects and identify gaps. Different gaps and some insights arose from the analysis. Searches were conducted in Google Scholar database and the set of academic papers 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.

Besides data collected in the literature review, the semi-structured interview was the source of primary data used to evaluate and refine the framework. Targeting project managers, stakeholders and members of IT project teams, 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.

For this study, ten Brazilian IT team members and stakeholders of projects using the agile approach and the SCRUM method were invited from distinct business sectors and were interviewed, between November 2021 and March 2022. 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). Ten people were then interviewed until data saturation was reached, when information and opinions started to repeat. Figure 3 presents the interviewees' profiles.

Figure 3 – Interviewees’ profiles

Interviewee	Role	Business Sector	Team Location	Years in IT Projects
I01	Scrum Master	Consulting Company	Hybrid	23
I02	Project Manager	Multinational Company	Hybrid	21
I03	SCRUM Consultant	Consulting Company	Virtual	29
I04	Project Owner	Consulting Company	Hybrid	20
I05	Technical Leader	Bank	Virtual	15
I06	Developer	Consulting Company	Virtual	3
I07	Scrum Master	State Government	Virtual	38
I08	Development Manager	Consulting Company	Virtual	20
I09	Project Manager	Multinational Company	Virtual	22
I10	Agile Coach	State Government	Hybrid	20

Note: Created by the authors.

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.

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

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 software ATLAS.ti, version 7.5.4, was used to support the analysis, by automating coding and storing transcriptions and results.

4 RESULTS

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.

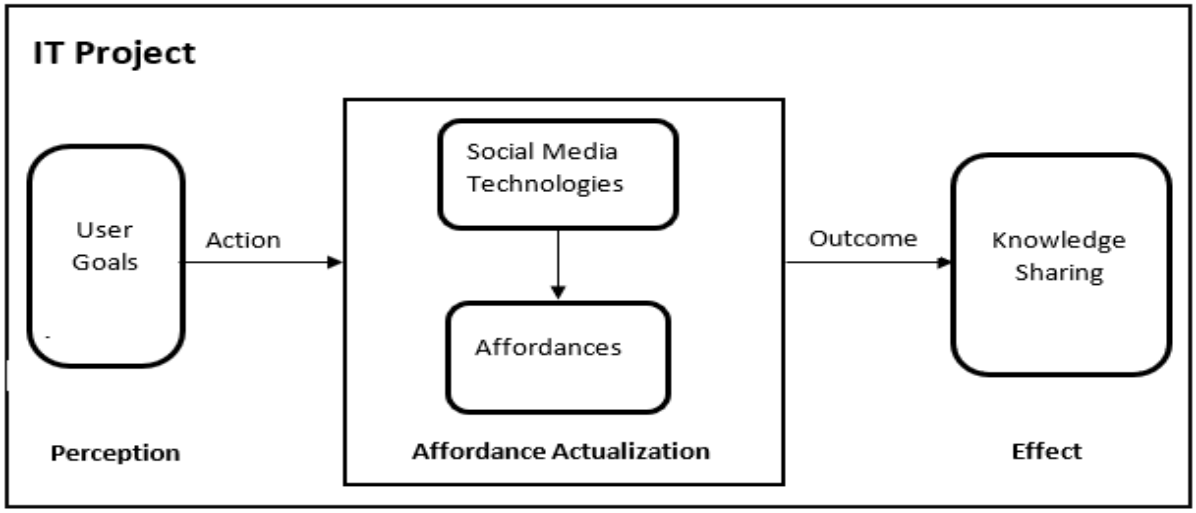
Initially, problem recognition was anchored in the extant literature. It was noticed that SM tools have been mostly used in isolation, suggesting that research on the use of integrated SM tools to support KS needs should benefit both researchers and practitioners. On the other hand, the literature review 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.

4.2 SUGGESTION

The suggestion is a creative phase in which an initial version of the to-be-developed artifact 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 here 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 4 illustrates the Tentative Design proposal for the framework.

Figure 4 – Tentative Design.



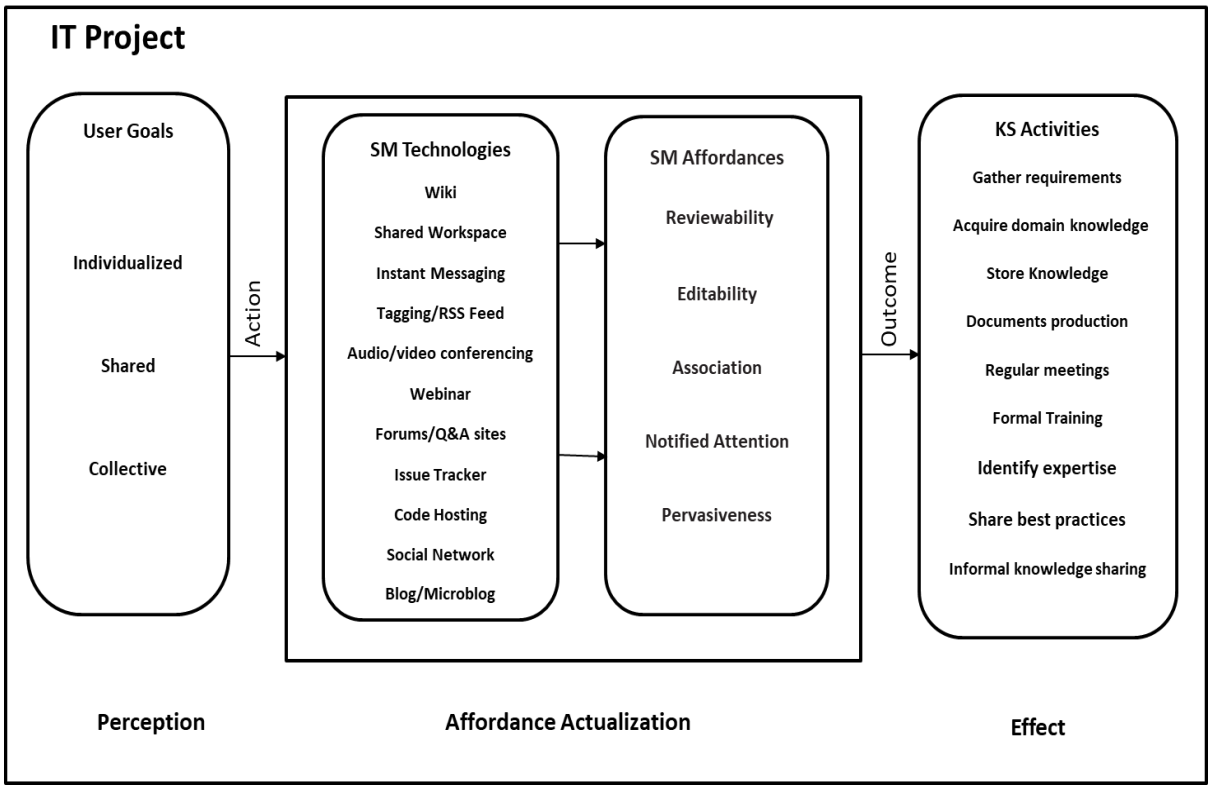
Source: Created by the authors.

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.

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 5 illustrates the overall proposal, presenting the developed framework.

Figure 5 – Framework proposal.



Note: Created by the authors.

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.

4.3.1 STEP 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). Therefore, 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). Thus, 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).

4.3.2 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 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 code hosting environments.

4.3.3 STEP 2.2 - 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 into five affordances: Association, Editability, Notified Attention, Reviewability, and Pervasiveness. The five resulting consolidated affordances and their related affordances, offered in prior literature classifications, are summarized in Figure 6.

Figure 6 - 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 authors.

4.3.4 STEP 3 – 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 categorize 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 7.

Figure 7 - 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 authors.

The list in Figure 7 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.

4.4 FRAMEWORK EVALUATION

Following the process model, once the framework proposal was developed, the next step was its validation and refinement. Ten interviews were then carried out, where the framework was presented to practitioners, stakeholders and members of virtual and hybrid agile IT project teams. To evaluate 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.

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, 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 or updating the "who knows what" spreadsheet in the knowledge repository; and users also take collective actions such as finding a problem solution by creating a temporary channel, inviting specialists, discussing and storing the knowledge produced.

4.4.2 AFFORDANCE ACTUALIZATION/SOCIAL MEDIA TECHNOLOGIES

The interviewees' responses uncovered some contrasts between the findings of the literature given 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 or webinars in their current or previous projects. Discussion forums were not mentioned either, but their function was replaced by the communication channels in integrated SM platforms and by groups in instant messenger tools, as reported by I01, I05, I08 and I09. Additionally, I07, I08, I09, and I10 reported the use of Jira and Redmine issue trackers to store and share project management knowledge.

On the other hand, interviewees mentioned activities facilitated by the canvas tool, a virtual environment not included in the framework that permits synchronous and asynchronous collaboration. Canvas tools can be used in activities such as training, brainstorms, presentations, process design and requirements specification. Such products as Miro, Whiteboard, Fun Retrospective, Project Canvas and Easy Retro are used by I04, I05, I09 and I10 in their projects.

Corroborating the findings of Silva and Chaves (2021), along with the use of SM tools respondents also reported 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 and I10. Besides that, corporate wikis (I05, I07) and corporate discussion forums (I09) were also mentioned as SM collaborative tools available to all the organization areas and also used by project team members.

4.4.3 AFFORDANCE ACTUALIZATION/SOCIAL MEDIA AFFORDANCES

The five categories of consolidated affordances and all of their related affordances, as proposed in Figure 7, 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 eleven additional affordances to be incorporated to the original set of related affordances. The new list is present in section 4.14.

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 moments 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 8.

Figure 8 - Mapping between SM tools use and KS activities

	Audio/Video Conferencing	Canvas	Code Hosting	Instant Messenger	Issue Tracker / Project Mgmt	Shared Workspace	Tagging / RSS Feed	Wiki	TOTALS
Acquire Domain Knowledge	10	0	0	6	0	3	2	0	21
Documents Production	1	2	0	0	3	4	0	0	10
Gather Requirements	8	1	0	4	2	0	2	1	18
Identify Expertise	1	0	0	0	0	3	0	1	5
Informal Knowledge Sharing	4	0	1	11	0	1	0	0	17
Regular Meetings	9	0	0	8	1	1	4	0	23
Share Best Practices	4	2	1	2	1	1	2	0	13
Store Knowledge	4	0	1	3	12	19	1	6	46
Training	8	1	1	2	0	0	0	0	12
TOTALS	49	6	4	36	19	32	11	8	165

Note: Created by the authors.

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 Canvas for training, for example, was mentioned once. It should be noticed that more than one mention in a cell may have come from the same interviewee.

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). It was considered that the integration facilitates communication and documentation (I07, I09) contributing to increase project performance (I02, I03). It is worth noting that, except I03, I09 and I10, all of the interviewees 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).

In their responses, all the interviewees reported 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. MS-Teams was the most mentioned, corroborating Kolluru et al. (2021. Azure DevOps, Jira, Trello, Redmine, and Google Meets were also mentioned. Additionally, respondents reported the use of integration in all KS activities included in the framework, mostly to store knowledge. Figure 9 presents the mapping between the use of integrated SM tools and KS activities.

Figure 9 - Mapping between integrated SM tools use and KS activities

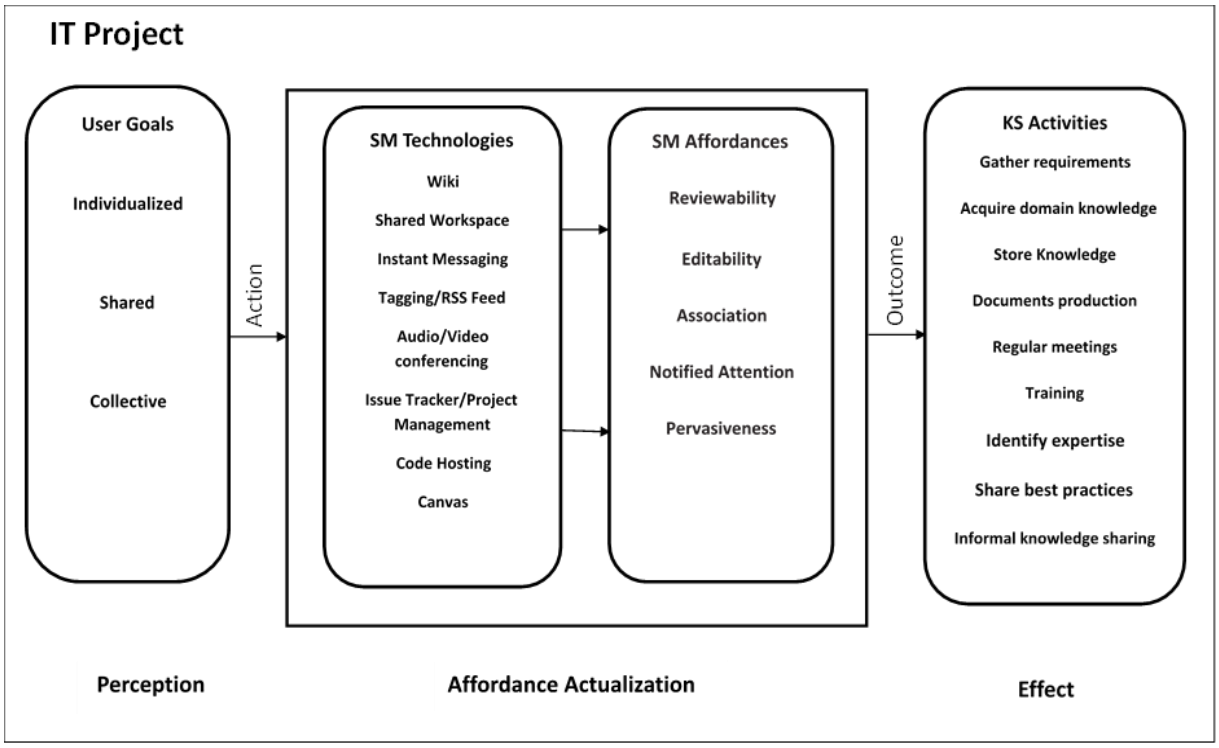
	Azure DevOps	Google Meets	Jira	Redmine	Teams	Trello	TOTALS
Acquire Domain Knowledge	1	1	0	0	7	0	9
Documents Production	0	0	0	0	2	2	4
Gather Requirements	1	1	1	0	4	1	8
Identify Expertise	1	0	0	1	1	0	3
Informal Knowledge Sharing	1	1	0	0	7	0	9
Regular Meetings	0	1	0	1	5	0	7
Share Best Practices	0	0	0	1	3	1	5
Store Knowledge	3	2	3	7	9	8	32
Training	0	0	0	0	6	0	6
TOTALS	7	6	4	10	44	12	83

Note: created by the authors.

4.6 THE INT-SM4KS FRAMEWORK

In this section, we present the definitive version of the Integrated Social Media for Knowledge Sharing (INT-SM4KS) framework in Figure 10, updated to reflect the refinements made during the evaluation process. Additionally, the new related affordances identified in the same process are presented in Figure 11.

Figure 10 – Final INT-SM4KS version.



Note: created by the authors.

Figure 11 - Additional related affordances.

Affordance	New Related Affordance	Mentioned by…
Editability	E40 – Control file update permission	I10
Notified Attention	N30 – Send notification about audio/video events	I03
	N35 – Send notification about content to another user	I01, I02, I03, I05, I08
Association	A60 – Disable file sharing.	I04, I08
	A65 – Disable chat funcionality to internal and/or external users.	I01, I08
	A70 – Share screen in video events	I01, I05, I08, I10
	A75 – Control audio/video events participation permission	I08
Reviewability	R 65 - Store and make available files, documents, photos, videos, audios and other information.	All the interviewees
	R70 – Record audio/video content.	I01, I05, I08, I09, I10
	R75 – Transcribe audio/video content.	I09
	R80 - Retrieve a list of the audio/video event participants	I01

Note: Created by the authors.

We consider that this section 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.

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 and refined by ten 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, and webinars are not used for KS in their current projects. In contrast, issue trackers are being used to store and share project management knowledge, while canvas tool has increasingly facilitated KS activities, thus both were included in the framework. Additionally, eleven affordances were identified and were also included.

The main limitation of the study is the small number of interviews conducted. However, the steady systematic development process and the solid interviewee's background on the subject contribute to validate the results. This research will proceed with more interviews

complementing and strengthening the findings. In its end, practitioners will be provided with a support tool specifically developed and validated for them. Future research can investigate the efficiency of the framework when used in a real-world project environment.

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