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

USO DE MÍDIAS SOCIAIS PARA PROMOVER COMPARTILHAMENTO DE CONHECIMENTO EM PROJETOS DE TECNOLOGIA DA INFORMAÇÃO: REVISÃO SISTEMÁTICA E AGENDA DE PESQUISAS FUTURAS

USO DE LAS REDES SOCIALES PARA PROMOVER EL INTERCAMBIO DE CONOCIMIENTOS EN PROYECTOS DE TECNOLOGÍA DE LA INFORMACIÓN: UNA REVISIÓN SISTEMÁTICA Y UNA AGENDA DE INVESTIGACIÓN FUTURA

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ABSTRACT

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

Methodology/Approach: With descriptive and exploratory purposes, a systematic literature review was carried out, adopting a systematic process to define the research protocol.

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

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

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

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

RESUMO

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

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

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

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

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

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

RESUMEN

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

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

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

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

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

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

1. CONTEXT AND BACKGROUND

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

1.1 – Social Media

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

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

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

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

1.2 - Knowledge, knowledge sharing and social media

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

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

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

Information technology is a main enabler of KS processes (Panahi et al., 2012) and SM tools foster effective KS through social interaction and collaborative practices at individual, group, and organizational levels (Naeem, 2019). In this context, organizations seek to inspire and exploit it by expanding technologies and practices (Gaál *et al*. 2015). Leaders, consultants and researchers increasingly try to intensify SM tools adoption to support KS, however it is usually complex and complicated (Gaál *et al*., 2015; Naeem, 2019).

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

1.3 - Knowledge sharing and project management

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

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

1.4 - IT project management

"Organizations undertake IT projects to transform and grow" (Daemi et al., 2020, p. 6), so much so that IT project management is a key concern, leading to a special interest in its improvement (Rai, 2016). However, despite the new concepts, methodologies, and tools, IT project management is still notorious for failures, due to such factors as rapidly changing environment, increased demands, complex systems development and complex infrastructure required (Babenko et al., 2019; Gholami & Murugesan, 2011).

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

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

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

1.5 – Objective and Research Question

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

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

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

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

2. METHODOLOGY

In the context of the objective proposed, this review is both descriptive and exploratory. As a descriptive review, it aims to organize what is known about a recent or emerging technology, service or practice (Rowe, 2014b), and as an exploratory review it aims to

provide an overall picture of the subject area, generating ideas, insights, and clarifications, as the first step of a broader investigation (Petticrew & Roberts, 2008).

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

2.1 - Research question formulation

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

2.2 - Search strategy

Two leading academic databases were searched for papers, Scopus and Web of Science. To ensure rigor, only peer-reviewed journal articles were considered in the result set. Additionally, manual searches were carried out using the technique of backward reference. The search string defined comprises three sections: “Social media”, “Knowledge sharing” and “IT project management”. Along with these terms, other keywords with similar meanings were used to avoid omitting studies. Table 1 presents the search string used.

Table 1
Search string used

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

Note: Created by the authors

2.3 - Database screening

The search on the two databases was conducted in December 2019 and January 2020. The search engine was configured to select only articles and reviews published in journals, to

filter by subject area/category and to look for the search string in titles, abstracts, and keywords. The search was limited to the timeframe of 2010–2019. Figure 1 presents a summary of the database screening step.

Database Screening

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

Figure 1: Summary of the database screening
Note: Created by the authors

2.4 - Study selection

Inclusion and exclusion criteria were applied to the result set retrieved from the databases, to select adequate studies to answer the research question. The final set is composed of 43 papers. A summary for this process is presented in Figure 2.

Study Selection

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

Figure 2: Summary of the study selection
Note: Created by the authors

After the selection, the papers were sorted by publication year and name and assigned a unique identification number. Table 2 presents the complete list of the selected papers.

Table 2
List of selected papers

Id No.	Title	Authors	Year
P01	Analysis of virtual communities supporting OSS projects using social network analysis	Toral, S.L., Martínez-Torres, M.R. & Barrero, F.	2010
P02	Knowledge repository to improve agile development processes learning	Amescua, A., Bermón, L., García, J. & Sánchez-Segura, M.-I.	2010
P03	Qualitative Analysis of Semantically Enabled Knowledge Management Systems in Agile Software Engineering	Rech, J., & Bogner, C.	2010
P04	Design guidelines for software processes knowledge repository development	Javier García, Antonio Amescuaa, María-Isabel Sánchez & Leonardo Bermón	2011
P05	Global IT Project Management Using Web 2.0	Gholami B. & Murugesan S.,	2011
P06	Global Software Development and Collaboration: Barriers and Solutions	Noll, J., Beecham, S., & Richardson, I.	2011
P07	Antecedents of collaborative behavior in companies: An analysis of the use of corporate blogs	Fernández-Cardador, P., Agudo-Peregrina, Á.F. & Hernández-García, Á.	2012
P08	Knowledge management: A Solution to requirements understanding in global software engineering	Khan, H., Ahmad, A. & Alnuem, M.A.	2012
P09	Tools used in Global Software Engineering: A systematic mapping review	Portillo-Rodríguez, J., Vizcaíno, A., Piattini, M. & Beecham, S	2012
P10	Wiki as a corporate learning tool: Case study for software development company	Milovanović, M., Minović, M., Štavljanin, V., Savković, M., Starčević, D.	2012
P11	Assessing technical candidates on the social web	Capiluppi, A., Serebrenik, A. & Singer, L.	2013
P12	Empirical studies on the use of social software in global software development-A systematic mapping study	Giuffrida, R. & Dittrich, Y.	2013
P13	Interactive knowledge asset management: Acquiring and disseminating tacit knowledge	Heredia, A., Garcia-Guzman, J., Amescua, A. & Sanchez-Segura, M.-I.	2013
P14	Knowledge transfer challenges and mitigation strategies in global software development – A systematic literature review and industrial validation	Nidhra, S., Yanamadala, M., Afzal, W., & Torkar, R.	2013
P15	Network ties and the success of open-source software development	Peng, G., Wan, Y. & Woodlock, P.	2013
P16	The use of different information and communication technologies to support knowledge sharing in organizations: From e-mail to micro-blogging	Yuan, Y Connie, Zhao, Xuan, Liao, Qinying & Chi, Changyan	2013
P17	Microblogging in open-source software development: The case of Drupal and Twitter	Wang, X., Kuzmickaja, I., Stol, K.-J., Abrahamsson, P. & Fitzgerald, B.	2014
P18	Organizational learning networks that can increase the productivity of IT consulting companies. A case study for ERP consultants	Bologa, R. & Lupu, A.R.	2014
P19	Study of factors influencing the adoption of agile processes when using Wikis	Heredia, A., Garcia-Guzman, J., Amescua-Seco, A. & Serrano, A.	2014

Id No.	Title	Authors	Year
P20	Understanding the attitudes, knowledge sharing behaviors and task performance of core developers: A longitudinal study	Licorish, Sherlock A. & MacDonell, Stephen G.	2014
P21	An Analysis of Problem-Solving Patterns in Open-source Software	Koo, H.-M. & Ko, I.-Y.	2015
P22	Automatic Mapping of User Tags to Wikipedia Concepts: the Case of a Q&A Website - StackOverflow	Joorabchi, A., English, M., & Mahdi, A. E.	2015
P23	Empirical investigation of the challenges of the existing tools used in global software development projects	Niazi, M., Mahmood, S., Alshayeb, M. & Hroub, A.	2015
P24	TagCombine: Recommending Tags to Contents in Software Information Sites	Wang, X. Y., Xia, X., & Lo, D.	2015
P25	Utilizing online serious games to facilitate distributed requirements elicitation	Ghanbari, H., Similä, J. & Markkula, J.	2015
P26	A systematic review of knowledge sharing challenges and practices in global software development	Zahedi, Mansooreh, Shahin, Mojtaba & Babar, Muhammad Ali	2016
P27	Knowledge Sharing on Enterprise Social Media: Practices to Cope With Institutional Complexity	Oostervink, N., Agterberg, M. & Huysman, M.	2016
P28	Network dynamics and knowledge transfer in virtual organizations	Gandal, N. & Stettner, U.	2016
P29	Open-source project success: Resource access, flow, and integration	Daniel, Sherae & Stewart, Katherine	2016
P30	Producing Just Enough Documentation: An Optimization Approach Applied to the Software Architecture Domain	Díaz-Pace, J.A., Villavicencio, C., Schiaffino, S. & Nicoletti, M. & Vázquez, H.	2016
P31	Semantic tagging and linking of software engineering social content	Bagheri, E., & Ensan, F.	2016
P32	A semantic wiki approach to enable behavior driven requirements management	Marques-Lucena, C., Agostinho, C., Sarraipa, J. & Jardim-Goncalves, R.	2017
P33	Documenting and sharing software knowledge using screencasts	MacLeod, L., Bergen, A. & Storey, M.-A.	2017
P34	Increasing the Impact of Wikis on Project Performance: Fine-tuning Functional Quality and Knowledge Sharing	Nabelsi, Veronique, Gagnon, Stephane & Brochot, Damien	2017
P35	Innovation In The Management Of Lessons Learned In An IT Project With The Adoption Of Social Media	Winter, Roberto & Chaves, Marcirio Silveira	2017
P36	Knowledge sharing via social media in software development: A systematic literature review	Sarka, P. & Ipsen, C.	2017
P37	Motivators for adopting social computing in global software development: An empirical study	Niazi, M., Mahmood, S., Alshayeb, M., Baqais, A.A.B. & Gill, A.Q.	2017
P38	The Role of Task Uncertainty in IT Project Team Advice Networks	Keith, Mark, Demirkan, Haluk & Goul, Michael	2017
P39	The structure and dynamics of knowledge network in domain-specific Q&A sites: a case study of stack overflow	Ye, D., Xing, Z., & Kapre, N.	2017
P40	Use of social media in IT project management: a literature review based on hermeneutics and a	Ikemoto, M. N., Gantman, S., & Chaves, M. S.	2017

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

Note: Created by the authors

2.5 - Data extraction and analysis

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

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

3. RESULTS AND DISCUSSION

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

3.1 - Types and denominations of IT projects

Although IT domain encompasses different types of projects, regarding the development of products, services, or processes such as software, information systems, software implementation, and deployment of IT infrastructure (Babenko et al., 2019) all but one papers address software development projects. Only P18, addresses *Enterprise Resource Planning* (ERP) projects. Figure 3 presents the types of IT projects found.

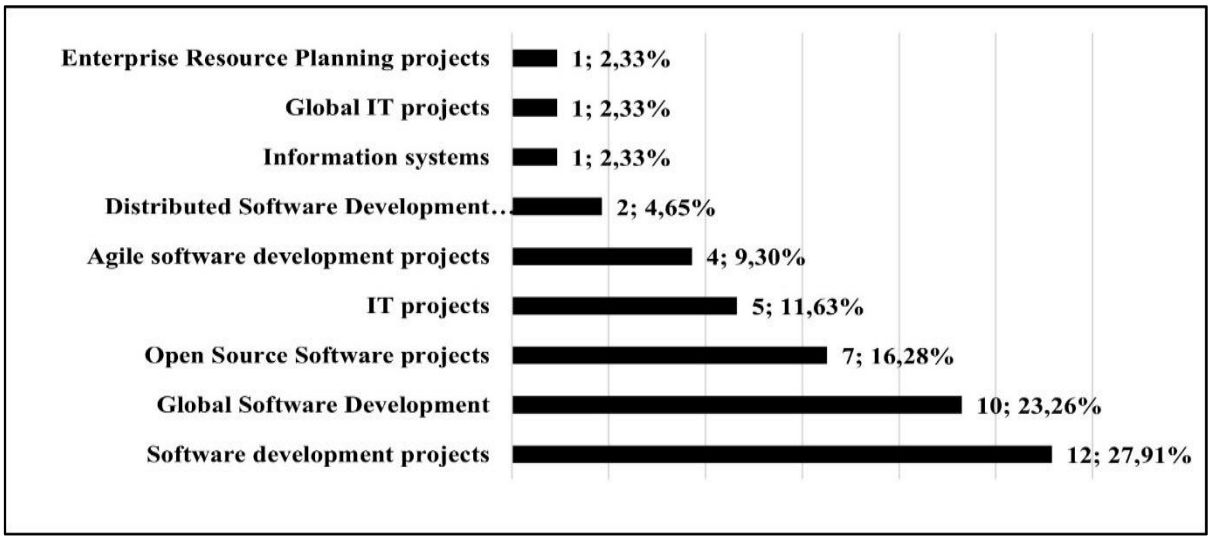

Figure 3: Types and denominations used in IT projects
Note: Created by the authors

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

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

3.2 - What are the most used social media to promote knowledge sharing in IT projects?

There were 113 mentions to SM tools in the 43 papers. Wikis, instant messengers and blogs, received 41.6% of all mentions. An intermediate group composed by discussion forums, internet conferencing tools, question-and-answer (Q&A) sites, microblogs, open-source environments, shared data repositories, social networks and tagging received 43.4% of the mentions. The remaining tools received 15.04% of the mentions, where two studies mention SM in general.

These numbers echo other systematic reviews results, particularly those regarding global software development (GSD) projects. Giuffrida and Dittrich (2013), in P12, found that instant messengers are the most used tool. Portillo-Rodríguez *et al*. (2012), in P09, report that wikis, blogs and shared data repositories are the main support for knowledge acquisition, sharing and distribution. Zahedi *et al*. (2016), in P26, report the comprehensive and increasing use of the same three tools. In a broadened scope, considering software projects in general, Sarka and Ipsen (2017), in P36, also found that wikis are the most used tool.

Along with commonly used SM tools, such as wikis and blogs, it is significant that tools strongly related to software development are among the most mentioned. Discussion forums, open-source environments, issue trackers and Q&A sites, mentioned in P22, P29, P39, P42, for example, are popular among software developers. This result highlights the importance of their use and suggests that researchers are increasing investigation on their contribution to KS.

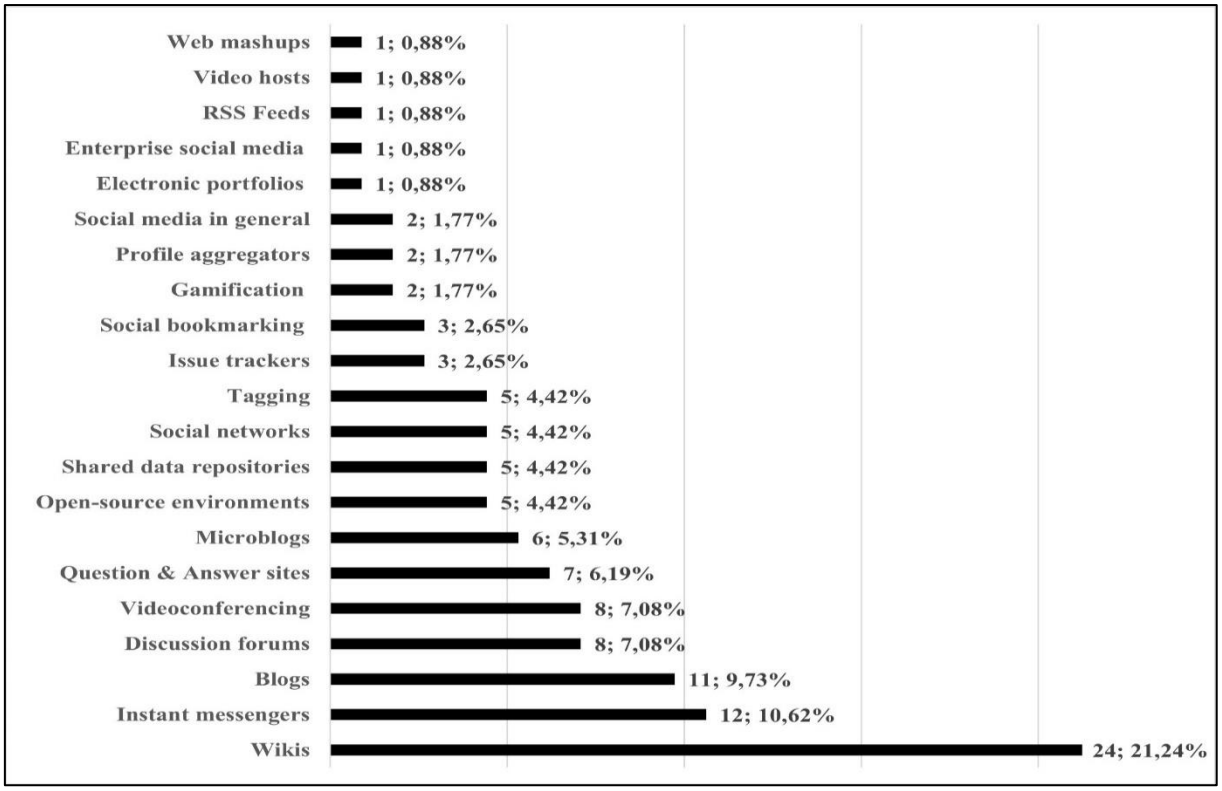

Figure 4: Most used social media tools to support knowledge sharing in IT projects
Note: Created by the authors

3.3 - Project tasks and processes where social media support knowledge sharing

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

Additionally, studies P05, P08, P25, P32 and P42 focus on requirement elicitation and management; P02, P04, P13, P19, P28, and P35 refer to lessons learned and learning processes; P12, P20 and P37 refer to project coordination and communication; P03, P04, P13 and P21 refer to software reuse; P10, P30, P33, and P43 refer to documentation and useful information; P01, P38, and P41 report contributions to support, bug fixing and clarifying doubts; P05, P11, P18, and P20 refer to team management. P03 refer to PM practices in general and, finally, P34 addresses the overall project performance. Tasks and processes are presented in Figure 5.

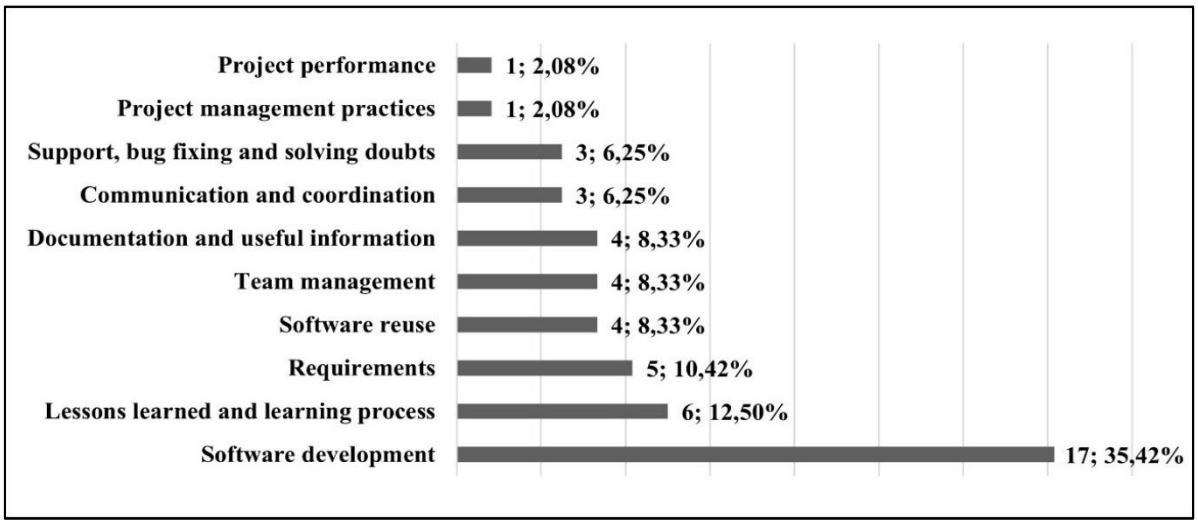

Figure 5: Tasks and processes where social media knowledge sharing.
Note: Created by the authors

3.4 - Stakeholders involved in using social media to share knowledge

Internal and external stakeholders involved are presented in Figure 6. Consonant with the prevalence of software development projects, software developers and software engineers are the main class of stakeholders involved in sharing knowledge. They are mentioned in 33 studies: P01, P02, P03, P04, P05, P08, P09, P10, P11, P13, P14, P15, P16, P17, P19, P20, P21, P22, P23, P24, P25, P27, P28, P29, P31, P32, P33, P35, P36, P39, P41, P42, and P43.

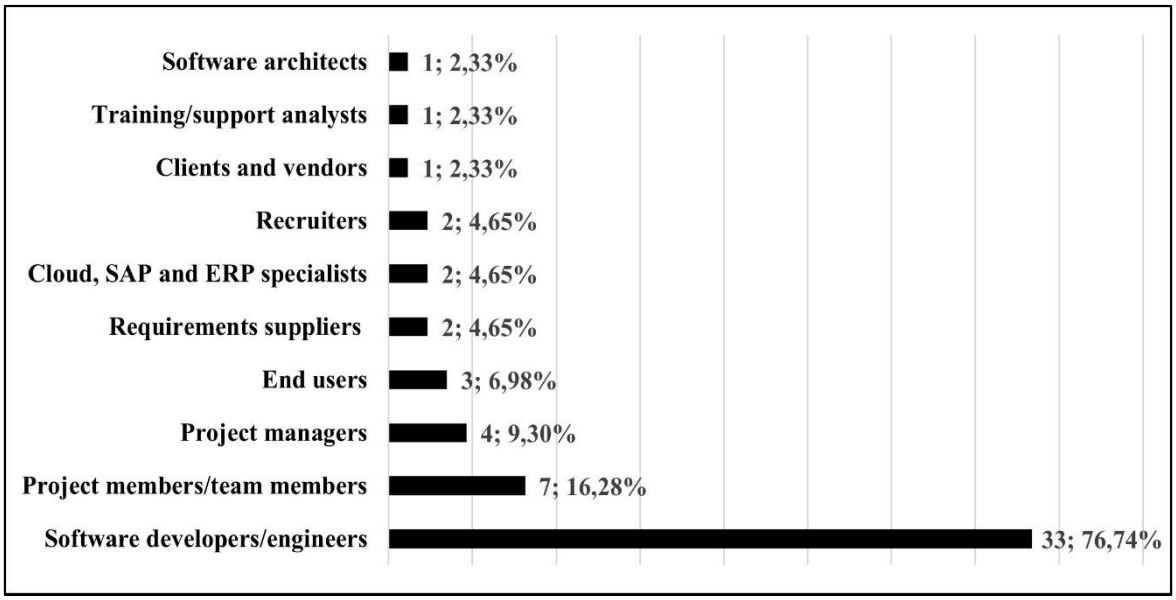

Figure 6: Stakeholders involved in knowledge sharing processes
Note: Created by the authors

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

3.5 - The contribution of social media use to promote knowledge sharing in IT projects

To discuss this topic, the categorization of six high-level themes proposed by Zahedi *et al.* (2016) was adopted: i) management; ii) team structure; iii) work processes/practices; iv) team cognition; v) social behavior; and vi) tools/technologies. Their SLR addressed GSD projects, but they suggest that these categories constitute a basic standard for other types of IT projects. Figure 7 presents the contribution of SM use to promote KS.

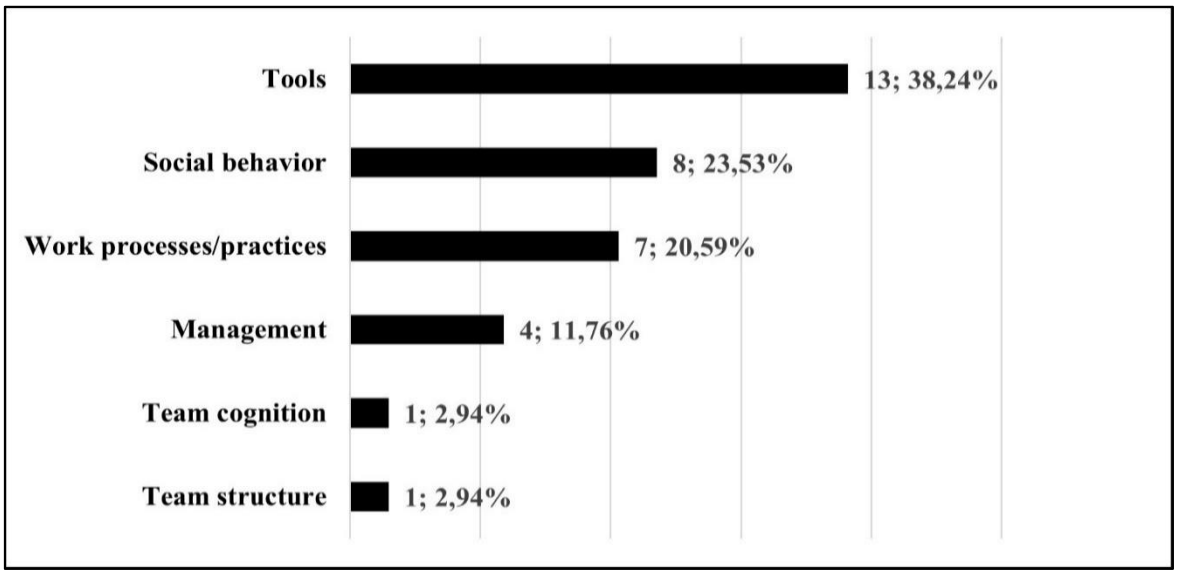

Figure 7: Contribution of social media use to promote knowledge sharing
Note: Created by the authors

3.5.1 - Management

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

projects in the public sector. P05 addresses team management, discussing awareness and use of SM to enable more efficiency and effectiveness.

3.5.2 - Team structure

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

3.5.3 - Work processes/practices

P10 is about wiki usage as a corporate learning tool by the software development team in a multinational company. P33 analyzes the use of screencasts hosted on YouTube to document and share software knowledge. P41 analyzes the use of instant messengers for software bug fixing activities between client and vendors. In P08, KS practices supported by audio/video conferencing and discussion forums are investigated as solution for challenges on requirement understanding. P25 raises a discussion on how the use of online serious games can improve requirement elicitation. P39 examines how URL diffusion in Q&A sites enables more effective sharing, use, representation, and search of knowledge in software engineering. P42 identifies the relevance of wikis and bug trackers as communication channels to capture, share, and update knowledge in GitHub.

3.5.4 - Team cognition

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

3.5.5 - Social behavior

Zahedi *et al*. (2016) highlight the influence of such factors as social ties, credibility, and trust to enable faster and more extensive KS. Studies under this category address these individual or collaborative social interactions. P01 discusses how the role played by developers in discussion forums can stimulate or decrease participation, co-learning and KS in projects. P07 characterizes and measures collaborative behavior in an Information Systems department, identifying factors influencing the use of corporate blogs. P15 examines network ties and co-membership among teams in a data repository to reveal the impact of KS on

project success. P16 addresses the contribution of SM in handling KS difficulties in a software company, related to awareness of expertise distribution, motivation for sharing, and network ties. P17 analyzes interactions, concluding that Twitter is useful in projects when tacit knowledge is externalized, saved persistently, and made publicly available. P20 analyzes instant messenger and discussion forums data from a corporate repository to study developers' attitudes, KS behaviors and task performance correlated to team success. P28 examines data from a software repository to study how changes in social network structures can foster knowledge transfers across distinct projects. P38 investigates IT projects teams in times of uncertainty, showing that blogs and wikis motivate and increase the importance of advice networks in KS.

3.5.6 - Tools/Technologies

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

lessons learned in IT projects. P43 proposes a tool to capture and tag relevant knowledge from objects in software information sites, along with a search mechanism to make KS easier and improve software development performance.

3.6 - Further research

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

3.6.1 - Addressing IT project management practices.

The first reflection regards the low number of papers addressing the management of the project itself, focusing on project manager activities, for example. A knowledge gap exists on how to make effective use of SM to promote KS within IT project management practices. Only a few papers contribute to improving project life cycle phases such as planning or controlling, thus echoing Chadli et al., (2016) who reviewed tools used in GSD and suggest that some PM areas need more attention from tool developers, so as to cover project whole life cycle.

3.6.2 - Addressing IT project management methodologies.

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

3.6.3 - Conducted in the public sector.

The low number of studies conducted in the public sector is also noteworthy, confirming Karagoz et al. (2020) assertion that KS in ICT project environment is under-researched within that context. Only two papers, P41 and P07, address research in governmental organizations. This evidence corroborates both Ahmed et al. (2019) and Sun et al. (2019), who suggest that organizations in the public sector are just beginning to take full advantage of SM use for KS. Nabelsi et al. (2017) also report a research gap on new

collaboration and knowledge management technologies in the public sector. On the other hand, Asrar-ul-Haq and Anwar (2016) detected a growing academic interest in KS in public sector after 2010, although they also report a lack of understanding of knowledge management in the public sector.

3.6.4 - On knowledge sharing in virtual and hybrid project teams.

Approximately half of the studies focus on projects developed by distributed teams, highlighting the importance of the relationship between team location and KS processes (Noll et al., 2011), confirming the increasing delocalization of project teams and the growing importance of collaboration tools to support virtual project workers to put their work activities together (Forsgren & Byström, 2018; Zin et al., 2018). Additionally, the recent COVID-19 pandemic led many project members to work from home and forecasts indicate an increase in global scale projects and the growth of distributed project environments (Ozguler, 2020). These facts intensify the interest in research on improving collaboration in IT projects developed by virtual or hybrid teams.

3.6.5 - On the use of different and integrated social media tools.

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

3.6.6 - On the integration of social media and new technologies.

Besides SM, other technologies have reached maturity and are now part of organizational life. Mobile technology permits knowledge to be created and shared in real-time and cloud computing is increasing efficiency and economy by moving IT services to the internet (Nach, 2016). Also, machine learning, AI, IOT, and other digital technologies are radically changing IT projects, generating multidisciplinary knowledge in real time, to be

managed and disseminated (Ghimire et al., 2017; Marnewick & Marnewick, 2019; Rai, 2016). Information is stored, processed, and retrieved using data-driven tools and SM will access it from watches, pens and vehicles via IOT (Carr & Hayes, 2015). Thus, new research is needed on the integration of these improvements with SM, in novel and useful artifacts.

4. CONCLUSION

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

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

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

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

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

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

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