Collaborative Mind Map Tool to Facilitate Requirement Engineering (RE) Initial Project Report
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Abstract

Mind Map is a thinking “tool” which reflects how the information is stored and retrieved in the brain. It is an “intelligent” way of expressing individual ideas and its associations in an organized way (Morris, et al., 1998). It assists individual or a group in generating, classifying, categorizing and visualizing ideas in more efficient approach. Given that, it will be advantageous to use mind Map in facilitating the process of Requirement Engineering (RE). RE can be defined as the systematic process of gathering and capturing user’s needs and priorities by analyzing and modeling the problem in an iterative and cooperative approach, and document the findings in a variety of representations (Macaulay, 1996). It is an activity which requires cooperative work from all stakeholders (both business and technical sides). On this point, Mind Map will be more beneficial in Requirement Engineering if it is used in group cooperative manner. We will analyze how Mind Map can facilitate RE process and propose a Collaborative Mind Map tool to support RE activities. However, in this work/study, the tool will specifically design to support requirement elicitation. Then, an evaluation studies will be varied out against the prototype in supporting the hypothesis:“Collaborative Mind Map Tool to facilitate RE process”. The tool will be a part of existing groupware application and intended to be more focus for supporting RE activities; it may be integrated with any groupware applications that provide cooperative work for requirement activities.

Introduction

Project Background and Problem Statement

Having understood the Mind Map thinking theory and practices, we observe that Mind Map is and can be used in almost every situation of life where we normally write linear notes or writing down a list of words. It enhances creativity and thus generates more ideas in structured and organized presentation. Mind Map has been used widely by many individuals and organizations mainly in decision making, analysis, problem solving, planning and to do list, note taking, brainstorming and presentation. Many who understand and know how to apply the skills of Mind Map have benefited much from it. For example, IBM has been using Mind Map at their accounting headquarters in handling all their major accounting process. And, according to their trainer, Tony Dottino, they have saved ten millions of dollars by using the Mind Map thinking process (Morris, et al., 1998). In analyzing the above points, Mind Map seems to have great benefits if it were to be applied in RE process.
The main purpose of RE process is to gather understanding of the problem specified by the users to ensure the capabilities or conditions of a system or system component are met. Subsequently, the problem must be described with explicit and precise descriptions to ensure all stakeholders are having the same understanding and objective of the project. This is the most important aspect in software development as it defines the application domain and problem context of the system to be built which will be the basis of measurement for users to gauge whether the development has fulfilled their needs. Thus, it is essential to capture the “right” understanding of the problem to be solved and interpret it correctly in agreeing representation. Yet, it is notable that RE is the major contributor to the failure in software development project (Macaulay, 1996) (Bohem, 1981) (Rahman, 2004).

Many studies indicate that the main problems in RE area are: communication gap among stakeholders; inadequacy of management; lack of knowledge and skilled people in RE; and process with wrong techniques and methods (Al-Rawas, et al., 1996) (Wiegers, 2003) (Tsumaki, et al., 2005). We believe Collaborative Mind Map is capable to contribute in improving RE process especially in the requirement elicitation phase.

Project Objectives

Following are the objectives of the studies that are expected to achieve by the end of the project.

- To demonstrate an understanding of the concept of Mind Map mainly in Group Mind Map, RE process as a whole and criteria in developing good groupware system.
- To evaluate the existing mind map tools available, to compare and to identify best features to be incorporated in the Collaborative Mind Map for supporting RE process.
- To build a prototype web based system based on PowerMeeting; a synchronous groupware framework, to manifest the capability of Collaborative Mind Map in facilitating RE process.
- To explore the theoretical and technical of the groupware framework to support in building the prototype system.
- To further enhance the capabilities in software development and programming skills using JAVA, AJAX technologies and Object Oriented paradigm.
- To test and evaluate the system in determining whether the Collaborative Mind Map is competent to facilitate RE process.
Background

Mind Map

The Mind Map Concept
Mind map is a technique which uses graphical illustration in expressing thoughts and ideas based on the concept of Radiant Thinking; a natural function of human mind. The term Radiant Thinking was first introduced by Tony Buzan to reflect the way our brain structures and processes information. Each bit of information entering our brain can be considered as a central point which then can radiate out into up to millions of directions. And each direction has its own infinite array of links and connections (Buzan, et al., 1995).

In Mind Map, it places the subject of attention in a central image, radiates the Basic Ordering Ideas (BOI) from the central image and hierarchically expands and associates the branches and its sub-branches with keywords. It promotes idea generation, information categorization and classification; and layouts the subject or problem in a “snapshot” and organized way.

Figure 1: Example of Mind Map
Mind map is represented with shapes, pictures, symbols or even making the words or letters into pictures. From the research done by Ralph Haber, and later by R. S. Nickerson, have proven that images are more stimulating than words and thus generate more creative ideas and encourage better memorization.

The Mind Map is capable of enduring the potential balanced use of both right and left brain (Morris, et al., 1998). As founded in 1960s by Dr Roger W. Sperry, each part of brain hemisphere has its own way of thinking, learning and expressing ideas (Sperry, 1981). The left side of hemispheres is more dominant into word and process into more logical and sequential order. On the contrary, right side is more into visual and operates based on intuitive, holistic and random manner. Most people tend to be dominant in one side of the brain but the ideal is to have it balance so that a full power or potential of the brain can be utilized.

**Mind Map Law and Mind Map Recommendation**

Following to the concept, there are rules in creating the Mind Map so that ones can maximize the benefits of it. There are categorized into laws of technique and laws of layout (Buzan, et al., 1995).

**Laws of technique**

- Use emphasis – use central images, incorporates images where appropriate though the mind map, use different colors, use variation of sizes for the keywords, images and branches and use appropriate spacing
- Use associations – use arrows for connection, use color coding to categorize and grouping
- Be clear – make it easy to capture the overall picture, the associations, the keywords and categorization and classification.
- Develop a personal style

**Laws of layout**

- Use hierarchy and categorization
- Use numerical orders –( where appropriate) to indicate prioritization or chronological orders

**Mind Map functions and its applications**

Since its introduction, Mind Map has been serving and contributing significantly to those who apply it. Common functions that have been described in Min Map literatures are 1) to provide overall picture of the subject matter 2) to generate more creative ideas and options 3) to
categorize and organize information 4) to help in maintaining the focus on subject matter 5) to assist in memorizing (Buzan, et al., 1995) (Morris, et al., 1998) (Buzan, 1989).

1) Mind map is to provide overall picture of the subject matter in a snap shot. By looking at the Mind Map, people can immediately get the idea of the subject matter and its associations. This can be a useful mechanism for analyzing problem or issue, describing a flow of processes, presenting or reviewing the concerned topic or even for storytelling.

2) Mind Map is to generate more creative ideas and options – a brainstorming activity. In Mind Map it encourages people to think radiantly which indirectly triggers more ideas and options from the keywords or associations captured earlier. Furthermore, it can initiate mind to look into many other aspects or see options and problems in different perspectives and in a wider context. Because of this, any kind of activities that need idea generation can benefit from it. Examples of scenarios are in essay writing, meetings, capturing user requirement and planning (e.g.to do list).

3) Mind Map is to categorize and organize information. In mind map, information is organized by its category and classification. Information can be classified by order of importance which is essential element in planning. By organizing the information into category, problem can be tackled in modular and this makes the problem solving activity more efficient. It also helps in organizing a report writing or flow of presentation in more systematic way.

4) Mind Map is to help in maintaining the focus on the subject matter. For example, when using the mind map in discussion or presentation, it protects the discussion or presentation from diverting outside the subject matter.

5) Mind Map to assist in memorizing. Since the representation structure mirrors the way information is stored and retrieved in our mind, it will enable an individual to memorize things better. In this respect, education industry would gain the most by using Mind Map. Besides helping students in studying, the Mind Map can become an attractive and creative tool for teaching.

In summary, Mind Map is just about everything. However, it needs skills to achieve and realize the full potential of it. Furthermore, it is easy and fast to learn. Lastly, Mind Map, when incorporated with, could further enhance activities such as problem solving, work analysis, decision making, brainstorming, planning, note taking, presentation and project management.

**Group Mind Map**

Group mind Map is a way for groups of individuals to combine, collaborate and multiply their personal creative capabilities (Buzan, et al., 1995). It is known and agreed that working in group is better than working individually. It applies the same to group Mind Map. The capabilities and
functions of individual Mind Map are multiplied in group Mind Map. For example, when group mind map is used in brainstorming session or ideas capturing, individual ability is increased by the instantaneous feedback from group members. More information, viewpoints, creative ideas and opinions can be triggered from group Mind Map.

Other than that, group Mind Map encourages information sharing and teamwork (Morris, et al., 1998). All team members will have the feeling that they have made contributions which then encourage them to commit on the job execution. Group Mind Map also, helps group members to view and understand the one and same objective of the subject matter. This is an essential criterion in teamwork in achieving the same vision and mission (Hughes, 2008).

The main applications of group Mind Map are joint creativity, combined recall, group problem solving and analysis, group decision making, group project management and group training and education (Buzan, et al., 1995).

According to Tony Buzan in his book “The Mind Map Book”, there are seven main stages in the group Mind Map process.

1) Define the subject – The topic and objective must be clearly defined and understood by all team members. Also, all relevant information to be considered in the discussion must be conveyed to all group members.
2) Individual brainstorming – Each member must be given at least one hour to construct their own individual Mind Map.
3) Small group discussion – Then, the groups will be divided into small groups to exchange and share their ideas. Members must maintain totally positive and accepting attitude.
4) Creation of first multiple Mind Map – Combine all the ideas and starts building the group Mind Map.
5) Incubation – A process where the pursuit of ideas tends to non-stop verbal and analytical activity until a result is achieved.
6) Second reconstruction and revision – To iterate the step 2, 3, and in order to capture the results of the newly considered and integrated thoughts. Output of this activity is another group Mind Map that can be used to compare as preparation for final stage.
7) Analysis and decision making – Makes decision, sets objectives, devices plans and edit it accordingly.

**Requirement Engineering**

RE is the earliest phase in software development project. It is the most essential and crucial phase of software development process which the gist of the goal is to capture and understand the problem to be resolved. Designing and building an elegant software system will be of no use if it does not serve the purpose of the intended needs.
Requirement Engineering Process

There are many views and descriptions on RE process. In summary, it involves a set of following activities: (Pressman, 2005) (Kotonya, et al., 1998) (Nuseibeh, et al., 2000)

- Requirement Elicitation

Requirement elicitation is a process of identifying the requirements of the problem to be resolved. It is the core process in RE which defines the details understanding of a specific problem, the scope and the nature of the problem, criteria to be met and its constraints. The requirements are obtained from the stakeholders as the primary resources, careful analysis of the organization, the application domain and business process where the system will be used (Kotonya, et al., 1998). Obviously those activities require intensive communication, collaboration and cooperation between requirement engineers and system stakeholders.

There are many methods used in discovering the requirement elicitation process and it is essential to understand each of the methods and its usefulness in different context. This is to ensure that all customers’ requirements are discovered in effective way. The methods are categorized into conversational methods, observational methods, analytical methods and synthetic methods (Zhang, 2005).

  - Conversational methods are those methods that require verbal communication which includes one to one communication or group communication. These methods are the most common and practical way to elicit non tacit knowledge. However, they involve people’s commitment which sometimes makes them difficult. Examples of the method are interviews, workshops, focus groups and brainstorming sessions.
  - Observational methods involve observing how people do their work as a means of information acquisition. Unlike conversational methods, these methods are more suitable to obtain tacit knowledge and understand complex societies. But, they require times consuming and difficult to analyze the subject’s perception. Examples of the methods are social analysis, observation, ethnographic study and protocol study.
  - Analytical methods deal with exploration of a set of related documentation and expert knowledge. These methods have the least involvement of users involvement. Careful analysis must be done to avoid misinterpretation. Examples of the methods are documentation studies, content analysis, laddering and card sorting.
  - Synthetic methods combine all the above methods and analysis into coherent method. It has its own specific model for the type of information to be gathered. Each of the model has its own advantages and disadvantages. Examples of the methods are scenarios, prototyping and JAD/RAD session.
Each method has its own limitation and thus, it is necessary for analysts to realize and cautiously choose the combination of the methods to support elicitation process based on specific particular problem (Goguen, et al., 1993).

- Requirement modeling and analysis
  Requirement modeling phase focuses on developing a refined technical model of software function, features and constraints (Pressman, 2005). It can be used as elicitation tool to further expand and refine the requirements. The goal of requirement analysis is to identify any discrepancy and conflicts in the draft document produced as the output of requirement elicitation (Kotonya, et al., 1998). Gerald and Ian also suggested to perform necessity checking, consistency and completeness checking and feasibility checking as part of the main activities in an analysis.

  Modeling artifacts can be used as analysis medium to check and verify the gathered requirements and provide a mechanism to detect any uncovered conflicts in the requirements. A field studies observed that there are five different type of modeling abstraction in RE process (Nuseibeh, et al., 2000).

  - Enterprise modeling – manages the understanding of an organization structure; the business rules that effect operations, goal, task and responsibilities of each organization’s member
  - Data modeling – handles the understanding of the input, output and how data is processed in the system
  - Behavioral modeling – serves as the comprehension illustration of the dynamic or functional behaviours of stakeholders and systems which includes current and future behaviours
  - Domains modeling – provides an abstract description of the world in which the system will operate
  - Non Functional modeling – demonstrates the understanding of non functional aspects of the systems and stakeholders which includes reliability, security, accuracy, performance, looks and feels, cultural and political requirements

- Requirement specification
  Requirement specification can be a written document, a set of graphical models, a formal mathematical model, a collection of usage scenarios, a prototype or any combination of those (Pressman, 2005). The principles in expressing the requirements are that they must cover what the user expects, must be practicable, can be verified and validated and must include the properties of the machine and how it interacts with its environment – the hardware and people (Bjørner, 2006). Additionally, according to IEEE standards of SRS, a good requirements document must have the following characteristics: - correct, unambiguous,
complete, consistent, ranked for importance and/or stability, verifiable, modifiable and traceable (IEEE, 1998).

- **Requirement validation**
  Requirement validation is the last stage of RE process. It is the process of clarifying the requirement specification for consistency, completeness and accuracy (Kotonya, et al., 1998). The output of this process is to get customers’ certification and acceptance on the formal and final requirement specification. This must be a collaborative process where all the stakeholders (software engineers, analysts, customers, users, and others) come to a mutual agreement on the same understanding of requirements of the concerned project.

- **Requirement management**
  Requirement management is the process of managing the life cycle of the requirements throughout the process of software development. It involves a process of documenting the requirement change, analyzing the impact of the requirement change, changing the specifications, analyzing the cost incurred and implementing the change accordingly (Kotonya, et al., 1998).

  One of the main dilemmas of RE is that the requirements keep changing (Sutcliffe, 2002). When a requirement is changed, all the impacted areas need to be analyzed and assessed. Thus, it is important to ensure that all requirements dependencies, requirements rationale and the implementation of requirements are kept on track for traceability (Kotonya, et al., 1998).

**Requirement Engineering Concerned Areas**

Studies have observed that a substantial potential impact of poorly problem definition lead to the failure of software project (Bohem, 1981) (Macaulay, 1996) (Rahman, 2004). The cost incurred in fixing the problem is high, the customer’s trust is reduced or lost and the overall project could be in jeopardy. From the review and analysis done, we have concluded that there are 4 concerned areas or factors that will affect the success of RE process which eventually determine the success of the whole process of software development.

1. **Communication**
   As described earlier, RE involves rigorous activities which involve people interaction. This involves the issue of human communication which needs careful attention and action. People have own ideas and viewpoints normally based on their backgrounds, experiences and beliefs. Some ideas and thinking may not be conversed to others for some private or political reasons. Also, ones may unconsciously not telling the obvious fact to others because the information is no longer in conscious term.
   Though natural language is a flexible means of expressing ideas, the expression can be ambiguous. This may drive to misunderstanding and misinterpretation of the ideas
expression-the requirements. Some information expression are “scattered” for which we need the capability to link and associate those information and relate it to the subject matter.

Therefore, the practice of requirements must also incorporate the knowledge of sociology and psychology such as tacit knowledge, the ambiguity of natural language and the role of power and personality that influence attitudes and opinions (Sutcliffe, 2002).

2. Requirement management
Requirements are volatile. More than 50% of a system’s requirements will be modified before it is put into services (Kotonya, et al., 1998). This is the reason why RE management is important in RE process. In general, requirement management concerns on the strategic application of activities for identifying, analyzing, monitoring, documenting communicating and restructuring requirements interaction (Wiegers, et al., 2005). This includes the management of stakeholders, the project plan, resources, commitment and negotiation due to requirements change and the processes involves in RE.

To achieve this, a capable and experienced project manager is essential (Emam, et al., 1995). In summary, the role of project manager in RE process includes planning (milestones, resources and cost) and control and managing the people involved in RE team. In addition, a project manager must also maintain a fairly good relationship between the RE team and users as they are the important sources of requirements.

3. Knowledge and skilled people involvement
According to Hubert and Franz in their studies of RE practices that contributes to projects success are team knowledge, resource allocation and process (Hofmann, et al., 2001). The team must gather adequate domain knowledge of the problem from all possible sources of requirements. The findings shows that user involvement from the early stage throughout the RE process has a significant impact on getting better understanding of “real needs”.

Sufficient resources (time and people) with appropriate skills in RE also contribute to the success of the project. The best practice in resources allocation is to assign 15 to 30 percent of total project effort to RE process. And by assigning suitable people to handle each of RE activity can improve the efficiency of the execution of RE process.

4. Chosen processes, techniques and methods
A proper and strategic RE process is another factor that contributes to the success of a project (Hofmann, et al., 2001). A strategic process will adapt a set of techniques, method and tools tailored to a specific target domain, stakeholders and project’s
characteristic. Due to that fact, combination of RE techniques, methods and tools is vital to help in developing high-quality requirements. A limitation of one technique, method or tool can be complemented with other techniques, methods or tools that the former technique, method or tool does not address.

Groupware

Groupware is a technology that supports the work of group (RAMA, et al., 2006). In other words, it exploits technology to facilitate people in working together. One must not confuse with Computer-Supported Cooperative Work (CSCW). CSCW is a field of study which aims to explore and study the design, adoption and use of groupware (Bannon, et al., 1989). The target area of CSCW research is cooperative work which supported by groupware technology.

Groupware technologies are categorized into two main dimensions of perspectives– space and times as illustrated below. The below shows the four dimensions (illustrated by quadrants) of groupware and its examples of application.

Sources: (RAMA, et al., 2006)

There are many significant advantage of using groupware as opposed to single user systems. Some of the advantages are:-

- To facilitate communication: make it faster, clearer and more persuasive
- To use a mechanism to transfer knowledge from one individual to another
- To help in motivating individual to perform better
- To collaborate a group of people with same interest
- A way to form a structured group coordination and proactive collaboration
- To enable telecommuting
To save time and cost

The task of building groupware system is more challenging than individual design process. A successful adoption of groupware is critically influenced by a user-centered development strategy, which emphasizes on specific functionality; a phased of implementation strategy that involved iteration of pilot studies and the compatibility of the groupware application with the cooperative culture of group or organization that will be using the groupware system (Ciborra, 1996). Thus, it is important to first understand the type of group or organization context that will be using the groupware system and its social context. A group and organization must see the benefits of using the system to intensively use the groupware system. A groupware system has no use if no mass of users chooses to use the system.

There are criteria that need to be considered in building groupware system. They are (Wells, 1996) (Völksen, 1992):-

- **Presentation of the groupware**
  
  There are predominant paradigm under which each groupware system is presented to the user such as application sharing paradigm, groupware applications paradigm and WWW pages. In whatever paradigm applied, a high level of usability is the most crucial criterion that must be embedded into a groupware system. It must be easy to learn, easy to use, easy to remember, error tolerant and subjectively pleasant.

- **Collaboration mechanism that supports the groupware system**
  
  In supporting collaboration and communication, it is important to classify the private and shared information and maintain the consistency of the data between the participants of groupware system. To support this, the data, the information and the architecture of the application must be implemented in centralized way.

- **Support work coordination**
  
  There must be a certain way of coordination in running the groupware system. There must be a floor control or session control or any mechanism to encourage groupware participants in following the defined processes to accomplish their work.

- **Support generic or application specific**
  
  Based on the domain group of the target users, groupware system can be either of generic or specific purpose.

- **Openness**
  
  Groupware system can also be designed so that it can be integrated with other applications.
Group composition
The participants of the group can be made static or dynamic and their accessibility
must be managed and controlled.

PowerMeeting Framework

For the purpose of prototyping and initial work, we will incorporate the collaborative Mind Map
tool in PowerMeeting. PowerMeeting framework is a web based synchronous groupware. It is a
collaborative framework based on AJAX technologies. Currently the framework is under thorough
investigation by Dr. Weigang Wang in supporting his research area in web-based collaborative
hypermedia systems and their underlying methodologies and frameworks.

The aim of the framework is to present a platform for a wide range of participants to collaborate
with a natural way of group communication setting to gain common understanding.

The main features of the framework can be summarized as below:-

- Uses standard browsers as front end making it accessible by wide range group of
  people with no installation required
- Supports direct manipulation of shared artifacts and direct textual and voice
  communication for real time collaboration and coordination.
- Provides data consistency across client and server, and across session.
- Uses Model-View-Controller programming model on top of GWT framework supported
  with Java IDE. With this it makes the development and integration of groupware tools
easier.

Collaborative Mind Map in Facilitating Requirement Engineering Process

Many researchers have been done in finding ways to improve RE processes mainly due to the
cognizance of RE as one of crucial factors that contributes to the success of software project.
From the literature analysis, we have apprehended that RE process is more about people,
communication and collaboration. The RE process cannot be tackled purely on technical side, but
also to take into consideration of its social context for which we believe is more crucial. Due to
this fact, RE is not a simple job and the evidence from the studies shows that there still rooms for
improvements. We believe, with collaborative mind map tool, RE process can be improved in many ways.

There are already a few informal researches and attempts to use Mind Map tool in various phase of software development process (Eric T. Blue, 2006). There are quite a number of mind map tool used in project management, but very little in RE process. One obvious example which shows a very convincing practical use of mind map in requirement elicitation is by Kenji Hiranabe. In his article, he has outlined few benefits and illustrated the examples with specific templates in using the mind map in RE process. He also provides a way on how to map mind map into UML diagrams using JUDE-a design and communication tool (Hiranabe) (Change Vision, Inc, 2006).

Surveyed by Chucked Frey; presumably the first big research of mind Map in software development environment, shows that the most beneficial feature of using mind map tool is collaboration. This shows that collaboration mind map has significant impact in people work and software development in particular. Furthermore, according to Nikos Drakos, a Gartner Inc. analyst, collaborative mind map will become more interesting if it is online (Gilhooly).

Conceptually, we summarize that web based collaborative mind map can facilitate RE process as follows:-

- To facilitate in communication
  Web-based collaborative mind map tool can serve as a mechanism to capture requirement in more structured, faster, clearer and more persuasive manner. The communication between stakeholders will become more efficient. It will enable communication (where it would not be otherwise possible) and bring down multiple perspectives or information in one place. Information gathered will be stored in centralized manner to secure data consistency. Other than actual requirements, it can also help in capturing the requirement attributes (priority, source, person responsible and etc) that will help to understand the requirement better.

- To promote group work
  RE requires intensive group work and this can be supported by the tool. Not only it provides a tool for any group work activities, but it also permits a group of people to work in well organized structured, distributed and coordinated manner. In addition, team spirit and trust among team members can be harnessed.

- Save time and cost
  Increasing in globalization has demanded multi site software development organizations (Damian, et al., 2003). The demand can be accommodated by
collaborative mind map tool which it can help in saving time and cost. It will not be necessary for analyst to fly over continent just to capture requirements.

More specific into each RE activity, the benefits can be observed as follow:-

- **Requirement elicitation**
  In gathering the requirements, it can helps in “structured brainstorming”. Unlike typical brainstorming, collaborative mind map encourages creative idea generation and “out of box” thinking formed in structured way through natural way of thinking. Besides the brainstorming method, it can also illustrate the process or procedures of future system and categorizes the wish lists of customers.

- **Requirement modeling and analysis and Requirement validation**
  In requirement modeling and analysis, collaborative mind map can help in categorizing requirements (e.g. functional requirements vs non functional requirements), refining, reviewing, prioritizing and validating requirements. And, if there are issues arisen from this phase, collaborative mind map tool can be used to facilitate in decision making.

- **Requirement management**
  In requirement management, the tool can assist in decision making, planning, meeting (as in presentation) and problem solving.

### Requirements for Collaborative Mind Map Tool

In making the collaborative mind map tool favorable, few essential groupware features such as high level usability, communication (synchronous communication), coordination (floor control, session control, centralized data sharing) and cooperation (support group cooperation, sharing stored information) must be addressed. It will have flexibility to manage the user access such as enable or disable features of the moderator, specifying the number of group members for each session and their roles and access rights. To make it explicitly to requirement elicitation, the tool will also includes features to store data dictionary, term definition, and requirements attributes. Further detail of the features will be described in *Chapter 3- Requirements & Specification* of the final report.
Research Methodology

The question that motivates the project is “Can collaborative mind Map tool improve the process of RE?”. The answers to or results of the question will be gained from an evaluation and testing of the prototype to be built; a web based collaborative Mind Map tool (specifically for requirement elicitation).

The project starts with a preliminary and background study. The goal of the study is to demonstrate an understanding of the concept of Mind Map with special focus on Group Mind Map, RE process as a whole and criteria in developing a good groupware system. Based on the preliminary understanding of the above, a list of contributions and benefits of applying mind Map concept in RE process will be outlined. The understanding will also be used to define the requirement for both functional and non functional of the collaborative mind Map tool. As an addition, numbers of existing mind map software will be evaluated for the purpose of comparison and identifying the best features to be incorporated in Collaborative Mind Map tool.

Since the collaborative mind Map is categorized under groupware system, the tool must have some features of best groupware application. The groupware design and presentation paradigm will be taken into consideration in designing the tool. Moreover, in ensuring the effectiveness of the collaborative mind Map tool, a high level of usability will be employed. By addressing this in designing the tool it can further support the research question by which it provides the best way possible to the user to accomplish their task in using the tool.

For development, we will adopt the framework activities of “Water Fall” model with emphasis on Web Engineering1. This means that the process will embrace specialize methods matches the characteristics of WebApps. The process composed of communication, planning, modeling, construction, testing and deployment.

Source: (Pressman, 2005)

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1 Web Engineering is the process that is used to create high-quality Web-based systems and applications (WebApps) (Pressman, 2005).
Communication

As described earlier, the requirements are defined from the preliminary and background study. For functional requirements they will be described in use case description (UCD) so that the user interface (UI) flows are clearer.

Planning

The project is divided into two main parts; 1) Preliminary and background study phase 2) Development and Implementation phase. The preliminary and background study phase can be described as part time self study to identify feasible scope of the project and to develop an understanding of mind map, RE, groupware system and the framework and tools to be used. The phase is to be carried out in second semester of academic calendar which starts in early February until end of May. While for development and implementation phase is where the actual prototype system is developed and implemented parallel with report writing. It will be executed in fulltime basis from June until the first week of September. Below grant chart the details of the plan and its milestones.

For the planning and tracking tool, we utilize Microsoft Office Project: Grant Chart.
Modeling

The analysis and design of the collaborative mind Map tool will be based on object orientation paradigm. All design artifacts will be presented using several UML diagrams such as use case diagrams, activity diagrams and sequence diagrams.

Firstly, we will first examine the information domain model and design the required data objects. Then, identify the appropriate architecture, design the classes and components and their relationships. Next, is to design the UI. High usability, best groupware characteristics and the navigation structure are criteria that need to be considered in designing the UI. And lastly, is to specify the sequence of processes and sequences of the tool.

Implementation/Coding

The prototype web based system will be built on top of PowerMeeting; a synchronous groupware framework. The framework provides a basic and common foundation for developing collaborative synchronous groupware application. It uses AJAX technology which supports rich user experience on top of GWT frameworks and using GWT graphical interface libraries (Wang, 2004).

As for the implementation, it will be coded using Java language and Eclipse as the IDE. Java language is chosen because of its platform-independence features. Furthermore, it is an object oriented language which very much well suited with object orientation paradigm. It is easy to code, flexible and of good efficiency for our purposes.

Testing

The prototype system will be tested and evaluated to determine whether the Collaborative Mind Map is competent to facilitate RE process. Only by this evaluation, a report and conclusion will be summarized. The evaluation process will be divided in several phases;

1. Unit testing : “White box” testing
   - To test on each procedural details of functional requirements.
   - Will be tested and evaluated by the developer.

2. System testing : “Black box” testing
   - To test on the system as a whole. In this phase both functional and non functional requirements will be tested together to ensure the integration and collaboration among them are smooth and working.
   - To test on WebApps attributes the testing will also include content testing, UI testing, usability testing and navigation testing.
   - Will be tested and evaluated by developer.

3. User Testing · Group testing
As groupware system, it is more convincing for the system to be tested by a group of people acting to be in RE process. A set of scenarios of RE activities will be provided to simulate the real scenarios which are expected for the tool to support.

**Project Deliverables**
The main deliverables of the project are:-

1. A prototype system of Collaborative Mind Map in supporting RE process (Specifically for requirement elicitation).
2. A project report.

**Project Report Outline**
The report will be divided into 8 main chapters as describe below:-

*Chapter 1 – Introduction:* Introduces the problem context and background of the research topic. It defines the background and problem statement, the objectives, deliverables and project plan.

*Chapter 2- Literature Review:* Discusses the relevant literature addressing the research topic (Mind Map: Group Mind Map, RE and Groupware System). Each section discusses evidence relating to the problem to the development of the ideas, the best practices, methods and processes and research contribution influencing the topic field.

*Chapter 3- Requirements & Specification:* Outlines the requirement and specification of the collaborative mind Map tool which cover both functional and non functional requirements

*Chapter 4 – Success Criteria:* Defines the success criteria of the project

*Chapter 5 – Analysis & Design:* Describes the process of analysis and design in the project and technologies used.

*Chapter 6 – Implementation:* Presents the detail process of the implementation and description of main classes and methods.

*Chapter 7 – Testing & Evaluation:* Layouts the process of testing and evaluation of the prototype system and explore the major findings of the project.

*Chapter 8 – Conclusion and Future Work:* Concludes the result of the study and the recommendation for the future research.
References


