Managing Organizational Knowledge Transfer in Requirements Elicitation Process

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ABSTRACT
The organizational knowledge highlights the capability of members in the organization in carrying out their work, and using their collective understanding and experiences in the business process. The organizational knowledge transfer is important for sustaining and enhancing organizations’ competitive advantage. Knowledge transfer during the requirements elicitation process is crucial in order to attain a consensus between customers and developers in respect of all issues required for a system. In order to achieve that, they need to effectively and efficiently organize and manage the process of knowledge transfer, within intra-organization as well as inter-organizations. The aim of this paper is to show the structural components that engage in knowledge transfer and how the organization can manage the transfer.

Keywords: knowledge transfer, requirements elicitation, organizational knowledge.

I. INTRODUCTION
The knowledge for the requirement elicitation process is essential to ensure that the requirements for the system to be developed is sufficient, complete, correct and agreed among the stakeholders. There can be varieties of knowledge shared as a result of obtaining and providing by the both organizations. Knowledge possibly created by individuals and while working in a team, part of the knowledge get shared and contributes to the collective of knowledge between customers and developers. The knowledge can be retrieved from the internal source which is intra-organizational and inter-organizational which is between the both sides.

Knowledge transfer has become a challenge and issue for globally distributed work, such as global software development projects regarding how to effectively transfer knowledge-related requirements (Distantont et al, 2012). The organizational knowledge transfer is important for sustaining and enhancing organizations’ competitive advantage. The effectiveness of organizational knowledge transfer is influenced by many factors such as the knowledge sources, prior experiences, cultural distance, and limitations in delivering the knowledge. While, as knowledge creation and utilization are also affected by the social and cultural contexts. The factors are interconnected, and need to be concerned in knowledge transfer. Therefore, the impact of the factors on the effectiveness of the intra-organizational and inter-organizational knowledge transfer process cannot be overlooked.

The paper has the following structure: the second section contains a theoretical background requirements elicitation process and knowledge transfer. In the third section presents the study of organizational knowledge transfer in requirements elicitation process. Section four elaborates the structural components of the organizational knowledge in requirements elicitation process. It is also discuss on how organization can manage the knowledge transfer. The conclusion will be discussed in the final section.

II. THEORETICAL BACKGROUND
In this section, we provide brief theoretical background of software requirements elicitation process and knowledge transfer before we move forward to the proposition.

A. Requirement Elicitation Process
Requirements elicitation involves searching, exposing, obtaining and detailing the requirements for computer-based system (Coulin et al, 2005). According to Grunbacher and Braunsberger, 2003; Grunbacher et al, 2004, to reach a consensus between customers and developers in respect of all issues that required for a system is crucial during the requirements elicitation process. Furthermore, data and information that consider as knowledge is be acquainted with appropriate for supporting and automating the task in an organization (Yang and Tang, 2003). This process also involves many techniques, approaches, tools and skill, commitment and cooperation by the stakeholders. According to (Aurum and Wohlin, 2005) this process is repetitively. Sommerville (2011) break down the process activities such as requirements discovery, requirements classification and organization, requirements prioritization and negotiation and requirements specification (refer Table 1).
Table 1. The Requirements and Analysis Process (Sommerville, 2011).

<table>
<thead>
<tr>
<th>Activities</th>
<th>Description</th>
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<tbody>
<tr>
<td>Requirements Discovery</td>
<td>The process of interacting with stakeholders for discovery their requirements. Many techniques (e.g. interview, ethnography, use case) will used.</td>
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<tr>
<td>Requirements Classification and Organization</td>
<td>This activity takes the unstructured collection of requirements groups’ related requirements and organizes them into coherent clusters. Used the model of the system architecture to identify sub-system and to associate requirements with each sub system.</td>
</tr>
<tr>
<td>Requirements Prioritization and Negotiation</td>
<td>This activity is concerned with prioritizing requirements and finding and resolving requirements conflicts through negotiation.</td>
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| Requirements Specification.       | Formal or informal requirements documents may be produced.  

B. Knowledge Transfer

Organizational knowledge is defined as 'the capability members of organization have developed to draw distinctions in the process of carrying out their work, in particular concrete contexts, by enacting sets of generalization (propositional statements) whose application depends to historically evolved collective understanding and experiences' (Tsoukas and Vladimirou, 2001). This definition reveals some characteristics of organizational knowledge for some specific purpose of the organization including in the context of the requirement elicitation process. The advancement of the technology nowadays has increased the issues on the globally distributed work such as global software development projects (Kotlarsky and Oshri, 2005).

![Figure 1. A Knowledge Transfer Intra-organizations.](image)

Knowledge transfer referred in the literature such as to describe knowledge exchange processes (Wilkesmann and Wilkesmann, 2011), consists of both knowledge acquisition and use (Williams, 2011) and a substantial transfer of knowledge from one team member to another (i.e., transmitting knowledge to and absorbing knowledge from each other) (Sarker, et al, 2005). Other definition such as given by (Hansen, et al, 1999), knowledge transfer as a process through which one organization identifies and learns specific knowledge that resides in another organization and reapplies this knowledge in other contexts (refer Figure 1).

In Williams, (2011) used knowledge-based theory to develop and test a model of client-vendor knowledge transfer at the level of the individual offshore information systems engineer. The knowledge types identified are declarative and procedural knowledge. The declarative knowledge is straightforward to transfer, however the procedural know-how is difficult to articulate and transfer. The knowledge-based theory was applied to address the gap of the client-vendor knowledge transfer at the level of the individual offshore vendor engineer.

In conclusion, the knowledge can be created by individual stakeholder as well as a team, thus, the knowledge should be shared within the organization and between the organizations. Knowledge transfer is crucial since elicitation process is involving many stakeholders and various resources that are usually geographically distributed. Furthermore, transferring knowledge within the organization and inter-organizations will tackle issues concerning on tacit knowledge, familiarity with the problem domain and technology, constraints on effort, time and facilities support. The issues in conducting requirements elicitation process that brings to light the important of knowledge transfer.

III THE STUDY ON ORGANIZATIONAL KNOWLEDGE IN REQUIREMENTS ELICITATION PROCESS

An empirical study [14] has been conducted to identify the main components of organizational knowledge that involved during requirements elicitation process. From the survey we identify the knowledge sources and the knowledge limitation.

The results from the survey showed that 50% respondents identify the software requirements from expert knowledge and 69.0% of respondents have chosen the business process as their main information source. There are many types of information is use during requirements elicitation process in which we can group into formal and informal information. For example we can get informal information thru face-to-face meeting and documentations or diagrams as sources of formal information. While Software Requirement Specification (SRS) document can provide formal information in which the analysis showed that 53% respondent have their own organization’s standard or refers to similar organizations in writing the SRS document. Whereas for requirements models, the survey shows that only 28.6% of them have
considered using diagrammatic tools to represent the requirements (e.g., Rational Rose, Enterprise Architect and Microsoft Visio).

Moreover, the result from the survey also shows the familiarity of the stakeholders to their business domain. In which, the customer familiar with business domain, scope project, interface design, input and output design that refer as a content in SRS.

This including their ability to provide information related to functional requirements, 89.2%; 73% in system scope and business part, 73% in interface part, and 73% in part. Whilst at the developer side, the findings show that 52.4% of the developers have experience and good knowledge as Project Leader, and 21.4% as System Analyst. The findings also show the elicitation techniques that mostly used by the developer is interview which is 81%, although also familiar with other techniques in which 59.5% document analysis, 35.7% survey, 31% questionnaire, 28.6% scenario and 21.4% focus group. This can be conclude that the findings show their skills and knowledge on requirements elicitation process in relation to requirements discovery, requirements classification and organization, requirements prioritization and negotiation and requirements specification.

Stakeholder’s participation is very important in requirements elicitation process. It can be as individual as well as project team member. Findings from the survey shown that most stakeholders are involved in checking the SRS document in which 88.1% respondent claimed customer involvement in checking on SRS document. The survey also shows that the itemized content of SRS document is validated by customer. Besides, the development team generally using prototype to communicate requirements that were developed in effort to seek feedback between organizations (i.e., customer and developer). From the survey, the feedback from respondents who used prototype is 30 out of 42 persons. From the analysis, it is shown that 71.4% of developers used prototype techniques to validate their requirements. The study found out as much as 86.7% presented their prototype for interface, 26.7% for schedule, 80% for process flow, and 3.3% for working system.

Additionally, the results of the study show the developer’s knowledge that relevance to the requirements elicitation process. In which, the developers have knowledge in employing established methodology in software development. For example, the survey shows that most of the developers prefer to use Structured System Analysis and Design Method (SSADM) as compared to Object Oriented Analysis (OOA) with small percentage of preference on internal methodology. This is probably because the traditional method is easy to understand and represent the actual customer requirements.

The analysis of data also showed on how the stakeholders utilized their knowledge in the business process. For example in preparing SRS document, in which 53% respondent follows their own organization standard or at least refer to similar organization, 13% of respondents adhered to standard set by IEEE, 3% adhered to ISO standard 9000-3, 3% adhered to the National Standards and 28% of respondents do not adopt any formal standard.

The limitations for delivering the requirements among stakeholders during requirements elicitation process are also discuss based on the feedbacks given by the developers (Noraini and Abdullah, 2011). Several interviews with developers have been conducted in order to find out the limitations. The limitations can be looked in terms of competency, credibility, communication coverage, and culture.

Based on the feedbacks, the problems related to competency for communication such as the developers lack the communication skills (verbal), lack of skill to express ideas by using proper language construct, lack of presentation skill and lack of skill to write documentations. And, the limitations regarding on managerial competency are including lack of the ability to organize ideas, lack of cooperation, lack of commitment, lack of tolerance, lack of ability to solve ambiguous problems, lack of ability to plan and to work in groups and being emotional. Whereas, problems related to credibility within organization might involve authority, no formal information, and changes of management and political rules. Whereas, credibility between organizations such as company loyalty.

The feedbacks also highlight the problems related to communication medium usage such as late in giving responses, misinterpretation, no formal information, no answer or line busy (phone), unclear pronunciation, only the representative that answering the phone or attending the meeting, informal or unrecorded information and lack of monitoring and action on decisions made during the meetings. It is also mentioned about the problems on culture that related to social relationship and education background.

Basically, the problems mentioned above are interconnected, and always happens during the requirements elicitation process.
MANAGING ORGANIZATIONAL KNOWLEDGE TRANSFER IN REQUIREMENTS ELICITATION PROCESS

The components of the organizational knowledge in requirements elicitation process that related to knowledge transfer inter and intra-organizations are including the purpose, the knowledge sources and the knowledge limitations.

A. The Purpose of Knowledge Transfer

Initially, the organization need to set the information related to knowledge transfer that will be conducted. In order to set the organizational knowledge transfer we need to identify the answers for the following questions:

- Who will involve?
- How to transfer knowledge intra-organization and inter-organization?
- What is the knowledge?
- Why that knowledge need to be transferred?
- Why choose that knowledge?
- In which process the knowledge is needed?

Based on the study, we identify that those who are familiar with the process on the developers side such the project leader, Software engineer, System analyst and Programmer, that are basically will involve in the knowledge transfer. In order to transfer knowledge between developer and customer, they can use techniques such as interview, survey, scenario, document analysis, questionnaire, and focus group.

The knowledge that can be transferred between the customers including their ability to provide information related to functional requirements, system scope and business part, interface part, and in input and output part. Besides, the development team generally using prototype to communicate requirements that were developed in effort to seek feedback between organizations (i.e., customer and developer).

The needs of knowledge transfer between the developers due to the importance of their tacit knowledge on their experiences, familiarity, problem domain, skills and technology. The knowledge can be used during the elicitation activities such as requirements discovery, requirements classification and organization, requirements prioritization and negotiation and requirements specification.

B. The Knowledge Sources

Based on the study, we can categorize knowledge sources into five main categories such as formality, attachment, familiarity; relevancy and utilization.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Description</th>
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<tbody>
<tr>
<td>Formality</td>
<td>The type of information used for knowledge transfer such as formal and informal. (e.g., requirements document(formal), idea(informal))</td>
</tr>
<tr>
<td>Attachment</td>
<td>The attachment or involvement of the stakeholders as individual and as project team.</td>
</tr>
<tr>
<td>Familiarity</td>
<td>The familiarity of the stakeholders to the business domain. (e.g. experiences)</td>
</tr>
<tr>
<td>Relevancy</td>
<td>The relevancy of the knowledge that contributes to the business. (e.g. involvement)</td>
</tr>
<tr>
<td>Utilization</td>
<td>The utilization of knowledge in technology, business process and design solutions to the customer.</td>
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</table>

C. The Knowledge Limitation

Based on the study, we can categorize the knowledge limitations into competency, credibility; communication coverage and culture.

- **Lack of competency**
  It involves a various skills in conducting requirements elicitation process. The skills can be group into few categories, such as competency in domain knowledge, technical, managerial and communication.

- **Lack of credibility**
  Based on finding the credibility can be group into two categories, within organization and between other organizations.

- **Communication interruption and level of commitment.**
  Based on findings, communication coverage can be affected by type of medium (e.g., telephone, email, and meeting)

- **Culture differentiation**
  Problems on culture related to social relationship and education background.
Table 3. Categories of Knowledge Limitation in Requirements Elicitation.

<table>
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<tr>
<th>Type of Limitations</th>
<th>Description</th>
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<tbody>
<tr>
<td>Lack of competency</td>
<td>The stakeholder have differences of skill related to business domain, technical, software development and Project management.</td>
</tr>
<tr>
<td>Lack of credibility</td>
<td>Lack of credibility in term of confidential, privacy and security.</td>
</tr>
<tr>
<td>Communication interruption and level of commitment.</td>
<td>The communication problem occurs during knowledge transfer.</td>
</tr>
<tr>
<td>Culture differentiation</td>
<td>Differences of cultural background.</td>
</tr>
</tbody>
</table>

The transfer of knowledge may improve the knowledge integration between two or more teams working together and also between the representatives of the development team and customer on the requirement elicitation processes. The links of knowledge transfer can be in different field of knowledge either the directions of the intra-organizational and inter-organizational levels of knowledge transfer. However, addressing the gap of the knowledge transfer between the requirement engineers and their client also need to be address so that the developer are able to gain and apply knowledge for the benefit of their customer (refer Figure 2).

In order to manage the organizational knowledge transfer there are four considerations that emphasize:

- Initially, the organization responsible to determine who will involve in the process that considering their expertise and experiences related skill such as techniques, domain knowledge and managerial knowledge.
- Managing the involvement of stakeholder is very important in ensuring delivering and receiving of the correct knowledge and the right participants. By having the representatives, it is worried that the
knowledge given by them is insufficient and thus difficult to make a decision. Therefore, it is important to select appropriate representatives that involved in the process.

- Once the representatives are identified, then the purposes of knowledge transfer need to be set before starting the process. The purpose depends on the organizational needs such as type of knowledge, the expertise and the communication facilities.

- Eliciting requirements involves various sources that include tacit and explicit knowledge that are intensely used to communicate between intra-organization and inter-organization. Therefore the knowledge sources need to be identifying in terms of formality, attachment, familiarity, relevancy and utilization.

- During the communication, there are limitations that need to be concern in managing the knowledge transfer to ensure the both parties satisfied.

The effectiveness of managing intra-organizational and inter-organizational knowledge transfer is influenced by the structural components. The components involved different level of management within and between the organizations. The organization needs to take into account the limitations and opportunities that are relevant in direction of knowledge transfer.

V CONCLUSION

This paper highlights the issues on knowledge transfer in requirements elicitation process that involved customer and developer. It is also presents structural components for managing the knowledge transfer intra-organization and inter-organizations. The knowledge transfer is influenced by many factors that are interconnected such as the knowledge sources, prior experiences, cultural distance, and limitations in delivering the knowledge. In order to achieve the effectiveness of the knowledge transfer, there are four components considered: knowledge representatives, the purpose of knowledge transfer, knowledge sources and knowledge limitation. The proposition of managing the organizational knowledge transfer can be applied in another organization that has interest in this area. As for future work, we will look on how the management can design the incentive structure for optimal transfer, measuring the optimization and validating the proposition by applying it in a suitable case study and show the effectiveness of proposition.

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REFERENCES


