MODELLING AN APPLICATION FOR TACIT KNOWLEDGE ACQUISITION SUPPORT FOR AN IT COMPANY

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Abstract: *This paper focuses on modelling an information system to support the management of knowledge-workers in an IT company. Knowledge workers are defined as those employees important in the completion of IT projects, and as those employees whose work is focused on the application of knowledge. The main aim of this work is to elaborate a method for acquiring knowledge from knowledge workers to be used to facilitate the completion of IT projects in an IT company. The design of the application was built on a conceptual model and UML models. The proposed application is based on a study of 30 knowledge workers in two innovative Polish IT business types which were selected for study.*

1. Introduction

Knowledge acquisition in an IT company, an important area of research, should be primarily concerned with gathering tacit knowledge from workers, who work in a company, in the form of an ontological construct. Knowledge workers have tacit knowledge, a form of knowledge which is difficult to capture. According to Davenport [2005], knowledge workers are important for a company, because their work is focused on knowledge. Moreover, Spira [2008] states that they carry out certain and specific jobs. As for definitions are concerned, we characterize knowledge workers in an IT company as employees whose work is based on their knowledge and who are typically a critical source in the development of IT projects. The management of knowledge workers is understood to be difficult due to the intangible character of their knowledge. Our previous research on knowledge workers presented a possible method to define and classify such workers in a company [Patalas-Maliszewska 2013], [Patalas-Maliszewska and Krebs 2015]. In this paper, we continue our research and propose a model of a tool for Tacit Knowledge Acquisition Support for an IT company. Due to know-how, when a knowledge worker leaves a company, his knowledge leaves with him [Mládková 2012]. Naturally, it follows that a model for tacit knowledge acquisition is an important issue.

In this study, we state that acquiring tacit knowledge from knowledge workers in an IT company is very important for the development of IT projects. This study tries to ascertain how managers acquire knowledge from knowledge workers who execute IT projects; and how our proposed tool can support this process in an IT company. Our model of an application for Tacit Knowledge Acquisition Support for an IT company is investigated via the general procedures of the determination of Main Tacit Knowledge Sources and UML models. Furthermore, we provide an explanation of the form of knowledge acquisition about IT projects, based on research results from 30 knowledge workers in two innovative Polish IT companies.

The remainder of this paper is organised as follows. Section 2 presents the theoretical background of the study. Section 3 describes the conceptual model of our application. Section 4 discusses the method of knowledge acquisition for IT projects for an IT company. Section 5 summarises the research results.

2. Theoretical background

In reviewing the literature on knowledge workers, it is evident that as intangible sources in a company, they play a crucial role in a company's development processes. Unfortunately, however, their knowledge is very difficult to absorb [Loebecke et al. 1999], [Bennet 2002], [George and Chattopadhyay 2005], [Sharma et al. 2009], [Patalas-Maliszewska and Krebs 2015].

The process of identifying knowledge workers and, moreover, the process of determining who are the main tacit knowledge sources in a company was described in previous works [Patalas-Maliszewska and Krebs 2016]. We formulated a personnel usefulness function and the values of this function can be obtained for each worker in a company through interviews/tests. Then, using the FAHP (Fuzzy Analytic Hierarchy Process) for validating the values of this function for each knowledge worker, it is possible to determinate the Main Tacit Knowledge Sources (MTKS) in a company.

However, we know that we cannot build a universal model to define knowledge workers as well as a universal tool for acquiring their knowledge. Each IT project is unique and to achieve the success of a project it is necessary to acquire expert knowledge from workers. Davenport [2010] states that workers who work on the development of IT projects can be typically classified as knowledge workers and according to [Alawneh, Hattab and Al-Ahmad 2008] they should have both social and technical skills. Therefore, our studies are limited to IT companies and to the development of projects from IT departments. This limitation is a practical necessity designed to narrow the scope of the model to maintain its accuracy.

Tacit knowledge, in contrast to explicit knowledge, is difficult to capture within a formula [Le Nguyen Hau and Felicitas 2007]. We seek to improve our understanding of tacit knowledge acquisition by answering the question: how can tacit knowledge about IT projects from knowledge workers be conceptualized and defined? Lee and Hong state that we can find many types of knowledge management (KM) tools on the market. Yet, according to Cascão [2014], we also know that knowledge is associated with a company, is unique and its use allows a company to cope with various different situations. The work of Anquetil et al. [2007] is focused on the capture of knowledge in software maintenance, but special attention is paid to the promotion and creation of a knowledge management culture. In this paper, we aim to develop the process of knowledge acquisition, i.e. how knowledge is acquired from knowledge workers in an IT company.

Therefore, Fig. 1 shows the concept of our model of acquisition of the knowledge about IT projects in an IT company.

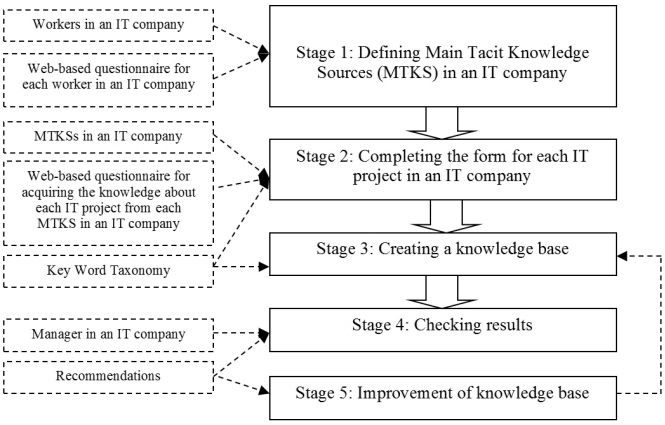

Figure 1: A model of acquiring the knowledge about IT projects in an IT company, own elaboration

Stage 1 was developed in our previous research [Patalas-Maliszewska and Krebs 2016]. Stage 2, this research, presents a model Application for Tacit Knowledge Acquisition Support for an IT company.

3. A model of an Application for Tacit Knowledge Acquisition Support for an IT company

Our proposed model is built using UML as a set of diagrams in which three categories of actors are defined: administrator, manager in an IT company and worker in an IT company. Figure 2 shows a fragment of the diagram of the variants of workers who initiate efforts to complete a survey form for an IT project in an IT company.

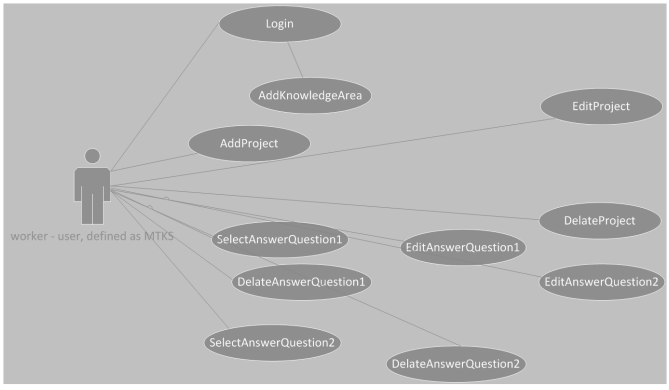

Figure 2: Fragment of a diagram of variant use in the Application for Tacit Knowledge Acquisition Support for an IT company, own elaboration

According to Patalas-Maliszewska and Dudek [2016], we can distinguish the following method of acquiring tacit knowledge: real-time teacher observations, analyses of problem solving procedures, training sessions, courses, demonstrations, auditing knowledge and hidden interviews. We propose the use of survey forms in our information system for each IT project in an IT company, which should be filled by the defined MTKS in a company. The general procedure of determining the Main Tacit Knowledge Sources (stage 1 in Fig. 1) in the information system is proposed below:

Stage 1:
INPUT: Web-based questionnaire about typically realised processes: $P_n \in \leq 1;69 \geq$ for each worker in an IT company: $W = \{W_1,\ldots, W_m\}$, $m \epsilon N$
begin
select workers, whose realise business processes P_R in time in a given month in a defined range of hours (1h-160h):
$\{P_R\}$ = {preparing a new project, defining the scope of a new project, creating a new product, improving existing products, providing market analysis, providing market research, providing technical research, designing a concept of a new product, creating a prototype, creating a final product, sharing marketing processes and best practices, preparing a firm's strategy, planning a firm's development, human resource management, risk management, controlling, finding new projects, making decisions, support and benefits realisation, participating in meetings, learning, training, administrative work/reporting}
if a $worker_1$ selects$P_n \in \{P_R\}$ and attributes the time in a given month in a defined range of hours 1h-160h to this P_n: then select a $worker_1$, $n \epsilon N$
if a $worker_m$ selects$P_n \in \{P_R\}$ and attributes the time in a given month in a defined range of hours 1h-160h to this P_n: then select a $worker_m$, $n \epsilon N$, $m \epsilon N$
do
until a set of workers who realise business processes P_R in time in a given month in a defined range of hours (1h-160h): $W' = \{W'_1,\ldots, W'_m\}$, $m \epsilon N$
end

Each worker should select the processes that are carried out by this worker and if the processes are carried out more than 80% of the time in a given month by a particular worker, then that particular process will be attributed to that particular worker [Patalas-Maliszewska and Krebs 2016]. The 69 different processes are defined for an IT company.

Stage 2:
INPUT: Web-based questionnaire: knowledge of each worker K_n in an IT company: $KW = \{KW_1,\ldots, KW_m\}$, $m \epsilon N$
begin
select a KW1
($F_1 \geq 17$ and $ACT_1 \geq 3$)
select a KW2
($F_2 \geq 17$ and $ACT_2 \geq 3$;)
select a KWj, $j \epsilon N$
($F_j \geq 17$ and $ACT_j \geq 3$;)
do
until KW =
end

Description:
For each worker in a company, we can receive the value of his/her personnel usefulness function defined as:
where:
$1 \leq Fn \leq 25$ and $1 \leq f1(GK) \leq 5$; $1 \leq f2(PK) \leq 5$, $1 \leq f3(A) \leq 5$, $1 \leq f4(E) \leq 5$, $1 \leq f5(I) \leq 5$,
GK-the general knowledge function for the n-th worker in a company, where $1 \leq GK \leq 5$
PK-the professional knowledge function for the n-th worker in a company, where $1 \leq PK \leq 5$
A- the professional abilities function for the n-th worker in a company, where $1 \leq A \leq 5$
E-the experience function for the n-th employee in a company, where $1 \leq E \leq 5$

CI-the capacity for innovation function for the n-th employee in a company, where $1 \leq CI \leq 5$
ACT – the acceptance of F_n by a manager in a company, where $1 \leq ACT \leq 5$.

The values of the personnel usefulness function and of the «acceptance» module for each worker in a company will be obtained from workers and managers through interviews/tests conducted at each stage of this function. Each worker/manager completes a defined survey form. Using an algorithm to test solutions for each work-er, it is possible to determine the value for the personnel usefulness function of the worker [Patalas-Maliszewska and Krebs 2016].

Stage 3:
INPUT: the use of the Fuzzy Analytic Hierarchy Process method
begin
determine the relative dominance of each factor in the function F_1 for each KW_1
($w_{GK1}, w_{GK1}, w_{PK1}, w_{A1}, w_{E1}, w_{CI1}$)
determine the relative dominance of each factor in the function F_2 for each KW_2
($w_{GK2}, w_{GK2}, w_{PK2}, w_{A2}, w_{E2}, w_{CI2}$)
determine the relative dominance of each factor in the function F_j for each KW_j
($w_{GKj}, w_{GKj}, w_{PKj}, w_{Aj}, w_{Ej}, w_{CjI}$)
select a KW1
($F'_1 \geq 3$ and $ACT_1 \geq 3$)
select a KW2
($F'_2 \geq 3$and $ACT_2 \geq 3$;)
select a KWj, jϵN
($F'_j \geq$' and $ACT_j \geq 3$;)
do
until MTKS =
end

Description:
MTKS – Main Tacit Knowledge Source in an IT Company.

Thus, our method for Knowledge Acquisition about each IT project will be presented in the next section.

4. Knowledge Acquisition about IT projects – discussion

Our motivation to develop an application for Tacit Knowledge Acquisition Support for an IT company was based on the needs of managers of IT companies during our cooperation with them. According to our research results from two innovative Polish IT businesses with a combined total of 30 workers, it is possible to identify the most important knowledge which should be supported by an IT tool. The survey data were collected between March 2015 to May 2015. For all kinds of knowledge that were measured, a five-point Likert scale was adopted in which: 1- strongly unimportant and 5 – strongly important. Figure 3 presents the results.

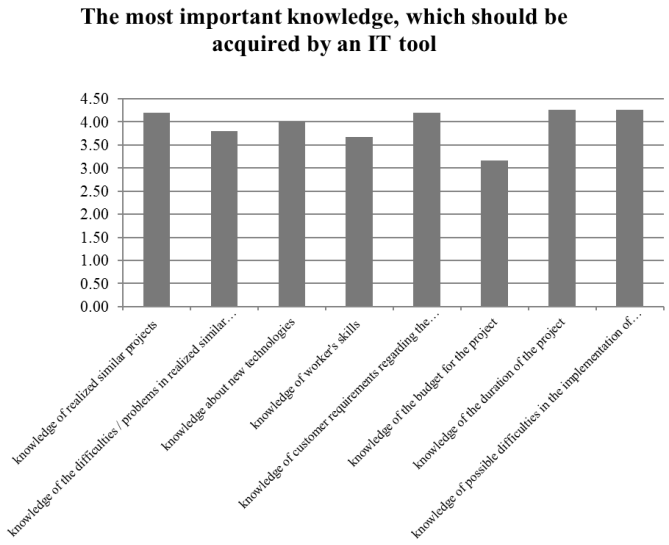

Figure 3: The most important knowledge which should be acquired by an IT tool based on the discussion with 30 workers in Polish IT companies, own elaboration

Based on the research results, we propose a survey form for knowledge acquisition about each IT project for our application for Tacit Knowledge Acquisition Support for an IT company. For each IT project, the Main Tacit Knowledge Source (MTKS) identified in an IT company should complete a defined form. He/she selects one answer for each question. Based on the results, and on Key Word Taxonomy, a knowledge base about IT projects is created. Also, the process of converting tacit knowledge from MTKS workers into explicit knowledge can be carried out using our proposed application.

Below is a fragment of the form for Knowledge Acquisition about each IT project:

1. Client:
□ Manufacturing Company.
□ Services Company.
□ Trading.
2. Client:
□ Small Company (49 employees or fewer).
□ Medium Company (from 50 to 249 employees).
□ Large Company (over 250 employees).
3. The goal of the IT project:
□ Implementation of an application.
□ Creation of a new solution for the customer.
□ Improving the existing functionality solutions in an application.
□ Adding current functionality solutions to an application.
...
12. Programming works were carried out using:
□ Programming – Language: Java
□ Programming – Language: Java Script
□ Programming – Language: C (C++), (C#)
□ Programming – Language: Objective-C

 Programming – Language: Python
 Programming – Language: PHP
 Programming – Language: (Visual) Basic
 Programming – Language: Perl
 Programming – Language: Delphi/Object Pascal
 Programming – Language: Visual Basic .NET
 Programming – Language: Język asemblera
 Programming – Language: PL/SQL
 Programming – Language: Swift
 Programming – Language: MATLAB
 Programming – Language: Groovy

13. During the project realisation, the following were reported:
 Mistakes in customer requirements.
 Errors in the application?

14. During the project realisation were done:
...

18. Was the IT project:
 completed in the defined time?
 completed in the defined scope?
 completed in the given budget?

Then we can receive for each MTKS, a completed table about each IT project according to the rules:

- If there is a «word» in the answer, it is a type: 1.
- If there is no «word» in the answer, it is a type 0.
- If no data word is in the answer, it is a type 0.5.

Naturally, this form for knowledge acquisition about IT projects is dynamic and can be adopted to the needs of companies. Besides, the whole proposed system for Tacit Knowledge Management Support is a tool which can be modified to the needs of a company and may be adaptable to the profile of a company. Further studies will construct a knowledge base describing each of the following IT projects

5. Conclusions

In IT project management, tacit knowledge acquisition becomes crucial for effective software development. In this paper, we have argued that the adoption of a dedicated tool for Tacit Knowledge Management Support would improve the effectiveness of an IT company. In order to elaborate the application, a conceptual model was built, which presents the principle of how the system works. The use of the developed application, can provide the possibility for an IT company to save critical tacit knowledge gathered from any identified Main Tacit Knowledge Sources (MTKS). In this paper, the procedures implemented in the application for determining MTKS were also presented.

The next step of the development of the application for Tacit Knowledge Acquisition Support for an IT company is the design of all software components. The proposed approach could also be applied not only in private companies, but also in public organisations. However, this statement requires more in-depth research in the area of the needs of public organisations in the field of knowledge management support tools.

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