IFactor-KM: A Process for Supporting Knowledge Management Initiatives in Software Organizations Considering Influencing Factors

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

Keywords: Knowledge Management, Influencing Factor, Process, Software Organization.

Abstract: Knowledge management has become a real need in the software industry. Knowledge management factors refer to management and organizational factors that need to be addressed effectively in order to increase the chances of a knowledge management successful implementation. Many organizations have questions about the approach they should take in their knowledge management initiatives. Literature studies have been conducted to identify the factors that affect the implementation of a knowledge management, but do not suggest knowledge management practices for organizations. A process named IFactor-km (influencing factors on knowledge management) was created to address these needs. The goal of this process is to support knowledge management initiatives and to suggest knowledge management practices for software organizations considering the following influencing factors: people, leadership and culture. The IFactor-KM supports software organizations by: a) identifying the knowledge management objectives; b) checking how tacit knowledge is shared; c) showing the knowledge experts; d) understanding leadership and people aspects; e) characterizing the organizational culture profile; and f) suggesting knowledge management practices. The process is composed of: i) a procedure detailing the steps of the process; and ii) a set of artifacts detailing how to use the process and examples of completed artifacts to facilitate the use of the process.

1 INTRODUCTION

Knowledge is considered to be a valuable asset and a key resource for the permanent competitive advantage of an organization (Allameh et al., 2011). Organizations have problems with keeping track of content, its location, and how to best make use of it (Rus and Lindvall, 2002). Knowledge Management (KM) is important in large, medium and small organizations (Le Dinh et al., 2014).

Knowledge in software development projects is varied and grows in proportions (Carreteiro et al., 2016). 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 (Rus and Lindvall, 2002). Organizations are suggested to share knowledge of how they believe that this effort will result in: (a) productivity, (b) performance and effectiveness, (c) improving efficiency, (d) cost reduction, (e) reduction of available resources and (f) quality improvement (Yang, 2009; McAdam and Reid, 2000).

According to Moffett et al. (2002), many organizations have questions about the approach they take in their KM initiatives. Several papers in the literature have investigated which facilitators influence KM implementations. 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 and Hassan, 2012). For example, 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) are significant influences on the implementation of knowledge management systems in organizations. Allameh et al., (2011) conducted a study to determine the impact of KM facilitators and the KM process. The results show that the information technology and culture facilitators are related to the KM process. Also, their results suggest that the organizational structure is not related to knowledge management processes. Furthermore, the

Rabelo, J. and Conte, T.
IFactor-KM: A Process for Supporting Knowledge Management Initiatives in Software Organizations Considering Influencing Factors.
DOI: 10.5220/0006360701660177
In *Proceedings of the 19th International Conference on Enterprise Information Systems (ICEIS 2017) - Volume 2*, pages 166-177
ISBN: 978-989-758-248-6

research by Mehta et al., (2014) concludes that the main factors contributing to effective knowledge management are human and technical. Human behavior is the key to success or failure in KM activities, since KM involves an emphasis on organizational culture, teamwork, learning promotion, and sharing of skills and experiences.

This work differs from the previously mentioned researches, since it intends to list and suggests practices for KM initiatives in software organizations considering factors influencing these initiatives. The main goal of this paper is to present the IFactor - KM (Influencing Factors on Knowledge Management initiatives) Process.

The goal of the IFactor KM process is to support knowledge management initiatives and to suggest knowledge management practices for software organizations considering the following influencing factors: people, leadership and culture. The proposed process supports software organizations to: a) identify the knowledge management objectives; b) check how tacit knowledge is shared; c) show the knowledge experts; d) understand leadership and people aspects; e) characterize the profile of the organizational culture; and f) suggest knowledge management practices.

Besides this introductory section, the paper is organized in four more sections. Section 2 presents the background for this research. The IFactor-KM process and its details are shown in Section 3. Section 4 presents some results obtained using the process. Finally, Section 5 shows the conclusions and future work.

2 THEORETICAL BACKGROUND

The knowledge that an organization can hold and its ability to create and use that knowledge is the central ability to maintain a competitive advantage and innovation (Nonaka and Teece, 2001). The main asset of Software Companies is knowledge (Silva-Filho et al., 2016). The development practices of software organizations are based on the knowledge and experiences of software developers and stakeholders (Vasconcelos et al., 2009). The collection, storage and sharing of knowledge is essential, but hard to do. By managing knowledge, organizations can better respond to customer and market demands, delivering faster and better-quality results (Schneider, 2009).

According to Nonaka and Takeuchi (1995), there are two types knowledge that need to be managed: tacit and explicit. Tacit knowledge is based on the person's experience, which, due to being subjective, is difficult to express with words, numbers and sentences (Nonaka and Takeuchi, 1995). This kind of knowledge cannot be found in documents, but only in the minds of the collaborators (Dingsoyr et al., 2009). Therefore, tacit knowledge is usually shared directly, by face-to-face contact, and is considered the most valuable type of knowledge (Patel, 2012). On the other hand, explicit or codified knowledge is considered transmissible in formal and systematic language. Nonaka and Teece (2001) state that, since it is objective, this type of knowledge can be represented in several ways, such as documents, reports, databases and others. Also, it can be processed, transmitted and stored easily. Only managing the types of knowledge is not enough. It is necessary that this knowledge is learned at the organizational level, so that it adds success to the executed software development activities.

Several authors propose different objectives for knowledge management (Probst et al., 2000; Tiwana, 2000; Alavi and Leidner, 2001; Rus and Lindvall, 2002). For instance, Alavi and Leidner (2001) did a research of works that used the KM objectives and carried out a feature analysis. Based on the comparison of these works, they reached the following goals: creation, storage/retrieval, transfer and application. Due to the feature analysis already performed by these authors, the defined KM objectives used in our present work consider the steps defined by Alavi and Leidner (2001).

Knowlede Creation is about creating new knowledge or replacing existing knowledge. This creation can be done by individuals, throughout the organization or acquisition of external sources (Rodríguez-Elias et al., 2008). **Knowledge Storage/Retrieval** is the process of storing the knowledge after it is created so that other people in the organization can access it. This process feeds and seeks to ensure that the organization does not forget what it has learned or the knowledge that has been created. **Knowledge Transfer** focuses on activities aimed at the dissemination and distribution of knowledge. This transfer can occur at various levels, such as: between collaborators, from employees to explicit bases, from collaborator to group, within a group, between distinct groups and from the group to the whole organization (Alavi and Leidner, 2001). **Knowledge Application** occurs when knowledge of a given domain is applied. Thus, it is possible to generate new knowledge.

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 and Faust, 1994). These actors 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; two people who modify the same source code of an application; relationships in the dependencies between organizations; and so on.

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 in 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.

2.1 Influencing Factors in Knowledge Management

In order to identify the factors that influence Knowledge Management initiatives and the ways of evaluating these influencing factors, a research was conducted in the literature.

AL-Hakim and Hassan (2012) conducted a literature review that addressed the factors that influence knowledge management, increase innovation, and improve organizational performance. According to analyses AL-Hakim and Hassan (2012), most of the explored factors within the identified works mention:

- human resources management;
- information technology;
- leadership;
- organizational learning;
- organizational strategy;
- organizational structure;
- organizational culture.

The most cited are: organizational culture, structure and information technology.

We carried out a search for other research papers in the Scopus library (www.scopus.com). The aim of that search was to identify the influencing factors in knowledge management initiatives in software development companies. In addition, our search aimed to identify the evaluation questionnaires used by other researchers. Our search results showed that the most cited factors are: leadership, people and information technology.

2.1.1 Organizational Culture

Organizations should establish an appropriate culture that encourages people to create and share knowledge within an organization (Holsapple and Singh, 2001). Organizational Culture (OC) works as a repository of knowledge, as it determines how individuals act and behave (Gonzalez and Martins, 2014). Also, Alavi and Leidner (2001) state that OC is considered a critical factor in the construction and effort of Knowledge Management, and can act as a barrier or facilitator of these initiatives.

According to Ribiere and Sitar (2003), Organizational Culture has been identified as the main impediment for the occurrence of activities related to knowledge management. OC affects how members learn, acquire, and share knowledge (Gupta and Govindarajan, 2000). Organizational Culture support to KM in the software development context can be encouraged, for example, by sharing knowledge and improving the opinion of post-mortem analyzes (Aurum et al., 2008).

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

In this work, we used the evaluation questionnaire proposed by Cameron and Quinn (2006) - the Computing Values Framework (CVF). CVF is one of the most used models in the research area of organizational culture due to its reliability and validity (Giritli et al., 2013).

Based on the identification of the four cultural types of CVF, Cameron and Quinn (2006) developed and validated the Organizational Culture Assessment Instrument (OCAI). This instrument uses a questionnaire to establish the organizational culture profile based on the four types of culture. In other words, the instrument evaluates the relative importance of the elements of the types of culture within an organization.

2.1.2 People and Leadership

People are seen as important elements in KM initiatives (Ndlela and Toit, 2001). Holsapple and Joshi (2001) argue that people are the key to the

creation of organizational knowledge. It is the people who create and share knowledge. People's attitudes are an important pre-requisite in KM projects (Naghib, 2003).

People have to feel like sharing and offering their knowledge to other people inside the organization. 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).

The initiative of a KM program can be a major change in an organization. Therefore, leadership involvement is considered fundamental (Más-Machuca, 2014; Storey e Barnett, 2000). Liu and Fang (2006) argue that leadership is seen as the ability to influence the behavior of others to align their goals with those of the leader. KM leadership should encourage people to participate in the decision-making. In addition to identifying success measures, the inclusion of decision makers is a critical leadership aspect that should not be underestimated (Schwarber, 2005).

2.2 Works on Knowledge Management Practices

The works presented in the previous subsections describe investigations of the factors that influence knowledge management in organizations. However, these works do not suggest KM practices that can be employed in these organizations. Some papers suggesting KM practices are shown below.

Viana et al., (2015) and Viana (2015) proposed a framework to support organizations in the identification of current Organizational Learning (OL) and knowledge management practices. Also, the authors suggest practices that these organizations can use. This framework consists of a process describing the steps required to identify current OL and KM practices and activities, and the suggestion of new practices that can be applied. The framework also has a practice catalog that contains a list of practices that can be used to support the diagnosis of the current state of the organization, as well as helping to suggest new practices for the organization.

Menolli et al. (2015) presented a set of tools and technologies used by software organizations. The authors have related these tools and technologies to theories of knowledge sharing and organizational learning. The most commonly used tools and the frequency of use by employees were identified. One of the results of the authors' work shows that although organizations have adopted the tools, they are not often used.

The work by Santos et al. (2013) presents a set of identified practices aimed at organizations that execute agile development processes. The identified practices were evaluated by an industry consultant who employs aspects of agile methodologies and knowledge management in their activities. In addition, the set of practices were validated through case studies in the industry. These practices aimed to promote the interaction and knowledge sharing among agile teams.

3 THE IFACTOR-KM PROCESS

Based on the results of the literature review, two research categories were identified:

- Papers that show the factors that influence KM initiatives (Wang and Wang, 2016; AL-Hakim and Hassan, 2012; Allameh et al., 2011; Holsapple and Singh, 2001);
- Research that suggests KM practices (Viana et al., 2015; Viana, 2015; Santos et al., 2013).

However, we did not identify a work that linked the two categories.

The greatest motivation of this work is to propose a process for software organizations that suggests knowledge management practices considering the characteristics of each organization through its influencing factors. By doing so, we expect that organizations can use practices that meet their needs in KM initiatives, and that they can succeed in their knowledge management activities.

The IFactor-KM (Influencing Factors on Knowledge Management initiatives) Process proposed in this work aims to identify the levels of KM in the organizations, support the diagnosis of the state of practice and support the insertion of KM practices in software organizations considering the factors influencing the organization (i.e. culture, people and leadership).

The Process IFactor-KM is composed of: a) a procedure detailing the steps of the process; b) a set of artifacts detailing how to use the process and examples of finished artifacts to facilitate the use of the process. The Process has activities and artifacts that help software organizations to: i) identify the knowledge management objectives; ii) check how tacit knowledge is shared; iii) show the knowledge experts; iv) understand leadership and people aspects; v) characterize the profile of the organizational culture; and vi) suggest knowledge management practices.

This process contains the definition of activities

required to perform the diagnosis and identify improvements in knowledge management activities in software organizations. The IFactor-KM process was specified using the Business Process Model and Notation (BPMN) (OMG, 2016). The main elements used for its representation are shown in Table 1. Figure 1 shows the overview of the IFactor-KM process.

Table 1: Elements of the BPMN notation used for defining the IFactor-KM Process.

	Start Event
	End Event
	Activity
	Sub-process that contains other activities
	Gateway
	Link event - to throw
	Link event - to catch
	Sequence flow
	Data object - input
	Data object - output

3.1 Collecting Data

The first step of the IFactor-KM Process is to gather the organization's data according to the following activities:

- To identify the context of the organization and the needs related to KM;
- To identify collaborators participating in the diagnosis;
- To apply the KM Objectives Questionnaire;
- To apply the questionnaire that supports the knowledge sharing diagnosis - through social networks analysis;
- To apply the OCAI questionnaire.

The details of these activities will be shown next.

3.1.1 Identifying the Organization's Context and KM Needs

The activity of identifying the organization context and the needs related to KM aims to extract the necessary information from the organization that will participate in the diagnostic process. Table 2 shows the details of this activity.

The questionnaire used in this activity has fields to describe the organization's context, how it works and the number of employees. Additionally, the organization is asked to state the main needs regarding knowledge management, in addition to which KM objectives the organization wants best: creation, storage/retrieval, transfer or application of knowledge.

Table 2: Identifying the context of the organization and the needs related to KM.

Name	1. To identify the organization context and related needs
Description	This activity is performed to identify the necessary information that will guide the diagnosis of the Knowledge Management in software organizations. This activity is also useful for suggesting practices for the organization.
Variability	Required
Tasks	• Use the <<Organizational Context Template>> document • Fill in the document as in the template • Transfer these results to the presentation <<Result Presentation Template >> document
Participants	Project Manager, Senior Management
Input	Organizational Context Document
Output	Finished Organization Context Document Results Presentation Document

3.1.2 Identifying Collaborators Participating in the Diagnostic Process

The purpose of this activity is to identify who will be the people participating in the Knowledge Management diagnosis process. The person responsible for executing the process in the organization will request the data of each participant. This activity has an artifact that helps to document the data. The fields from the artifact in this activity ask for the basic data from the collaborator regarding his/her role, time in the organization, projects in which (s)he participate and time spent in these projects.

3.1.3 Applying the KM Objectives Questionnaire

This activity aims to apply the knowledge management objectives questionnaire with the organization's collaborators. Therefore, it seeks to

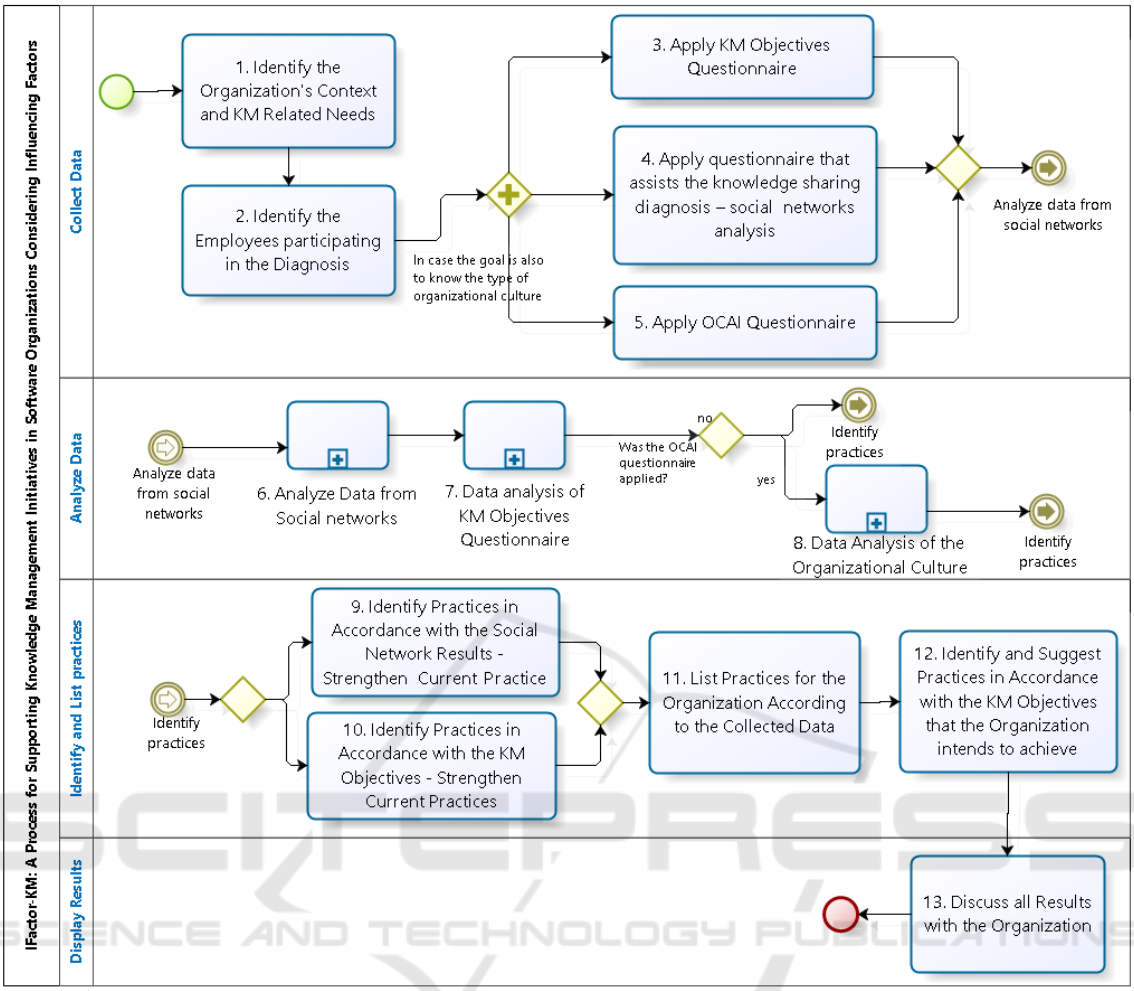

Figure 1: Overview of the IFactor-KM Process.

understand the level of KM in the software organization or software teams. This is done with respect to the KM objectives. The investigated KM objectives are in agreement with those defined by Alavi and Leidner (2001): creation, storage/retrieval, transfer and application of knowledge.

The KM objectives are evaluated through a questionnaire. The employed evaluation questionnaire was based on the one proposed by Lawson (2003). It is possible to identify, through the results of the applied questionnaires in the organization, what the purpose of the KM is being used and what needs to be improved. By doing so, one can verify if these characteristics are meeting the real needs of each organization.

3.1.4 Applying the Questionnaire that Supports the Knowledge Sharing Diagnosis – Social Networks Analysis

The goal of applying this questionnaire is to identify how knowledge sharing occurs among the organization's collaborators. This questionnaire helps to identify social networks aspects. In this questionnaire, the collaborators inform who they consult inside the organization to obtain knowledge or who they ask questions to about their daily activities.

3.1.5 Applying the Questionnaire that Evaluates the Organizational Culture Profile

The purpose of this activity is to apply a questionnaire that evaluates the profile of the

organizational culture. This questionnaire is called the Organizational Culture Assessment Instrument (OCAI) and was proposed by Cameron and Quinn (2006). Through the results of this questionnaire it is possible to identify the current and desired culture profile of the organization. The artifact of this activity provides an example to facilitate its use by employees. This questionnaire is answered by all the collaborators identified in the Identification of the Collaborators Participating in the Process activity (see Subsection 3.1.2).

3.2 Data Analysis

The second step of the IFactor-KM Process is to analyze the data collected in the first step. Three analyses are carried out at this stage: data analysis of social networks, data analysis of KM objectives questionnaires, and data analysis of the organizational culture.

3.2.1 Data Analysis of Social Networks

This stage includes the identification of how sharing of the tacit knowledge in the organization or teams takes place through the analysis of social networks (SNA). Social network analysis aims to find an understanding of the relationship between entities, as well as investigate the patterns and implications of these relationships (Wasserman and Faust, 1994). It is important to mention that there are several types of relationship patterns in social network analysis, as well as metrics that can be useful for analyzing a social network (Wasserman and Faust, 1994; Cross and Parker, 2004). However, this research focused on the identification of some specific types of collaborators, which are important for the recognition of opportunities, challenges related to knowledge dissemination and identification of the expert of an organization.

The sub process of analysis of social networks is composed of activities that help to identify: i) the most consulted people in the organization; ii) knowledge flow between the leader and the team; iii) knowledge flow between novice practitioners and the team; iv) peripheral people in the team; and v) centrality of the information.

These activities are presented below.

Transcribing Questionnaires - Social Networks Worksheet

The purpose of this activity is to transcribe the questionnaires identifying the knowledge sharing that was filled out by the collaborators.

Preparing Data to the Social Networks Structure

The purpose of this task is to develop a structure of social networks. This structure of social networks is created through the use of social network analysis tools. Aiming to facilitate the implementation of this activity was drafted a document explaining the steps needed to create a social network structure. This document is part of the artifacts proposed for the use of the IFactor-KM Process.

Identifying the Most Consulted People in the Organization

The purpose of this activity is to highlight the most consulted people in the organization. These people are the ones who most share tacit knowledge.

That data is obtained using a social network analysis tool. Also, we describe the steps to facilitate the presentation of the results to the organization that has been evaluated. Among, these, we can cite: i) to highlight the most consulted people: these are the people who are the closest to the center of the graph. (we suggest highlighting the four people closest to center); ii) for each of these specialists, provide a description of the results, while pointing out the most consulted knowledge from this person.

Identifying Knowledge Flow between the Leader and the Team

The purpose of this activity is to show how the knowledge flow between the leader and the team occurs. This information helps the organization members to get to know each other better.

IFactor-KM Process has some guidelines that help each member identify the flow of their knowledge exchange. First, based on the SNA graph, we highlight the team leader and then check the relationship between the leader and the team. The results of this analysis allow identifying who are the collaborators who consulted the team leader whenever they have a question.

Identifying the Knowledge Flow between Novice Practitioners and the Team

This activity is proposed in the IFactor-KM Process to identify how the knowledge flow occurs between novice practitioners (collaborators who have been in the team for less than six months) and team collaborators. This information helps verifying if novice practitioners have access to the team leader, as well as verifying if they exchange knowledge with other collaborators who perform the same role that they have. It is also possible to identify relationships between novice practitioners and experts on certain relevant subjects for the organization.

Identifying Peripheral people in the Team

This activity aims to identify the peripheral people of the team (employees who are poorly consulted by other employees). These people are the people who have few connections within the network. In other words, these people are further away from the center of the graph.

Centrality of Information - Knowledge Experts

The purpose of this activity is to identify collaborators who have a large part of the team's information. The centrality of information shows how information flows through many different paths. Therefore, it uses all the paths between the actors (when they consult and when they are consulted about a certain subject). For this analysis, a social network analysis tool is used.

3.2.2 Data Analysis of KM Objectives Questionnaire

The sub process of the data analysis of the KM objectives questionnaires is composed of the following activities: a) transcribing the questionnaires for identifying KM objectives; b) generating totalizer graphs for each KM objective; c) identifying the perception of the leaders and people in the team.

These activities are detailed below.

Transcribing the KM Objective Identification Questionnaires

The purpose of this activity is to transcribe the questionnaires of identification of knowledge management objectives. Each questionnaire filled out by collaborates must be transcribed. The artifact created in the IFactor-KM Process for this activity has the full details on how it can be used.

Generating totalizer graphs for each KM Objective

The purpose of this activity is to show the graphs with results of each of the knowledge management objectives. These graphs are generated based on the data recorded in the "Transcribing the KM Objective Identification Questionnaires" activity.

The graphs show the total degree of agreement (totally agree and agree) and disagreement (disagree and totally disagree) with respect to the KM objectives (creation, storage/retrieval, transfer and application).

Identifying the Perception of the Leaders and People in the Team

The purpose of this task is to show the perception of the team leader with respect to the KM objectives. The results help the organization to know how the leader perceives the process of knowledge management in the team.

The process allows identifying which employee has a different response when compared to most of the participants. These aspects are provided to the evaluated organization so that it can talk to employees and understand their point of view.

The identification of the perception is done for each of the KM objectives. First, the median of the agreement and disagreement answers from all participants is calculated. This result is compared to the response of the team leader. The result shows this difference in responses between the leader and the team.

3.2.3 Data Analysis of the Organizational Culture

The Organizational Culture profile is analyzed at this stage of the IFactor-KM process. The sub process of the data analysis of the organizational culture has activities in order to transcribe the applied questionnaires and to generate the graphs that show the profile of the culture. These activities are presented below.

Transcribing the OCAI Questionnaire - Culture Profile Identification Worksheet

The goal of this activity is to transcribe the questionnaires identifying the organizational culture profile that were filled by the collaborators.

Generating the Organizational Culture Profile Charts

The purpose of this activity is to show the charts that show the profile of the organizational culture (current and desired). It is obtained through the OCAI questionnaire that was applied in the "Applying the Questionnaire that Evaluates the Organizational Culture Profile" activity.

The application of the OCAI questionnaire makes it possible to analyze the organizational culture profile, as well as the single results from each of the six dimensions that form the instrument, which are: (a) dominant characteristics; (b) organizational leadership; (c) organizational management; (d) the “glue” that keeps the organization together; (e) strategic emphasis; (f) success criteria. In the investigated organization, the organizational culture profile is analyzed according to the perception of each team.

The graphs generated in this activity show this analysis of the organizational culture. That is, the current and desired profile, as well as the stratified

analysis.

3.3 Identifying and Listing Practices

In the third stage IFactor-KM Process practices identification and listing activities are carried out. The activities from this stage are to:

- Identify practices according to the results of the social network - strengthening current practices;
- Identify practices in accordance with the goals of KM- strengthening current practices;
- List practices for the organization according to the collected data;
- Identify practices according to the KM objectives that the organization wants to achieve.

The detail of these activities is shown below.

3.3.1 Identifying Practices According to the Social Network Results - Strengthening Current Practices

This activity of the IFactor-KM process aims to identify which practices may already be in use in the organization. This identification is based on the results of social network analysis. KM practices related to social networks are selected when most of the employees (51% or more of the total number of employees) exchange tacit knowledge.

3.3.2 Identifying Practices According to the KM Objectives - Strengthening Current Practices

The purpose of this activity is to identify which practices may already be employed in the organization. This identification will be based on the results of agreement with the KM objectives.

The analysis of this step is done with regards to the total of agreement with each KM objective pointed out in the questionnaire. When the response count is more than 50% of the total responses for each KM goal, practices that can meet KM objectives are highlighted in the "KM Practice Catalog" document. The suggestion of these practices aims to strengthen or improve what may already be practiced in the organization.

3.3.3 Listing Practices for the Organization According to the Collected Data

The list of practices is in accordance with the analysis of the previous activities: "Identifying practices according to the results of the social network - Strengthening current practices" and "Identifying practices according to the KM objectives - Strengthening current practices".

Based on the results, the organization's current situation is presented to the organization – i.e. what it does (even if it does not know that it does). These results include a listing of all practices and examples of application of these practices. In addition, examples are given to contemplate other KM objectives and the totalizer graph of each KM objective.

Table 3 shows an example of a practice listed in the 'KM Practice Catalog' document. The "Experts participation in certain activities of the organization" practice is related to the creation, transfer and application of knowledge objectives.

Table 3: Part of the Practice Catalog with an Example of a KM Practice.

Practice: Experts participation in certain activities of the organization	
Definition: This practice supports the dissemination of the organizational knowledge. Also, it enables problem solving during project / process execution and in updating the organizational knowledge base. **Note**: The experts on a certain subject are obtained through the Knowledge Expert Identification activity.	
Creation Knowledge	Create new knowledge for the organization, so that it can be used in future projects, such as components. In addition, the expert collaborators stimulate the creation of new knowledge in the organization, through innovation. Examples of how to achieve this result: ▪ New solutions created by specialists.
Knowledge Storage/Retrieval	-
Knowledge Transfer	They support the exchange of specialized knowledge about some important process, technology or business rule for the software development. Examples of how to achieve this result: ▪ Consult experts in case of questions.
Knowledge Application	Involving experts in problem solving assists the application of knowledge.

3.3.4 Identifying and Suggesting Practices According to the KM Objectives that the Organization Wants to Achieve

The purpose of this activity is to identify and suggest knowledge management practices according to the KM objectives that the organization wants to achieve. The results also show the graph according to the KM objectives.

In the first activity of the IFactor-KM- Process (i.e. "Identifying the context of the organization and the needs related to KM"), the organization indicates what KM goals it wants to achieve. For example, an organization may be more focused on knowledge creation, but wants to be focused on knowledge storage/retrieval. According to the requirements of the organization, the practices that meet this objective are selected in the "KM Practice Catalog" document. For each suggested Practice, examples are given of how to apply them in the organization.

3.4 Presenting Results

The last step of the IFactor-KM Process is to show the results to the organization participating in the process. The purpose of this activity is to show to the organization all the results through the IFactor-KM Process. The collected and analyzed data in the previous steps are presented to a senior management of the organization and others authorized by them. The discussion of the results is carried out in a meeting and recorded.

4 EXPERIENCE OF USE THE IFACTOR-KM PROCESS

An experience of using the complete IFactor-KM Process was performed to verify the proposed process and to improve the employed artifacts. This usage experience was made with real data from a software organization.

The software organization is responsible for developing and maintaining information systems in several contexts such as education, human resources, public safety, administration, planning and health. The organization has 392 employees, divided into several software teams. This organization is in the process of changing its organizational structure and is interested in understanding how knowledge management works for later improvements.

The data used for the IFactor-KM Process experience was collected in one of the sector within the organization that is responsible for projects related to public sector management systems. This sector is divided into two teams. A team is responsible for a new system that is developed and deployed in contracted companies. The other team maintains and implements another system in companies. The results are based on the data from 17 participants from this organization.

By using the entire IFactor-KM Process with the actual data of the software organization, it was possible to identify the applicability of the process. Some of the obtained results regarding the organization are:

- The organization's two software teams focus more on sharing tacit knowledge. The leader is accessible to the teams (all the collaborators look for the leaders when they have a question). The leaders of the two teams also consult each other when they have questions;
- The identified culture profile in the teams is more focused on teamwork, participation and a high degree of commitment. The work environment is considered to be “an extension of the family”. This may be evidence of the identification of tacit knowledge sharing in these teams;
- The collected data shows that the organization has little knowledge storage / retrieval. This is a real need in the organization. KM practices related to these be suggested to the organization through the proposed IFactor-KM Process.

5 CONCLUSIONS

Knowledge in software engineering is diverse and its proportions are immense and growing (Rus et al., 2001). (Rus et al., 2001). This causes organizations to have trouble keeping track of what this knowledge is, where it is, and who has it. Some organizations have difficulties regarding which approach to adopt in their KM initiatives. In order to diminish these doubts, surveys are being carried out seeking to create a body of knowledge about the influencing factors on knowledge management.

People and leadership have also been identified as factors that influence KM activities. People have to feel like sharing their knowledge with others in the organization (Storey and Barnett, 2000). The team leaders should also create an environment that encourages knowledge sharing.

The IFactor-KM Process (Influencing Factors on Knowledge Management) was presented in this

paper. This process supports software organizations to: a) identify the knowledge management objectives; b) check how tacit knowledge is shared; c) show the knowledge experts; d) understand leadership and people aspects; e) characterize the profile of the organizational culture; and f) suggest knowledge management practices.

An experience using the entire process from the IFactor-KM was performed. During this use experience, it was possible to verify the whole defined process, to identify and to suggest KM practices for the software development organization. A careful analysis is being carried out with the collected data for later publication. Some of the already identified results are: i) the organization's two software teams focus more on sharing tacit knowledge; ii) culture profile in the teams is more focused on teamwork, participation and a high degree of commitment; and iii) the collected data shows that the organization has little knowledge storage / retrieval.

As future work, we intend to carry out controlled experiments in software organizations using the IFactor-KM Process. By doing so, it will be possible to verify the feasibility of the process and to improve the KM activities in these organizations. In addition, we intend to develop tool support for the proposed process.

ACKNOWLEDGEMENTS

We thank the financial support granted by CAPES to the first author of this paper (through a doctorate scholarship); and by FAPEAM through process 062.00578/2014. Finally, we thank all the subjects from the Software Organization who participated in this study.

REFERENCES

Alavi, M., Leidner, D.E., 2001. Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. In MIS quarterly, p. 107-136.

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, v. 4, n. 1, p. 31-49.

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

Anklam, P., 2003. KM and the Social Network. In KM Magazine, v. 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, v. 50, n. 6, p. 511-533.

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, p. 59-68.

Cross, R.L., Parker, A., 2004. The Hidden Power of Social Networks: Understanding How Work Really Gets Done in Organizations. Harvard Business Press.

Dingsoyr, T., Bjornson, F.O., Shull, F., 2009. What Do We Know about Knowledge Management? Practical Implications for Software Engineering. In IEEE Software, v. 26, n. 3, p. 100-103.

Giritli, H., Öney-Yazıcı, 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, v. 31, n. 2, p. 228-238.

Gonzalez, R. V., Martins, M. F., 2014. Knowledge Management: An Analysis from the Organizational Development. In Journal of Technology Management & Innovation, v. 9, n. 1, p. 131-147.

Gupta, A.K, Govindarajan, V., 2000. Knowledge Management's Social Dimension: Lesson from Nucor Steel. In Sloan Management Review, v. 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, v. 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, v. 9, p. 235-261.

Le Dinh, T., Ho Van, T., Moreau, E., 2014. A Knowledge Management Framework for Knowledge-Intensive SMEs. In Proceedings of the 16th International Conference on Enterprise Information Systems (ICEIS), v. 3, p. 435-440.

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

Más-Machuca, M. (2014). The Role of Leadership: The Challenge of Knowledge Management and Learning in Knowledge-Intensive Organizations. International Journal of Educational Leadership and Management, v. 2, n. 1, p. 97-116.

McAdam, R., Reid, R., 2000. A Comparison of Public and Private Sector Perceptions and Use of Knowledge Management. In Journal of European Industrial Training, v. 24, n. 6, p. 317-29.

Mehta, N., Hall, D., Byard., T., 2014. Information Technology and Knowledge in Software Development Teams: The role of Project Uncertainty. In Information & Management, v. 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.

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, v. 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.

Naghib, A., 2003. Effective Factors of Knowledge Management. In Journal Knowledge Management. Malezia, v. 3, n. 7, p. 10-22.

Ndlela, L. T., Toit, A. S. A., 2001. Establishing a Knowledge Management Programme for Competitive Advantage in an Enterprise. In International Journal of Information Management, v. 21, p. 151-165.

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.

OMG, 2016. Business Process Model and Notation (BPMN). Object Management Group, formal/2011-01-03, 2011. In http://www.omg.org/spec/BPMN/2.0/.

Patel, S. (2012). Discovery of Knowledge Management in Organisation. In Indian Journal of Applied Research Management, v.1, n.12, p 134-136.

Probst, G., Raub, S. and Romhardt, K., 2000. Managing Knowledge: Building Blocks for Success, New York: John Wiley & Sons.

Ribere, V.M., Sitar, A.S., 2003. Critical Role of leadership in Nurturing a Knowledge Supporting Culture. Knowledge Management Research and Practice, v. 1, p. 39-48.

Rodríguez-Elias, O. M., Martínez-García, A. I., Vizcaíno, A., Favela, J., Piattini, M., 2008, A Framework to Analyze Information Systems as Knowledge Flow Facilitators. In Information and Software Technology, v. 50, n. 6, p. 481-498.

Rus, I., Lindvall, M., 2002, Knowledge Management in Software Engineering. In IEEE Software, v.19, n. 3, p. 26-38.

Santos, V., Goldman, A., Roriz Filho, H., 2013. The Influence of Practices Adopted by Agile Coaching and Training to Foster Interaction and Knowledge Sharing in Organizational Practices. In System Sciences (HICSS), 46th Hawaii International Conference on, IEEE, p. 4852-4861.

Schneider, K., 2009. Experience and Knowledge Management in Software Engineering Heidelberg", Springer.

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

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), Roma, v. 1. p. 306-317.

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

Tiwana, A., Rames, B., 2001. Integrating Knowledge on the Web. IEEE Internet Computing, v.5, n.3, p. 32-39.

Vasconcelos, J. B., Kimble, C., Miranda, H., Henriques, V., 2009. A Knowledge-Engine Architecture for a Competence Management Information System. In Proceedings of the UKAIS conference, p. 14-31.

Viana, D., Conte, T., Marczak, S., Ferreira, R., Souza, C., 2015. Knowledge Creation and Loss within a Software Organization: An Exploratory Case Study. In Proceedings 48th Hawaii International Conference on System Sciences (HICSS 2015), v. 1. p. 3980-3989.

Viana, D., 2015. Facilitating Organizational Learning in Software Process Improvements. Ph.D. Dissertation in Computer Science. Postgraduate Program in Informatics. Federal University of Amazonas, 454 p. (In Portuguese).

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

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

Yang, L., 2009. Tacit Knowledge and Tacit Knowledge Sharing: Brief Summary of Theoretical Foundation. In Proceedings the International Conf. on Management and Service Science, Wuhan, p. 1-5.