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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, in such a way that managing IT projects is nowadays a key concern (Koriat & Gelbard, 2019; Rai, 2016). In accordance, Gholami and Murugesan (2011) assert that among the most relevant classes of projects there is a need and a particular interest in improving IT project management (PM), remarking that IT projects and their management are notorious for failures.

Advances in IT over the last decades provoked in 2011 the introduction of the so-called Industry 4.0, challenging the way companies and people collaborate with each other (Marnewick & Marnewick, 2019). Along with IT projects, information technology has gone through a radical change, leading enterprises to be reinvented digitally under the influence of social media (SM), mobility, cloud computing, internet of things (IOT), big data, artificial intelligence (AI), and other great transformational forces (Rai, 2016).

Organizations are running after digital transformation initiatives (Chowdhury & Lamacchia, 2019). Business leaders and policy makers recognize the need for change catalyzed by digital technologies and they are ready to invest heavily to make technology become an integral part of the product and service delivery (Chowdhury & Lamacchia, 2019; Wessel et al., 2021). Regarding the effects of this technological revolution, Porter and Heppelmann (2014, p. 4) observe that IT is becoming an integral part of the product itself, stating that "products have become complex systems that combine hardware, sensors, data storage, microprocessors, software, and connectivity in myriad ways".

Requirements to develop products under such an innovative conception result in new challenges for IT project managers. More dimensions are expanding the added value that IT projects bring to business, increasing complexity and turning the failures into multi-dimensional ones (Rai, 2016). Multidisciplinary knowledge must be gathered in real time and shared with all the stakeholders (Ghimire et al., 2017; Marnewick & Marnewick, 2019). The management of this knowledge plays a fundamental role in reacting timely to hasten problem solving and decision making processes, which are frequently found in the IT field (Koriat & Gelbard, 2019; Zin et al., 2018).

In IT projects, knowledge management processes involve acquiring, and sharing knowledge between the project managers, the team, the users, the top management, and other interested in the project (Foote & Halawi, 2018). These human interactions can yield benefits such as preventing mistakes from being repeated, reducing the loss of know-how, and leveraging existing experience and knowledge (Chaves et al., 2018). In this respect, knowing how to share knowledge across teams and between project members became a central concern in IT projects (Karlsen & Gottschalk, 2004).

Nabelsi et al. (2017), Sarka and Ipsen, (2017), Zahedi et al. (2016), Koriat and Gelbard (2019) agree that knowledge sharing is crucial for organizations' competitive achievements and that one of the ways it happens is by team members coaction using collaboration tools based on SM applications such as wikis, blogs, social network sites, instant messenger, digital forums, video conferences, podcasts, etc. Suh management and development tools support knowledge sharing processes in IT projects allowing users to create and share technical and professional knowledge (Kanagarajoo et al., 2019; Koriat & Gelbard, 2019).

As to the impact of social media use on IT projects, studies regarding different success criteria have been addressed since the beginning of the 10's. In recent studies Sarka and Ipsen (2017) affirmed that using SM to share knowledge can effectively help software developers to achieve project objectives; Nabelsi et al. (2017) reported project performance benefits from

wiki usage in 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 facilitate employees to share knowledge, contributing to successful digital transformation projects.

However, even considering this positive impact, it seems there have not been enough studies on this subject. Gholami and Murugesan (2011) point out the little academic literature linking the management of distributed IT projects and social media tools. Naeem (2019) also mentions the limited literature available exploring the role of social media applications in enhancing knowledge sharing practices in the workplace. Accordingly, Sarka and Ipsen (2017) assert that knowledge sharing via social media in software development projects is still a novel and emerging field, and research is in its early phases.

When it comes to the concrete use of social media by organizations, Ikemoto et al. (2017) affirm that its effective adoption is still beginning, in spite of the many benefits provided. Nevertheless, as project teams become increasingly delocalized, with information and communication technologies supporting the work (Zin et al., 2018), collaborative tools tend to gain more attention. Ozguler (2020) adds to this understanding, reporting that the imperative necessity to use collaborative solutions during the COVID-19 pandemic has made some existing barriers disappear and minds have opened to the advantages of social media. As an illustration, India's IT sector moved approximately 2.9 million employees to work from remote places, mostly from home, using SM tools such as video conferencing (Ramasamy, 2020).

In light of the above, one can perceive the relevance of the three themes approached here, both individually and altogether. As a reasonably new field of research, there is present and future interest on knowledge sharing in IT projects domain, focused on the use of collaborative social media tools. We expect to identify existing problems within this underexplored field of knowledge and gather useful information to construct solution-oriented artifacts to solve them. Considering this context, the objective is to investigate IT projects settings from the practitioners' perspective, interviewing fifteen Brazilian IT senior project managers to answer the research question "how do collaborative social media tools support knowledge sharing in IT project workplace?".

2. Theoretical Background

Social media

Social media and Web 2.0, are interchangeable terms, described by Kaplan and Haenlein (2010, p. 61) as "a group of applications that use the Internet and are based on the ideological and technological foundations of Web 2.0, enabling the creation and exchange of user-generated content". This definition applies to an internet-based and computer-mediated collection of highly interactive technologies and services, encompassing collaboration tools such as wikis, collaborative editors, blogs, microblogs, social network sites and instant messenger applications (Gholami & Murugesan, 2011).

Presently, the use of social media tools pervades our society and organizational settings in such a way that its benefits and challenges can no longer be ignored (Ahmed et al., 2019; Sarka & Ipsen, 2017). The advent and use of social media have been radically modifying the technological landscape, affecting people's interactions, changing the way many people, communities, and/or organizations, collaborate and share content (Ngai et al., 2015). Social media technologies and services enable different formats of social interactions where users

create and share their own content collaboratively, leading to new and more complex knowledge (Shang et al., 2011; Ngai et al., 2015; Leonardi & Vaast, 2017).

The increasing support of information technology to communication and collaboration and the constant pressure for continuous innovation are motivating organizations to leverage the use of social media to improve their performance (Sarka & Ipsen, 2017). A large and growing number of employees is using SM in the workplace and it is also affecting various organizational phenomena and processes, leading organizations to seek for the advantages of SM collaboration tools (Leonardi & Vaast, 2017; Sun et al., 2019).

Typically used for communication, collaboration, knowledge management, and knowledge sharing (Sarka & Ipsen, 2017), social media motivated a new set of models for various kinds of businesses, causing leading executives and researchers to keep prospecting new uses in business (Hanna et al., 2011; Naeem, 2019). Driven by new management trends and innovations, organizations are obtaining benefits from exploring SM for different business functions such as product development, insurance, sales and marketing, healthcare, information technology, market research, academia and government (Gholami & Murugesan, 2011; Kanagarajoo et al., 2019; Sun et al., 2019).

Social media, knowledge, and knowledge sharing

Knowledge is a meaning set of information, continuously created in organizations (Rowe, 2014). It can be thought as information in action, transformed and enriched by personal experience, beliefs, and values (Nidhra et al., 2013). Knowledge can be either tacit or explicit. Tacit knowledge is embedded in a person's mind, deeply grounded in an individual's action and experience, is difficult to be communicated, articulated, shared with others or between projects (Nidhra et al., 2013; Panahi et al., 2012; Rowe, 2014). In contrast, explicit knowledge is formal and systematic, shared in the form of data, specifications, manuals, books, procedures, papers, etc. (Nidhra et al., 2013; Panahi et al., 2012; Rowe, 2014).

Nowadays organizational competitiveness derives mostly from such intangible resources as knowledge, whose processes and practices set the foundation for ensuring operational effectiveness, employee creativity and high-performance standards (Navimipour & Charband, 2016; Sun et al., 2019). Knowledge is considered essential for the creation of competitive advantage (Gaál et al., 2015; Kearns & Lederer, 2003; Lindner & Wald, 2011), and sharing is the most vital among knowledge management processes, since the vast majority of the initiatives depend upon it (Anwar et al., 2019; Krumova & Milanezi, 2015).

By means of effective knowledge sharing, organizations are able to integrate experts' critical knowledge, skills and abilities to carry out complex and innovation work (Navimipour & Charband, 2016). Within organizations, the role played by knowledge sharing is meaningful among social interaction and collaborative behaviors, so much so that disseminating knowledge quickly and efficiently has become imperative (Naeem, 2019; Sun et al., 2019). In consequence, linking and sharing the produced and distributed knowledge is a key challenge for contemporary organizations, be it profit, nonprofit, or governmental (Yuan et al., 2013).

Information technology is one of the main enablers of knowledge sharing activities and processes (Panahi et al., 2012). In this regard, social media tools work to foster effective knowledge sharing at individual, group, community and organizational levels, encouraging participation, conversation, openness, creation, and socialization among the community of users (Naeem, 2019). Organizations then seek to inspire and exploit knowledge sharing by expanding their technologies and practices, making leaders, consultants and researchers increasingly try to intensify the adoption of social media tools to support knowledge sharing practices, although it is usually complex and complicated (Gaál et al. 2015; Naeem, 2019).

Panahi et al., (2012) describe some characteristics of social media tools, categorized into five features that encourage, support, and enable people to share knowledge easily and efficiently, helping people get connected, building relationships, and developing trust: i) user-generated content; ii) peer to peer communication; iii) networking; iv) multimedia-oriented; and v) user friendly. On the other hand, Naeem (2019) points out that social media has limitations as a technological support to enhance knowledge sharing, such as fear of losing power, lack of intention to share knowledge, lower level of motivation, and resistance toward technology. He claims that it is important for organizations to understand and manage these limiting situations to use social media tools efficiently and effectively.

Social media, knowledge sharing and IT project management

Organizations have been using IT projects to achieve strategic objectives and create competitive advantage and other sources of value since the mid-60s, at least (Bredillet, 2010). The rapid changes in technology, the design of the project team, the complexity of the project, and the goal, make IT projects different, since they may continue for a number of years, involve people from different countries, speaking different languages and having different cultures (Foote & Halawi, 2018). In this context, IT projects can be defined as 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; Karlsen & Gottschalk, 2004).

Technological advancement and the increased use of social media have transformed the practice of project management by project teams (Auinger et al., 2013) and the context in which team members operate (Storey et al., 2014), including IT projects. Collaborative social media tools enable project teams by effectively supporting remote work, facilitating collaboration with other partners and in different locations, which is a challenge in contemporary organizations (Kanagarajoo et al., 2019; Portillo-Rodríguez et al., 2012).

In project's collaborative activities, knowledge sharing efforts complement skills and generate synergy allowing members to increase their strengths and decrease their weaknesses (Davis, 2009; Hsu et al., 2011). According to such authors as Navimipour and Charband (2016) and Sarka and Ipsen (2017), knowledge sharing within projects provides a link between the individuals and the team, increasing team's performance, reducing cost and improving innovation capability. Thus, an effective learning from experience on other projects is considered an organizational key factor leading to consistently successful projects (Karlsen & Gottschalk, 2004).

For IT project managers it is a challenge to lead their teams in effectively conducting knowledge sharing and knowledge creation processes hence they are continuously looking for ways to share knowledge (Mueller, 2015; Rowe, 2014). In the same vein, effective knowledge dissemination within a project workplace or between different projects is also a challenge for it is difficult to establish consistent routines to capture learning and maximize knowledge flow (Karlsen & Gottschalk, 2004; Navimipour & Charband, 2016).

Technological support by different tools is a decisive facilitator to successful knowledge sharing and how to leverage on such a tool support becomes a key point in a project work environment (Nidhra et al., 2013). Collaboration tools such as the currently well-known Trello, Yammer, Slack, Zoom and Google Drive will become increasingly important for projects in the coming years (Walker & Lloyd-Walker, 2019). For project managers it is an opportunity and a challenge to go beyond traditional tools and exploit the potentiality of social media within the project management context (Nach, 2016).

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3. Method

This research adopted a qualitative method with exploratory approach, materialized by conducting semi-structured interviews regarding the use of social media collaborative tools to share knowledge in IT projects. The interview was designed according to the guidelines of the seven stages systematic process by Steinar Kvale (2008) consisted of the following elements:

Thematizing - Involved formulating the purpose and the theme of the investigation before starting the interviews. In this case the theme defined for the investigation was the use of social media collaborative tools to share knowledge within the context of IT projects.

Designing - The interview protocol was designed; a list of social media and project management collaboration tools was produced; and an informed consent form was created. Table 1 presents the interviewees' profiles.

Table 1
Interviewees' profiles

Interviewee	Occupation	Business Sector	Years in IT Sector	Years in IT Project Management
I01 - RC	Project Manager	Municipal Government	35	15
I02 - RK	Project Manager	State Government	25	25
I03 - RS	Project Director	Multinational Company	20	14
I04 -MA	Project Coordinator	Telecom	20	20
I05 - SC	Project Manager	Multinational Company	27	10
I06 -RP	Project Manager	Multinational Consulting	25	12
I07 - AF	Project Manager	Consulting Company	20	20
I08 - JI	Project Manager	Consulting Company	24	10
I09 - SC	Project Manager	Multinational Company	10	10
I10 - SV	Project Manager	Multinational Consulting	23	10
I11 - VV	Operational Manager	Consulting Company	30	22
I12 - LA	Project Manager	Multinational Company	18	8
I13 - VB	Project Manager	Multinational Bank	16	11
I14 - JQ	Research Manager	Multinational Company	26	10
I15 - TC	Project Manager	Multinational Company	11	10

Note. Source: Created by the authors

Fifteen Brazilian IT project managers accepted the invitation and were interviewed, five women and ten men from distinct business sectors, having at least 10 years of work experience in IT project management. The participation was voluntary, and the interviews were scheduled to suit interviewees' availability.

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

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

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Analyzing - The interviews content analysis was performed using the technique proposed by Bardin (2011). The software ATLAS.ti, version 7.5.4, was used to support the analysis, by automating coding and storing transcriptions and results. The analysis technique used comprised three phases: i) pre-analysis, in which the general reading of the transcribed material took place; ii) exploration of the collected material, which was grouped by theme; and iii) treatment of results, when the categorized content was interpreted.

We draw on Cram and Marabelli (2018) to categorize knowledge sharing processes. Those authors updated a conceptual framework by Chau et al. (2003), which identifies the characteristics of eight key processes to support knowledge sharing, comparing traditional and agile project management approaches. Figure 1 presents the resulting summary.

Knowledge Sharing Process	Knowledge sharing support	
	Traditional Approach	Agile Approach
Competence Management refers to identifying what team members know or do not know, as well as making each one aware of knowledge holders that might be relevant to their work.	Formal status reports, assigned responsibilities based on document ownership, direct managerial oversight.	Ongoing communication between stakeholders to establish a shared understanding and to discuss progress. Collective ownership allows team members to monitor their colleagues' work.
Continuous Learning, by reusing previous knowledge to raise, discuss and deal with success factors and obstacles.	Postmortem reviews and lessons-learned processes at the end of project stages, at big milestones or at the project completion.	Person-to-person interactions using techniques such as pair programming and feedback sessions. Retrospective activities at the end of sprints.
Use of **Documentation** referring to project knowledge about the requirements and designs of the product, the development process, the business domain, and the project status.	Extensive documentation, consisting of artifacts such as requirements definition, design specifications, and development plans.	Lean, mean and "just enough" documentation, which may include techniques such as user stories and user acceptance tests.
Use of infrastructure as **Knowledge Repositories** to facilitate the capture and store of knowledge, making it accessible to the entire organization.	Explicit knowledge stored in documents within formal repositories.	Reliance on tacit knowledge, trial and error, and communication among team members. Use of lightweight, informal knowledge repositories in either digital or non-digital form.
Gathering **Requirements and Domain Knowledge** by using techniques to determine and plan the features that must be implemented.	Formalized requirements captured before initiation of design and development. ore initiation of design and development; As-needed interaction between project team and customers.	Active stakeholders and user participation; high readiness for change. Requirements are estimated for workload, prioritized, and contextualized as stories or test cases.
Team Composition refers to grouping different roles in project teams and their influences on knowledge flow.	Clearly defined, role-based teams.	Cross-functional teams; team members play multiple roles throughout the project.
Training refers to disseminating management, process, and technical knowledge to the team.	Formal, facilitated training sessions, often using static training materials.	Informal training practices such as pair programming and daily meetings.
Trust and Care refers to the development of organizational and individual trust in the team and between the team and the customer.	Low reliance on trust. Formal policies including processes that mandate periodic management reviews.	High empowerment and trust within the team foster interactions among members, built from techniques such as collective ownership,

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The key for knowledge sharing here are the voluntary interactions.

standup meetings, and collaborative workspaces.

Figure 1. Knowledge sharing support in project management dimensions.
Source: Adapted from Cram, W. A., and Marabelli, M. (2018). Have your cake and eat it too? Simultaneously pursuing the knowledge-sharing benefits of agile and traditional development approaches. *Information and Management*, *55*(3), 322–339. https://doi.org/10.1016/j.im.2017.08.005

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

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

4. Results and Discussion

The relationship between knowledge sharing processes and social media tools was mapped and is presented in this section. Afterwards, we highlight and discuss details of the interviewees' answers considered relevant to build the knowledge pursued in the research.

4.1 Tools usage and knowledge sharing processes supported

In the course of the analysis, the collaborative tools were classified as categories and tool use mentions were considered as codes. Figure 2 presents the mapping between social media tools and the knowledge sharing processes they support, according to the interviewees.

	Competence Management	Continuous Learning	Documentation	Domain Knowledge and Requirements	Knowledge Repository	Training	Trust and Care	#Total	%
Canvas						1		1	0,55%
Microblog	1							1	0,55%
Q&A site						1		1	0,55%
Videoshare						1		1	0,55%
Blog					1	1		2	1,09%
Code hosting					2			2	1,09%
Forum							2	2	1,09%
Learning platform						2		2	1,09%
Podcast		1	1			1		3	1,64%
Tagging	1	1					2	4	2,19%
Social Network		2			4		3	9	4,92%
Webinar				1		8		9	4,92%
Issue tracker	1	2		1	2		5	11	6,01%
Instant messenger	3			1		5	14	23	12,57%
Videoconference	4	2		1		8	8	23	12,57%
Shared repository	1		7		17	1	4	30	16,39%
Wiki	1	6	10		34	5	3	59	32,24%
#Total	**12**	**14**	**18**	**4**	**60**	**34**	**41**	**183**	
%	6,56%	7,65%	9,84%	2,19%	32,79%	18,58%	22,40%		**100,00%**

Figure 2. Mapping between tools use and knowledge sharing processes supported.
Source: Created by the authors

The tools which use was mentioned were mapped to the corresponding knowledge sharing processes they support or where the interviewees recognize their potential use. Each cell of the spreadsheet in Figure 2 contains the number of citations regarding the relationship between line and column. The use of microblogs for competence management, for example, was mentioned once. More than one citation may have come from the same interviewee. Totals

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and percentages by tool and by process are presented. Details on the use of the most mentioned tools i.e., wikis, shared data repositories, videoconferencing, instant messengers, and issue trackers are as follows.

Wikis. All the interviewees but one mentioned the use of wikis in their organizations, mostly as a repository for technical and project management knowledge and documentation. Wikis were reported to be rich and powerful repositories of structured data, storing knowledge related to different subjects such as lessons learned, project history, training material, problem solving, bug fixing, software version updates, software code, sprints documentation, tools configuration optimization, project management processes, status reports, and project best practices. Searching for knowledge, project team members consult not only corporate wikis, but also public ones, like the Wikipedia, and vendor's wikis made available for a period. Interviewees considered wikis an effective and dynamic source of structured knowledge whose resources facilitate searching. In this regard, besides knowledge repository and documentation, they also reported wiki use to support knowledge sharing processes such as training, lessons learned and even trust and care, when project members and stakeholders collaborate in the production of technical documents, and best project practices.

Shared data repositories. Seven interviewees mentioned the importance of these repositories in the organization to preserve project knowledge, by storing process documents, templates, and manuals. These documents are used particularly to train newcomer employees. The capability of permitting collaborative edition was also highlighted because of the time reduction for project documents production it provides. SharePoint, Google Drive, Dropbox, and OneDrive were mentioned.

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

Instant messengers. All the interviewees highlighted the intense use of instant messengers in their projects. Team members and project managers usually take part in several groups, so much so that for some of them the great number of groups becomes a problem. In some cases, the interviewees have to join groups with the customers, although its use is forbidden for official use their organizations. Instant messengers are used for sharing knowledge in projects individually or in groups, to solve doubts, share technical and project management knowledge. Only one of the project managers reported it was not used for knowledge sharing activities. Mentions to instant messenger use are particularly related to sharing and storing informal knowledge in the course of personal interaction with the colleagues. One of the most appreciated and mentioned features is the possibility of immediate communication to disseminate urgent, recent, and important knowledge. WhatsApp, Telegram, Facebook Messenger, and Teams were mentioned.

Issue trackers. Five interviewees reported the use of an issue tracker tool. The discussions stored during bug solving and other activities of issues control are reused almost like lessons learned. An interviewee said that he and his team interact with customers within Jira, so the entire service history and the entire knowledge base to solve the customer's problem

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remains stored there. Different project teams can consult the stored knowledge to solve doubts and look for known problems solutions. Redmine and Jira were the issue trackers mentioned.

4.3 Discussion

To complement the construction of the knowledge pursued in the research we discuss the project managers answers, linking them with topics described in the literature, highlighting aspects related to most used tools, difficulties of use, organizational enablers and barriers, and the COVID-19 pandemic influence.

.Few tools concentrated most of the use, in spite of the number of different tools mentioned. Only five tools, 29,41%, were mentioned more than 10 times, but represent 80% of the mentions: wikis, shared repositories, videoconference tools, instant messengers, and issue trackers. The first two technologies suggest that storing and producing documents are perhaps the most relevant use of social media tools, as knowledge repository and documentation KS processes received 42,63% of the mentions. In this respect, Portillo-Rodríguez et al. (2012) found that wikis and shared repositories were among the three main support for such organizational activities as knowledge sharing whereas Zahedi et al. (2016) reported the comprehensive and increasing use of these same tools. The number of mentions to videoconferencing and instant messenger reflects a growing need of these technologies, especially in the current COVID-19 pandemic scenario. There is an increasing number of distributed IT project environments and of IT project members working from home and using them to perform their work activities (Forsgren & Byström, 2018; Ozguler, 2020). Foote and Halawi (2018) also pointed out that instant messengers and videoconferencing tools aided team members to develop higher quality software in an insurance company, keeping the number of defects to a minimum. The issue track use is related to software development technical activities such as bug tracking and issue control, but curiously the answers revealed that it also serves as a knowledge base for lessons learned, informal knowledge as well as an instrument for interaction with customers.

From the SM tools list presented to the project managers before the interview, RSS feeds and vodcasts received no use reports, but only one participant knew all the tools in the list. A possible cause of this unfamiliarity was pointed out: "these tools are very good, but I think that some of them were not very well disclosed, when they appeared.". Interviewees also reported difficulties with the sufficiency and the suitability for use of the technologies available to support knowledge sharing as well as the familiarity with the tools adopted, as described by Anwar et al. (2019) and Kukko (2013). One of them had to adapt a tool to share project Kanban visualization; another one uses an unofficial videoconferencing tool because the one available is outdated. Consistent with the findings of Ranjbarfard et al. (2014), a respondent related that the adoption of tools not aligned with projects processes resulted in employees' resistance and "that one person starts to influence the others. This fact creates a barrier affecting many processes and one of them is knowledge sharing". There were also reports of team members making little or no use of collaboration tools due to not realizing their benefits or even for not being aware that they are available, corroborating Hysa and Spalek (2019) who observed in a survey that the ''inability to locate the correct knowledge source'' was a major cause for inadequate knowledge sharing.

All but one of the interviewees mentioned a class of collaborative tools, which we call here "integrated", referring to an environment with a unified interface that comprises a set of SM tools. New applications and tools can be added by means of plugins, components that interact with the integrated environment through APIs - Application Programming Interfaces. Their answers show that integrated tools can provide support to the knowledge sharing

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processes categorized here. The evaluation has been positive, both when used in regular or experimental basis. One of them said that these tools are being adopted due to the power of bringing people together and that "in this moment that we are living, with the coronavirus and so on, until now, these tools have been useful for companies to be able to conduct their daily activities". Ten interviewees reported the use of Microsoft Teams, a platform where team members can find such collaborative tools as wikis, forums, instant messengers, videoconference, and webinar tool. Two respondents mentioned Microsoft Team Foundation Servers (TFS), an integrated tool that covers the entire software development life cycle, which is now called Azure DevOps Server, and two other use Jira and its plugins, especially Confluence and Bitbucket, as an integrated tool for project and knowledge management. All these reports are in accordance to Narazaki et al. (2020), who asserts that social media should be integrated, since individuals desire ease of use and accessibility.

Still in this respect, the lack of integration of IT-based tools has long been considered a barrier to knowledge sharing, causing much work to be carried out and impeding the way people do things (Riege, 2005; Santos et al., 2012). Niazi et al. (2015) found the "lack of data integration due to different collaboration tools" as the fourth more cited barriers to existing tools used in Global Software Development (GSD). Moreover, Forsgren and Byström (2018) refer to different types of SM tools used simultaneously, competing with one another, creating conflicts and redundancies, suggesting that ensuring efficient integration of the technology is an essential managerial task. The variety of tools available and incompatible with each other make this task even harder to project managers (Niazi et al., 2015; Pirkkalainen & Pawlowski, 2014). Consistent with that, studies referring the use of integrated tools have come out in the literature: Chadli et al. (2016) mapped tools that support group interactions in GSD projects and found some kind of integration in only 23% of them. Ikemoto et al., (2017) concluded that Web 2.0 concepts and technologies need to be integrated via a single interface to reach their full potential. Veronese and Chaves (2016) presented an integrated set of technologies to promote lessons learned in projects. Ikemoto et al. (2020) proposed the SM4PM a prescriptive framework for guiding the integrated use of SM in project management, to which they found no empirical evidence. Narazaki et al. (2020) instantiated the SM4PM, to evaluate knowledge management in project management in a public security organization.

Along with the use of SM tools, the respondents reported a significant use of such traditional instruments as file system directories and emails to store and share knowledge, produced mostly in such applications as PDF, Word, Excel, PowerPoint, and Project. There were also reports on the difficulties with unstructured data to perform searches both in traditional and in social media repositories. Barriers to using repositories are mentioned in the literature related to poor or ineffective search mechanisms and/or excess of contents, making data retrieve a difficult task, impacting on the behavior of team members in relation to the use of social media to share knowledge (Dingsoyr & Smite, 2014; Kukko, 2013; Ranjbarfard et al., 2014; Zahedi & Babar, 2014). In accordance, four interviewees reported the use of unfriendly tools in their companies, with a lot of stored data and problematic searches, so much so that it is ignored if knowledge is being reused, because "people don't really know how to search, if by hashtag, or by at sign, or by subject" and in this kind of situation people "tend to look for an easier way" or "give up seeking uncategorized knowledge, saying that it does not exist".

Cultural and organizational barriers were also mentioned. The interviewees reported team members' lack of interest, even resistance, to sharing knowledge by means of social media tools. This question seems to be generalized, taking place in national, multinational, public, and private organizations. There were mentions to the influence of cultural factors, like the conservativeness of public employees and to the difficulty with changes among the Latin-

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Americans, as cases were reported of a multinational company where the use of the same tool to store and share project knowledge is much more intensive in the United States and Europe than in Brazil and of organizations in the public sector where outsourced workers and employees coming from the private sector are more willing to share knowledge in projects.

Project managers also mentioned existing organizational aspects that make knowledge sharing processes more difficult as well as the lack of others that could facilitate it. Support in the literature was found to them. The lack of incentive and the lack of a clear institutionalized process to share knowledge within and between projects were reported. In this respect, Riege (2005) says that " the lack of leadership and managerial direction clearly affects communicating the benefits and values of knowledge sharing", whereas Asrar-ul-Haq and Anwar (2016) and Zahedi et al. (2016) identified the emphasis on KS practices, the definition of a well formed process and of plans for use of existing tool as important enablers of knowledge sharing practices. Project managers also complained that were not usually able to share knowledge due to the he lack of available time and heavy workload, corroborating studies defending that people should have enough time available to use knowledge sharing methods and tools if the organization intends to operate with knowledge creation and sharing (Anwar et al., 2019; Daemi et al., 2020; Ranjbarfard et al., 2014).

Finally, we highlight the impact of the recent COVID-19 pandemic on the use of social media tools in organizations, including for knowledge sharing. It was reported that before the pandemic scenario there was reluctance to release employees to work from home as well as other barriers posed by the companies due to the fear of falling productivity, to avoid security problems, and to guarantee the confidentiality of processes and products. An interviewee reported, for example, the ban on the use of instant messengers to carry out such official acts as closing a project stage. This lack of confidence in the use of SM tools, due to risks of productivity to drop, and the fear that project personnel would waste time on non-project related matters, had already been observed by Hysa and Spalek (2019) and by Daemi et al. (2020). As an illustration, Ramasamy (2020) cites the comment of a Indian IT senior manager that "not all employees are honest and capable of working from remote locations" and productivity would go down to some extent. The COVID- 19 pandemic, however, was a game changer, as the social isolation rules introduced led many organizations to rethink their policies and implement more intensive use of teleworking, forcing the adoption of collaborative social media tools in a short time, even some that had not been used before (Ozguler, 2020). In this regard, a project manager reported that before the pandemic, online meetings in projects were not approved by the top management in his company, but that all changed and even the status reports meetings are now held via videoconference.

5. Conclusion

This study aims to investigate IT project environment from the perspective of senior practitioners, seeking to gather useful information to identify user needs and carry out the definition of practical artefacts to support knowledge sharing in this kind of projects. Fifteen Brazilian IT senior project managers were interviewed with this purpose.

The technique proposed by Bardin (2011) was used to carry out the content analysis. The software ATLAS.ti, supported the analysis of the transcribed texts. The analysis and presentation of the results draw on the conceptual framework of eight knowledge sharing processes proposed by Chau et al. (2003) and updated by Cram and Marabelli (2018). The emerged relationships between processes and social media tools were mapped.

Results show that few tools concentrate most of the usage reported in the interview answers: wikis, shared repositories, instant messengers, videoconferencing tools, instant

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messengers, and issue trackers. RSS feeds and vodcasts received no usage mentions, while only the intention of video hosting sites use was reported. The increasing importance of the integrated tools to provide support to the knowledge sharing processes was identified, and Microsoft Teams was the most mentioned tool.

Interviewee's answers also show that Knowledge Repository, Trust and Care and Training are the knowledge sharing processes mostly supported by collaborative social media tools in IT projects. Documentation, Continuous Learning and Competence Management and Domain Knowledge and Requirements were less mentioned, while Team Competence was not mentioned by the interviewees.

Additionally, relevant topics to build the knowledge pursued in the research were highlighted and discussed. In this regard, interviews revealed that project managers do not have much information about some social media tools; that the use of e-mails and file system directories is still intense to store and share knowledge; that cultural factors influence the lack of interest and resistance of project team members in sharing knowledge by means of SM tools; that organizational aspects as the lack of management support, of available time and of a defined process are barriers to use SM tools for knowledge sharing; that the COVID-19 pandemic led many organizations to rethink their policies and implement more intensive use of teleworking adopting collaborative social media tools.

The main limitation of the current work is the somewhat low number of interviews conducted and analyzed. This limitation, however, does not invalidate the findings, once the study follows a steady systematic investigation process and the interviewee's background related to the object of study is solid.

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

The findings of this study will provide information and insights on the definition and development of artifacts to support knowledge sharing in IT projects. At the moment they are developed and made available, the use of such artifacts can contribute to benefit the communities of researchers and professionals in project and knowledge management, possibly increasing efficiency and positively influencing the success of IT projects.

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