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A Learning Oriented Approach for Organizational Development Requirements

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Abstract:

In an organizational environment, deciding on features of a new software system is challenging to realize the required behavior in the context of human activity. Requirements indicate what users need from the system and is described in terms of its effect in the environment. In requirements development, it is essential to make a software system fit-to-purpose and context. But, organizational situation in developing nations is by far complex due to lack of having standard practices, variability of employees' knowledge, and challenges in management. Hence, to address software requirements in this kind of organizational context, software projects need to assess 'suitable' learning oriented approaches. On the other hand, the value of software applications in supporting organizational processes critically depends on how well the business goals are satisfied. Goal oriented activities are profound metrics for the success of organizational systems. Indeed, the motive of this research was to study challenges and opportunities in organizational requirements development so as to enhance collaborative learning. To achieve this, an attempt was made to investigate ideas of collaborative learning to understand organizational context and design a technique that support learning.

To do this, a qualitative research approach is employed. It was aimed to study the practice and identify the challenges and opportunities. The research methods used were survey using structured open-ended interview to study requirements development practice at six public universities of Ethiopia and an empirical case study in Addis Ababa University (AAU).

The proposed ontology based learning oriented approach for organizational requirements development is a comprehensive approach and it enables to explore organizational situation. It is also a cyclic approach to make use of organizational ontology to support learning.

Keywords: Requirements Development, Organization, Ontology.

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1. INTRODUCTION

The dynamism and complexity of organizations is increasing as time goes on. Deciding on features of a new software system is becoming challenging to realize the required behavior in the environment it embeds. Nevertheless, many organizations in developing nations like Ethiopia are attempting to use ICT to leapfrog their development and use software as a means for development and being competitive.

In organizational system development, an organization is considered as the domain where the software is applied in the context of human activity to change the existing situation. But, organizational situation is by far complex. To specify what the new system should be, it is advisable to understand different aspects from different viewpoints to realize the required behavior.

Requirements development (RD), as part of system development in context, refers to the overall process of understanding the as-is situation of an organization, what is needed to improve, what are the to-be requirements, and how do we approach to do these. Requirements indicate what users need from the system and are described in terms of their effect in the environment. The notion of requirements in an organization refers to business requirements, user requirements, product requirements, project requirements, etc (Weiger, 2003) (Wiegers, 2000). According to the reference model of requirements and specification proposed by Gunter et al. (Gunter, Gunter, Labs, Jackson, & Zave, 1998), requirements can be described from general system perspective in relation to domain and environmental properties.

But, in general, it is hardly possible to understand and manage organizational requirements without continuous and step-by-step communication with users. Situational and contextual factors influence stakeholders' decision. Such factors are multi-dimensional in their origin and construction. Some of the issues might be observed as organizational behaviors that possibly emerge in the history of the organization, social and cultural status, economic status, believes, etc. Furthermore, other factors such as individual experience, nature of work processes and practices might also become possible causes to determine contextual settings. These occur in a specific or across similar organizational environment (Cornut, 2009).

Thus, in reflection to these factors, it is strongly recommended to assess 'suitable' learning oriented approaches for requirements development that enable active users' participation, promote organizational learning and enlighten with goal orientation.

2. METHODOLOGICAL APPROACHES IN CONTEXT

In requirements development, it is a common practice to deal with purpose and context of an organization to make a system fit-to-purpose and fit-to-context. In Soft System Methodology (SSM), the human factor is discussed in line with the notion of problematical situation of an organization (P. Checkland and J. Scholes, 1990). Furthermore, since the situation in an organization is complex, understanding the problematical situation is important before taking

action for change. Therefore, in modeling, it is essential to address issues that concern people in a way that represent their viewpoint. It is also required to get root definition of a system to proceed.

Furthermore, according to Reflective System Development (Mathiassen, 1998) problem-setting is a process and if developers fail to engage in problem setting, they may be in a position either to misunderstand the situation or limit their understanding. Hence, to understand, support, and improve systems development, developers must go beyond theories and methods and understand the role of knowledge and the relation between knowledge and action in systems development practice.

The Reflective Steps approach, proposed by Biru (T. Biru, 2008), has given more emphasis on transformational type of participation taking experience based learning oriented approach through reflection. He underlined that collaborative reflection is important in designing a product and a process in a given context. It is also discussed that success of collaborative reflective learning depends on factors related to participants' knowledge, group combination, individual participant's outlook and contribution.

Application of collective mind theory in requirements development is elaborated by Crowston et al. (K. Crowston and E. E. Kammerer, 1998) and Hsu et al. (J. Hsu, T. Liang, G. Klein, 2010). Individual and group level learning, understanding and building performance have been suggested to elaborate users' contribution in the process.

Therefore, an approach that fosters user-developer collaboration to build shared understanding about the existing and anticipated (to-be) organizational knowledge is paramount. Understanding of users' situation can lead to more innovations. Defining the problem setting in organizations particularly in developing nations is challenging due to the reasons including:-there are multiple views and knowledge gaps in organizations, there are limitations and gaps on aligning IT systems

to support activities, processes and goals, and system development activities lack to anticipate and pursue changes effectively in line with organizational goals.

Along with the facts raised above regarding to organizational requirements development, the research questions identified for investigation were: what are the “practices” in defining organizational requirements that have been used across requirements development projects in academic information management systems and how a learning oriented approach contributes to address the situation.

3. METHODOLOGY

In order to get better understanding of the situation and practice of requirements development at the public universities in Ethiopia and answer the research questions, it was required to conduct an empirical investigation. Due to the researcher’s past experience, ease accessibility and having long history, Addis Ababa University (AAU) has been taken as a case to conduct in depth study. To this end, a qualitative research approach has been preferred.

The methods selected to use were survey and case study. Both were used to do situational analysis. The purpose of the investigation was to study patterns and variability factors of employee task knowledge at AAU and organizational requirements development practices at six public

higher learning institutions in Ethiopia, namely, Jimma, Mekele, Bahr Dar, Adama, Gonder and Addis Ababa University so as to find out situational factors that impair or facilitate requirements development. These six universities have been selected since they are established long before and have relatively better experience in requirements development. Therefore, it is assumed that the aforementioned universities can sufficiently represent the domain for this research.

A survey is used to get a more apparent picture of the requirements development practice. Assessments were made to understand the situation through 1) open-ended interviews with the main responsible actors in software development projects and 2) review of requirements documents. Analysis of data is done with themes corresponding with the issues – user participation, domain and goal orientation. The survey was conducted about aspects of existing campus management system projects such as their failure & success, challenges in requirements development, etc. at the six public universities.

Case study is among the common qualitative research approaches that are used to study a given phenomenon in depth taking specific events or projects as cases. It is used for the purpose of practice studies – situational analysis. Case studies are descriptive reports of episodes. Regarding the strength and weaknesses of cases studies from a research perspective, Cockburn (Cockburn, 2003) wrote, "each case study provides a data point. The strength of the case study is that it captures the local situation in greater detail and with respect to more variables than is possible with surveys. … Case studies are helpful in developing and refining generalizable concepts and frames of reference…" (p. 29).

Case studies can also be used to study complex phenomena in its institutional context. Yin (Yin, 1994) defines case study "as an empirical inquiry that investigates a contemporary phenomenon within its real-life context…" (p. 13).

In this research context, the purpose of the case study was to explore organizational, human and technical factors that have impact on requirements development. It was done at the office of the registrar, AAU.

4. FINDINGS OF SITUATIONAL ANALYSIS

4.1 The Survey

While attempting to identify key issues, in addition to the researcher's experience in system development and working at AAU and a utility company, similar attempts have been reviewed including the work of (R. Kifle, 2004) and (T. Biru, 2008). Both attempts were made to assess the practice in software development in general. The findings related to requirements development in the two studies have been noted down to find the gap and do further survey. In this research, to deal with relevant issues in depth and enrich the previous findings, emphasis was given for requirements development in view of user participation, goal orientation, and requirements development approaches. For this purpose, structured open-ended qualitative interview type was preferred to design.

Once the initial design of the interview was drafted, it was made to try out the interview with three experts at AAU. All the experts have masters' degree in ICT related areas and by the time when the interview conducted, they were serving in three different positions: as system administrator of the registrar system, as project manager of the budget and financial system project, and application development unit head of the University ICT office. After reviewing the interview results, the issues were further refined before moving to the next steps.

In the selection of interviewee in each institution, the researcher was guided by the roles individuals play according to the organizational structure. All the selected institutions had ICT office which is fully responsible in software development within the institution. The researcher attempted to reach to all individuals in the office who had stake in a particular software development project. Though it was planned to conduct the interview one-to-one, whenever possible and the situation allowed it was also conducted in group.

In general, a total of 18 ICT professionals in the six public universities were purposefully selected in the survey. In the time range from Oct 2011 to Dec 2012, the researcher physically travelled into the five universities outside Addis Ababa and conducted the interview at their premises. Each interview session lasted on the average for 45 minutes. The interview and discussions were conducted in the Amharic language. The interview and discussion points which were noted down were then consolidated and interpreted in view of the issues identified in this research. Moreover, the interviewee provided relevant requirements documents which had been used in a particular project. Not all documents are the same in terms of content and completeness. While some are very brief description of system requirements others include a detailed description of the requirements anticipated from the system-to-be. These documents were reviewed by the researcher.

The number of interviewee and projects assessed in the survey is shown in table 1.

Table 1: Summary of the interviewee involved and projects assessed in the survey

Public University Name	No of Interviewee	No of Software Development Projects Assessed
Addis Ababa University	3	2
Adama Science and Technology University	4	5
Bahir Dar University	2	2
Jimma University	2	3
Mekele University	4	2
University of Gonder	3	2
Total	18	16

A total of 16 projects were assessed in the survey. Among these, 8 of them were in-house projects with an attempt to customize open-source products. Among these, only 3 were partly implemented in the institutions' business environment and they were small projects. It is observed that in relatively large projects, problems in requirements development were complex. The remaining eight projects were either outsourced or customization of commercially available packages or open-source products.

Due to the initiative of the government to reengineer public services across the country, since 2008, all the six universities included in the survey have conducted business process reengineering. As a result, the business context was continuously changing and 50% of the projects were affected. Moreover, the ICT policy of each institution had impact on the way projects were designed and managed. While three of the institutions were more inclined to adopt open source principles and policies, the other three did not have a strong stand on this matter and heavily relied on outsourced projects. In all these projects, only the conventional requirements development methods including document review, interview, and observations have been used to understand and describe the requirements.

According to the survey results, the level of user participation was minimal in all the projects assessed. Lack of a means to share knowledge with users is a common problem and the problem was aggravated due to lack of a common language. Similar problem was also noticed in the survey conducted by (T. Biru, 2008).

The situation was worse in one institution which had a strategy to customize and use open source products. Users' participation was little and the IT professionals were not experienced and trained in methods that promote user participation.

Another important factor that hindered user participation is that users lose their motivation as the project progresses though they are eager to see positive impacts of the to-be systems immediately on their working environment. But, only 50% of the projects have been completed partially at the time of project completion.

Therefore, in order to increase quality, it is worth noting to address active user-participation particularly at the time of organizational requirements development to increase understanding of organizational context and react accordingly.

Regarding goal orientation, it was found out that all professionals at least believed that software development projects should be aligned and support business goals and processes set out for institutions. But, in practice, the attempt made to define projects in line with business goals taking possible opportunities and traits into account was not satisfactory in most of the institutions. It was also noticed that the existing environment does not allow realizing some of the business goals anticipated in the BPR process. Even, some have faced challenges to set a strategy that directs to the intended goals. On the other hand, top decision makers were not active to learn the situation and respond promptly.

The attempt in one of the institution was relatively better than the others. In the remaining five, though the business goals have been used to drive the requirements development process, less is done or with limited capability in aligning product requirements with goals.

Moreover, it has been noticed that as requirement experts able to understand and use organizational goals in requirements development, communication and collaboration with users becomes better.

4.2 Findings of Employee Task Audit- the Case Study

The case study is conducted at the office of the registrar, AAU, to explore and study employee knowledge about their day to day tasks. The following three major goals were set out for the study: understand employees' knowledge and detect pattern of tasks and variability that can possibly be exhibited, build shared understanding among employees across the different campuses of AAU and finally explore the use context of the existing registrar system.

The study was conducted by the researcher collaboratively with 11 campus registrar unit heads and one IT section head of the office. The researcher acted as a leader and involved on activities including planning, preparing task audit samples by investigating the registrar system database, assign task audit assignment for each head, review audit reports, organize and facilitate face-to-face plenary discussions, reflect on the actions taken, prepare for action to improve 'bad' situations on some campus registrar units.

During the study, four task accomplishment or performance audits have been conducted including employees' experience in the existing registrar system. And then, based on the audit reports, consecutive plenary face-to-face discussions were made with heads of the units. During these meetings, the unit heads were prompted to reflect on 'what was intended to achieve', 'what had been observed during the study' and 'what can be done to improve.' Due process, the heads were able to share knowledge, understand the strengths and weakness of the existing system, and

suggest alternative solutions to improve the situation. They were also able to detect and understand knowledge variability.

Consequently, based on the analysis result across the campuses, variability factors that affect organizational requirements were identified in relation to employees' knowledge about their tasks. These factors are:

- Location factor: in the study it was observed that employees in seven registrar units had developed their own knowledge, which was unique to each unit. The two basic reasons which have contributed for this are: the unique type of problems that had happened in the units and prior experience of the units. For instance two campuses were independent institutes before they were integrated to the University, and had their own practices.

- Experience and competency factor: due to self competency and range of work experience some employees have developed their own set of activities to accomplish a similar task than others. Such situations have also been observed in the same location.

- Education type factor: employee educational qualification type had also affects the nature of employee knowledge while doing their job. For example, for roles like registrar unit heads, the educational qualification requirement is basically defined based on educational level than type. To be a unit head, having a bachelor degree in any field with some years of experience was enough.

Taken together, the lesson taken from these findings point out that, in order to have a wider and in depth understanding about the working environment and situational problems in organizations, it is necessary to have a set of criteria during organizational requirements development so as to reach to the various types of employee knowledge, detect variability and understand what has to be done. Attention should also be given to domain knowledge and business goals.

5. A LEARNING OREIENTED APPROACH

The main aspects of the proposed ontology based learning oriented approach are shown in figure 1. As can be seen, it identifies three major integrated activities. Namely: Establish and maintain ontology, Select Relevant Goals and Processes for planning, and Develop Requirements.

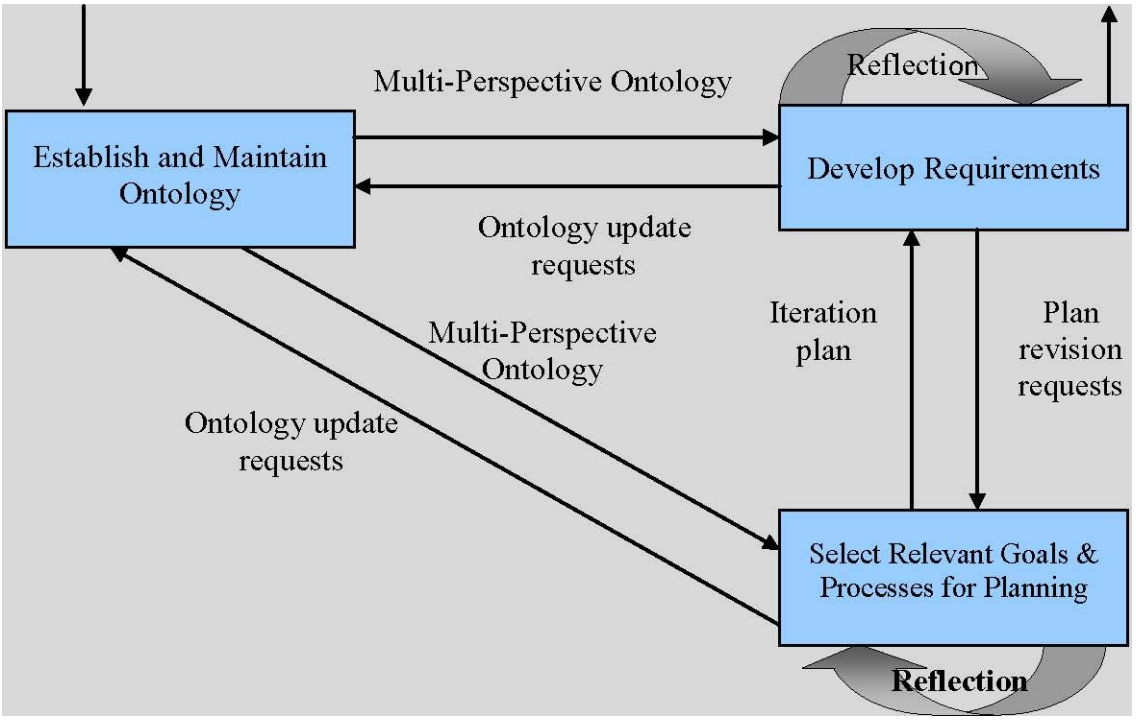

Figure 1: High-Level Block Diagram of the proposed approach

Establish and Maintain Ontology is an activity introduced in the proposed approach by reflecting on the need to capture, maintain and use the required concepts as per defined in the organizational ontology model described in (M. Kifle, 2012). It helps to continually and iteratively support organizational learning. Since understanding an organizational context is a result of continuous learning process, the ontology content evolves over a project time until the requirements development is reached to the desired level. Indeed, the ontology update request arrow is shown in the diagram to reflect this fact in relation to the other two activities.

At initial stage of a software development project a requirement expert shall conduct preliminary assessment about the domain of interest and scope of the project to have firsthand impression and high level understanding of the project. Techniques like document review, interview and any other which are deemed appropriate can be used for the purpose and start to maintain the ontology. Domain experts within the organization can also assist on updating the ontology.

Select Relevant Goals and Processes for planning is the second activity introduced in the proposed approach by reflecting on the need to learn and understand contextual issues iteratively and incrementally. It is a means to deal matters like user group establishment and define a reflection process. In each round, an iteration plan is prepared to guide the third activity, develop requirements.

Develop Requirements is the third activity introduced in the proposed approach in which the product requirements development is carried out. It is a process to understand the as-is situation, envision the to-be system and define requirements. The learning oriented process is mainly carried out in this activity. Requirements definition is the final output of the activity. An ontology update request and iteration plan revision might be initiated depending on the learning curve users and developers will be.

The proposed learning oriented approach was applied in a small scale on the requirements development project at AAU in 2012. The results obtained are encouraging. It enables to explore and identify requirements which were overlooked in the previous attempts.

6. CONCLUSION

In this paper, it is reflected that an organization is considered as the domain where application software is applied in the context of human activity to change the existing situation. The situation in large organizations is by far complex particularly in developing nations. Requirements describe what is needed from the new system and it is hardly possible to easily understand and manage organizational requirements without continuous and step-by-step communication with users. Understanding of the users' situation can lead to more innovations.

The two studies described in this paper have shown that during organizational requirements development attention should be given to learning oriented active user participation, domain orientation and goal-orientation. Moreover, taking the following factors into account is very important: location factor, experience and competency factor, and education type factor.

As a result, in this research, ontology based learning oriented approach is recommended. It is an iterative and incremental process in reflection to participants' level of understanding. Further work is needed to evaluate its effectiveness.

7. References

Cockburn, A. (2003). People and Methodologies in Software Development. PhD Dissertation, University of Oslo, Norway.

Cornut, F. (2009). The Discursive Constitution of Software Development. PhD Dissertation, London School of Economics and Political Science.

Gunter, C. A., Gunter, E. L., Labs, B., Jackson, M., & Zave, P. (1998). A Reference Model for Requirements and Speci cations University of Pennsylvania.

J. Hsu, T. Liang, G. Klein, and J. J. (2010). Promoting the integration of users and developers to achieve a collective mind through the screening of information system projects. International Journal of Project Management, 1–11. doi:10.1016/j.ijproman.2010.06.006

K. Crowston and E. E. Kammerer. (1998). Coordination and Collective Mind in Software Requirements Development. IBM Systems Journal, 37, 227–245.

Kifle, M. (2012). Multi-Perspective Ontology to Understand Organizational Requirements. Proceedings of the African Conference on Software Engineering and Applied Computing, Gaborone, Botswana (pp. 21–27).

Kifle, R. (2004). Software Development Assessment in Ethiopia. Masters Thesis, Department of Computer Science, Addis Ababa University.

Mathiassen, L. (1998). Reflective Systems Development. in Scandinavian Journal of Information Systems, 10(1 & 2).

P. Checkland and J. Scholes. (1990). Soft Systems Methodology in Action. New York: John Wiley and Sons.

T. Biru. (2008). Reflective Steps: A Collaborative Learning Oriented Approach to Software Development and Process Improvement. Forschung. PhD Dissertation, Hamburg University.

Weiger, K. E. (2003). Software Requirements (2nd Ed.). Microsoft Press, Washington, USA.

Wiegers, K. E. (2000). Karl Wiegers Describes 10 Requirements Traps to Avoid. Proceedings of Software Testing & Quality Engineering, pp 1 - 8.

Yin, R. (1994). Case Study Research: Design and methods (2nd ed.). Sage Publishing, Thousand Oaks, CA.