



Knowledge Sharing in Collaborative Research Activities

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Abstract — Collaboration is the process of creating new knowledge that involves communication through a shared artifact by creating a new understanding that the participants could not have achieved on their own. There are many collaborative tools designed to help researchers working within groups, but does not support the motivation to use it, and also the integration between collaborative tools. This leads to an information silos problem resulting in scattering of information and knowledge. A questionnaire was constructed to identify essential problems that impede the course of the collaborative process and finding solutions in solving the problems that can contribute to raise the level of teamwork. For that a Knowledge Sharing (KS) in Collaborative Research Activities framework is designed to solve the problems and to visualize an integration of the collaborative tools by configuring correlation between the research information, based on the workflow management technology. The framework aims to motivate researchers to exchange their research information especially knowledge where the KS process supports the development of a research information repository. This paper shows how a combination of the three pillars of collaboration, Ellis framework and the KS framework contributes to design the proposed framework.

Keywords –knowledge sharing, collaborative research, motivation, research activities, research information, workflow management

1. INTRODUCTION

Collaboration leads to a creation of a new knowledge by using communication tools in order to establish a new understanding which helps participants to achieve their objectives. Collaboration can be successfully supported by providing a knowledge sharing (KS) environment and communication facilities. Most communication tools are designed on the basis of a single user environment and there is a lack of an integration of these tools not just to support communication but also to help the collaborative researchers to learn and gain new information they may not discover if they work in isolation. In existing research, the creation of knowledge should be naturally aligned with collaborative activities [1]. This paper introduces an approach of research collaboration within a group of researchers, based on the sharing of knowledge, during participation of research activities. Collaborative research activities deals with the exchange of research information e.g. published paper ideas or advices. There are many collaborative technologies designed to help groups work easily, such as sharing information and supporting collaboration tools for research activities.

Exchange research information does not give the full meaning of collaborative research, it requires building relations among information. Workflow management is one of the technologies that allow people and organizations to automate, manage, and improve that process of collaboration. The collaborative research problems that are faced by the researchers, and the main required tools for collaborative research had been identified by conducting a survey in the Faculty of Computer Science and Information System, University Technology Malaysia (UTM). A total of 50 researchers participated in this survey, and the study concluded that 45 responses were usable.

The result of this research could be useful for the researchers in order to facilitate the method in sharing and managing process in conducting the research and can help them to enhance their collaborative work in enhancing their research process. The rest of this paper is organized as follows. Section 2 gives a concept of KS. Section 3 gives an overview of collaboration and collaborative research activities with technologies used in it. Section 4 summarizes collaboration frameworks models. Section 5 shows the methodology Section 6 shows the identified problems from the conducted questionnaire. Section 7 introduces the proposed framework. Section 8 briefly concludes the paper.

2. KNOWLEDGE SHARING

KS is defined as “individual/organization obtains access to any individual's own and other knowledge”[2]. [3] stated that, the most commonly activity of knowledge management is KS, where many researchers set it as positively related with the organization performance by increasing organization’s resources. There are opportunities to share knowledge in organizations including teams and technology-based systems that facilitate the sharing of knowledge. The KS process includes both the creation and the transfer of knowledge through different means such as documentation or communication, among individuals, groups and organizations. Knowledge Management (KM) is fundamentally about people, not technology. However, there is no way that one can share knowledge effectively within an organization or in large geographically dispersed one, without the use of technology. Information technology (IT) can be classified into the use of proper repository for storing and sharing knowledge and the use of a communication medium for communicating and transporting knowledge among individuals [2]. Collaborative work requires more than just sharing information or tools such as shared whiteboard, it requires KS [4]. Some of the technical barriers of KS are, lack of integration of IT systems, processes impede the way people do things, and lack of compatibility between diverse IT systems and processes. Collaboration is one of the fundamentals for sharing knowledge, experience and skills of multiple team members to contribute to the development of new product more effectively.

3. COLLABORATION

Collaboration is the process of sharing knowledge and working together to accomplish stated goals and objectives [5]. As collaboration receives wider usage in today’s computerized world, it is appropriate to regard email, video teleconferencing, internet chat or the World Wide Web as collaboration. Therefore, collaboration can be defined “as the integration of many technologies into a single environment to facilitate information sharing and information management”. The access to resources in a collaborative system is another aspect of collaboration, synchronous or asynchronous [3].

Research information may include published papers, documents regarding research in progress, PowerPoint files used for seminars, and so on. It can be also preliminary ideas in the researcher's head and advise. Therefore, collaboration among members through information sharing is important to exchange useful research information, at any time, and members can remain aware of the research situation [6].

Support for discovering and sharing knowledge in research activities is not enough. Therefore, relations among information is sometimes difficult to understand. In addition, another problem is that research process is hard to grasp since the classification of information and relations among them are unclear. Properly, the product of research works and related information should be managed systematically [7]. [7] defined user demands in supporting research activities as a) Clear classification of collecting knowledge, b) Easy understanding of relations among knowledge and information associated with the process of research activities, and c) Effective consideration of the research process.

One of the technologies that can be used to classify and correlate information is workflow management. [8] defined workflow management technologies as "Workflow Management Technologies allow people and organizations to automate, manage, and improve the process that governs interpersonal coordination and collaboration". Most KM-systems enable users to retrieve knowledge artifacts from repositories, but rarely allow distribution and process awareness. [9] proposed a hybrid architecture for reconciliation of knowledge and workflow management systems to support participants in organizations, which are increasingly needed in distributing knowledge artifacts.

Due to workflow systems inherently supporting communication and collaboration, it needs to be followed by integration with communication and collaboration tools such as online conferencing, email, shared workspaces, synchronized browsing, collaborative authoring, calendaring and other Computer Supported Cooperative Work (CSCW). Approaches should be easily accessible from within a workflow process.

The benefits of using workflow management is to break down task activities of fixed procedure into good tasks, and which can effectively rationally organize the people and information. Thus, the flow of information is more reasonable and more conducive to efficient operation of distributed systems [10].

Recently some innovations have found their way into the business world that bears a potential to harmonize workflow management system. Workflow management can obviously help to distribute knowledge in an organization in a more consistent, repeatable and reliable fashion. It also can help in identifying the knowledge, whenever a workflow management system is used for the execution of collaborative tasks, the processes can be revisited and analyzed.

4. THE THREE PILLARS OF COLLABORATION AND ELLIS FRAMEWORK

Frameworks are targeted re-usable set of components that are developed to be readily utilized, establish best practices and guidelines to be utilized across projects. To be successful with collaboration, you have to deal with the people, process, and technology issues. These three pillars are key factors in delivering research excellence, both operationally and strategically, Figure 1 represents the three pillars of collaborations. People can come from all part of the globe , and they need to have a set of collaboration tools that work well, allowing them to maximize their productivity and driving them to adopt the tool in associated process. People inside and outside the organization are researchers, they share their knowledge, collaborate and re-use to achieve business results. Where critical processes for the organization represents sharing best practices, working on proposals, designing products, gathering data, and other services vital to the success of the business.

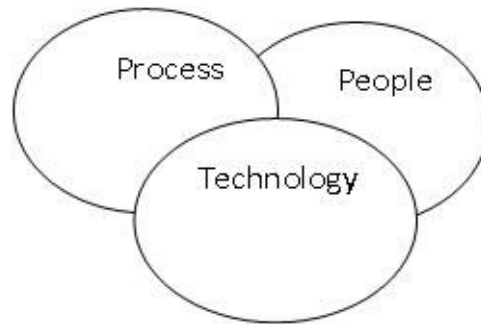


FIGURE 1: The three pillars of collaboration

The advances in collaboration would not be possible without the underlying technologies “the collaborative infrastructure”. No matter how good the collaboration technology is, unless everyone in the organization is willing to adopt and use it, it would not be deemed successful. It provides functionality to support knowledge-sharing, collaboration, workflow and document management across the organization. These tools typically provide a secure central space where researchers can exchange information, share knowledge and guide the organization to better decisions.

TABLE 1: Collaborative systems classification for integration of workflow and groupware systems

Classification	Conception	Characteristics
Keeper	Shared workspace	Access control
Communicators	Point-to-point	Support communications between participants
Coordinators	Coordination	Synchronization of activities
Team-Agent	Applications	Provide specific functionalities, such as a meeting scheduler.

The classification system of Ellis [11] provides a functionally oriented classification of collaborative systems, which assists in understanding the integration issues of workflow and Groupware systems, which is shown in Table 1. Ellis’ framework has their strength in one or two categories. Most systems on the market today provide features for Keepers and Communicators support or are solely Coordinate systems (e.g. Workflow Management Systems) or are Team-Agents [9]. There is no system integrating at least the three of the above categories in one system.

5. METHODOLOGY

A simple questionnaire was distributed to gather data for identifying essential problems among researchers working together in Universiti Teknologi Malaysia. Understanding and analyzing the essential problems that have been identified and proposing solutions to solve it can contribute to a basis of the KS in collaborative research activities framework design.

There are also three models that have been used to build the collaborative research activities framework, which are: The Three Pillars of Collaboration, the classification system of Ellis and KS framework.

6. THE IDENTIFIED PROBLEMS

There are many problems that arised when working as a group research. The result from questionnaire showed that 47% of the responders have suffered from the lack of the motivation for participation, 28% of them face an ineffective communication (lack of a way to correlate tasks), availability problem afflicting 15% of them, a 6% Conflict between team researchers and a 4% trust between team researchers.

The main problem was the lack of participant motivation, where the motivation property could raise the level of collaborative performance, this problem can represent a cause of failure [12]. Table II represents these problems with the proposed solutions.

TABLE 2: Researchers group work problems and solutions

PROBLEMS	SOLUTIONS
Motivation	Support the participants in their objectives of sharing by using technology for exchanging information and knowledge, i.e. both repositories and communication tools
Ineffective communication	Workflow process to allow an effective linkage and communication between a large number of interrelated distributed tasks.
Team researchers availability	Scheduling tools and share meeting calendar.
Conflict between team researchers	Workflow process.
Trust between team researchers	Communication tools, social communication.

7. KS IN CRA FRAMEWORK

There is a need of working collaboratively within research group and there is a great interest of using online collaborative environment to manage and control the flow of research information and motivate sharing of knowledge. Many collaborative applications, especially in scientific research, focus only on the sharing of tools or the sharing of data. The proposed framework which is designed based on the KS framework [13] introduces an approach to collaborative research that is based on the sharing of knowledge, trying to build an environment with naturally enabling sharing of knowledge by using a set of tools.

The integration of the Three Pillars and Ellis frameworks with the solutions proposed to solve the researchers group work problems (Table 2), represent the new KS in collaborative research activities (CRA) framework as shown in Figure 2. The KS in CRA framework provides a guide to establish collaboration and KS environment between researchers in order to accomplish their research activities in an organization, it aims at developing collaboration among researchers, bringing them together in groups and developing a link between academic research work and technology. This framework combines the four categories of Ellis in one platform. These categories are arranged as layers depending on the three pillars of collaboration.

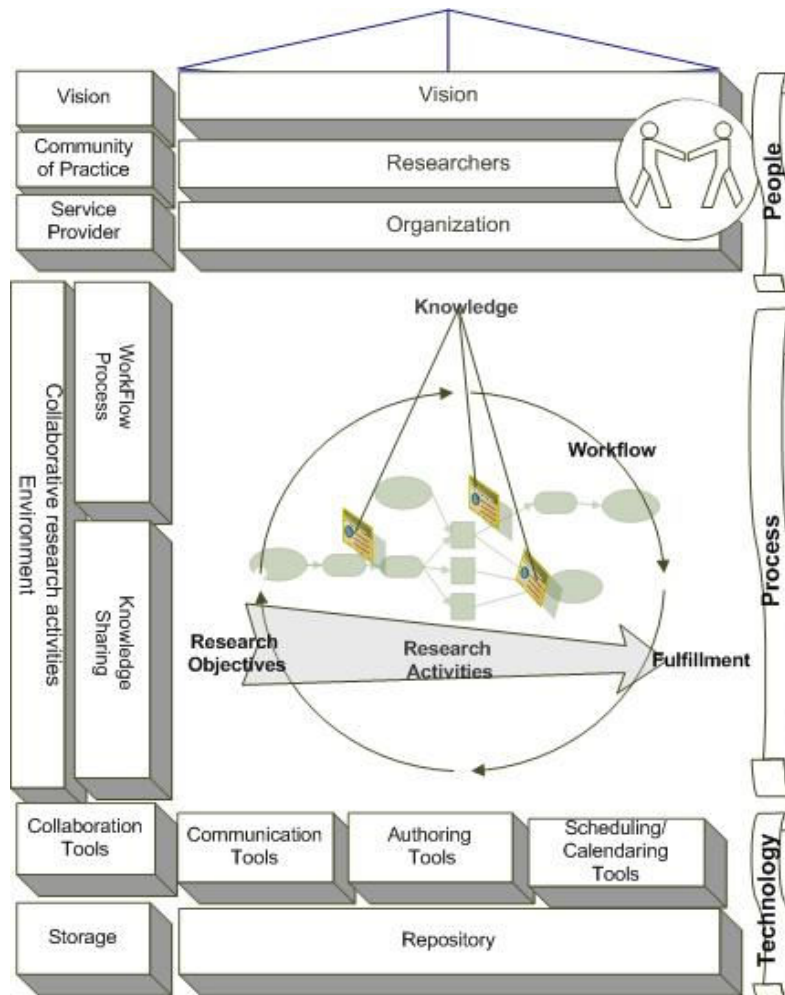


FIGURE 2: KS in CRA framework

A. Technology

In the bottom layer of the framework, represents the technology component of the three Pillars of collaboration model, providing an efficient and a convenient communication channel between the researchers and their related research information and knowledge, integrate collaboration tools, and backed by main repository with access control. There are many types of collaborative applications and there will be many more. Wikis, blogs, virtual workspaces, video presentations, instant messaging, web conferencing. In addition, organizations need to search for a method to integrate tool packages into a single collaborative environment, single portal. Importantly, these tools, should also provide individuals with personalization options to best support their unique needs.

In this layer, there are four main components presented as follows: 1) Communication tools, where communication is how persons understand each other and how information and all other human experiences are transferred in organizations. Allows people to converse with others and exchange information with the help of synchronous tools enabling real-time communication and collaboration in a "same time-different place" mode (e.g., chat, conferencing tools) and asynchronous tools enabling communication and collaboration over a period of time through a "different time-different place" mode (e.g., email, weblog). 2) Authoring tools encourages researchers to work with each other on particular problems, and encourage to edit content posted by others contributions and to create new pages to improve the content of the site. The wiki has been selected as an authoring tool. 3) Scheduling tools support researchers in coordinating appointments, enables to see multiple calendars at the same time, For example, a group calendar is helpful when scheduling a team meeting, because it can help to see the availability of team members and conference rooms. 4) Repository, stores all information and knowledge to use them whenever the researcher need. The technology layer represents the main three categories of Ellis framework, keepers, communicator and team-agent.

B. Process

This is the core layer, representing the process component of the three pillars of collaboration model. While research is a human-based activity on investigation, to produce new knowledge, or to offer a new manner of understanding present knowledge, the coordination of activities related to research produced by continuous attempts to create a common concept to solve the problems. When we look at the research by the successive processes that occur to accomplish, we find that there are tasks performed by researchers, such as meetings, create new ideas for research and also practical coordination and research evaluation. To perform such tasks it needs to share information and knowledge appear to strengthen the value of effort. Collaborative research activities where the KS activity may become as a routine practice needs to be managed carefully. When researchers are conducting their research activities to solve research problems and to fulfill the research objectives, KS evolution is highlighted, and thus represents the coordinator category from Ellis framework. In this layer, the important role is to ensure the smoothness of the KS process. To inform each unit or part of the whole as to how and when it must act which is the engine of the collaborative process in this framework, it has the responsibility of coordinating work between communities of practice, automate the process of collaborative research activities, ease the access to the integrated collaboration tools and organize a community of practice with information and knowledge flow, what people need to do to work together effectively.

C. People

People as a community of practice are defined as groups of virtual or local researchers with similar interests. To practice an effective KS, there is a need to identify a community that cares about enhancing their ability to think together, stay in touch, share ideas, generate new knowledge and connect with other communities. These communities are communicating among each other to help solving any problems, exchange the information, experience, and expert among them, and also share their knowledge. The researchers' collaboration efforts are aligned with the organization's vision of research. Offering general advice and insights to active participation in the research process, researchers may collaborate by sharing data or ideas through correspondence or discussions at conferences, by visiting each other, or by performing parts of a project separately and then integrating the results. The desire of researchers to increase their scientific popularity the advancement of scientific disciplines which means that a researcher requires more and more knowledge in order to make significant advances, a demand which often can only be met by pooling one's knowledge with others, all researchers work together to advance scientific knowledge and exchange ideas.

In these and other tasks, members of a research group will not only talk among themselves but will also seek advice and help from others (and will often offer information in return). To keep an organization on course as it strives to improve its collaborative capabilities, the organization needs to develop a collaborative vision and strategy. In the middle of interaction between the communities of practice with collaboration tools, collaborative environment has the core components to push the process of collaborative research activities between the researchers from the first step of the research to the fulfillment, through the overlap of the research activities with research information, the knowledge will be generated and shared. These research information and knowledge needs repositories media in term of saving them so any member of the community of practice can reuse them. Table 3 illustrates the main components of the proposed framework.

TABLE 3: KS in CRA framework components

Components	Description
Community of practice	Could be Lecturer, PhD or Master students. Trying to accomplish the activities of research and share knowledge in an environment of collaboration.
Service provider	It is the high authorized unit which is responsible for, providing the researchers with the latest developments around them new information, and managing the contents.
Collaborative research activity environment	It is the core business process, where the KS growth through the interactions of research activities with the contribution of the coordinator, which is the workflow process.
Collaboration tools	Includes communication tools such as e-mail, authoring tools such as wiki and calendaring tools such as group calendar.
Repository	It is the layer where stores all information and knowledge to use them whenever the researcher need.

8. CONCLUSION

The proposed framework explains collaborative processes in information and knowledge seeking, and supports the development of better tools and techniques. Collaborative research activities represent the main process of collaborative work within a community of researchers working within groups, and exchange research information during research activities. Using collaborative tools to motivate sharing lacks of the integrity property, where the exchanged information and knowledge scattered. Workflow management helps to distribute knowledge in an organization in a more consistent, repeatable and reliable fashion, and allow to integrate all information.

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