International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:8, No:2, 2014

Knowledge Audit Model for Requirement Elicitation Process

Laleh Taheri, Noraini C. Pa., Rusli Abdullah, Salfarina Abdullah

***Abstract*—**Knowledge plays an important role to the success of any organization. Software development organizations are highly knowledge-intensive organizations especially in their requir ement elicitation process (REP). There are several problems regarding communicating and u sing the knowledge in R EP such as misunderstanding, being out of scope , conflicting information and changes of requirements. All of these problems occurred in transmitting the requirements knowledge during REP. Several researches have been done in REP in ord er to solve the problem towards requirements. Knowledge Audit (KA) approaches were proposed in order to solve managing knowledge in human resources, financial and manufacturing. There is lack of study applying the KA in requirements elicitation process. Therefore, this paper proposes a KA model for REP in supporting to acquire good requirements.

***Keywords*—**Knowledge Audit, Requirement Elicitation Process, KA Model, Knowledge in Requirement Elicitation.

I. Introduction

REQUIREMENT elicitation is a knowledge intensive process which aims to identify the needs of clients for the software to be developed. But there are some problems regarding the kno wledge in REP [1] s uch as misunderstanding, confliction of information, undefined scope and continuous changes of requirements. The misunderstanding means that users or stakeholders don't have a complete and accurate understanding of their needs, and computer capabilities. For example, the stakeholders use different language when delivering the r equirement information to developers. Sometimes, they may omit the important information or de liver unnecessary and u seless in formation [2], [3].

During requirements elicitation process it is difficult [2] to determine the scope due to project size and dimensions at an initial development phase. Furthermore, the boundary and scope of the system is not de fined well. The issues on conflicting information among stakeholder is mentioned in[1]. In addition, different users may have di fferent experience, knowledge and the ways to interpret t heir requirement's information [4]. Sommerville also points that the requirement engineers have to find main sources and potential sources of the requirements [5]. The others issues i n REP i s constant changes of requirements [5], [4] wh ich named as the problem of volatility by Christel [2].

As mentioned above, REP problems are regarding knowledge transmission from users and stakeholders to developers. According to Hylton [6] measurement of efficiency of knowledge transmission is considered as one of the processes and co ntributions of KA. Thus, we propose a KA model to assure ef ficiency of knowledge transmission during REP using Iterativ e triangulation method. Our model aims to supp ort knowledge transmission in REP between customers and developers and mitigate the mentioned problems.

This paper is divided into four sections. The first section is introduction. The seco nd section of the paper describes the related research regarding knowledge audit and knowledge in REP. The third section describes the propos ed model and the last section is the conclusion and future work.

II. Related Research

A. Knowledge Audit

Knowledge Audit is a dynamic process to evaluate, assess, and analyze knowledge policies, resources, structure, flow and need in organization [7].

Different researchers proposed various models, frameworks and methodologies for KA.

Ganasan and Dominic developed a hybrid model, they focused on core processes[8]. The six stages of their model are listed below:

1) Information and culture assessment
2) Core process prioritization
3) Knowledge health measurement
4) KA reporting
5) KM strategies recommendation
6) Continuous re-auditing

Wu and Li introduced the concept of knowledge capital and proposed a rocket-shaped model for KA. They focused on KA team, KA processes and methodologies and knowledge capital. The processes introduced by them are planning stage, data collection stage, data processing stage, data analysis stage, reporting stage and summary stage [9].

Handzic proposed a KM Audit model to get a precise illustration of organization's knowledge strategies and assets. Socio-technical enablers, knowledge processes and knowledge stocks, KM drivers (environmental factors) and KM outcomes are introduced as the elements of this model [10]. The authors consider the concept of contingency that states there is no single solution for all situations. The author also mentioned

Laleh Taheri is with Faculty of Computer Science and Information Technology, Universiti Putra Malays ia, 43400 UPM, Serdang, Selangor (corresponding author to provide e-mail: laleh.taheri@gmail.com).

Noraini C. Pa is with Facult y of Computer Science and Information Technology, Universiti Putra Malays ia, 43400 UPM, Serdang, Selangor (phone: 03-89471758; e-mail: norainip@upm.edu.my).

Rusli Abdullah Salfarina and Abdullah are wi th Faculty of Computer Science and Information Technology, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor (e-mail: rusli@upm.edu.my, salfarina@upm.edu.my).

the dynamic nature of knowledge processes. This model didn't introduce any processes or activities in order to perform KA.

On the other hand, Perez-soltero proposed a model and framework consisting of ten stages naming [11]:

1) Identifying organization objectives and process,
2) Identifying organization's core processes
3) Prioritizing and selecting organization's core processes
4) Identifying key people
5) Meeting key people
6) Knowledge inventory
7) Knowledge flow
8) Knowledge mapping
9) Auditing reporting
10) Knowledge re-auditing

This framework focuses on core processes and introduces support tools for each stage to assist the implementation.

Cheung proposed an eight-step framework [12]. The steps in their framework are:

1) Orientation and background studies
2) Cultural assessment
3) In-depth investigation
4) Building knowledge inventory and knowledge mapping
5) Knowledge network analysis
6) Recommendation
7) Deploying KM tools and building collaborative culture
8) Re-audit

This framework addressed the limitations of existing KA approaches because of lacking real-life implementation. The advantage of this framework is regarding consideration of knowledge management (KM) needs, strengths, weaknesses, opportunities, threats and risks.

Suo proposed a framework to measure the KM of organization [13]. This framework focuses on knowledge environment, knowledge process and knowledge capability and demonstrates that KA has an effective impact on continuous improving KM capability although does not provide details of KA activities.

The framework proposed by Sharmaon the other hand, consists of four main steps such as knowledge map creation (knowledge flow analysis), knowledge taxonomy (knowledge inventory), knowledge SWOT analysis (knowledge needs) and recommendations for tacit and explicit knowledge mobilization [14]. This framework mostly focused on knowledge map and taxonomy.

Jiuiling introduced a framework for KM audit based on processes which including three main parts. The first part is about the enterprise's knowledge and its practices or basic activities and focuses on the nature of knowledge (tacit and explicit). The second part relates to core processes of KM audit such as KM Environment Audit (KMEA), Knowledge Asset Audit (KAA), KM Capacity Audit (KMCA), and KM Performance Audit (KMPA). The third part explains support processes of KM audit and concentrates on KM System Standards, Enterprise culture leads, and KM Tool Support [15]. This framework provides a clear and well-defined classification of the processes. The aim of each process is stated in details but not adequate details are provided for KA implementation based on this framework.

Lee proposed an action-oriented and contextual audit methodology, namely STOCKS (Strategic Tools to Capture Critical Knowledge and Skills) [16]. This methodology also has various useful stages. Prioritizing and selecting processes is the first stage in this methodology. Studying the workflow, STOCKS form filling and STOCKS workshop come next. The following stages are regarding knowledge inventory and analysis, in-depth interview and data validation, and providing recommendations respectively. This methodology pays a considerable amount of attention to practical stages for implementing KA.

B. Requirement Elicitation Process

Requirements elicitation is defined as a process of acquiring, seeking, discovery, and elaborating requirements for developing a computer-based system [17].

There are four main activities in REP including requirement discovery, requirement classification, requirement prioritization and negotiation, and finally requirement specification [5].

The first activity is discovering requirements in which developers and stakeholders interact with each other in order to uncover system requirements. Domain requirements are discovered using stakeholders and documentation as well.

In the second activity the unstructured requirements from the previous phase should be organized into clusters.

The third activity is requirement prioritization. This activity is regarding the conflict of requirements because there are different stakeholders; their opinion about requirements may conflict.

The last activity of REP is requirement specification in which the documentation takes place.

C. Knowledge in Requirement Elicitation Process

Different researchers viewed REP with a knowledge orientation approach and studied various sets of knowledge. We identified six main knowledge categories in REP naming; technical knowledge, managerial knowledge, domain knowledge, human knowledge, infrastructure knowledge and software knowledge.

Technical knowledge is related to knowledge and skills such as computer science, requirements analysis, requirements modeling, designing, technical writing, using specific tools and methods, software architecture, network, programming and project management [18], [19].

Managerial knowledge refers to planning, staffing, and leading a project [18] and communication and negotiation skills. the ability to reach an agreement, gain commitment, and to encourage information exchange are some examples of managerial knowledge [19].

Domain knowledge is about the domain and environment in which software is going to be used and therefore the requirements are related to this environment [18], [20]. Domain knowledge is used to make sure the requirements are clearly defined, are complete and understandable and agreed by all of the stakeholders [19].

Human knowledge refers to knowledge and skills about leadership, teamwork, communication, negotiation, accepting direction, mentoring, consulting and past experience [21], [22].

For eliciting the requirements, developers need to communicate with the stakeholders. This communication can be face to face or remote [5]. Infrastructure knowledge is the knowledge about and the ability to use different communication and collaboration technologies including networks, Internet, and mobile technologies, email, web browser, social networks, online meeting and video conferencing [19].

Software knowledge refers to knowledge about using software tools which support the requirements elicitation process. For example we can name knowledge about diagramming tools, analysis tools, layout designer and report generators, document generators, code generators and repositories.

Several researches have been conducted on approaches, models, and methods regarding knowledge in REP; among all those, Laporti proposed an approach based on collective knowledge to progressively extract the system requirements. He used a narrative story telling technique and evolved to a more formal representation in form of scenarios and finally defined use cases [18].

Liu proposed a semantic approach for requirement elicitation and analysis. He aimed to encapsulate the domain knowledge of different aspects into a domain model. He claimed that the model provides robust semantically supports for requirement elicitation and analysis. They consider completeness and consistency of requirements in their approach [19].

Kaiya used domain ontology and web mining to propose a method and tool to enhance domain knowledge for requirements elicitation. They claim that their proposed enhanced ontology contribute to boosting the completeness and correctness of requirements [20], [21].

Wan found that the barrier of requirement elicitation is the knowledge asymmetry and difference between customers and developers. Thus, they put forward a knowledge conversion model based on SECI (Socialization, Externalization, Combination, Internalization) Spiral Model and knowledge flow between clients, developers and requirement experts [22].

As mentioned in section one, REP faces several problems due to knowledge transmission from stakeholders to developers. On the other hand one of KA roles is to measure the efficiency of knowledge transmission in organizations. Different researchers studied different aspects of knowledge such as knowledge conversation, using collective knowledge to extract requirements, focusing on domain knowledge in REP, but there is no work regarding KA in REP. Therefore, we aim to study KA in REP and proposed a KA model to support the process of requirement elicitation.

III. Conceptual Knowledge Audit Model for Requirement Elicitation Process

In developing our model, we used iterative triangulation method. There are six stages in iterative triangulation namely: literature review, selecting cases, analyzing case data, shaping conjectures, refining the model, and finally conclusion and evaluation [23]. Following the above-mentioned steps we performed literature review on KA models, frameworks and methodologies [7]. Then we selected the cases from different researches. The KA processes can be categorized into three main processes: knowledge acquisition, knowledge flow analysis and knowledge assessment. After make consideration for carefully and comprehensively studied and analyzed of data collected. Then we proposed a knowledge audit conceptual model for REP. With some reflection of response from respondent such as their comment and suggestion, we took consideration on several changes to improve the model.

Fig. 1 shows a knowledge audit conceptual model for REP. The model involves three main processes: knowledge acquisition, knowledge flow analysis and knowledge assessment. The knowledge acquisition process consists of various activities and steps. This process involved data collection [9], identifying organization's processes [11], [16], [8], identifying and meeting key people [11], and performing in-depth interviews [16], [24], [12]. The knowledge flow analysis process contains numerous activities and can be through different approaches. For example, activities that involved are building knowledge inventory [11], [12], [16], creating knowledge taxonomy [14], knowledge network analysis [12] and knowledge mapping [11], [12], [14]. Then, it followed by knowledge assessment process. There are some activities in this process such as audit reporting [11], [9], [8], providing summary [9] and recommendations [8], [12], [14], [16].

The model is including of five main components such as knowledge sources, requirement knowledge, elicitation techniques, knowledge inventory and assessment. The relationships among these components and their role in KA processes are described in the model.

The knowledge sources along with elicitation techniques are used in knowledge acquisition process. In this stage the knowledge possessed by knowledge sources from practitioners, stakeholders and organization's documents are acquired using proper elicitation techniques.

The requirements knowledge involves in knowledge flow analysis. The requirements knowledge is classified in six categories such as human knowledge, infrastructure knowledge, software knowledge, technical knowledge, managerial knowledge and domain knowledge. This knowledge is stored in knowledge inventory.

The assessment knowledge includes the scale of completeness, correctness, understandability and modifiability of requirements knowledge. The report toward results and recommendations will be provided to practitioners in REP.

The process of acquisition, analyze, stored and assessment may occurred in iterative to implement knowledge audit in

REP. The result of the process will assure the goo d requirements document created.

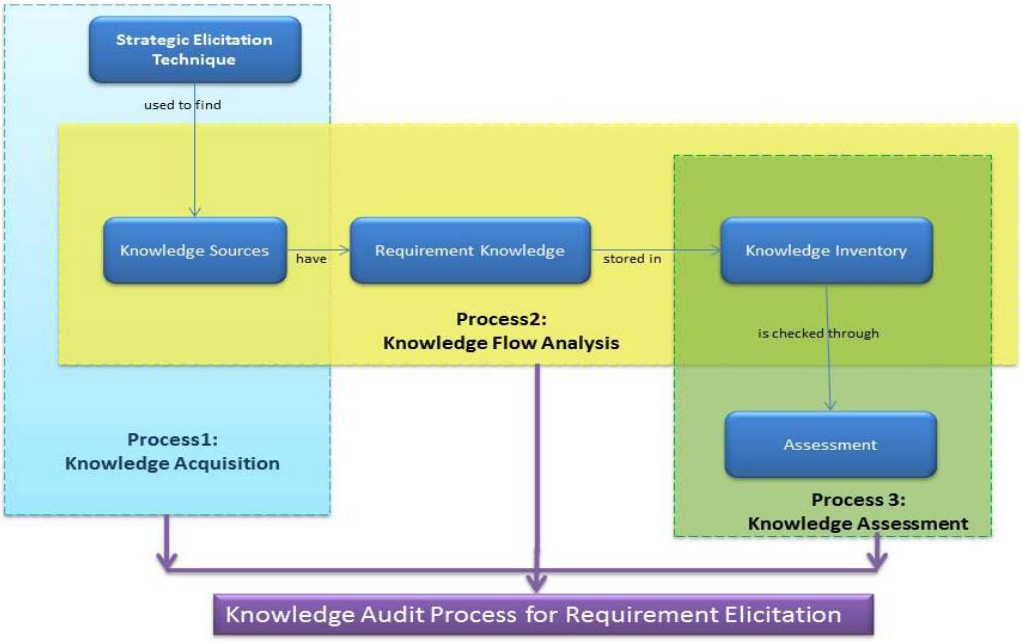

Fig. 1 Knowledge audit conceptual model for requirement elicitation process

IV. Conclusion

In REP, the problems such as misunderstanding, undefined scope, conflicting information and changes of requirements draw intention by researchers. All of these problems occurred regarding communicating and usin g the knowledge in REP. Knowledge Audit (KA) i s a dynamic process to analyze, evaluate and assess the knowledge toward policies, resources and need of organization. In regards to its capabilities the KA were proposed in order to solve managing knowledge in human resources, financial and manufacturing. This paper discusses on knowledge audit conceptual model for REP. The model involves three main processes: knowledge acquisition, knowledge flow analysis and knowledge assessment. The model is including of five main components such as knowledge sources, requirement knowledge, elicitation techniques, knowledge inventory and assessment. The processes of acquisition, analyze, stored and assessment of requirements knowledge are conducted iteratively during knowledge audit in REP to pledge good requirement document. A software system based on t his model is being designed to assist knowledge auditors in a sof tware organization.

Acknowledgment

The authors would like to thank supports by Faculty of Computer Science & Inf ormation Technology, Universiti Putra Malaysia and also our parents.

References

[1] N. C. Pa and A. M. Zin, "Managing Communications Challenges in Requirement Elicitation," pp. 803–811, 2011.

[2] Michael G. Christel and Ky o C. Kang, "Issues in Requirement Elicitation," Pennsylvania, 1992.

[3] J. Wan, Z. Hui, W. Dan, and H. Deyi, "Research on K nowledge Creation in Software Requirement Development," J. Softw. Eng. Appl., vol. 03, no. 05, pp. 487–494, 2010.

[4] X. Shan, G. Jiang, and T. Huang, "The Study on Knowledge Transfer of Software Project Requirements," in 978-1-4244-5316-0/10/$26.00 ©2010 IEEE, 2010.

[5] I. Sommerville, Software Engineering, Ninth Edit. 2011, ch 4.

[6] A. Hylton, "Measuring & As sessing Knowledge-Value & the Pivotal Role of the Knowledge Audit," pp. 1–9, 2002.

[7] N. C. Pa, L. Taheri, and R. Abdullah, "A Su rvey on Approaches in Knowledge Audit in Organizations," vol. 02, no. 05, pp. 1–8, 2012.

[8] A. Ganasan and D. D. Dominic, "Knowledge Audit Made Comprehensive thru 6 Stages," in Research and Innovation in Information Systems (ICRIIS), 2011 International Conference on , vol., no., pp.1-6, 23-24 Nov. 2011, 2011

[9] Y.-L. Wu and Y.-H. Li, "Research on the Model of Knowledge Audit," 2008 4th Int. Conf. Wirel. Commun. Netw. Mob. Comput., pp. 1–4, Oct. 2008.

[10] M. Handzic, A. Lagumdzija, and A. Cel jo, "Auditing knowledge management practices: model and application," Knowl. Manag. Res. Pract., vol. 6, no. 1, pp. 90–99, Mar. 2008.

[11] A. Perez-soltero, M. Barcelo-valenzuela, G. Sanchez-schmitz, F. Martin-rubio, J. T. Palma-mendez, and A. A. Vanti, "A Model and Methodology to Knowledge Auditing Considering Core Processes," pp. 7–23, 2007.

[12] C. F. Cheung, M. L. Li, W. Y. Shek, W. B. Lee, and T. S. Tsang, "A systematic approach for knowledge auditing: a ca se study in transportation sector," J. Knowl. Manag., vol. 11, no. 4, pp. 140–158, 2007.

[13] B. Suo, J. Wang, and H. Zhang, "Primarily Research on Knowledge Audit for Evaluating Enterprise Knowledge Management Capability," 2009 Int. Conf. Manag. Serv. Sci., pp. 1–5, Sep. 2009.

[14] R. S. Sharma, M. Chia, V. Choo, and E. Samuel, "Using A Tax onomy For Knowledge Audits: So me Field Experiences," J. Knowl. Manag. Pract., vol. 11, no. 1, pp. 1–16, 2010.

[15] X. Jiuling and W. Jiankang, "Enterprise Knowledge Management Audit based on Processes: Toward an Integrated Conceptual Framework," no. 2007, pp. 940–945, 2010.

[16] W. B. Lee, V. Shek, and B . Cheung, "Auditing and Ma pping the Knowledge Assets of Business Processes – A n Empirical Study 1 Background of the Study," pp. 11–16, 2007.
[17] A. M. Zin and N. C. H. E. Pa, "Measuring Communication Gap in Software Requirements Elicitation Process," in P roceedings of the 8th WSEAS Int. Conference on Software Engineering, Parallel and Distributed Systems Measuring, 2009, pp. 66–71.
[18] I. Rus and M. Lindvall, "Knowledge management in s oftware engineering," IEEE Softw., vol. 19, no. 3, pp. 26–38, May 2002.
[19] C. Pa and S. Hassan, "Bridging Information and Knowledge using Codification Technology in Re quirements Elicitation Process," in Knowledge Management International Conference (KMICe) 2012, Johor Bahru, Malaysia, 4 – 6 July 2012 180, 2012, no. July, pp. 4–6.
[20] J. Wan, H. De-yi, and Wan Dan, "Knowlegde Convertion in Software Requirement Elicitation *," in T he 1st International Conference on Information Science and Engineering (ICISE2009), 2009, pp. 2328–2331.
[21] V. Laporti, M. R. S. Borges, and V. P. Bra ganholo, "A Collaborative Approach to Requirements Elicitation," 2007 11th Int. Conf. Comput. Support. Coop. Work Des., pp. 734–739, Apr. 2007.
[22] L. Bass, P. Clements, R. Kazman, and M. Klein, "Models for Evaluating and Improving Architecture Competence," 2008.
[23] M. Lewis, "Iterative triangulation: a theory development process using existing case studies," J. Oper. Manag., vol. 16, no. 4, pp. 455–469, Jul. 1998.
[24] S. Y. Choy, W. B. Lee, and C. F. Cheung, "A Systematic Approach for Knowledge Audit Analysis: Integration of Knowledge Inventory , Mapping and Knowledge Flow Analysis," J. Univers. Comput. Sci. vol. 10, no. 6, vol. 10, no. 6, pp. 674–682, 2004.