Influence Factors for Knowledge Management Initiatives
A Systematic Mapping Study

Jacilane Rabelo and Tayana Conte
USES Research Group, Instituto de Computação, Universidade Federal do Amazonas, Manaus, Brazil

Keywords: Knowledge Management, Influence Factors, Software Engineering, Systematic Mapping Study.

Abstract: *Context:* Knowledge Management (KM) is becoming critical in software organizations due to the increasing demands of the market. Despite the importance of KM, there is no consensus on which factors can influence KM initiatives in software organizations. *Aim:* The goal of this paper is to investigate what are the factors that influence KM in software organizations. *Method:* we performed a systematic mapping study on influencing factors for knowledge management in software organizations. *Results:* From a set of 1028 publications, 147 publications were analyzed and 10 were selected in this mapping, which helped us identify the influence factors that were most cited by the authors. Among the selected publications, the following factors were the most cited: Organizational Culture, Leadership, Information Technology and Social Network of Knowledge. *Conclusion:* There is a shortage of papers that address this issue of influencing factors for software organizations, and how to assess these factors in software organizations. Most studies show statistical data on the relationship between KM and the factors, but do not show how these factors can be evaluated in the organization. These aspects need to be addressed in the influence factors in order to improve knowledge management initiatives in software organizations.

1 INTRODUCTION

Knowledge is essential for knowledge-intensive companies such as software-development companies (Menolli et al., 2015). Silva-Filho et al. (2016) state that knowledge is considered the main asset in Software Companies. Knowledge in software development projects is varied and grows in proportions (Carreteiro et al., 2016).

A successful Knowledge Management (KM) became a determining factor affecting the efficiency and performance of an organization (Sharma et al., 2012). KM in software organizations is seen as an opportunity to create a common language among software developers so that they can interact, negotiate and share knowledge and experiences (Aurum et al., 2013).

According to Moffett et al. (2002), many organizations are attempting to begin working with KM and they are unsure of which approach to implement. Mehta et al. (2014) argue that the main factors contributing to effective knowledge management are human and technical. Human behavior is the key to the success or failure of KM activities, since KM involves an emphasis on organizational culture, teamwork, promotion of learning as well as sharing of skills and experiences (Bollinger and Smith, 2001). Several papers in the literature have reported which facilitators influence KM implementations (Wang and Wang, 2016; Mehta et al., 2014; AL-Hakim et al., 2012; Allameh et al., 2011). In addition, related researches are focusing on how these factors can contribute to the successful implementation of KM, and which can lead to increased innovation and organizational performance improvement (AL-Hakim et al., 2012).

Although several papers investigate the relationship between influence factors and knowledge management, there is still a shortage of papers that show how these factors influence and can be exploited to support knowledge management initiatives in software organizations. Therefore, we have identified the need for a comprehensive research on factors influencing KM in software organizations.

Systematic mapping studies are carried out to give an overview of a research area through the classification of published contributions given an object of study (Oliveira et al., 2017). Our goal in this study, is to perform a Systematic Mapping on

Rabelo, J. and Conte, T.
Influence Factors for Knowledge Management Initiatives.
DOI: 10.5220/0006664700170028
In *Proceedings of the 20th International Conference on Enterprise Information Systems (ICEIS 2018)*, pages 17-28
ISBN: 978-989-758-298-1

research related to the factors that influence the initiatives of knowledge management. In addition, our intention is to identify ways to assess these factors in software organizations.

From an initial selection of 147 publications, we identified 22 different influencing factors. From the selected publications, the following factors were the most cited: Organizational Culture, Leadership, Information Technology and Knowledge Social Network. With this work, we present conclusions about the state of the art in this area of research and contribute to the improvement of the process of knowledge management in software organizations.

Besides this introductory section, the paper is organized in four more sections. Section 2 presents the background for this research. The research method and its details are shown in Section 3. Section 4 presents the results obtained in this research. Section 5 presents the discussions for this research. Finally, Section 6 presents our conclusions and future work.

2 RELATED WORK

This section presents literature reviews that have been conducted on knowledge management or influence factors for knowledge management.

The main asset from a software organization is the knowledge held by its employees and the organization's development culture (Bari and Ahamad, 2011). Knowledge in software development projects is varied and grows in proportions (Carreteiro et al., 2016).

According to Nonaka and Takeuchi (1995), there are two types of knowledge that need to be managed: tacit and explicit. Tacit knowledge is based on the person's experience, which due to its subjectivity is difficult to express with words, numbers and sentences (Nonaka and Takeuchi, 1995). Tacit knowledge is usually shared directly, by face-to-face contact, and is considered the most valuable type of knowledge (Ruhe, 2001). Explicit or codified knowledge is considered transmissible in formal and systematic language. Nonaka and Teece (2001) also state that, because this type of knowledge is objective, it can be represented in several ways (e.g. such as documents, reports and databases) and can be processed, transmitted and stored easily.

Due to the importance of KM, literature reviews on knowledge management and on the influence factors for knowledge management were carried out (Menolli et al., 2013; AL-Hakim and Hassan, 2012; Bjørnson and Dingsøyr, 2008).

Menolli et al. (2013) conducted a literature review aimed at understanding in which areas of software engineering the studies related to knowledge management are focusing, and how the concepts of knowledge management are being applied in software engineering work. The authors show that the publications focus on the software processes. In addition, the concepts of lessons learned and experience factory are widely used in the work of knowledge management in the area of software engineering.

Bjørnson and Dingsøyr (2008) present a Systematic Literature Review (SLR) that aimed to identify the empirical studies of knowledge management in software engineering. The authors present the main concepts and research methods being used, and point out possible gaps of research in the field that need further investigation. The authors concluded that: (a) software engineering has predominantly addressed the storage and retrieval of knowledge, ignoring other important aspects, such as the creation, transfer and application of this knowledge; (b) software development with agility has focused mainly on tacit knowledge-driven management activities, while traditional software development has focused primarily on explicit knowledge-driven management activities; and, (c) there is a lack of understanding about the identification and detailing of influence factors for knowledge management in software engineering.

AL-Hakim and Hassan (2012) conducted a literature review to examine the relationship between the critical success factors of knowledge management, innovation and organizational performance, particularly in the Iraqi mobile telecommunications industry. The goal of their study was to address the influence factors for KM, to increase innovation and to improve organizational performance. According to AL-Hakim and Hassan (2012), most of the influence factors explored by the reported works mention: (i) human resource management, (ii) information technology, (iii) leadership, (iv) organizational learning, (iv) organizational strategy, (iv) organizational structure, and, (v) organizational culture.

We have analyzed the three previously mentioned literature reviews and identified that:

- The review by Menolli et al. (2013) and Bjørnson and Dingsøyr (2008) - investigated knowledge management for software engineering, but did not verify the influence factors;

- The review by AL-Hakim and Hassan (2012) verified the influence factors of knowledge management, but did not analyzed them in the context of software engineering.

Therefore, we identified a need to associate a research that investigates the influence factors of KM in the context of software engineering.

In order to identify the factors that influence the initiatives of Knowledge Management and ways of evaluating these factors, we carried out a research in the literature. The next section shows the details of this literature mapping.

3 RESEARCH METHOD

Systematic Literature Mappings (SLM) are based on a well-defined research strategy that seeks to detect as much relevant publications of a research topic as possible (Kitchenham and Chartes, 2007). The following subsections detail the activities concerning the planning and conducting stages of this systematic mapping defined in our review protocol.

3.1 Research Question

Our main research question was: *"What are the factors that influence knowledge management initiatives in software development companies?"*.

The main goal of this systematic mapping was to identify the factors that can influence knowledge management initiatives in Software Engineering and related areas.

3.2 Search Strategy

The search terms were defined based on the procedures described by Kitchenham and Charters (2007), who suggested defining the parameters for PICOC (Population, Intervention, Comparison, Outcome and Context). The defined population is the organizations that develop software. The Intervention was composed of the influence factors of knowledge management. The Comparison was not applicable, since our goal was to characterize these influences factors. The Outcome were the influence factors and ways of evaluating these factors in software development organizations. Finally, the Context was not applicable, since there is no comparison to determine the context.

The search strategy should have the keyword sequences (terms) for carrying out the search (search strings). The choice of terms related to Software Engineering and Knowledge Management were based on the systematic review described in the paper by Menolli et al. (2013). The keyword sequences for the search were generated from the combination of terms. The formation of the search string respected the peculiarities of the search engine.

The search string is presented in Figure 1 and was used in the Scopus[1], Engineering Village[2] and IEEEXplore3 digital libraries. Scopus and Engineering Village are meta-libraries that index publications from several well-known publishers such as ACM, IEEE, Springer and Elsevier, besides allowing defining filters such as document type, language and knowledge area. IEEEXplore indexes various Software Engineering publication venues. Also, they allow the establishment of filters for selecting the document type and area of knowledge which were defined in our search strategy (http://ieeexplore.ieee.org/Xplore/home.jsp).

(("software engineering" **OR** *"software process"* **OR** *"software learning software organization")*
AND
("learning organization" OR "organizational learning" OR "knowledge management")
AND
("influence factor" OR "critical factor" **OR** *"critical success factor" OR "key factor"* **OR** *"knowledge management factor"))*
AND
(LIMIT-TO(SUBJAREA, "COMP"))

Figure 1: Search string used in the systematic mapping.

3.3 Publications Selection Process

The selection of the papers was carried out in two stages, in order to ensure the inclusion of publications that are relevant to the research. Not all publications returned with the use of the search string are useful in the context of the search, since search engines are restricted to the syntactic aspect:

- 1 St. Step – Selection of relevant publications (1st filter): in the 1st filter the title and abstract of the returned publications are read, applying the inclusion and exclusion criteria (see Table 1). This step was reviewed by another expert. In case of disagreement on any publication, this was included;

[1] http://www.scopus.com
[2] http://www.engineeringvillage.com
[3] http://ieeexplore.ieee.org/Xplore/home.jsp

- 2nd. Step – selection of the relevant publications (2nd Filter): all papers included as results of the previous stage (1st filter) were reviewed entirely by at least one of the researchers. This review concluded the selection of papers to be included in the data extraction process.

Table 1: Inclusion and exclusion set of criteria.

#	Inclusion Criteria
Inc1	The publication proposes/describes the factor(s) that influence KM initiatives
#	**Exclusion Criteria**
Exc1	The publication does not meet the inclusion criterion
Exc2	The full version of the publication is not be available for free in the selected sources
Exc3	Paper in languages other than Portuguese or English will be discarded

3.4 Data Extraction Strategy

The extraction process aims to extract relevant data from the selected publications. Table 2 shows the information that was extracted from each of the selected publications.

4 RESULTS

The systematic mapping involved two researchers, in order to avoid the bias of a single researcher carrying out the selection, analysis and extraction of the retrieved papers. One researcher specified the review protocol, which was reviewed by the second researcher.

For the first step, the researchers independently classified a sample of 86 randomly selected publications based on the selection criteria. The agreement between the researchers was evaluated by the Kappa statistical test (Cohen, 1960). The result of this evaluation showed almost perfect agreement between the two researchers (Kappa = 0,805) according to the range described by Landis and Koch (1977).

Table 2: Data extraction form for publications.

Item	Description
Publication data	Full publication reference
Publication summary	Short publication description
Context of use	Description of the context in which the influence factor was applied
Factor of influence / Bibliographic references	Name of the influence factor and data of the complete bibliographic reference of the cited factor
Does it show a questionnaire? If yes, please describe	Description of the questionnaire used and references used as a basis for the research
Type of carried out study	Description of the empirical study, case study, proof of concept and others
Type of data analysis	Description whether the data analysis is qualitative or quantitative
Procedures for collecting data	Description of how the data was collected to analyze the influence factors of knowledge management
Data analysis procedures	Description of the data analysis procedure used in the publication
Identified Results	Description of the results presented in the publication

4.1 Identified Publications

We started by finding a total of 712 publications in the Scopus digital library, 326 publications in the IEEEXplore digital library and 100 publications in the Engineering Village library. After removing the duplicated publications, the number of selected publications to employ the first step selection criteria was 1.028. Out of these 1.028 publications, 881 were rejected in the first filter, since they did not meet the inclusion criteria. The remaining 147 publications were fully read and classified in the second filter, according to the selection criteria. At the end of the process, 10 publications were accepted and extracted. The selected publications were published between 2008 and January 2017.

Figure 2 summarizes the complete selection and data extraction process.

4.2 Results Overview

Table 3 shows the relationship of influence factors cited by each of the selected publications. Next, we present a summary of the main contributions related to the influence factors of each publication presented in Table 3.

The work of Wang and Wang (2016) presents the results of a study that aimed to develop and test an integrative model of implementation and knowledge management systems (KMS) for companies. One Survey was applied to 291 companies in Taiwan. The authors show the applied questionnaire and used confirmatory factor analysis and the logistic regression technique to test the relationship of the hypotheses. The results of paper by Wang and Wang (2016) show that the technological innovation factors (perceived benefits, complexity and compatibility), the organizational factors (support to top management and organization culture), and environmental factors (competitive constraints) have significant influence on the implementation of knowledge management systems in organizations.

Chang and Lin (2015) carried out a study to clarify the relationship between five types of organizational culture (which include results-oriented, tightly controlled, job-oriented, closed system and professional-oriented cultures) and four kinds of individual KM processes (creation, storage, transfer and application). The authors sought to answer: "*How does the organizational culture influence the KM process of an individual?*". The results of the study showed that some organizational culture dimensions (results-oriented, tightly controlled and job-oriented) indeed have a significant effect on the KM process intention of the individual, whereas a tghtly culture negative effects. With regards to practitioners, the management can modify their organizational culture to improve the performance of KM process.

The work by Chen et al. (2015) sought to analyze the main factors that influence the sharing of knowledge in open source software projects. These authors analyzed data from four real projects (no evaluation questionnaire was applied) and created a conceptual framework. The authors concluded, based on the results of the 4 projects that participative motivation, social network and the organizational culture from the developers' side are important factors influencing knowledge sharing. From the point of view of users, user innovation was the most important factor. Participative motivation includes intrinsic motivation and extrinsic motivation. Social networks include the cognitive dimension, relational dimension and structural dimension. The organizational culture includes openness, collaborative sharing and the geek spirit.

Rabelo et al. (2015) present the results of a case study that aimed to compare, in practice, the relationship of the Knowledge Management cycle (SECI) with Organizational Culture through the Competing Values Framework (CVF). The authors show that the organization's KM practices are more focused on the internalization stage of the SECI model, that is, on the transformation of explicit knowledge into tacit knowledge. Regarding the cultural type, it was identified that the predominant type in the organization is Market. This type is characterized by results oriented and aggressively focused organizational leadership. The authors sought to identify the relationship between knowledge management (SECI) and organizational culture (CVF) based on a theoretical model of the literature. However, the authors conclude that they did not identify this relationship between the models (SECI and CVF) in the published research.

Yang et al. (2014) empirically investigated a sample of research and development (R&D) research projects. The goals were: (a) to evaluate the associations between application of Information

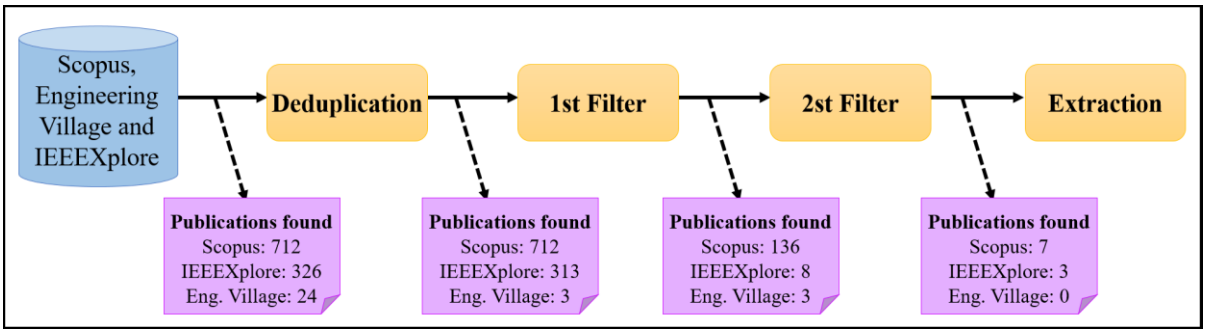

Figure 2: Publications selection process/results.

Table 3: Influence factors found in systematic mapping.

	Cognitive Capital	Complexity	Competitive Pressure	Compatibility	Ethical	Information Technology	Leadership	Learning Practices	Measurement	Motivational Participation	Organizational Culture	Organizational Learning	Organizational Performance	Perceived Benefits	Project Success	Project Uncertainty	Relational Capital	R&D Project performance	Social Network	Team Process	Top Management Support	User Innovation
(Wang and Wang (2016)		•	•	•							•			•							•	
(Chang and Lin, 2015)											•											
(Chen et al.,2015)										•	•								•			•
(Rabelo et al., 2015)											•											
(Yang *et al.*, 2014)						•												•		•		
(Akhavan et al., 2014)					•								•									
(McKay et al., 2014)								•				•			•							
(Mehta *et al.*, 2014)	•					•										•	•					
(Anantatmula, 2008)							•															
(Aurum et al., 2008)						•	•		•		•								•			
Total Instances	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**1**	**1**	**1**	**5**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**

Technology (IT), Knowledge Management (KM), Team Process (TP), and R & D Project Performance; (b) to determine whether TP may mediate the effect of KM on R & D project performance; (c) to examine the moderating role of project characteristics in the relationship between TP and R & D project performance. The authors' analysis suggests that KM may influence the performance of R&D projects through TP. Project managers, particularly for consumer electronics projects, should employ KM practice and encourage team members to share their knowledge to enhance team competency. The results also show that industry and team size have a moderating effect on the relationship between TP and R & D project performance.

Akhavan et al. (2014) investigated the relationship between the following factors: ethics, knowledge creation and organizational performance. The authors assessed the factors by applying a questionnaire in an organization. The research results showed that there is a strong and positive correlation between ethics and organizational performance. The relationship between ethics and

the knowledge creation processes is also positive and significant, but no significant relationship was observed between processes of knowledge creation and organizational performance.

McKay et al. (2014) presented the results of a research that explored the flow of knowledge transfer within an organization: (1) identifying factors at the organizational level that influence knowledge transfer; (2) identifying the factors at the unit or project team level that influence the transfer of knowledge; and (3) establishing the impact of these factors on a tangible measure of successful knowledge transfer (in this case, project success). The authors described a theoretical model that shows the relationship between OLFs (Organizational Learning Factors), PLPs (Project Learning Practices) and PSVs (Project Success Variables). The authors investigated three issues: (a) *What constitutes OLFs, PLPs, and PSVs?*; (b) *What relationships exist in IT organizations among OLFs, PLPs, and PSV*s; and, (c) *What portion of project success can be attributed to OLFs and PLPs?* The results of their research demonstrated a positive and significant correlation between organizational learning, project learning and project success in IT organizations. Factors related to organizational learning are important for learning. For example, if an organization does not have the confidence, leadership and incentives, project teams are less likely to implement project learning practices.

Mehta et al. (2014) report the results of the study that verified the effects of information technology, transfer and combination of knowledge and uncertainty of software projects. The study considered the three dimensions of social capital: (a) structural dimension (links between people or units), (b) relational dimension (trust through interpersonal relations), and (c) cognitive dimension (sharing of understanding and interpretations). The results of the study indicated that both the transfer and combination of knowledge are necessary to fully explain the relationships and that the consideration of the outcome of a project is also important. Furthermore, while project uncertainty confounds the knowledge-sharing processes regardless of technology, the frequency of routinely technology use increases knowledge transfer and combination in a software team.

The work of Anantatmula (2008) shows the challenges of KM from the point of view of leadership. The author sought to answer the following questions: (a) *"How does an organization manage knowledge resources to gain and sustain competitive advantage?"* and (b) *"What is the role of KM leadership in making effective use of KM?"*. The author conducted a literature review to understand the role of leadership and the relationship between KM and organizational performance. In addition, two research studies using interpretive structural modeling (ISM) were used to answer the two research questions. The author shows that effective leadership is a prerequisite for implementing a KM initiative, and the organization can achieve better results by choosing a leader before starting and developing the implementation of a KM plan.

Aurum et al. (2008) show the results of a study that investigated the current practices of Knowledge Management in Software Engineering (ES) in two Australian software development organizations. The authors also examine the facilitators of the KM process for Software Engineering (leadership, technology, culture, measurement and social networking). The results showed that among the five KM facilitators, leadership was considered the most significant factor. Technology was also considered to be an obvious mechanism for KM, despite some of its current KM systems being unsuitable or inaccessible. In addition, the role that informal personal networks played in accessing tacit knowledge was seen as one of the main reasons for fostering a culture that encourages participants to share their knowledge with others. Informal networks were also cited, such as knowledge management systems (informal networks and personal networks).

5 DISCUSSION

The results of the systematic mapping show that there is no consensus on the most used influence factors in knowledge management initiatives. Different authors use several factors. The papers show the relationship between influence factors and knowledge management based on statistical data or based on case studies / project analysis.

Based on our results (see Table 3), four factors stand out: Organizational Culture, Leadership, Information Technology and Knowledge Social Network. In the following subsections, we will describe the results found in literature with regards to these factors of influence.

5.1 Organizational Culture

Culture is a basic element for knowledge management (Choi and Lee, 2003). Organizational

culture is composed of practices, symbols, habits, behaviors, ethical and moral values, as well as principles, beliefs, formalities, internal and external policies, systems and organizational climate (Ajmal and Koskinen, 2008). Organizational culture can act as a barrier or facilitator to success in KM initiatives (Kayworth and Leidner, 2004; Ajmal and Koskinen, 2008).

Organizational Culture (OC) affects how members learn, acquire, and share knowledge (Gupta and Govindarajan, 2000). According to Boh et al. (2013), a positive organizational culture is needed to promote learning and sharing of skills and knowledge. OC supports KM in the software development context which can be encouraged, for example, by sharing knowledge and improving the opinion of post-mortem analyzes (Aurum et al., 2008).

Wang and Wang (2016) argue that an organizational culture with a positive orientation towards knowledge demonstrates that: (1) people are willing and free to explore; (2) senior management encourages employees to create, share and apply knowledge; (3) people are not inhibited to share knowledge; and, (4) people are rewarded for innovation and learning.

Several instruments were developed to evaluate the Organizational Culture, for example: a) inventory organizational culture; b) organizational culture profile; c) six-dimensional model and concurrent values model; d) organizational profile questionnaire; and, e) values framework (Giritli et. al., 2013).

The Competing Values Framework (CVF), created by Cameron and Quinn (2008), is one of the most frequently used instruments in the literature (Paro and Gerolamo, 2017). Based on the identification of the four cultural types of CVF, Cameron and Quinn (2008) developed and validated the Organizational Culture Assessment Instrument (OCAI). This instrument uses a questionnaire to establish an Organizational Culture profile based on the four types of culture, i.e. the instrument evaluates the relative importance of the elements from each type of culture in an organization.

We have identified in the literature that authors propose some relationships between organizational culture and knowledge management, but these relationships have not yet been proven. For example, in the paper by Rabelo et al. (2015), the authors sought to relate the CVF model (Cameron and Quinn, 2008) and SECI (Nonaka and Takeuchi, 1995) based on a theoretical model of the literature (Rai, 2011; Gray and Densten, 2006). However, when comparing our research results with the results found by Rai (2011) and Gray and Densten (2006), we did not find evidences that there is a relationship between quadrants of the SECI model and CVF in the way literature proposed. Therefore, future research should be conducted in order to answer the following research question: "*Is the relationship between the SECI model and the CVF model similar in other software organizations?*".

Chang and Lin (2015) made the relationship between five types of organizational culture and four kinds of KM process. Nevertheless, the relationships need more studies to be proven.

The results of the papers related to organizational culture show that more research should be carried out seeking to understand: *"(i) how can the organizational culture influence knowledge management initiatives in different software organizations; (ii) What is the relationship between organizational culture and knowledge management in different software organizations. Is there a model that can be used in different organizations? Using such a model, will the result be the same in all organizations? "*

5.2 Leadership

In the context of this work, we identified that leadership can be of three types: a) leader: person who can influence other people; b) organizational leadership: person who performs the role/function of team leader or team manager; and, c) top management: person who is responsible for the highest level of the hierarchy of an organization, for example: a director, president, manager or coordinator.

5.2.1 Leader

Leadership is seen as the ability to influence the behavior of others to align their goals with the ones of the leader (Liu and Fang, 2006). Team leadership should create an environment that encourages knowledge sharing, so that people feel secure in contributing and that these contributions are recognized by all (Storey and Barnett, 2000).

Team leaders are responsible for how the business must address and deal with the knowledge management processes. Leaders are important because they are examples and set standards to be followed by people (Holsapple & Joshi, 2000).

5.2.2 Organizational Leadership

Leadership has a critical role in developing and managing KM systems (Anantatmula, 2008). Merat and Bo (2013) state that the organization should choose the leader who will manage the aspects related to knowledge management before starting and developing the implementation of a QA plan.
The initiative of a KM program can be a major change in the organization, so the leadership involvement is considered fundamental (Davenport et al., 1998).

The organization's leadership should encourage people to take part in the decision-making, and share knowledge. Collaborative decision-making often leads to innovation (Aurum et al., 2008). In addition to identifying success measures, the inclusion of decision makers is a critical aspect of leadership that should not be underestimated (Schwarber, 2005).

Aurum et al. (2008) show that in the studied company, a variety of roles were responsible for leadership. In one of their projects, the participant cited quality role, business analyst, project manager, or team leader acting as team leaders. In other project, a participant stated that each participant in the team was responsible for leading their own knowledge. These results may be indications for future research: *"What is best for a software organization? (1) to define a single person as responsible for leadership or (2) that each team member is responsible for managing his/her own knowledge?"*

5.2.3 Top Management

Sharma and Yetton (2007) argue that top management support can reduce resistance, resolve conflicts, improve communications, persuade employees, and overcome barriers to KM implementation. Top management should provide sufficient resources and create a positive organizational climate for the implementation of knowledge management systems.

5.3 Information Technology

Information technology helps remove communication boundaries that often hinder the interaction between different parts of the organization (Allameh et al., 2011). It is important to invest in IT to expand knowledge management projects (Lee and Choi, 2003). Information technology should be used to assist in the specific business needs and projects of the organization.

The results of Metha et al. (2014) indicate that the use of information technology increases the level of knowledge exchange under conditions of high uncertainty in the projects. Nouri et al. (2013) claim that information technology is the most important factor when coding (knowledge management strategy) is the main focus of company strategy.

A variety of IT tools are required to develop Knowledge Management Systems (KMS). According to Wang and Wang (2016), when a company recognizes that a knowledge management system can contribute to the efficiency and effectiveness of its knowledge management practices, then they are more likely to implement KMS.

5.4 Social Network

Social networks are made up of connections between individuals seeking knowledge from each other. A social network can also be called knowledge network, network of ties or informal networks. Social network are effective because they show who has the knowledge (Alavi and Tiwana, 2002).

A social network in which employees share knowledge is an important factor for an organization to gain the value of knowledge sharing from person to person (independent of a knowledge management system) (Jennex, 2008). These networks are used by people to exchange resources and services (Aurum et al., 2008).

Research found in literature has used Social Network Analysis (SNA) to verify knowledge management (Helms et al., 2010; Müller-Prothmann et al., 2005; Anklam, 2003). SNA focuses on the relationships between nodes, since these relationships influence the nodes themselves. Basically, a social network represents a set of relationships of a group (Wasserman & Faust, 1994). The actors within a social network can be individuals, groups, entities or organizations. The relationships between the actors can be any connection they have, such as: people who consult in order to ask a question related to their activities at their job; people who modify the same source code of an application; or relationships in the dependencies between organizations.

According to Müller-Prothmann et al. (2005), social network analysis can assist: the identification of personal and knowledge skills; the research on the transfer and sustainable conservation of tacit knowledge; and the discovery of opportunities to improve communication and efficiency processes. According to Anklam (2003), SNA allows managers

to visualize and understand relationships that can facilitate or make it difficult to create and share knowledge.

6 CONCLUSIONS

In this systematic mapping, we investigated the influence factors for knowledge management initiatives in software organizations. From the initial set of 1028 publications, we identified 22 influencing factors. There is no consensus on the most commonly used influence factors in knowledge management initiatives. Among the selected publications, the following factors were the most cited by different authors: Organizational Culture, Leadership, Information Technology and Social Network.

Every study has threats that could affect the validity of its results (Wohlin et al., 2012). In this work, some threats can be identified, such as: (a) the researcher's bias regarding the analysis of the primary studies - to minimize this bias, all activities were reviewed by another researcher and we performed the statistical Kappa de Kohen test (see section 4.1); (b) limited university access to some scientific databases, which may prevent some publications from being accessed - we requested the full publication of the authors whenever possible and included those that have been made available; and (c) the limitation of the scope of this research to the two selected databases - although the research has been conducted in only three databases, these databases index publications from a large number of well-known venues, journals and conferences; which may reduce the number of publications that were not addressed by this literature review.

Although several papers investigate the relationship between influence factors and knowledge management, there is still a shortage of papers that show how these factors influence and how they can be used to support knowledge management initiatives in software organizations. We also identified that there is no single way to assess these factors. Many surveys state that they use evaluation questionnaires, but do not show them, or provide details on where they were taken from or how they were created. In addition, there is also a gap with regards to which actions an organization can take regarding these factors.

As future work, one can investigate how addressing one or more of these influencing factors can improve knowledge management initiatives in software organizations. Therefore, due to the differences between software development companies, one can include their type as influencing factor. Other sources and knowledge artifacts can also be considered in software development companies themselves in the research. In addition to the results presented in this paper, as part of this research, a catalog containing actions related to the most cited factors of influence is being developed. The purpose of this catalog is to encourage software organizations with regards to the state of practice based on the findings of the state of the art. This catalog of actions will map the knowledge management practices that the software organization can apply in their KM initiatives. The actions catalog will be part of the IFactor-KM Process proposed by Rabelo and Conte (2017). The IFactor-KM Process supports software organizations to: a) identify the knowledge management objectives; b) check how tacit knowledge is shared; c) indicate the knowledge experts; d) understand leadership aspects; e) characterize the profile of the organizational culture; and f) suggest knowledge management practices and action.

Finally, we hope that our results can contribute to the evolution and improvement of the research field of influence factors for knowledge management in software organizations.

ACKNOWLEDGEMENTS

We would like to thank the financial support granted by CNPq through process number 423149/2016-4, and CAPES through process number 175956/2013.

REFERENCES

Ajmal, M., Koskinen, K., 2008. Knowledge Transfer in Project-Based Organizations: An Organizational Culture Perspective. In *Project Management Journal*, vol. 39, n. 1, p. 7-15.

Akhavan, P., Ramezan, M., Yazdi Moghaddam, J., Mehralian, G., 2014. Exploring the relationship between ethics, knowledge creation and organizational performance: Case study of a knowledge-based organization. In *VINE: The journal of information and knowledge management systems*, vol. 44, n. 1, p. 42-58.

Alavi, M., Tiwana, A., 2002. Knowledge Integration in Virtual Teams: The potential Role of KMS. In *Journal of the Association for Information Science and Technology*, vol. 53, n. 12, p. 1029-1037.

AL-Hakim, L., Hassan, S., 2012. Critical Success Factors of Knowledge Management, Innovation and

Organizational Performance: An Empirical Study of the Iraqi Mobile Telecommunication Sector. In *British Journal of Economics, Finance and Management Sciences*, vol. 4, n. 1, p. 31-49.

Allameh, S., Zare, S., Davoodi, S., 2011. Examining the Impact of KM Enablers on Knowledge Management Processes. In *Procedia Computer Science*, vol. 3, p. 1211-1223.

Anantatmula, V. S. (2008). Leadership Role in Making Effective Use of KM. In *VINE: The Journal of Information and Knowledge Management Systems*, v. 38, n. 4, p. 445-460.

Anklam, P., 2003. KM and the Social Network. In *Knowledge Management Magazine*, vol. 6, n. 8, p. 24-28.

Aurum, A., Daneshgar, F., Ward, J., 2008. Investigating Knowledge Management Practices in Software Development Organizations – An Australian experience. In *Information and Software Technology*, vol. 50, n. 6, p. 511-533.

Aurum, A., Jeffery, R., Wohlin, C., Handzic, M., (Eds). 2013. Managing Software Engineering Knowledge. Springer Science & Business Media.

Bari, M. A., Ahamad, S., 2011. Managing Knowledge in Development of Agile Software. In *International Journal of Advanced Computer Science and Applications*, vol. 2, n. 4, p. 72-76.

Bjørnson, F.O., Dingsøyr, T., 2008. Knowledge Management in Software Engineering: A Systematic Review of Studied Concepts, Findings and Research Methods Used. In *Information and Software Technology*, vol. 50, n. 11 (10//), p. 1055-1068.

Boh, W. F., Nguyen, T. T., Xu, Y., 2013. Knowledge Transfer Across Dissimilar Cultures. In *Journal of Knowledge Management*, vol. 17, n. 1, 29-46.

Bollinger, A. S., Smith, R. D., 2001. Managing Organizational Knowledge as a Strategic Asset. In *Journal of Knowledge Management*, vol. 5, n. 1, p. 8-18.

Cameron, K. S., Quinn, R. E., 2006. Diagnosing and Changing Organizational Culture. In *the Jossey-Bass Business & Management Series*, revised Ed., 259 p.

Carreteiro, P., de Vasconcelos, J. B., Barão, A., Rocha, A., 2016. A Knowledge Management Approach for Software Engineering Projects Development. In *New Advances in Information Systems and Technologies. Springer International Publishing (WorldCIST (1))*, p. 59-68.

Chang, C. L. H., Lin, T. C., 2015. The Role of Organizational Culture in the Knowledge Management Process. In *Journal of Knowledge Management*, vol. 19, n. 3, p. 433-455.

Chen, X., Probert, D., Zhou, Y., Su, J, 2015. Successful or Unsuccessful Open Source Software Projects: What is the Key?. In *Science and Information Conference (SAI)*, p. 277-282.

Choi, B., Lee, H., 2003. An Empirical Investigation of KM Styles and Their Effect on Corporate Performance. In *Information & Management*, vol. 40, n. 5, p. 403-417.

Cohen, J., 1960. A Coefficient of Agreement of Nominal Scales. In *Educational and Psychological Measurement*, vol. 20, n. 1, p.37–46.

Davenport, T., Prusak, L., 1998. Working knowledge: How organizations manage what they know. Harvard Business Press.

Giritli, H., Öney-Yazici, E., Topçu-Oraz, G., Acar, E., 2013. The Interplay between Leadership and Organizational Culture in the Turkish Construction Sector. In *International Journal of Project Management*, vol. 31, n. 2, p. 228-238.

Gray, J. H., Densten, I. L. 20016. Towards an Integrative Model of Organization Culture and Knowledge management. In *International Journal of Organisational* Behaviour, vol. 9, n. 2, p. 594-603.

Gupta, A.K, Govindarajan, V., 2000. Knowledge Management's Social Dimension: Lesson from Nucor Steel. In *Sloan Management Review*, vol. 4, n. 1, 2000, p. 71-81.

Helms, R., Ignacio, R., Brinkkemper, S., Zonneveld, A., 2010. Limitations of Network Analysis for Studying Efficiency and Effectiveness of Knowledge Sharing. In *Electronic Journal of Knowledge Management*, vol. 8, n. 1, p. 53-68.

Holsapple, C. W., Joshi, K. D., 2000. An Investigation of Factors that Influence the Management of Knowledge in Organizations. In *Journal of Strategic Information Systems*, vol. 9, p. 235-261.

Jennex, M. E., Smolnik, S., Croasdell, D., 2008. Towards Measuring Knowledge Management Success. In *Hawaii International Conference on System Sciences, Proceedings of the 41st Annual*, p. 360-360.

Kayworth, T. Leidner, D., 2004. Organizational Culture as a Knowledge Resource. In *Handbook on Knowledge Management*. Springer-Verlag, Heidelberg, p. 235-252.

Kitchenham, B., Chartes, S., 2007. Guidelines for Performing Systematic Literature Reviews in Software Engineering. Technical Report (EBSE 2007). Durham, UK: Keele.

Landis, J.R., Koch, G.G., 1977. The Measurement of Observer Agreement for Categorical Data. Biometrics, vol. 33, n. 1, p. 159-174.

Liu, A., Fang, Z., 2006. A Power-Based Leadership Approach to Project Management. In *Construction Management and Economics*, vol. 24, n. 5, p. 497-507.

McKay, D. S., Ellis, T. J., 2014. Tracking the flow of knowledge in IT organizations: The Impact of Organizational Learning Factors and Project Learning Practices on Project Success. In *System Sciences (HICSS)*, 47th Hawaii International Conference on, p. 5185-5194.

Mehta, N., Hall, D., Byard., T., 2014. Information Technology and Knowledge in Software Development Teams: The role of Project Uncertainty. In *Information & Management*, vol. 51, n. 4, p. 417-429.

Menolli, A., Cunha, M. A., Reinehr, S., Malucelli, A., 2015. "Old" theories, "New" Technologies: Understanding Knowledge Sharing and Learning in

Brazilian Software Development Companies. In *Information and Software Technology*, p. 289-303.

Menolli, A., Reinehr, S., Malucelli, A., 2013. Organizational Learning Applied to Software Engineering: A Systematic Review. In *International Journal of Software Engineering and Knowledge Engineering*, vol. 23, n. 8, p. 1153-1175.

Merat, A., Bo, D., 2013. Strategic analysis of knowledge firms: the links between knowledge management and leadership. In *Journal of Knowledge Management*, vol. 17, n. 1, p. 3-15.

Moffett, S., McAdam, R., Parkinson, S., 2002. Developing a Model for Technology and Cultural Factors in Knowledge Management: A Factor Analysis. In *Knowledge and Process Management*, vol. 9, n. 4, p. 237-255.

Müller-Prothmann, T., Siegberg, S., Finke, I., 2005. Leveraging Boundary-spanning Knowledge Community Building. Interventions from a SNA in Interorganizational R&D Environments. In *Proceedings of KnowTech*, p. 247-254.

Nonaka, I., Takeuchi, H., 1995. The Knowledge-Creating Company, 17th ed. Oxford Oxford Univerity Press.

Nonaka, I., Teece, D.J., 2001. Managing Industrial Knowledge: Creation, Transfer and Utilization Londres, SAGE Publications.

Nouri, R.A., Moshabaki, A.B., Raissi, S.A., Javadinia, Y.C., 2013. The Influence of the Personalization and Codification Strategies on Successful Knowledge Management Case Study: National Iranian Oil Company". In *Research Journal of Applied Sciences, Engineering and Technology*, vol. 6, n.6, p. 989-996.

Oliveira, E., Viana, D., Cristo, M., Conte, T., 2017. How have Software Engineering Researchers been Measuring Software Productivity? - A Systematic Mapping Study. In *Proceedings of the19th International Conference on Enterprise Information Systems (ICEIS 2017)*, vol. 2, p. 76-87

Paro, P., Gerolamo, M., 2017. Organizational culture for lean programs. In *Journal of Organizational Change Managemen*t, vol. 30, n. 4.

Rabelo, J., Conte, T., 2017. IFactor-KM: A Process for Supporting Knowledge Management Initiatives in Software Organizations Considering Influencing Factors. In *Proceedings of 19th International Conference on Enterprise Information Systems (ICEIS 2017)*, vol. 2, p. 166-127.

Rabelo, J., Oliveira, E., Viana, D., Braga, L., Santos, G., Steinmacher, I., Conte, T., 2015. Knowledge Management and Organizational Culture in a Software Organization: A Case Study. In *Proceedings of the Eighth International Workshop on Cooperative and Human Aspects of Software Engineering*, p. 89-92.

Rai, R. K., 2011. Knowledge management and Organizational Culture: A Theoretical Integrative Framework. In *Journal of Knowledge Management*, p. 779 – 801.

Ruhe, G., 2001. Learning Software Organisations, Handbook of Software Engineering and Knowledge Engineering (S.K. Chang, ed.), World Scientific Publishing 2001.

Schwarber, P., 2005. Leaders and the Decision-Making Process. In *Management Decision*, vol. 43, n. 7/8, p. 1086-1092.

Sharma, B. P., Singh, M. D., Neha., 2012. Knowledge sharing barriers: An Approach of Interpretive structural modeling. In *IUP Journal of Knowledge Management*, vol. 10, n. 3, p. 35-52.

Sharma, R., Yetton, P., 2007. The Contingent Effects of Training, Technical Complexity, and Task Interdependence on Successful Information Systems Implementation. In *Mis Quarterly*, p. 219-238.

Silva-Filho, E., Viana, D., Rabelo, J., Conte, T., 2016. Knowledge Mapping in a Research and Development Group - A Pilot Study. In *The 18th International Conference on Enterprise Information Systems (ICEIS 2016)*, vol. 1. p. 306-317.

Storey, J., Barnett, E., 2000. Knowledge Management Initiatives: Learning from Failure. In *Journal of Knowledge Management*, vol. 4, n. 2, p. 145-56.

Wang, Y. M., Wang, Y. C., 2016. Determinants of Firms' Knowledge Management System Implementation: An Empirical Study. In *Computers in Human Behavior*, vol. 64, p. 829-842.

Wasserman, S., Faust, K., 1994, Social Network Analysis: Methods and applications, Cambridge university press.

Wohlin, C., Höst, M., Regnell, B., 2012. Experimentation in Software Engineering. Verlag: Springer.

Yang, L-R., Chen, J-H., Chou, S-C., 2014. KM as a Facilitator for Project Performance Through Team Process: Does Information Technology Make a Difference?. In *International Journal of Information Technology & Decision Making*, vol. 13, n. 05, p. 937-956.