Impact of Electronic Process Guide with Role Specific Views on Participant's Understanding

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FINAL APPROVAL

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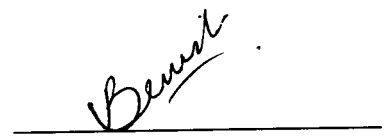
DECLARATION

I hereby declare that this Thesis, **"Impact of Electronic Process Guide with Role Specific Views on Participant's Understanding"** neither as a whole nor as a part has been copied out from any source. It is further declared that I have done this research with the accompanied report entirely on the basis of my personal efforts, under the proficient guidance of my teachers especially my supervisor **Dr. Naveed Ikram**. If any part of the system is proved to be copied out from any source or found to be reproduction of any project from any of the training institute or educational institutions, I shall stand by the consequences.



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DEDICATION

I would like to dedicate my work to

ALMIGHTY ALLAH,

Who has always showered His endless blessings upon me;

&

To my late father **Muhammad Mushtaq Bajwa**.

His words of inspiration and encouragement
in pursuit of excellence, still linger on.

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THESIS IN BRIEF

THESIS TITLE:	**"Impact of Electronic Process Guide with Role Specific Views on Participant's Understanding"**
OBJECTIVE :	To measure the participant's understanding during process implementation along with 'EPG with Role Specific views' support.
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Abstract

A comprehensive software process models are used to represent all important process activities of a software development project which serves as a basis of a central information system for coordinating, guidance, and supporting the different roles. Different problems are associated with the implementation of software process models such as process awareness , lack of experience, timely availability of the desired information, a major time slot required for communicating the new processes to the practitioners, and variation in the participants understanding.

This research aims at proposing an Electronic Process Guide with role specific to improve the participant's understanding during process implementation. It also intends to highlight the impact of EPG on participant's understanding during implementation. Quasi experiment is conducted for this study to investigate and understand the cause-effect relationships. Conceptual models are used to measure the participant's understanding and the data obtained from the experiment is compared with the accurate conceptual models by using a CMAP tool. Finally, Statistical Student's t-test is used to test the Null Hypothesis.

Electronic process guide brings the improvement to the traditional process models implementations, by introducing the concept of Role specific views into it. Its practicalities are presented in discrete manners to help in its use during software process models implementation. The outcomes are documented to provide a feedback that may be used for making necessary improvements in Electronic process guide.

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List of Abbreviations

[illegible]	Electronic Process Guide
VRRM	Value Based Requirements Risk Management
[illegible]	Software Change Request
SPEARMINT	Software Process Elicitation, Analysis, Review and Modeling in an Integrated Environment
[illegible]	Concept Mapping

Chapter 1

Introduction

Chapter 1 – Introduction

Implementation is in jeopardy, if a lot of time is spent to communicate the new processes to the practitioners. A generalization can be made that the more complex the process, the more time it take to implement [1]. Different implementation problems are highlighted by the researchers and provides different solutions, which are not enough to resolve them; lack of experience, technical knowledge only through training [2], serious commitment, process engineer continuously work closely with practitioners, resource consumption- resources used in the initial phases analysis design, this means only few resources are available during the implementation phase and software practitioners have significant fear and uncertainty [1], a lot of information spread all over the document in the process description [3], variation in the participants understanding, programming challenge, artifacts production as a burden, collaborative work is limited [4].

Software processes play an important role in coordinating different participants. Different resistance factors are identified which effects the participants understanding such as; lack of professionals experience and skill, insufficient and ineffective assessment of the current software process, lack of flexibility in the use of the documentation in projects of different types and sizes [5].

Research recorded the problem of process awareness [6] [7] [8], timely availability of the desired information [9], training on the support tools and technologies defined [9] [10]. Also one of the problems highlighted during the implementation of a process model [11] "*there is the need of tools to minimize management efforts required for its repeated usage*".

Different problem arises without the Electronic Process Guide (**EPG**) support such as; software development processes are so complex that process performers cannot cope with this complexity unless they are adequately supported, that is, provided with the process knowledge they need to perform their tasks [12]. Lack of consistent documentation is mentioned as a major problem in maintaining systems, therefore researchers made this the goal for improvement [6].

From the evaluation of the electronic process guide, it is concluded that it provides core benefit to the software industry where different process models employ in order to carry out the activities. Also as a technology concern, electronic process guide have more importance over paper-based process guide [6]. A huge potential for improving guidance oriented documents- this

would be a real value in practical setting [9]. Different techniques are available in software engineering and management literature but, it is very difficult to select appropriated technique(s) for the given situation. EPG is the useful tool for the software process improvement for medium to large size organizations and it also contributes to the improvement outcomes [8].

A comprehensive software process model is use to represent all important processes of a software development project which serve as a basis of a central information system to guide, coordinate and support the different roles; this also acts as an explicit software process model which can assist in performing, managing, and improving the development of software [13]. Role specific view improves support sharing and coordination of knowledge in geo-collaborative planning [14]. Also multiple view approach was assessed to support common ground in geo-collaboration within multi-role team [15]. Role specific view approach improves the quality of guidance by using measurements and the successful measurements requires a solid understanding of the product, processes, and resources to be measured, an understanding which can only be gained via explicit models [7]. Role specific views should be modeled independently [13].

1.1. Research Aim

This research plans at representing the software process model aid i.e. 'Electronic Process Guide' with a focus on role specific views during process implementation within software projects. It also intends to measure the participants understanding during the process implementation and to highlight the impact of EPG on participant's understanding. Finally, all together, this research aims at proposing an Electronic Process Guide with role specific views to improve the participant's understanding during process implementation, as a final output.

It is hoped that this task will highlight the importance of EPG with role specific views during process implementation. This research can be helpful in many ways to all those interested in software project management and related activities. These can include project managers, project team members, risk managers, functional managers, QA and those who are proposing process models to software industry.

1.2. Significance

For any process an effective project management is integral for its success. It is a critical element whiles developing software systems and is important to make the management independent to any activity rather than engaging management resources to a single process activity. The failures of many large projects highlighted the problems of participants understanding. These problems of process awareness includes [6] [7] [8], timely availability of the desired information [9], training on the support tools and technologies defined [9] [10].

Some process models do not provide guidelines to understand the properties including their modular structure, the control-regulation configuration of common features in a key process area, and the arrangement of key process areas at each level [16], which ultimately have an impact on participants understanding. Electronic Process Guide results in positive outcome for the company including improvements in documentation, better project estimation, planning and management and improved relations with customers [8].

This research shall focus on the participants understanding during process implementation in order to introduce Electronic Process Guide with Role specific views. The thesis will present the process implementation problems, Electronic Process Guide, Role specific views and at the end, impact of Electronic Process Guide with Role Specific Views on participants understanding will be measure by conducting a quasi experiment. The research shall provide great deal of benefits to the project managers, practitioners of software engineering, risk managers, requirements manager, software developers, business owners and executive management.

1.3. Research Objectives

The objective of this thesis is to measure the participants understanding during process implementation along with the 'EPG with Role Specific views' by performing a quasi experiment in academic environment. The experiment shall be conducted on two groups of undergraduate students. The Process Models was implemented in terms of its understanding and its usage in comfortable manners. The research shall answer the following question:

What is the impact of "electronic process guide with role specific views" on participants understanding?

1.4. Expected Outcome

- An electronic process guide, which will act as a practical tool and an analytical device.
- Helps participants to perform their tasks easily
- Clear understanding of the techniques, methods and tools through a simple electronic process guide.
- Electronic process guide will help to elaborate different activities.
- Through EPG with role specific views, subset of information will present in an adequate style, oriented to their particular roles (Project manager, SQA, tester, Analyst).

1.5. Hypothesis

1.5.1 Research Hypothesis:

EPG with role specific views has impact on participant's understanding.

1.5.2 Null Hypothesis

EPG with role specific views has no impact on participants understanding.

1.6. Research Methodology

As first step of the thesis, the existing literature from previous researches is used. This existing literature describing the process models used within the software industry and problems faced by the practitioners during the process implementation. Such literature includes published articles and research papers plus some case studies, experiment, workshops and reports. Literature survey has been performed as a starting point of the research.

The second step is to perform a quasi experiment. An experiment provides good insight into why relationships and results do and don't occur [17] [18] [19]. It allows conducting well-defined studies and focusing on specific variables, measures and the relationships between them [17] [20] and helps to identify contextual factors, better control assignments to treatments, and refine measurement before a more extensive and expensive study [21]. Also useful to understand their limits, to see how and when they really work, and to understand how to improve them [22].

The purpose of the study is to determine the impact of EPG on participants understanding and the Quasi experiment is used for this study to investigate and understand the cause-effect

relationships and this is a good mechanism to gather evidences of EPG with role specific views. In many cases, if an approach does not work in experimental settings, it will likely be unsuccessful in more realistic settings [21] and EPG with role specific views is a preparatory step to field studies.

1.7. Thesis Structure

Table 1 presents the overall structure of the thesis.

S N	Structure Elements	Description
1	Introduction	Overall introduction, background and related work of thesis
2	Literature Survey	Detailed review of available literature on the subject
2.1	Process Model	Brief Introduction to the basics of process models
2.2	Participant's Understanding	Importance of Participants Understanding
2.3	Introduction to EPG	Significance of Electronic Process Guide
2.4	Introduction to Role Specific Views	Brief introduction of role specific views with their importance in EPG
2.5	Supported Tools	
2.5.1	SPEARMINT	Detail of SPEARMINT modeling tool
2.5.2	CMAP	Brief introduction of comparing tool of conceptual models
3	EPG With Role Specific views	Proposed a new EPG with Role Specific views to help the participants.
3.1	Electronic Process Guide	Detail of EPG with Process Entities
3.2	Role Specific Views	Details of Role Specific views according to the roles in the process
4	Experiment	
4.1	Experiment Design	Experiment Design
4.2	Selection of Group and Project	Details of Group performed the experiment and the projects used during the projects with selection criteria
4.3	Implementation of Process model with and without EPG Support	Execution of treatments with and without EPG support
5	Results & Analysis	
5.1	Procedure	
5.2	First Treatment	Results during the first treatment with complete analysis
5.3	Second Treatment	Results during the second treatment with complete analysis
5.4	Hypothesis Testing	Statistical test, student's t test is used for testing the null hypothesis.
6	Conclusion & Future work	

Table 1 : Thesis Structure

Chapter 2

Literature Review

Chapter 2 – Literature Review

2.1. Process Models:

Sequence of networked activities involve in developing, mainitaing and delivering a secure software solution to software industry, which could be iterative or concurrent [39]. Models use for identifying the management and technical practices [38].

A comprehensive software process model are used to represent all important process activities of a software development project which serve as a basis of a central information system for coordinating, guidance, and supporting the different roles [13].

Models provide significant productivity and quality factor which define the order and overflow of the work[38]. They are extensively used to guide process improvement programs and introduce best practices into organizations. By focusing on managerial and technical percepectives,different process models are use for different purposes. Classical software process models (water fall, incremental, RAD etc) focused more on technical perspectives rather than management. RUP focued more on management perspectives. Also some process models are proposed by focusing on some specific domains such as requirement engineering , risk management, software maintainence, software modeling and testing and software change request. Mainly use to promotes the common measure of software organization process throughout the SDLC.

Value Based Requirements Risk Management (VRRM) process model is one of the process models proposed to represent the 'value-based' trends in risk management with a focus on risk management during requirement engineering within software projects [11]. It employs almost all the activities that deem to be important and taken for the purpose.

Software Change Request Submission phase process model [23] is a collection of different activities that starts with identification of need for change and followed by a software change request submission activity and ends with the activity that incorporate all requested changes is the release of a new version of a software. SCR might be specified in any phase of a software life cycle.

The Value Based Requirements' Risk Management Process Model is first of its kind to provide a risk management process that is based upon the concept of value. VRRM Process

Model is based on IEEE standards for risk management (IEEE Std. 1540-2001). It comprises of almost all activities considered mandatory by CMMI Model [11].

Most of the time, software companies face issues after the successful implementaion of the software and they need to persist their software process due to explicit issues like political and technologial factors. Software changes is one of the activity that continously engages with the software. The practical part of SCR process model is to focus in the context of running application on both customer business and software development organization environment during submission phase [23] .

A solution required to uncover the implementation problems of process models and make it effective for the software industry. This research is intended to implement the selected Process Models in practice and improve the participants understanding during the implemenation. To generalize the practices of the process models, validation must be required.

Process models are typically developed for process engineers to analyze and assess the process activities but the process participants who actually carry out these activities usually face problems during implementation and thus it affects the usability of the model. Most of the time software experiences reside in the head of process engineers and is therefore not made explicit to a larger audience. Process knowledge must be explicity avaliable to the practitioners.

Most of the time during implementation, a major time slot is require for communicating the new processes to the practitioners. Different implementation problems are highlighted by the researchers and provides different solutions, which are not enough to resolve them such as explained in [2] [1] [3] [24].

- Lack of experience of the team
- Proposed solution was a real struggle throughout meetings,
- Technical knowledge only through training,
- Difficulties in the identification of impediments
- Extra efforts required from the managements in order to increase the participants awareness about the availability of the techniques and tools
- Serious commitment,

- Process engineer continuously work closely with practitioners,
- Resource consumption- resources used in the initial phases analysis design, this means only few resources are available during the implementation phase and software practitioners have significant fear and uncertainty
- A lot of information spread all over the document in the process description
- Variation in the participants understanding,
- Programming challenge, artifacts production as a burden,
- Collaborative work is limited

A detailed comparison among process models (plan driven, evolutionary agile) was performed by focusing on software related problem items [25]. Implementation related problems are; lack of competence (personnel skills), size, complexity, novelty, gold plating(developer adding unnecessary functionality), communication gaps (project internal), new techniques, excessive documentation, project external dependencies, loss of (key) staff either because they leave or get transferred, low morale motivational support [25].

These problems becomes the impediment in generalizing the practices of software process. Participants should work independently rather than manging the problems by involveing other team members. Problems especially during implementations become fear for the organzitaion in order to implement the software process in long run. To cope with technological changes in software environment, they need to handle the problems effiecently.

2.1.1. Value Based Requirements Risk Management Process Model:

The Value-Based Requirements Engineering is based upon different principles and practices which includes the identification of the system's Success Critical Stakeholders (SCS's), eliciting their value proposition and reconciling thes propositions into a set of objectives for the system by mutual satisfaction [26].

Value-based risk management includes principles and practices for risk identification, analysis, prioritization, and mitigation.The organizations should practice the value based risk management processes and methods to improve its ability to manage the uncertainties and critical risks.

For software requirements, VRRM Process model is a risk management process [26]. It conforms to CMMI and based upon IEEE Std. 1540-2001. It consist of different activities that deems to be important for the purpose of managing requirements related risks..

Two levels of abstraction is ued to represent the VRRM process model. The first level 'abstraction level-1' divieded into two parts; Management and Assessment & Mitigation of risks. Planning and Monitoring & Control activities are the part of management whereas Identification, Analysis and Treatment of risks are the part of Assessment & Mitigation.

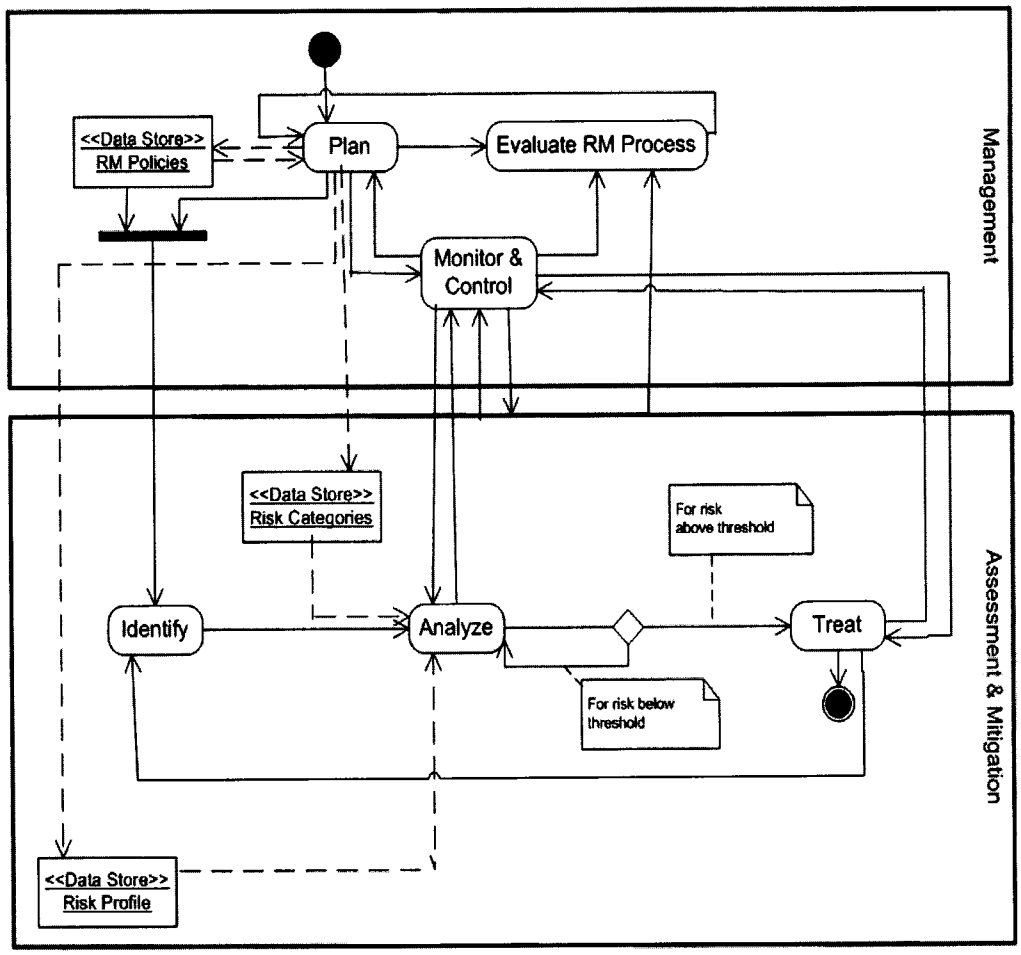


Figure 1 : VRRM ABSTRACTION LEVEL – 1

The second level of abstraction is the detail of the activities represented in the first level of abstraction.

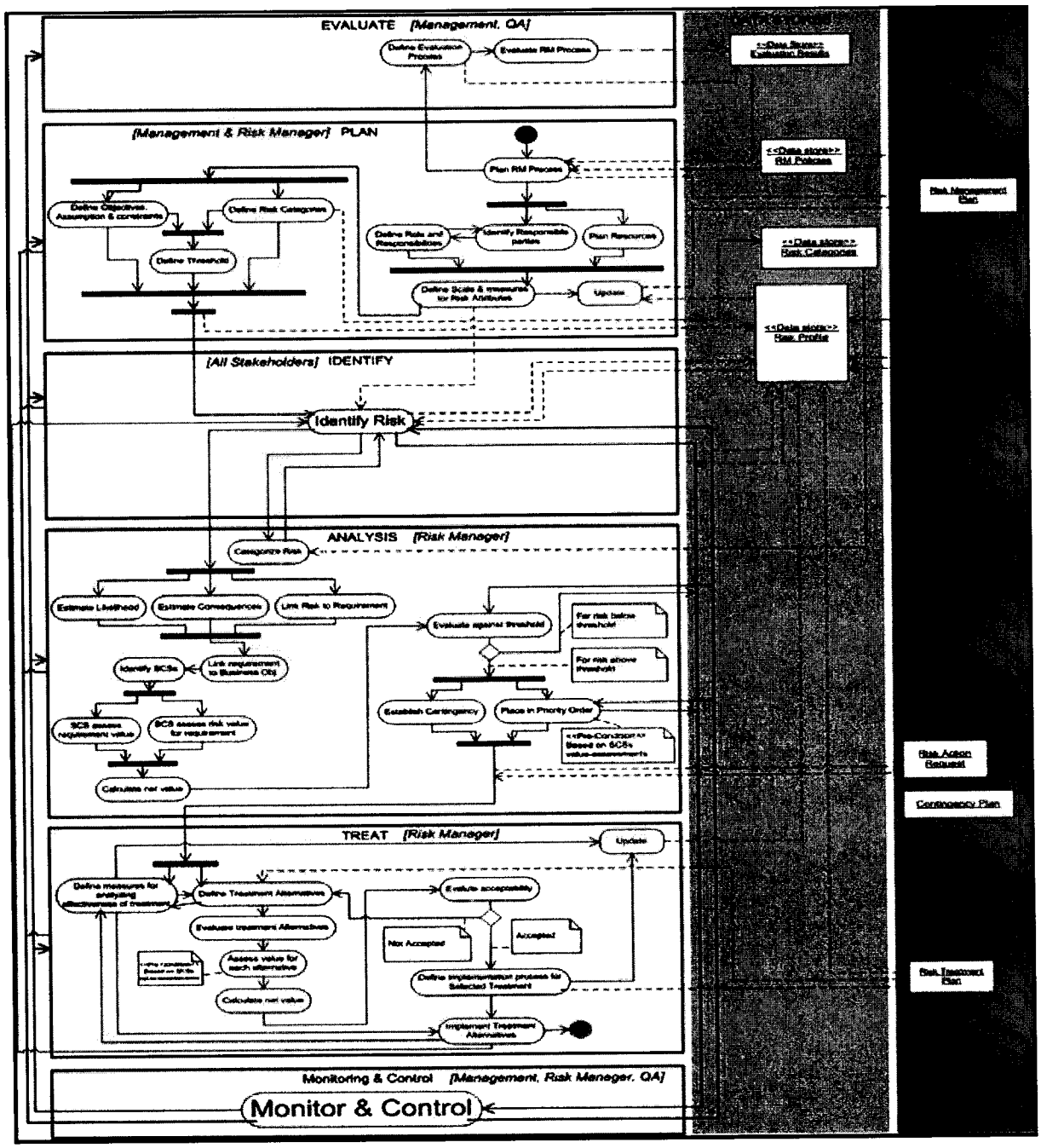


Figure 2 : VRRM ABSTRACTION LEVEL – 2

It comprises of the set of activities which are further divided into six major categories:

1. Plan
2. Identify

3. Analyze
4. Treat
5. Monitoring & control
6. Evaluate

2.1.2 Software Change Request submission phase process model:

According to [23], formal procedure provided by the SCR process for accepting, rejecting, submitting and recording requests for software change and evaluating their impact and estimate the potential cost of any proposed change. A SCR process starts when the need for change is identified and defined. It may include changes priorities according to the requests and suggested solutions. Besides presented standard processing path in a SCR process, "emergency path" usually exists for serving urgent SCRs..

Basic element in the software change process is the change request. The change process required to change the logical changes in the software. Logical changes that effect the software are usually described in a document and at the end of the change process, change request contains information about the physical and logical changes made on the files in the software. During the software change process, all the information about physical changes which are are affected by the logical changes are collected by the software change request . Usually requests are come from the bug reports or the SRS. Activities of the process that provide relationship between "row change request" from customers, the software products and development activities is the main focus in change request [27].

The main aim is to introduce an approach in modeling initial phase of SCR process and improvement for developers maintenance related activities and customer support after software delivery. The approach of modifying this initial phase emphasizes close relationship with software architecture[25] . Observe the change requests in the context of end user business environment and running application's architecture is one of the main contirbution and according to that the model is focused on the submission phase of SCR process.

Communication between the organization and customers are improved by implementing the change management process in development and an IT support envirnoment [24].

SCR process begins with identifying the need for change, followed by a SCR submission and ends with the release of a new version of software that all requested changes are incorporated. SCR might be requested by various actors in a software life cycle. Also, SCR might be specified in any phase of a software life cycle. In this approach, focus is on SCRs submitted by end software users in maintenance phase of a software product.

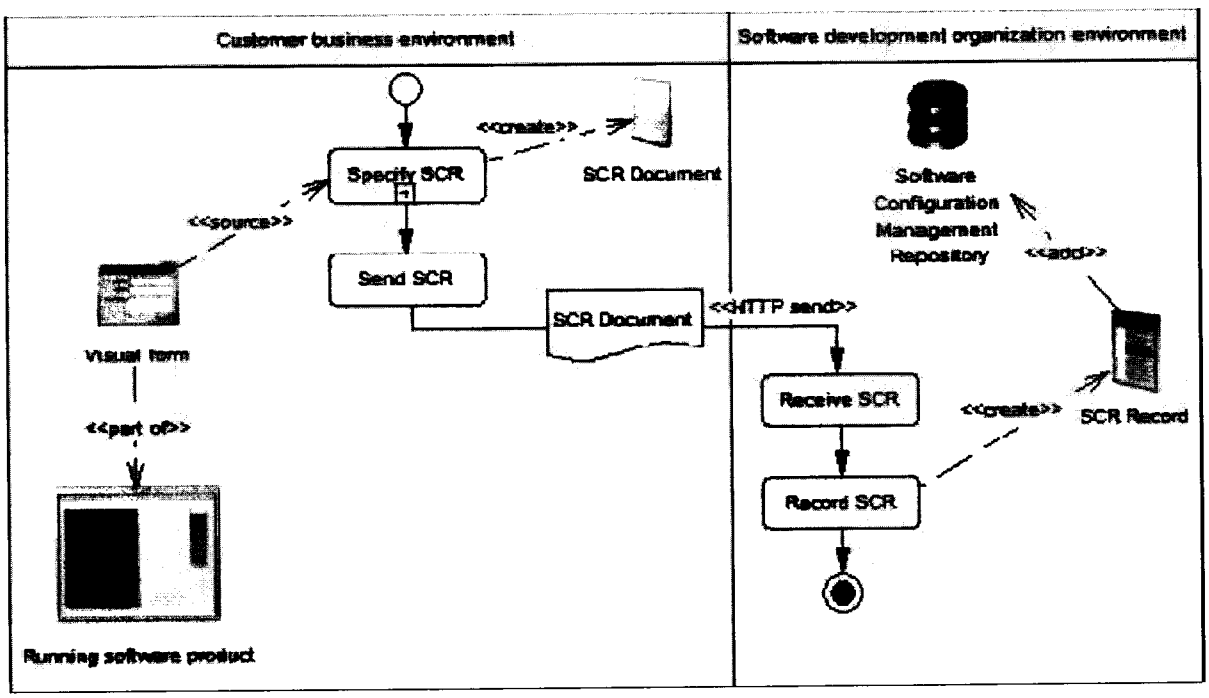


Figure 2 : Submission Phase of Change Request Process in Context of a Running Application

In practice, there is no standardized SCR process, but each organization (academic or from industry) adopts a version of SCR process that is most suitable for its needs. What is the common for all SCR processes proposed and implemented from various organizations is that all typical activities take place at developers organization, except the change implementation phase that is realized at the end user side. Submission phase of SCR process is partly moved from developers side to end user side. SCR submission is divided into different steps inorder to carry out the tasks.

SCR is a document that contains a formal specification of change to be implemented in a software. A SCR may be related to a specific component or part of a software, or to a software as a product. It may be defined and submitted in any phase of a software life cycle. Managers, software developers or the customers might specified the SCR and after the software delivery, SCRs often specified by the end users. Specification of SCR in the context of running software

application and in customer business environment is created with the help of software component SCR Specifier. Event object called SCR Event used to collect software application related attributes of SCR from a running application context. This event object is related to actual visual form. After choosing the type of event in "change request mode", an object of type SCR Event is created with the purpose to gather data about application, SCR document, and signed in user that is in SCR model viewed as change request originator. This part of SCR is called "source" because it provides link to the part of application where the SCR originates.

Successful software development and maintenance management needs efficient methods and tools for managing changes. Specifying a SCR in close relationship with an application context where it originates is the primary goal of the presented research.

2.2. Participant's Understanding:

Software processes plays an important role in developing the understanding of the software among software participants. Different resistance factors are identified and some of these factors which effect the participants understanding are lack of professionals experience and skill, unsatisfactory and unproductive assessment of the current software process, inflexibility in the use of the documentation on projects of different sizes and types [5]. Majority of models do not provide guidelines for understanding the properties: that is, the modular structure, the configuration of the control-regulation of the common attributes of a key process area and the accurate place of the key process areas at each level. [16], which ultimately affects the participants understanding.

Research recorded the problem of process awareness [6] [7] [8], timely availability of the desired information [9] and the need of training on the defined tools and technologies [9] [10]. Also one of the problems highlighted during the implementation of VRRM process model [11] *"there is the need of tools to minimize management efforts required for its repeated usage"*.

2.3. Introduction to Electronic Process Guide:

A process guide which serve as a reference document for a particular process used for providing assistance to the process participants in order to carry out the activities. A major objective for process technology is to help process participants effectively, efficiently and accurately carry out

a process. Process guides are not necessarily in the form of e-guides but also in the printed form such as process manuals, printed standards, guidebooks, and the like, are widely used in software industry. Frequently, however, intended users are not interested in the use of these printed documents. In addition, guidebooks are currently the major medium for communicating process changes.

As the technology is rapidly shifting towards the electronic media, printed process handbooks is now becoming obsolete. Electronic process guides usually structured like a web application which encompass the process details including descriptions, artifacts details, involved parties, hyperlinks for additional information like references, examples, templates and tools. Also searching features and navigation make it more powerful as compared to the printed documents.

Different commercial and non-commercial tools such as Adonis [37], Spearmint [30] and ARIS [36] are available which allow to generate EPGs of the organization specific processes cheaply and quickly. Widely used electronic process guides of the process are RUP [34] and Mentor [35].

SPEARMINT is one of the widely used tools for generating electronic process guides. The streamlined IS0 12207 processes guides were generated directly from the SPEAMINT tools. By using electronic process guide, the resulted process guide consist of roles, artifacts, activities and tools also the graphical product flows which describe the relationship between them. Each used concept has descriptions and details which can be accessed through a navigational tree. Each page of the guide has hyperlinks to all of the entity pages.

Different problem arises without the electronic process guide support such as; Most of the software processes are so complex that it become difficult to participants to handle the complexity of that process unless they are supported by some valuable aid i-e, presented with the process knowledge which can be fruitful for the participants in order to carry out their tasks. [12]. Lack of consistent documentation as a major problem in maintaining systems, therefore researchers made this the goal for improvement [6]. Training was necessary, given to the engaged resources. There was a need of elaborating the process activities like the need of elaborating monitoring and control activity [11] during the process implementation.

From the literature survey of electronic process guide, it was concluded that the use of EPG provides core benefit to the software organizations as compare to process models which lacks of consistent electronic process guide. Also as a technology concern, electronic process guide have

more importance over paper-based process guide [6]. A huge potential for improving guidance oriented documents- this would be a real value in practical setting [9]. In the result, the EPG usage improve participants knowledge of the process which ultimately shows the improvements in process estimation, documentation, planning and management also helps in building a good relations with the customers [8]. Process participants who usually find the information related to the particular activity on their own sometimes become risky in long run for the software organization. For performing tasks, participants must be guided efficiently to the clear-cut process knowledge. [28]. EPG is the useful tool for the software process improvement, whether in medium to large size organizations and it also contributes to the improvement outcomes [8].

2.4. Introduction to Role Specfic Views:

Role specific views are a descriptive software process modelling and it will be a good choice especially when the process models structure is complex, large, many people involved and variety of sub processes [14].

Role specific view improves support sharing and coordination of knowledge in geo-collaborative planning [14] and subsequently multiple view approach was assessed to support common ground in geo-collaboration within multi-role team [15]. Role specific view approach improves the quality of guidance by using measurements and the successful measurements requires a solid understanding of the product, processes, and resources to be measured, an understanding which can only be gained via explicit models [7]. Role specific views should be modelled independently [13].

Many practitioners of the large and complex process models are unable to look at a process as a whole, then they usually prefer views [13]. Roles views are sometime conflicting and the reason might be inadequate use of constructs of process modeling language or the Weak understanding of the process and sometimes inconsistency in the process itself [13] [27].

Role specific views approach works well in different context and helps to improve the understanding of the model [13].

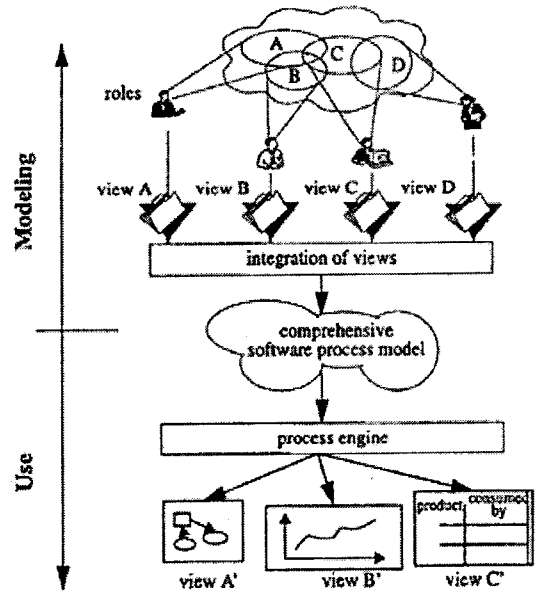


Figure 1: Role specific views

2.5. Supported Tools:

2.5.1. SPEARMINT:

In the software engineering domain, more exclusive processes having Electronic Process Guides (EPGs) like RUP[34] and Mentor [35] are available and different commercial and non-commercial tools such as Spearmint [30], Adonis [37] and ARIS [36] are available which allows to generate EPGs of the organization specific processes cheaply and quickly [28]. Process workshops are now use as a tool for developing the process guide, proposed in a Norwegian satellite software company, they presented their experiences in implementing this method [32].

SPEARMINT is use as a modeling tool for generating the software process guides quickly and cheaply in the form of HTML pages. It capture the process activities efficiently and can be used easily for the analysis and maintenance purposes by representing the process graphical.

SPEARMINT process models comprisies of number of views which are the visual representation of the activities and subactivities of the process. Any change in one view may effect the other view which become immediatly visible in any other associated view(s).

Multiple process models can be combined in a single project and SPEARMINT repository is used to store the set of projects with the extension of .sxml.

SPEARMINT Repository	Project 1	Process Model 1.1	View 1.1.1
			View 1.1.2
		Process Model 1.2	View 1.2.1
			View 1.2.2
	Project 2	Process Model 2.1	View 2.1.1
			View 2.1.2
		Process Model 2.2	View 2.2.1
			View 2.2.1

Table 2 : SPEARMINT Repository Structure

SPEARMINT consist of eight different views: role Involvement View, activities View, artifacts View, roles View, tools, control and product Flow View and the resource usage View

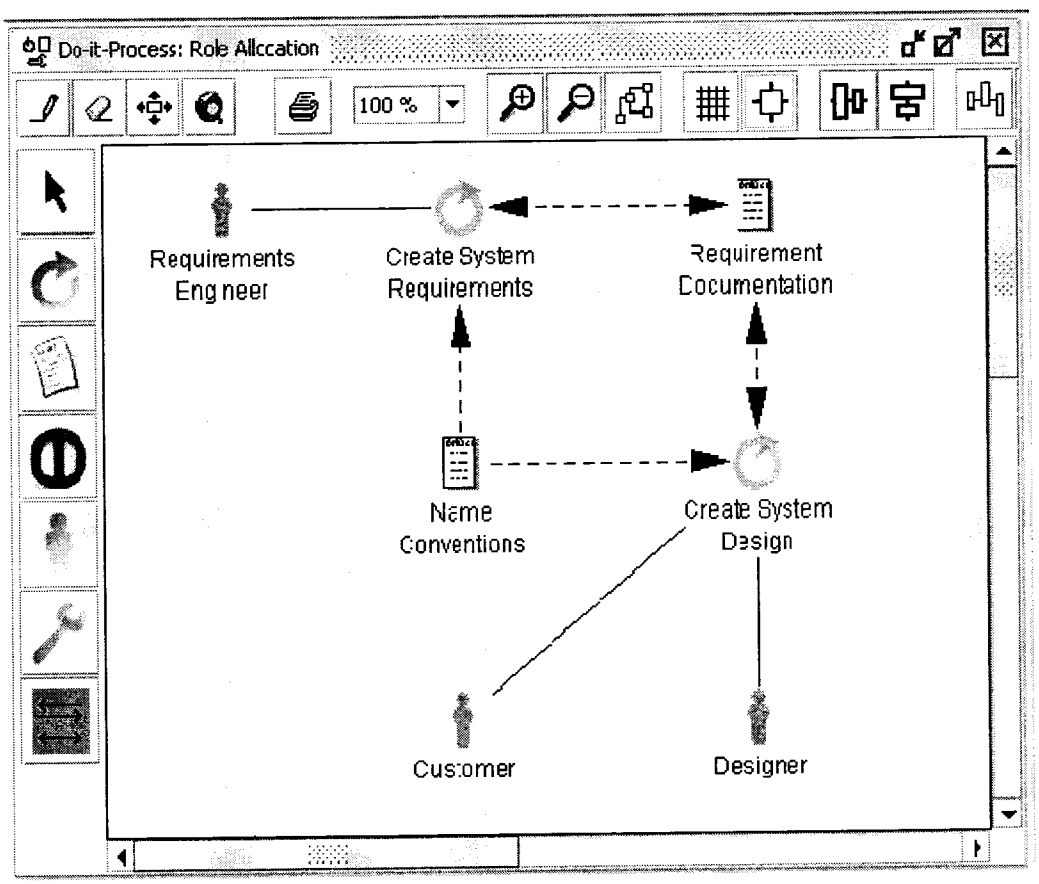


Figure 2: SPEARMINT, Graphical View

2.5.2. CMAP Tool:

A concept map is a model of knowledge which comprised of concepts and relationships. It mainly consist of several links used to represent the relationships between the nodes refer to as nodes.

CMAP tool is a java programmed based commercial product and is run on almost all operating systems without any compatibility issues.

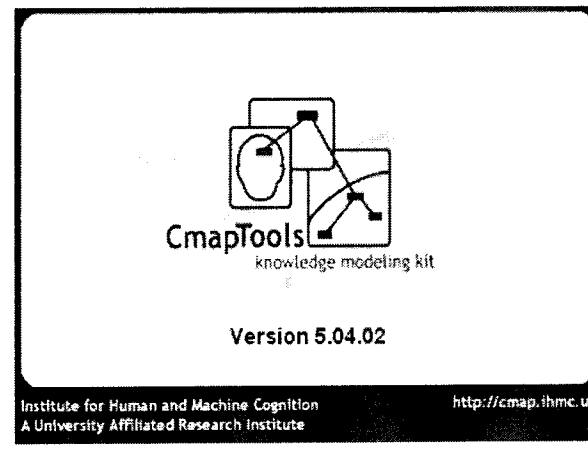


Figure 3: CMAP Tool

More complex the process, the more it take to implement. Different process problems regarding the implementations were reported by different researchers and emphasized on to critically evaluate the process from easy to adapt stand point, assessing and resolving implementation risks, outlining an initial plan for implementation and practitioners are fully guided by the process flow. EPG is one of the suitable solution to practitioners not only for the newly joined practitioner but also for the team in long run. It assist participants in carrying out their intended activities. To make the process models more comprehensive to participants, EPG with roles specific view is proposed as many different roles are associated with the process. Role specific approach helps in improving understanding in different context such as role-based multiple view approach to support sharing and coordination of knowledge in geo-collaborative planning[15]. SPEARMINT [30][31] is the one of the best commercial tool available for generating electronic process guides. Participants understanding is effected with the use of EPG or not, is asses by using a commercially available free CMAP tool [29] is use. It is important to mention that EPG with roles specific views solution is not specific to VRRM and SCR. It is equally applicable to all other process models because neither of the concept of EPG with roles specific view is dependent on any of the process model.

Chapter 3

Electronic Process Guide

with

Role Specific Views

Chapter 3–Electronic Process Guide with Role Specific Views

A major objective for process technology is to help process participants effectively, efficiently and accurately carry out a process. EPG is currently the major medium for communicating process changes. Also as a technology concern, electronic process guide have more importance over paper-based process guide [6]. A huge potential for improving guidance oriented documents- this would be a real value in practical setting [9].

EPG of both selected models VRRM and SCR process model are generated. One of the most widely used tools, SPEARMINT is used for generating electronic process guides.

3.1. Electronic Process Guide:

Electronic process guides usually structured like a web application which encompass the process details including descriptions, artifacts details, involved parties, hyperlinks for additional information like references, examples, templates and tools.

The generated EPG (figure 7) based on HTML pages and divided the web page into three frames. The left two frames are use for navigation and the third frame is use for displaying the information on the process. The top frame of the left two frames display a hierarchical structure like a tree of the process entities and the lower frame of the left side contains a dynamic contents, which changes according to the selection made in the upper frame.

The process entities on the left top frame consist of :

- Activities: List down only the activities and allows a display of their hierarchical structure for easily navigation
- Artifacts: Lists only the artifacts used in the process and allows a display of their hierarchical structure for easily navigation
- Roles: Lists roles those participated in the process in order to carry out the activities
- Tools/Techniques: Lists tools and techniques only use in the process model.
- Role specific Views: The specific view of the process model according to the roles participated in the process.

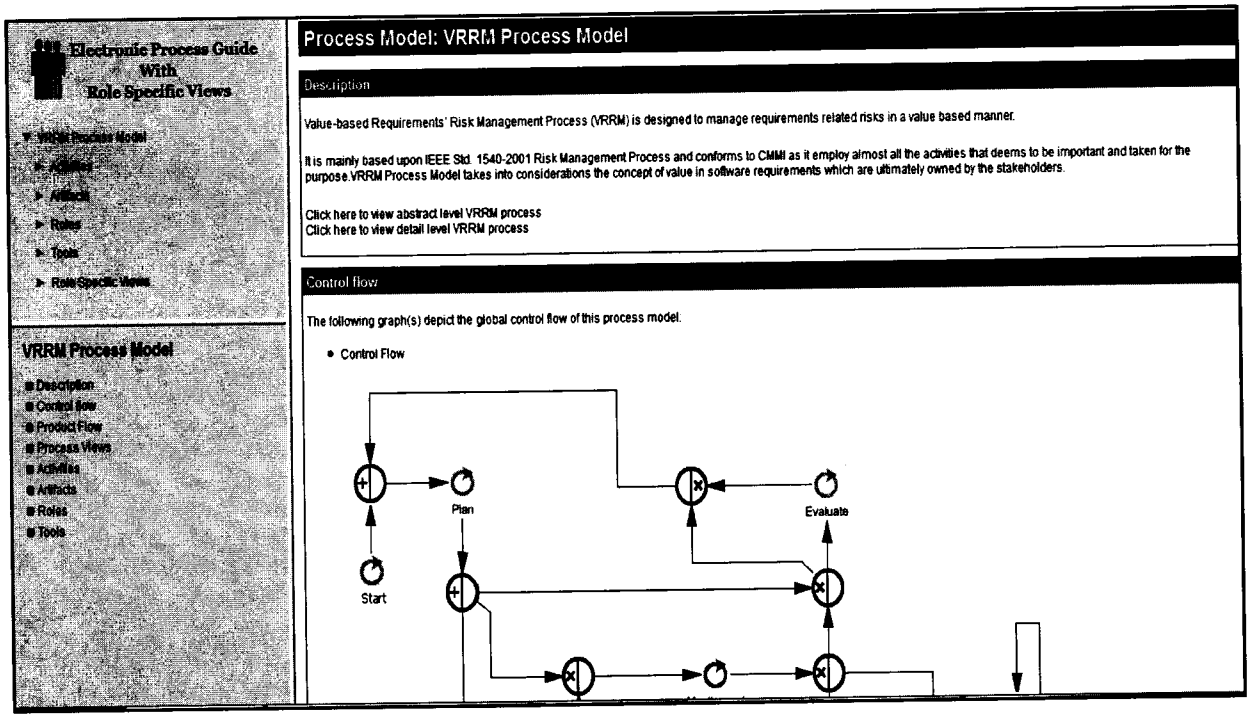


Figure 7 : EPG view of VRRM Process model

3.1.1. Activities:

Every process model comprises of different activities. Each activity plays an important role in carrying out the tacks. The EPG left frame shows the activities link (figure 8). Which lists all the activities only and allows a display of their hierarchical structure.

By clicking on the main node of the activities, list down all down all the sub-activities involved in the particular activity. The right frame shows the associated information which makes to easily understand the purpose of the activity.

Activity information includes product flow Refinement, Control flow refinement, refined activity(parent activity), sub-activities, involved roles, used Tools/Techniques.

For easiness, each tools, activities, roles mentioned on the information page are link to the detail page.

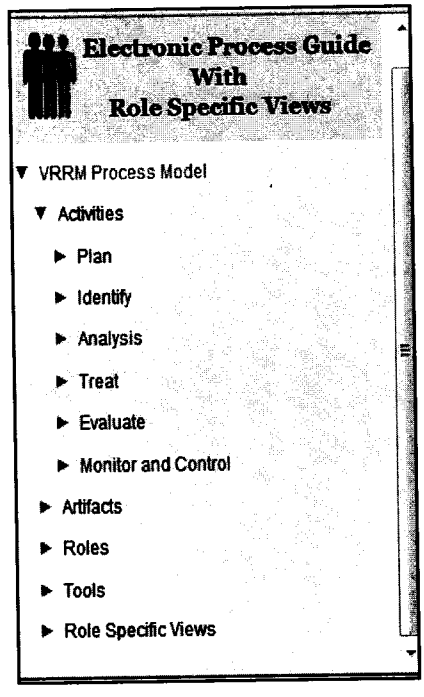


Figure 8 : Process Activities in EPG

3.1.2. Description:

Each process entities involved in the process have complete and econcise description for easily understanding the entity purpose, rather than gusses from the name of the activity. Some of the activity have diagrams, templates and examples and external links for any further detail (figure 9). By clicking on the process entities, a complete information page open in the right pane.

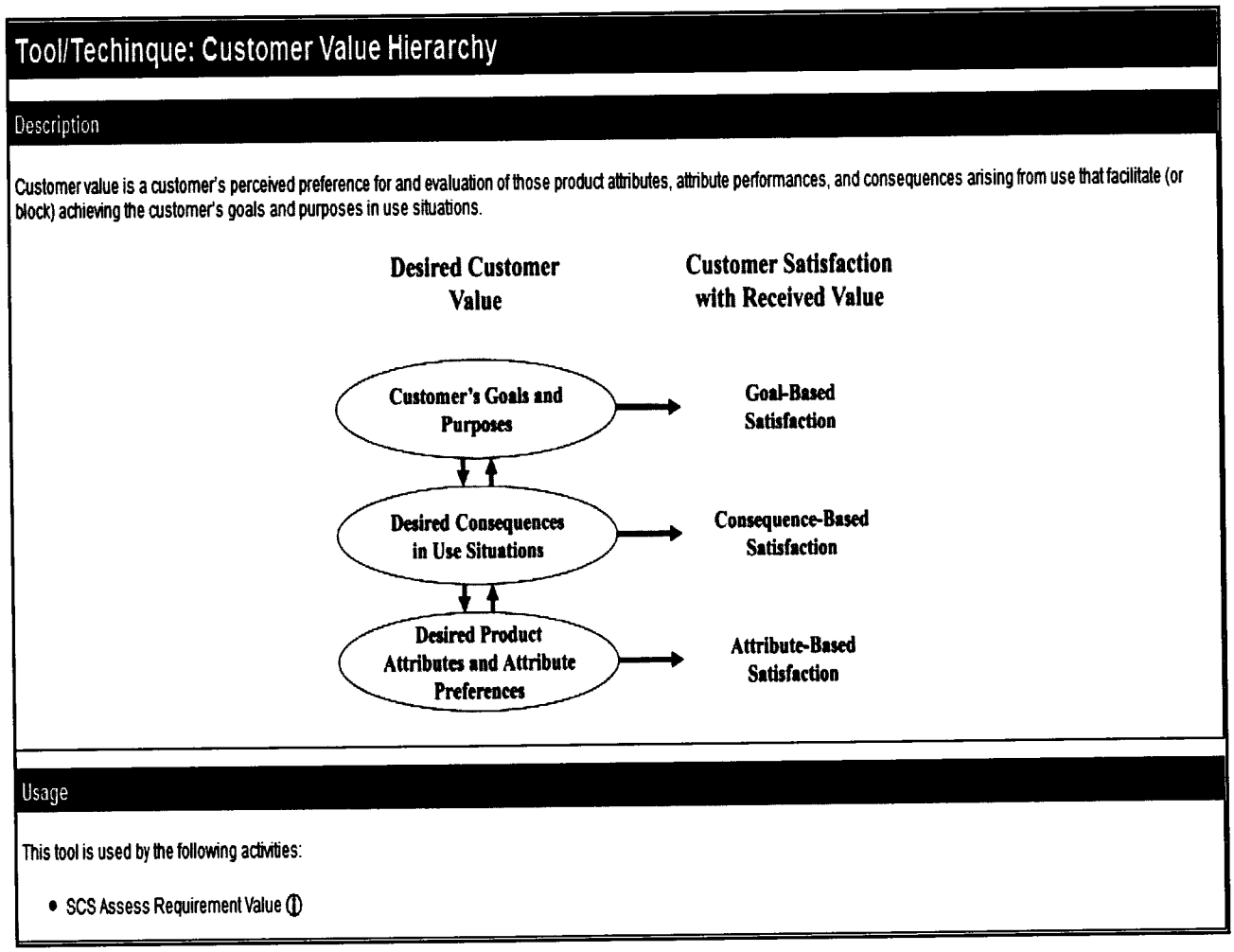


Figure 9 : Customer value hierarchy technique detail

3.1.3. Control flow

Control flow among the activities of the process are easily captured in the control flow view. Join and split symbol are use inorder to link the activities (figure 10).

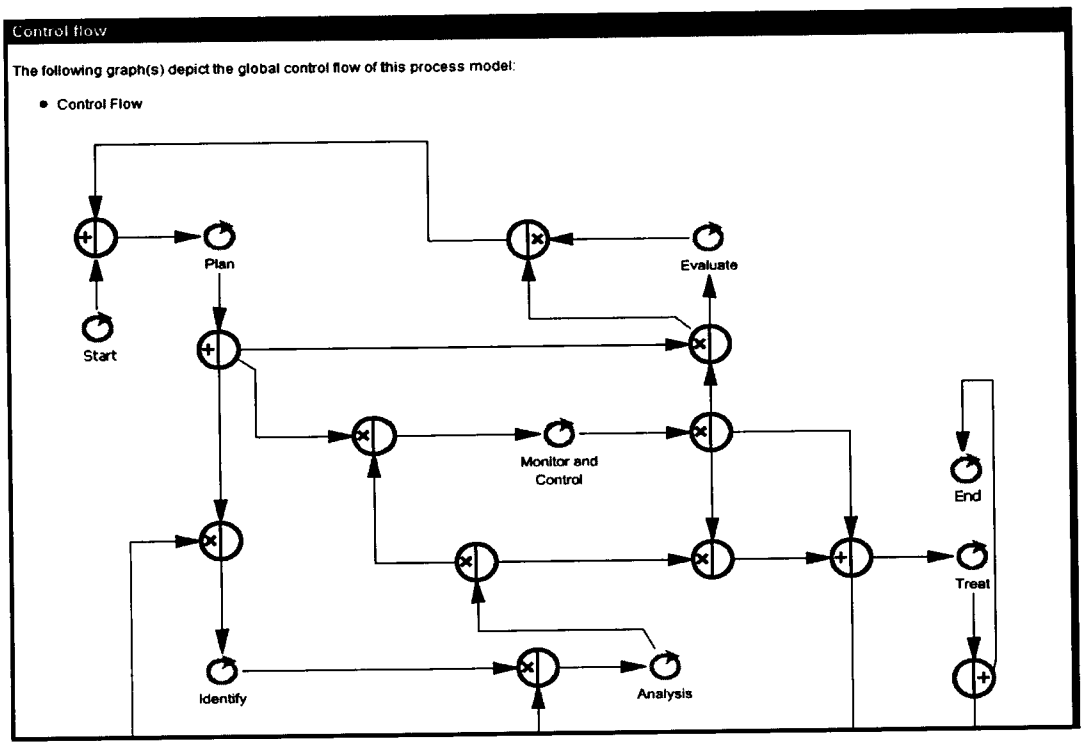


Figure 10 : Control Flow of VRRM Process Model

3.1.4. Product flow

The product flow graphs model the product flow between activities and artifacts. Which activity will produce which artifact and which activities involved in modifying that particular artifacts are clearly mentioned. So any participants responsible for any particular activity will easily track down the other activities.

Product flow also list down all the activities who use this artifact as an input(figure 11).

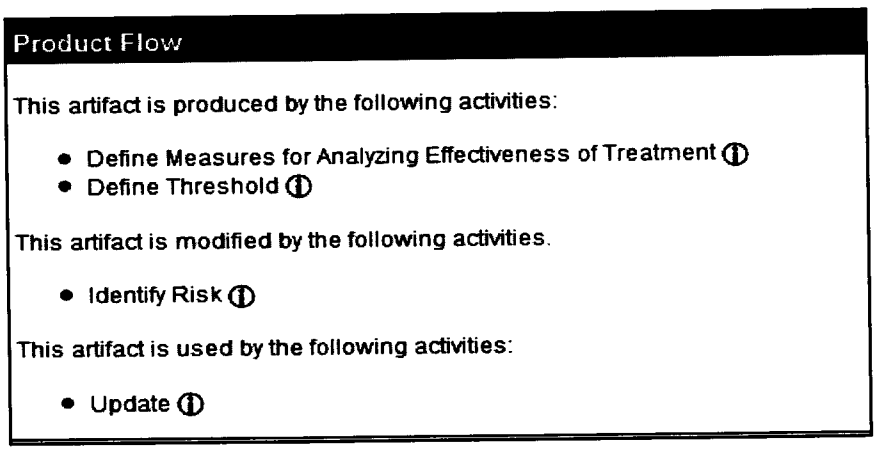


Figure 11: Product flow

3.1.5. Process views

The process view is a special type of view where roles and tools are detain in a graphical view (figure 12). A graphical view can contain all four process entities, namely activities, artifacts, roles, and tools. Roles and tools can be linked to activities. Activities and artifacts can be linked displaying the relationship of consumption, usage, and modification It is not possible to link two activities or to link two artifacts directly. This view is not part of the refinement hierarchy and can contain parts from each level of the refinement hierarchy.

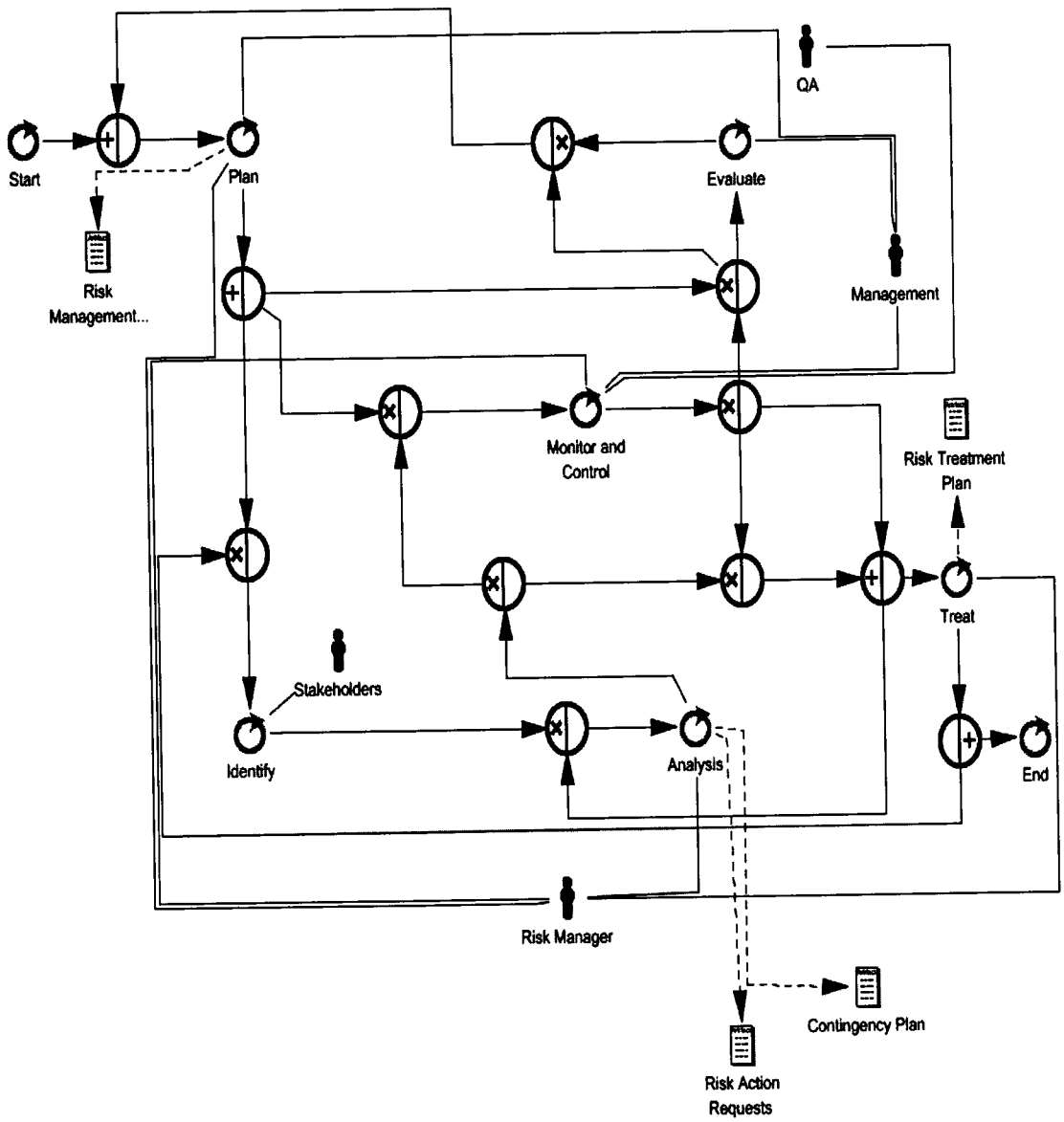


Figure 12 : Graphical View of VRRM Process

3.1.6. Artifacts:

Artifacts display the list of all the artifacts defined in the process model (figure 13). They are displayed in alphabetical order and the sub-artifacts are displayed as sub-nodes of the tree. The tree can be expanded and collapsed.

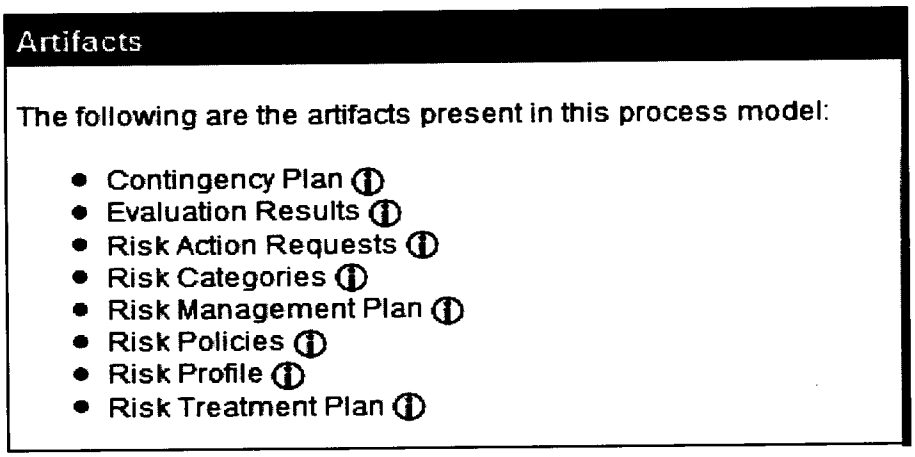


Figure 13 : Artifacts

3.1.7. Roles:

List down all the roles who have to be participated in the process model to carry out the activities (figure 14). This is helpful for allocating their resources for the particular process.

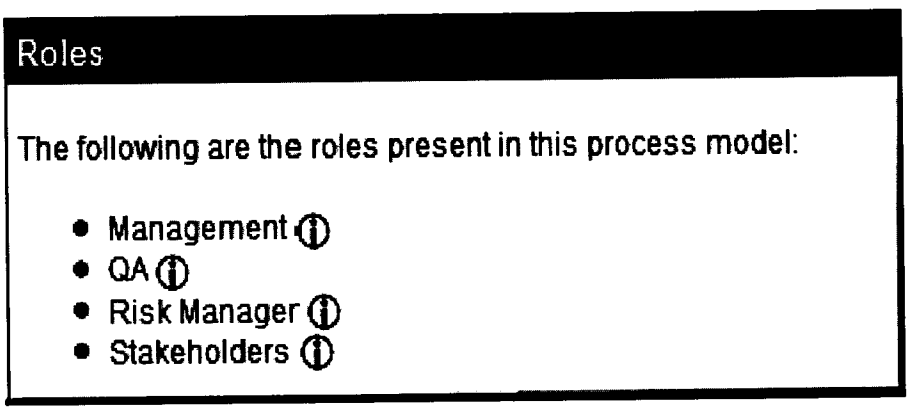


Figure 14 : List of Roles in the VRRM Process

3.1.8. Tools:

Participants can easily navigate the tools/ technique (figure 15). Just one click far from tool and technique used to carry out the activities of the process.

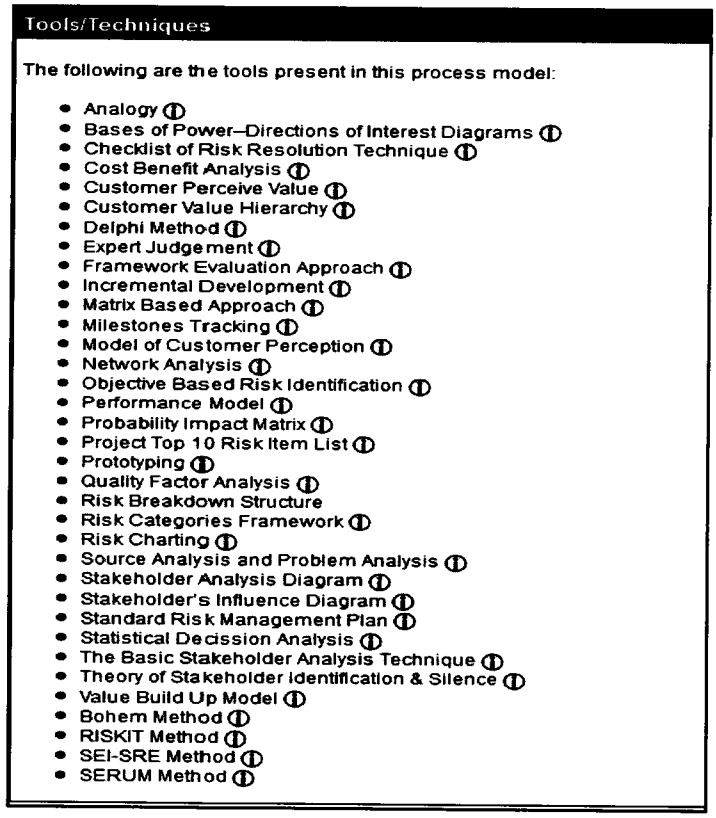


Figure 15 : List of Tools and techniques

3.2. Role Specfic Views

Role specific view approach improves the quality of guidance by using measurements and the successful measurements requires a solid understanding of the product, processes, and resources to be measured, an understanding which can only be gained via explicit models [4]. Role specific views should be modelled independently [12].

A complete view of the process model according to the particular role is easily accessed by just one click (figure 16). Each view shows the complete process entities but this all are specific to the particular view.

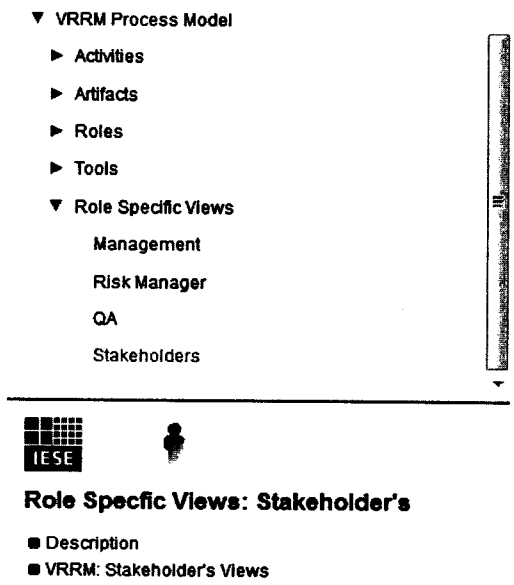


Figure 16 : Role specific view

Chapter 4

Implementation of EPG with Role Specific Views

A Quasi Experiment

Chapter 4 – Experiment

The aim of conducting this research is to improve the participants understanding through EPG with role specific views. An experiment provides good insight into why relationships and results do and don't occur [17] and provide a high level of internal and external validity [18]. Experiment allows conducting well-defined studies and focusing on specific variables, measures and the relationships between them [17] [20]. It is also useful to understand their limits, to see how and when they really work, and to understand how to improve them [22].

The experiment was conducted on undergraduate students. There were two separate groups; Group A and Group B. Two different web projects called as "ILM Montessori" and "Geriatrics Education" was selected for the experiment.

4.1. Experiment Design

In some experiments, all factors that might affect the phenomena of interest are under control, which is preferred design. However, it is not possible that all the important factors ban be determine. Quasi experiment is used for this study to investigate and understand the cause-effect relationships. It is near to field experiment. The design method for analyzing the impact of EPG with role specific views is cross-over design method (refer table 3) [18]. This is a balanced design in which each experimental unit (i.e. group of 10 members) implemented the process model. Server log also provided as an aid in order to calculate the EPG usage.

	Group A	Group B
	Questionnaire	Questionnaire
	Group B	Group A
	Questionnaire	Questionnaire

Table 3 : CROSS OVER DESIGN

In the 1st treatment, members of Group-A implemented the VRRM process model[26] on the project of "ILM Montessori" without EPG support and Group-B implemented VRRM Process Model on "ILM Montessori" project with EPG support (EPG Role Specific Views).

In the 2nd treatment, Members of Group-B implemented SCR Process Model [23] on "Geriatrics Education" without EPG support and Group-A implemented SCR Process Model on "Geriatrics Education" with EPG support.

Results are compared on the basis of treatment, so the difference of understanding is easily measured. It is important to mention that the members of the group remain the same during the experiment.

4.2. Selection of Groups and Projects

Systematic sampling is used for the selection of group members from the population of students and because of periodic nature of systematic sampling, firstly BSSE students were selected for the experiment and after that, criterion is used for the selection of groups and projects (refer table 4).

S.N.	Parameter	Criteria
1	Status	Undergraduate students
2	Semester	Above 5th semester students
3	Experience	• Having knowledge of risk management and software Change Process • Good Programming skills (HTML,CSS)
4	Member s	10 members

Table 4 : SELECTION CRITERIA – GROUPS

Table 5 criterion is used for the selection of projects.

S.N.	Parameter	Criteria
1	Commercial	Yes
2	Type	Software development
3	Duration	Approximately: 2 weeks
4	Stake-holders	Identifiable and accessible
5	Client	Web solution company

Table 5 : SELECTION CRITERIA – PROJECTS

Based on the criterion given above, the selected groups are taken as unit of analysis for this experiment.

4.2.1. Selection of Groups Members

The groups are selected on the basis of above given selection criterion after the systematic sampling. Initially students of software engineering and computer sciences were selected for the experiment. By narrow down the sampling size, students of BSSE were selected as they are good in software processes and are more suitable for the experiment. For evaluating the group members and for avoiding the biasness of selection, the student evaluation questionnaire is designed. The basic purpose is to assess the basic knowledge of students about the risk management and software change request management as the selected process models are based on these concepts. Participants must have basic knowledge of these concepts. Questions must be understandable to the students and all questions are MCQ's based (Annexure A). The objective of the questionnaire before the experiment is to evaluate the students to recall the concepts of risk management, value based and software change request process. Evaluation is one of the levels of intellectual behaviors in the cognitive domain of blooms taxonomy[43]. On the basis of the evaluation students are divided into two groups; Group A and Group B. Group members remain the same throughout the experiment.

4.2.2. Introduction of Group-A and Group-B

The web project were carried out by the undergraduate students of International Islamic University Islamabad "Group-A" who are the students of 6th semester of BSSE (software Engineering). Each Group-A and Group-B comprised of 10 members.

4.2.3. Introduction of Projects:

ILM Montessori was formed in order to provide parents an option for Montessori education with Islamic studies for their children in Glendale Heights and surrounding communities. The "ILM Montessori" project is an informatics website.

The main components of the "ILM Montessori" project are:

1. Provide valuable information to parents about the school
2. Easily find the location of ILM Montessori
3. Parents can easily contact them through an online form
4. Should have an overview of Curriculum
5. Gallery of curricular and non-curricular activities

"Geriatrics Education" is dedicated to the education of health care provider in practice as well as in training e.g. medical student, PA student, nursing students, residents or fellows. The online registration form is provided with an option of payment through PayPal and the user can also print the form after submission & Mail them with a check.

The main components of the "Geriatrics Education" project are:

1. Provide Valuable information about Geriatrics Education
2. Courses Overviews
3. Online Registration with printing and payment option
4. For any query, suggestion, user can easily contact them through online form.

4.3. Implementation of Process Models with & Without EPG Support

The VRRM Process Model and SCR Process model implemented on two real projects. The subsequent sections capture the detail of implementation of VRRM & SCR process models on both projects.

First treatment start with the implementation of the VRRM process model, members of Group-A implemented the VRRM process model on the project of "ILM Montessori" without EPG support. Groups members are divided into sub groups and each subgroup consist of 2 members. Managers, risk managers, QA, stakeholders and developers. Because of the new to the process, all group members were confuse and try to find the information on their own without following the standard techniques \tools and try to engage everyone in their tasks in order to complete. The project was not complete even after 12 working days whereas the project total time is one week i.e. 7 days.

In the first treatment, Group-B implements the VRRM Process Model [26] on "ILM Montessori" project with EPG support (EPG Role Specific Views). The project starts parallel with group A but on different timings. Both group works were schedule on different times. Same group b is divided into subgroups and each sub group consists of 2 members. Managers, risk managers, QA, stakeholders and developers. Each group member aware of their responsibility and EPG with role specific views makes their tasks simple. Project was completed in 8 working days with proper documentations. As ILM Montessori is Chicago based project, the generated documentation during the project was approved by appreciating their works.

In the 2nd treatment, Members of Group-B will implement SCR Process Model [23] on "Geriatrics Education" without EPG support. Geriatrics education was the running project but there was a long list of integrating new features. As this project requires PayPal module which requires extra time from the development environment. To reduce the number of changes, all requires handling the changes very systematically because of the shortage time and understanding any change from the customer environment. Each group member is divided into subgroups and each subgroup consists of 2 members except developers sub group. Developers sub group consist of 4 members because of extensive work in development environment. Sub groups are; Project manager, change committee, developers and stakeholders. The project was not completed within the defined timeframe. The total time of the project is 10 working days.

Group-A will implement SCR Process Model on "Geriatrics Education" with EPG support in the 2nd treatment. Same as group A, group B is divided into sub groups. Each participant follows the standards and handles the work efficiently. Proper documentation was generated to track the changes. Schedule the work to minimize the repeating changes from the stakeholders. The project was completed within 10 days.

4.3.1. VRRM Process Model and SCR Process Model without EPG Support

Due to the lack of EPG support, the group members faced lots of difficulties during implementation. During the first treatment, Group-A implemented the VRRM Process Model without EPG support on the project of "ILM Montessori" and the second Group-B implemented the SCR Process model on the project of "Geriatrics Education".

Software development processes were so complex for both groups and because of absence of proper guideline, the practitioners cannot coped the complexity and the number of difficulties were notice during the implementation of process models such as; difficulties in the identification of impediments and extra efforts required from the managements in order to increase the participants awareness about the availability of the techniques and tools. Lack of consistent documentation is also one of the major problems in maintaining the systems. And at the end the project did not meet the timelines and extra time required to complete the project. One of the main reason was the practitioners were implement these process model first time and they tried to complete them without understanding the model and always find a short cut like their own guesses without following the standard techniques in order to proceed to the next step.

Each member continuously involved in other activities without focusing on their own responsibilities and this is one of the reasons the project did not meet the time line. Most of the activities were repeated again and again because some important features were missed and the risks associated with them was ignored by the practitioners.

The change request were handled according to the model description but still fails to produce the consistent SCR document and for that the management committee returns the document back with a request to provide them some standard documentation.

Both projects were completed with delay and required extra efforts from all team members at the end.

4.3.2. VRRM & SCR Process model with EPG Support

During the second treatment, Group-B implemented the VRRM Process Model without EPG support on the project of "ILM Montessori" and the second Group-A implemented the SCR Process model on the project of "Geriatrics Education".

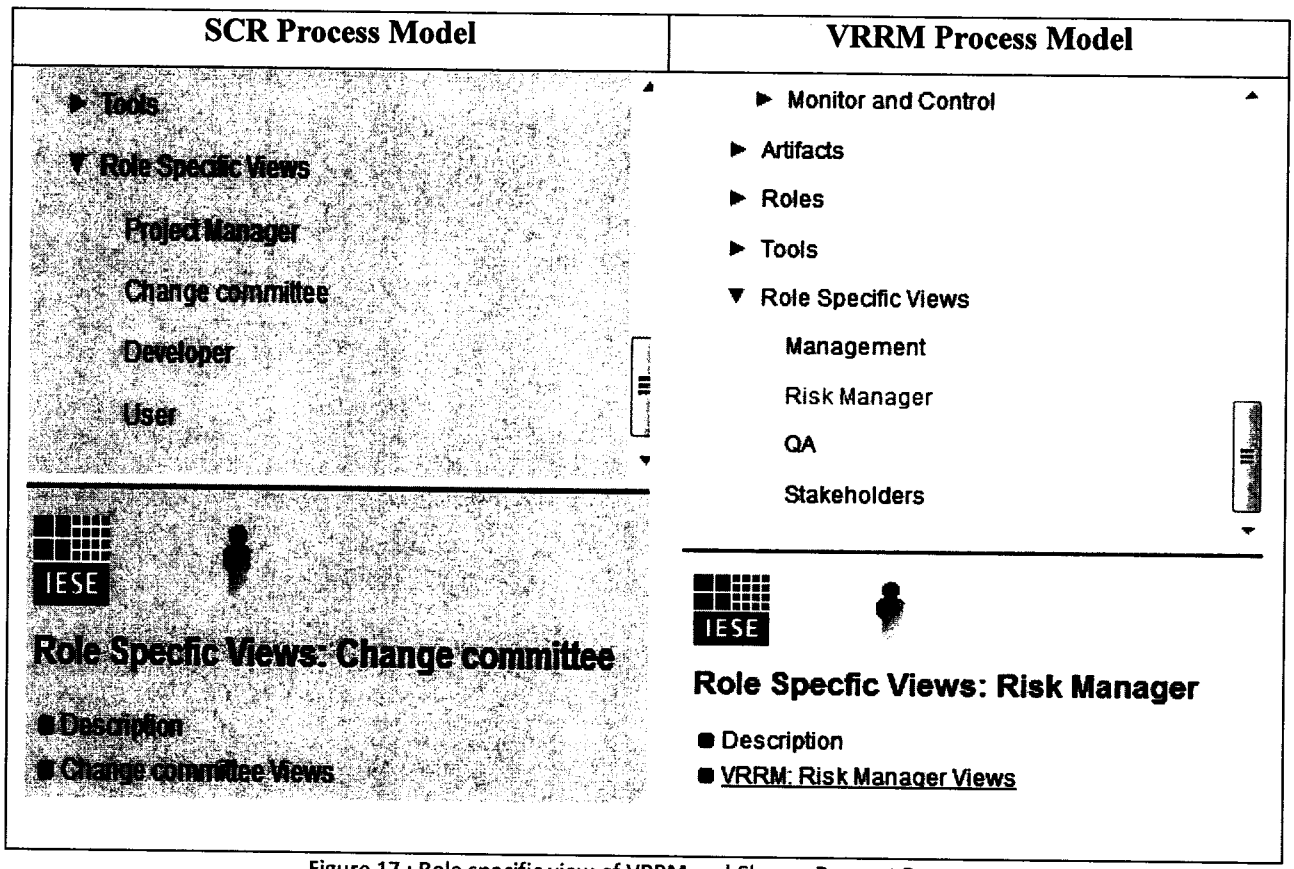


Figure 17 : Role specific view of VRRM and Change Request Process

Role specific view approach improves the quality of guidance by using measurements and the successful measurements requires a solid understanding of the product, processes, and resources to be measured [7][13]. For that, Role specific views approach is used in EPG.

All the members are clearly aware of their responsibilities and tasks during the implementation of process models because of roles oriented nature of this EPG. The concept of role specific views helps to make a more comprehensive process guide to all the practitioners of VRRM & SCR Process model. Management, QA, stakeholders, Risk Mangers, change committee, developers all have separate views and they can easily manage their involvement without interfering and continuously engage themselves in other activities. The Electronic Process guide with role specifics views gives the detail picture of each activity with different techniques and tools, so the user used some standard guideline.

By using EPG with Role Specific views support, the flow of the project was very smooth. The both Group-A and Group-B maintain their consistency throughout the projects and the projects was completed within the specified timeline with customer satisfaction.

EPG with roles specific views played an important role in completing the projects within the time frame and more important, completed with satisfaction of the customer. Roles are associated with every project and participating and engaging themselves in other activities is one of the reasons of slippage of schedule rather than focusing on their own responsibilities. It was observed that during the experiment, participants who are not using EPG with role specific views were confused about their responsibilities during the project implementation most of them have limited knowledge regarding the activities but the participants who are using the EPG with role specific views works systematically and every one are fully aware of their responsibilities.

Chapter 5

Results & Anaylsis

Chapter 5 – Results & Analysis

Conceptual model [40][41][42] is used for measuring the understanding level of participants regarding the implementation of the process models after the usage of EPG with role specific views. Conceptual model provides the formal representation of a domain. It is used for communicating and understanding of the domain.

5.1. Procedure:

After the 1st and 2nd treatments, questionnaires (Annexure B) are given to participants to depict their understanding regarding the used process model. By using conceptual model, the impact of EPG on participants understanding is easily measured.

The members of Group A conceptual models is compared with the original accurate models (Annexure D) and depending on the statistics, their understanding is measured and this comparison is through CMAP tool [29].

5.2. First Treatment:

5.2.1. Implementation of VRRM without EPG support by Group A:

Group A consist of 10 members and the questionnaire comprises of 5 conceptual models of VRRM Process model. 10*5=**50** conceptual models (Annexure B) are used for measuring the understanding of the group A participants by using CMAP tool.

The understanding is measured based on the given below scales (refer table 6).. Scales are defined by considering the following points:

- Participants background are from software engineering and have some prior knowledge .
- Even explaining the model first time, participants have exposure regarding the different activities of process model by finding the activities on their own.
- Participants have overview, exposure and by providing guideline regarding the standards make the process activities more understandable.

Below 40% means the participants just understand the concept and implement the model on their own way which will be risky for the organization in long run. The range between 40-80% means the participants trying to understand the model but knowledge regarding the implemented model is limited which will also not beneficial for the organization in long run. Above 80% means participants acquire a good knowledge and their understanding level is considerably affected.

SCALE	MEASUREMENTS
Below 40 %	poor knowledge regarding the implemented model
40-80%	Average knowledge regarding the model
80-100%	Having good knowledge

Table 6 : MEASUREMENT SCALE

Results by comparing the 50 conceptual model with the accurate model are given below. The criteria used for comparison are propositions, connections, linking phrases. CMAP tool calculate the percentage on the basis of above criteria. Participants are represented with P1,P2..Pn along with the focused questions.

P: Participant

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the sixteen nodes with arrows.	10%	21%	42%	21%	36%	31%	21%	52%	36%	21%
Link the management and assessment & mitigation activities of VRRM process model separately	33%	50%	33%	33%	33%	33%	66%	66%	33%	50%
Link the activities to their sub activities.	77%	55%	55%	66%	55%	55%	55%	55%	66%	55%
Name the artifacts and link to the associated activity of VRRM Process model.	33%	33%	33%	0%	33%	0%	0%	100%	0%	66%
Interrelate the activities according to flow of VRRM process model.	33%	26%	40%	40%	26%	26%	53%	26%	40%	26%

Table 7 : COMPARISON ON THE BASIS OF PROPOSITION

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the sixteen nodes with arrows.	10%	26%	44%	23%	44%	55%	26%	57%	57%	26%
Link the management and assessment & mitigation activities of VRRM process model separately	91%	100%	91%	83%	91%	100%	91%	100%	83%	91%
Link the activities to their sub activities.	88%	88%	88%	94%	88%	88%	94%	88%	94%	84%
Name the artifacts and link to the associated activity of VRRM Process model.	100%	66%	100%	60%	100%	60%	60%	100%	60%	83%
Interrelate the activities according to flow of VRRM process model.	90%	96%	86%	93%	96%	96%	100%	96%	86%	96%

Table 8 : COMPARISON ON THE BASIS OF CONNECTIONS

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the sixteen nodes with arrows.	94%	94%	100%	78%	100%	94%	94%	78%	89%	94%
Link the management and assessment & mitigation activities of VRRM process model separately	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Link the activities to their sub activities.	100%	100%	100%	100%	100%	100	100%	100%	100%	100%
Name the artifacts and link to the associated activity of VRRM Process model.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Interrelate the activities according to flow of VRRM process model.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 9 : COMPARISON ON THE BASIS OF LINKING PHRASES

On the basis of above percentage of the given criteria's , the aggregate percentage of the model is calculated (refer table 10).

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the sixteen nodes with arrows.	38%	47%	62%	40.6%	60%	60%	47%	62.3%	60.6%	47%
Link the management and assessment & mitigation activities of VRRM process model separately	74.6%	83.3%	74.6%	72%	74.6%	77.6%	85.6%	88.6%	72%	80.3%
Link the activities to their sub activities.	88.3%	81%	81%	86.6%	81%	81%	83%	81%	86.6%	81%
Name the artifacts and link to the associated activity of VRRM Process model.	77.6%	66.3%	77.6%	53.3%	77.6%	53.3%	53.3%	100%	53.3%	83%
Interrelate the activities according to flow of VRRM process model.	74.3%	74%	75.3%	77.6%	74%	74%	84%	74%	75.3%	74%
	70.56%	70.32%	74.1%	66.02%	73.4%	69.1%	70.5%	81.8%	69.56%	73.0%

Table 10 : AGGREGATE PERCENTAGE OF PARTICIPANTS AFTER IMPLEMENTING VRRM PROCESS MODEL WITHOUT EPG SUPPORT

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	TOTAL
Aggregate Percentage	70.56%	70.32%	74.1%	66.02%	73.4%	69.1%	70.5%	81.8%	69.56%	73.0%	71.84 %.

After the first treatment, the aggregate percentage of the group-A participants are **71.84%.**

5.2.2. Implementation of VRRM with EPG support by Group B:

Members of group B implemented the VRRM process model with EPG support. With the help of conceptual model ,the impact of EPG on participants understanding will be easily measure. The comparison criteria of conceptual model of participants with the accurate model of the process model is calculated in terms of percentage and with the help of CMAP tool.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the sixteen nodes with arrows.	89%	73%	78%	73%	73%	57%	52%	78%	68%	73%
Link the management and assessment & mitigation activities of VRRM process model separately	66%	83%	66%	66%	50%	83%	66%	50%	66%	33%
Link the activities to their sub activities.	88%	66%	88%	77%	77%	66%	77%	66%	55%	66%
Name the artifacts and link it to the associated activity of VRRM Process model.	33%	00%	33%	100 %	100 %	66 %	33 %	66 %	66%	66 %
Interrelate the activities according to flow of VRRM process model.	53%	60 %	80 %	73 %	80%	66 %	60 %	60 %	80 %	66 %

Table 11: COMPARISON ON THE BASIS OF PROPOSITION

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the sixteen nodes with arrows.	92%	81%	84 %	76 %	76 %	65 %	52 %	78 %	68 %	76%
Link the management and assessment & mitigation activities of VRRM process model separately	100%	91%	91 %	100%	100 %	100 %	100%	100%	100%	100 %
Link the activities to their sub activities.	100%	100%	100%	100%	100%	100%	100%	94%	88%	100%
Name the artifacts and link to the associated activity of VRRM Process model.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Interrelate the activities according to flow of VRRM process model.	86%	90%	96%	96 %	100 %	100 %	90 %	93 %	100%	90 %

Table 12 : COMPARISON ON THE BASIS OF CONNECTIONS

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the sixteen nodes with arrows.	100%	100%	100%	89%	100%	89%	78 %	100 %	89 %	89%
Link the management and assessment & mitigation activities of VRRM process model separately	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Link the activities to their sub activities.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Name the artifacts and link it to the associated activity of VRRM Process model.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Interrelate the activities according to flow of VRRM process model.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 13 : COMPARISON ON THE BASIS OF LINKING PHRASES

On the basis of above percentage of the given criterions , the aggregate percentage of the model is calculated (refer table 14):

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the sixteen nodes with arrows.	93.6%	84.6%	87.3%	79.3%	83 %	70.3 %	60.6 %	85.3 %	75 %	79.3%
Link the management and assessment & mitigation activities of VRRM process model separately	88.6%	91.3 %	85.6%	88.6 %	83.3%	94.3%	88.6%	83.3%	88.6 %	77.6 %
Link the activities to their sub activities.	96%	88.6%	96%	92.3 %	92.3%	88.6 %	92.3 %	86.6%	81 %	88.6%
Name the artifacts and link it to the associated activity of VRRM Process model.	77.6%	100%	77.6%	100%	100%	88.6%	77.6%	88.6 %	88.6 %	88.6 %
Interrelate the activities according to flow of VRRM process model.	79.6%	83.3%	92 %	89.6 %	93.3%	83.3 %	84.3 %	93.3%	85.3%	85.3 %
AGGREGATE PERCENTAGE	87.08%	89.59%	87.7%	89.9%	90.3%	85.0%	80.6%	87.4%	85.3%	83.8%

Table 14 : AGGREGATE PERCENTAGE OF PARTICIPANTS AFTER IMPLEMENTING VRRM PROCESS MODEL WITHOUT EPG SUPPORT

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	TOTAL
Aggregate Percentage	87.08%	89.59%	87.7%	89.9%	90.3%	85.0%	80.6%	87.4%	85.3%	83.8%	86.66%

After the first treatment, the aggregate percentage of the group B participants are **86.66%.**

5.3. Second Treatment:

5.3.1. Implementation of SCR Process Model without EPG support by Group B:

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the six nodes with arrows.	60%	40 %	60 %	100 %	60 %	20%	100 %	60 %	40 %	20 %
Link the activities to their respective environment.	60%	60 %	80 %	100%	80 %	80%	60%	100%	40 %	40 %
Interrelate the activities according to flow of SCR submission phase process model.	20%	20%	100%	40 %	40 %	100 %	60 %	40 %	20 %	40 %

Table 15 : COMPARISON ON THE BASIS OF PROPOSITION

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the six nodes with arrows.	60%	40 %	60 %	100 %	60 %	30 %	100 %	60 %	40 %	20 %
Link the activities to their respective environment.	100%	100%	100%	100 %	90 %	100 %	100 %	100 %	100 %	100%
Interrelate the activities according to flow of SCR submission phase process model.	100%	90 %	100 %	100 %	90 %	100%	90%	100%	100%	100%

Table 26 : COMPARISON ON THE BASIS OF CONNECTIONS

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the six nodes with arrows.	100%	80 %	100 %	100%	80%	100%	100%	100%	100%	40%
Link the activities to their respective environment.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Interrelate the activities according to flow of SCR submission phase process model.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100 %

Table 37 : COMPARISON ON THE BASIS OF LINKING PHRASES

On the basis of above percentage of the given criteria's , the aggregate percentage of the model is calculated (refer table 18):

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the six nodes with arrows.	73.3%	53.3 %	73.3 %	100 %	66.6 %	50 %	100%	73.3%	60 %	26.6%
Link the activities to their respective environment.	86.6%	86.6 %	93.3%	100 %	90 %	93.3 %	86.6%	100 %	80 %	80 %
Interrelate the activities according to flow of SCR submission phase process model.	73.3%	70%	100%	80 %	76.6 %	100 %	83.3%	80 %	73.3 %	80 V
	77.7%	69.9%	88.8%	93.3%	77.7%	81.1%	89.9%	84.4%	71.1%	62.2%

Table 48 : AGGREGATE PERCENTAGE OF PARTICIPANTS AFTER IMPLEMENTING VRRM PROCESS MODEL WITHOUT EPG SUPPORT

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	TOTAL
Aggregate Percentage	77.7%	69.9%	88.8%	93.3%	77.7%	81.1%	89.9%	84.4%	71.1%	62.2%	**79.6%**

After the second treatment, the aggregate percentage of the group A participants are **79.6%.**

5.3.2. Implementation of SCR Process Model with EPG support by Group A:

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the six nodes with arrows.	100%	60 %	80 %	100%	100 %	80%	100 %	60%	100%	100 %
Link the activities to their respective environment.	100%	60 %	80 %	80 %	100 %	100 %	100 %	80 %	80 %	100%
Interrelate the activities according to flow of SCR submission phase process model.	100%	20 %	100 %	100 %	40 %	100 %	100 %	80 %	100%	100 %

Table 59 : COMPARISON ON THE BASIS OF PROPOSITION

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the six nodes with arrows.	100%	60%	80%	100%	100%	90 %	100 %	100 %	100%	100 %
Link the activities to their respective environment.	100%	90 %	100%	100 %	100 %	100 %	100 %	100 %	100 %	100%
Interrelate the activities according to flow of SCR submission phase process model.	100%	100%	100%	100%	100%	100%	100%	90%	100%	100%

Table 20 : COMPARISON ON THE BASIS OF CONNECTIONS

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the six nodes with arrows.	100%	100%	80%	100%	100%	100%	100%	100%	100%	100%
Link the activities to their respective environment.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Interrelate the activities according to flow of SCR submission phase process model.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 21 : COMPARISON ON THE BASIS OF LINKING PHRASES

On the basis of above percentage of the given criteria's , the aggregate percentage of the model is calculated as follow

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Use some or all of the following verbs to link the six nodes with arrows.	100%	73.3 %	80 %	100 %	100 %	90 %	100 %	86.6%	100 %	100 %
Link the activities to their respective environment.	100%	83.3%	93.3%	93.3%	100%	100%	100%	93.3 %	93.3 %	100 %
Interrelate the activities according to flow of SCR submission phase process model.	100%	73.3%	100 %	80 %	100 %	100 %	100 %	90 %	100%	100 %
AGGREGATE PERCENTAGE	100%	76.6%	91.1%	84.4%	100%	96.6%	100%	89.9%	97.7%	100%

Table 22 6: AGGREGATE PERCENTAGE OF PARTICIPANTS AFTER IMPLEMENTING SCR PROCESS MODEL WITH EPG SUPPORT

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	TOTAL
Aggregate Percentage	100%	76.6%	91.1%	84.4%	100%	96.6%	100%	89.9%	97.7%	100%	**93.6%**

After the second treatment, the aggregate percentage of the group A participants are **93.6%.** The participant's understanding is measured in percentage after the treatments and from this percentage, the understanding level is easily measured.

	Without EPG	With EPG
VRRM Process Model	Group A	Group B
	71.84%	86.6%
SCR Process Model	Group B	Group A
	79.6%	93.6%

Table 23 : CALCULATED MEAN AFTER THE TREATMENTS

As shown in the table, there's a notable impact on participant's understanding who uses the Electronic Process Guide with Role Specific Views during the implementation. Although without EPG, the percentage lays in average scale but this may because of the descriptive nature of the models. This may not be the same for other models but using EPG with role specific views have considerable impact on the participants understanding during the implementation.

5.4. Hypothesis Testing:

5.4.1. Student's t-Test:

For testing the null hypothesis, t-test is used from inferential statistics. Research hypothesis is in this quasi experiment is 'EPG with role specific views have impact on participants understanding', so the null hypothesis is that 'EPG with role specific views have no impact on participants understanding'. The research hypothesis is directional and permits a one-tail test of significance. The null hypothesis is rejected if the value of $P < 0.05$.

For the two samples, Group A and Group B, of sizes of $N_a=10$ and $N_b=10$ respectively. The t-test is calculated by using excel formula's for the two samples.

5.4.2. First Treatment:

After the first treatment, Group A and Group B data collected in table:13 is use for t-test to obtain the mean, variance, size, degree of freedom and p-value for validating the null hypothesis.

Participants	Group A	Group B
P1	87.08	77.7
P2	89.59	69.9
P3	87.7	88.8
P4	89.9	93.3
P5	90.3	77.7
P6	85	81.1
P7	80.6	89.9
P8	87.4	84.4
P9	85.3	71.1
P10	83.8	62.2

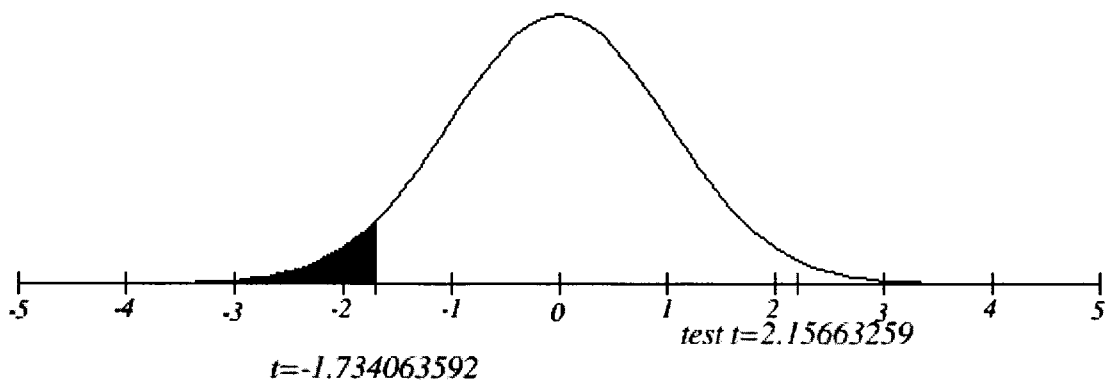
Table 24 7: PARTICIPANR'S AGGREGATE DATA AFTER IMPLEMENTING THE PROCESS MODEL WITH AND WITHOUT EPG SUPPORT

For computing the p-value, excel formula of t-test is used, which calculate the mean, variance between two groups, number of participants in each group, degree of freedom, t value and p-value. After the first treatment it clearly shows that p-value is less than 0.05 i.e. 0.022. Which means after the first treatment, null hypothesis is rejected and research hypothesis is accepted because of their significance.

t-Test: Two-Sample		
	Group A	*Group B*
Mean	86.667	79.61
Variance	9.293956667	97.781
Observations	10	10
Pooled Variance	53.53747833	
Hypothesized Mean Difference	0	
df	18	
t Stat	2.15663259	
P(T<=t) one-tail	0.022402719	
t Critical one-tail	1.734063592	

Table 85 : T-test RESULT AFTER THE FIRST TREATMENT

For assessing the statistical significance of the difference between two Group means, the t-distribution graph is constructed. Which defines the confidence level.



After the 95% confidence level, it fully satisfy the results of the experiments.

5.4.3. Second Treatment:

After the second treatment, Group A and Group B data collected in table:17 is use for t-test to obtain the mean, variance, size, degree of freedom and p-value for validating the null hypothesis.

Participants	Group A	Group B
P1	100	77.7
P2	76.6	69.9
P3	91.1	88.8
P4	84.4	93.3
P5	100	77.7
P6	96.6	81.1
P7	100	89.9
P8	89.9	84.4
P9	97.7	71.1
P10	100	62.2

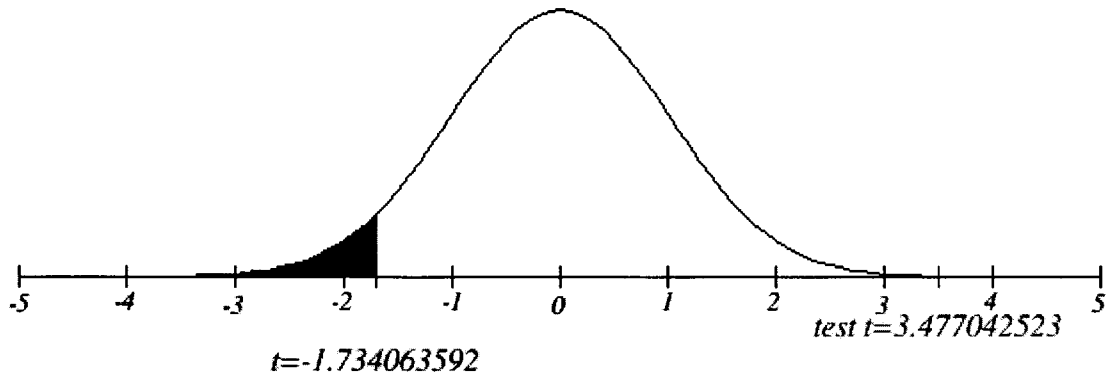
Table 26 : PARTICIPANR'S AGGREGATE DATA AFTER IMPLEMENTING THE PROCESS MODEL WITH AND WITHOUT EPG SUPPORT

After the second treatment, it clearly shows that p-value is less than 0.05 i.e. 0.0013. Which means after the second treatment, null hypothesis is rejected and research hypothesis is accepted.

t-Test: Two-Sample		
	Group A	Group B
Mean	93.63	79.61
Variance	64.80233333	97.781
Observations	10	10
Pooled Variance	81.29166667	
Hypothesized Mean Difference	0	
df	18	
t Stat	3.477042523	
P(T<=t) one-tail	0.001345199	
t Critical one-tail	1.734063592	

Table 97 : T-test RESULT AFTER THE SECOND TREATMENT

The t-distribution graph shows the mean of two groups, Group A are and Group B is 95% confidence level.



After both the treatment, null hypothesis is reject and the research hypothesis is accepted on the basis of t-test rules. Reject the null hypothesis when:

1. Calculated *t*-value > critical *t*-value
2. P-value < 0.05

Also from the experiment and the statistical test of hypothesis, it is concluded that the EPG have significant impact on participant's understanding and the participants who uses the EPG with role specific views are more efficient in meeting the deadlines and well aware of their responsibilities and they have enough knowledge to completed their activities rather than those participants who did not use the EPG with role specific views and busy in finding the sources on their own in order to complete the tasks but not within the time scale.

Chapter 6

Conclusion & Future Work

Chapter 6 – Conclusion & Future Work

Electronic process guide brings the improvement to the traditional process models implementations, by introducing the concept of Role specific views into it. The two of the process models used VRRM Process model and SCR process model at two stages. Firstly, the VRRM Process model implemented with and without the support of "EPG with Role Specific Views". Secondly, the SCR process model implemented with and without the support of "EPG with Role Specific Views". During the treatment alternatives, all participants are consulted for assessment so that their understanding will be measured.

As discussed in the introduction section, this is the first of its kind of implementation in academic environment for different process models along with the support of 'EPG with Role Specific Views'. Keeping in view the objectives of the experiment, the VRRM Process Model and SCR Process Model implemented on two web projects of different natures to validate the aim and to know the practicalities and differences in its implementation between two groups of undergraduate students in each treatment.

The implementation process remained successful on two projects yielding the desired outcomes that 'EPG with Role Specific Views' has significant impact on participant's understandings. Some problems occurred as the both groups are undergraduate students and they have limited knowledge but the group who used the 'EPG with Role Specific Views' support, completed the process in time, according to schedules and their understanding regarding the process models in terms of tool/ techniques, artifacts increases and the group who did not use the 'EPG with Role Specific Views' support, search the desired information in their own and for that a lot of time wasted on searching and engaging management resources repeatedly. The satisfaction of projects owners during the experiment shows that the success rate remained high for the group who used 'EPG with Role Specific Views' as compare to the other group which was not having the benefits of 'EPG with Role Specific Views' support.

The clear differences were observed during and after the implementation of the process models. Further, the activities related to Process Models should have been executed by team member on time but lacked in the group of those who did not have the support of 'EPG with Role Specific Views'. However, the smooth execution was experienced on those Projects where

group with the support of 'EPG with Role Specific Views' was more keen and concerned to have successful delivery of software solution with complete understanding of the process.

The problems faced by the practitioners during the implementation process without EPG support have been highlighted during the proceedings presented in above sections. These problems should be used as lessons learned for future implementations of Process Models. The important observation is the non existence of views repository to keep and maintain the role specific views and related data stores in software development companies. This may lead to the non-availability of historical role specific views to these companies for future implementations. EPG required further work in order to make more comprehensive to the participants. Some of the techniques and tools are missing for some of the process model activities. As this is the first kind of implementation , implemented in academic environment and unavailability of any historical data like views of different roles; EPG is designed by focusing on these issues but for the commercial environment a lot more work need to be done and requires deep considerations to be used effectively during the process implementation.

It is strongly suggested to develop a repository storing the views of different roles in a process so that it can easily adopted by the software industry. The repository shall help to minimize the management efforts required for its repeated usage by the industry. The project records and historical data shall remain available for future reference.

The future research should focus on further elaboration of activities tools and techniques in EPG to make it more robust.

In the end, the companies' willingness is required to amend 'EPG with Role Specific Views' support and take process implementation problems seriously in order to deliver the successful software solutions to their customers.

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Annexure

Annexure A – Student Evaluation Questionnaire

Annexure B – Student Assessment Questionnaire- VRRM Process Model

Annexure C – Student Assessment Questionnaire- Filled VRRM Process Model

Annexure D – Student Assessment Questionnaire- SCR during submission phase Process Model

Annexure E – Student Assessment Questionnaire- Filled SCR during submission phase Process Model

Annexure A:

Student Evaluation Questionnaires

Risk management is a wide and diverse area, with different issues and challenges for each of us. The incorporation of value concepts in software engineering is highly encouraged. While risk management with value based software engineering practices will be covered in the experiment. This questionnaire helps in the evaluation of students for conducting the experiment.

Name: .....

Class: .....

Software Development Background : .....

.....

.....

You must answer ALL the questions. Select the correct answer(s).

Question 1: Risk Management is a process that is used to minimize or eradicate risk before it can harm the productivity of a software project.

A. True

B. False

Question 2: Steps of Risk Management are Planning, Risk Identification, Risk Analysis, Risk Treatment, Risk Monitoring and control.

A. True

B. False

Question 3: Risk analysis and management are a series of steps that help a software team to understand and manage ----------.

A. Uncertainty

B. Crises

C. Problem

D. None of above

Question 4: Risk mitigation is the process of dealing with risks and risk contingency planning is risk avoidance.

A. True

B. False

Question 5: Cost, effort, risks, and resources are the factors included in--------

A. Estimation

B. Testing

C. Development

D. Maintenance

Question 6: A successful risk management program will rely on

A. Senior management's commitment

B. The full support and participation of the IT team

C. The competence of the risk assessment team

D. All of the above

Question 7: .....is a pre-requisite of all sorts of estimates, including, resources, time, and budget.

A. software scope

B. software Risk

C. software Quality

D. software Management

Question 8: Which type of risk factor is most likely to cause problems for a software project developing commercial software?

A. Inadequate user documentation

B. Litigation expense

C. Low productivity

D. Cancellation of project

Question 9: The two main steps are

A. Risk Assessment and Risk Control

B. Risk Identification, Risk Analysis

C. Risk Management, Risk Resolution

D. Both B and C

Question 10: Contingency plan helps to reduce the risks or at least helps in minimizing their impact through the use of different strategies or methodologies.

A. True

B. False

Question 11: Stakeholders are:

A. Third Parties

B. Developer

C. End User

D. All of the above

Question 12: Value is

A. the worth

B. a consumer wants in a product

C. Quality obtained for what he/she gives

D. All of the above

Question 13: Value based software engineering aims to assign values to the things /concepts and then use for decision making at different stages/situation in software development projects.

A. True

B. False

Question 14: Identification of responsible parties is the responsibility of

A. Project Manager

B. Stakeholders

C. Quality Assurer

D. End User

Question 15: Threshold is define in

A. Analysis

B. Identification

C. Planning

D. Monitoring & Control

Question 16: Change request management is the process that approves and schedules the change to ensure the correct level of notification and minimal user impact.

A. True

B. False

Question 17: Change request is used to track all stakeholder requests including:

A. New features

B. Enhancement requests

C. Defects and changes in requirement

D. All of the above

Question 18: Change request is a formally submits artifact

A. A: True

B. B: False

Question 19: Software change request management is one of the main requirements to achieve quality in software maintenance process.

A. A: True

B. B: False

Question 20: The roles Change Request Process are:

A. Change Request Creator, Tester and Change Request Coordinator

B. Change Request Reviewer, Analyst and Developer

C. Both B and C

D. None of the above

Annexure B:

Student Assessment Questionnaires

The questionnaire is focused on listing your experience of experiment execution. Kindly provide answers to the below given questions. The information will be used for measuring the understandability of the participants.

Name: ..... **Process Model: .....**

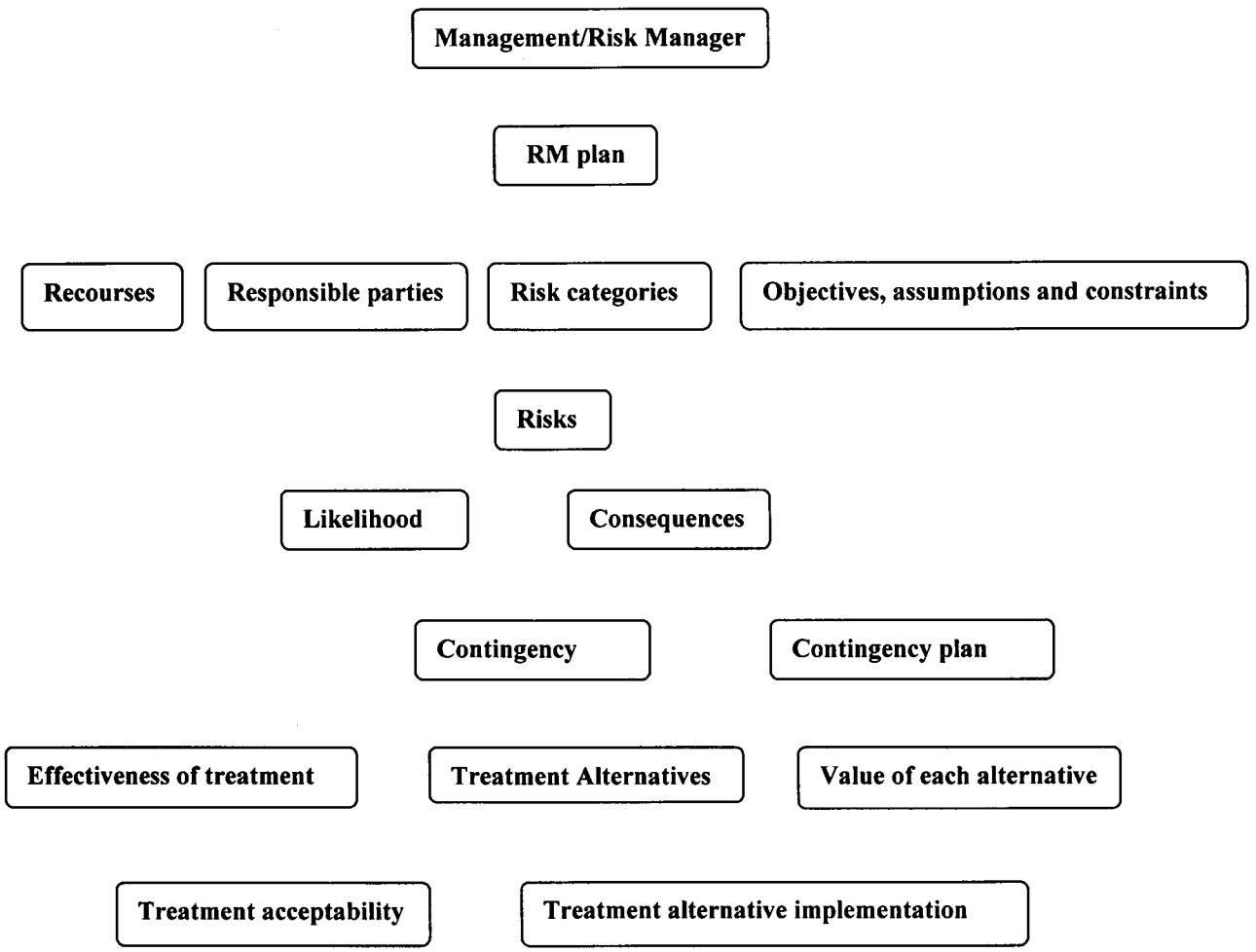
Role: .....

Process model used: ☐ With "EPG with Role Specific Views" Support

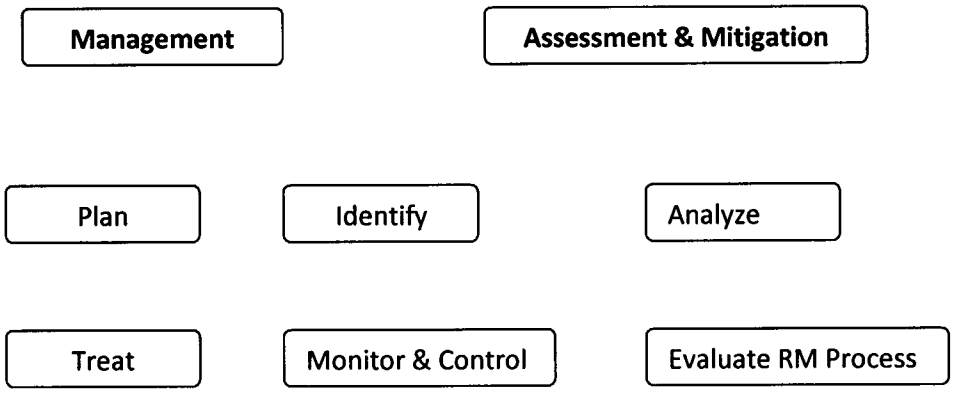
☐ Without "EPG with Role Specific Views" Support

Question 1: Use some or all of the following verbs to link the sixteen nodes with arrows.

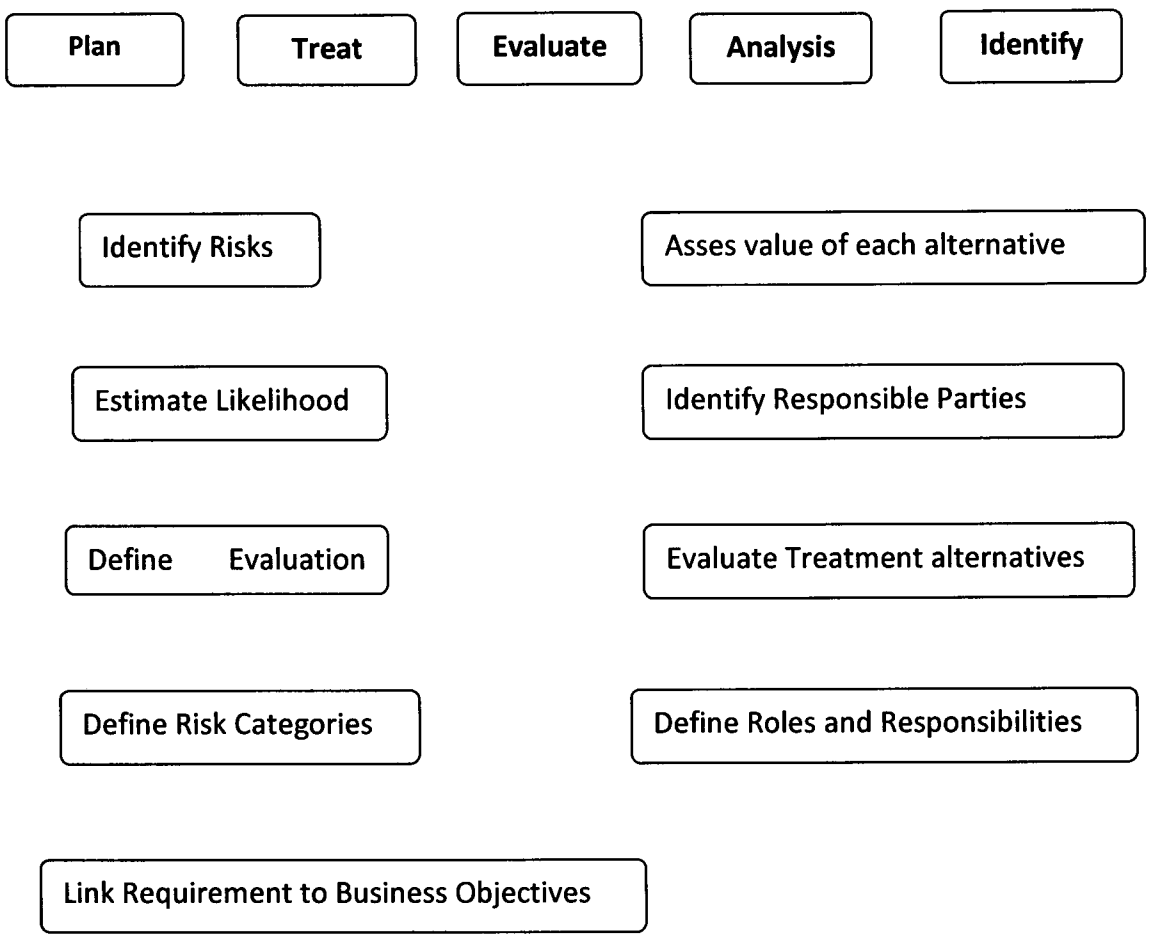
***Verbs**: Drives, evaluates, has, includes influences, identify, access, analyze, value, establish*



Question 2: Link the management and assessment & mitigation activities of VRRM process model separately.



Question 3: Link the activities to their sub activities.



Question 4: Name the artifacts and link it to the associated activity of VRRM Process model.

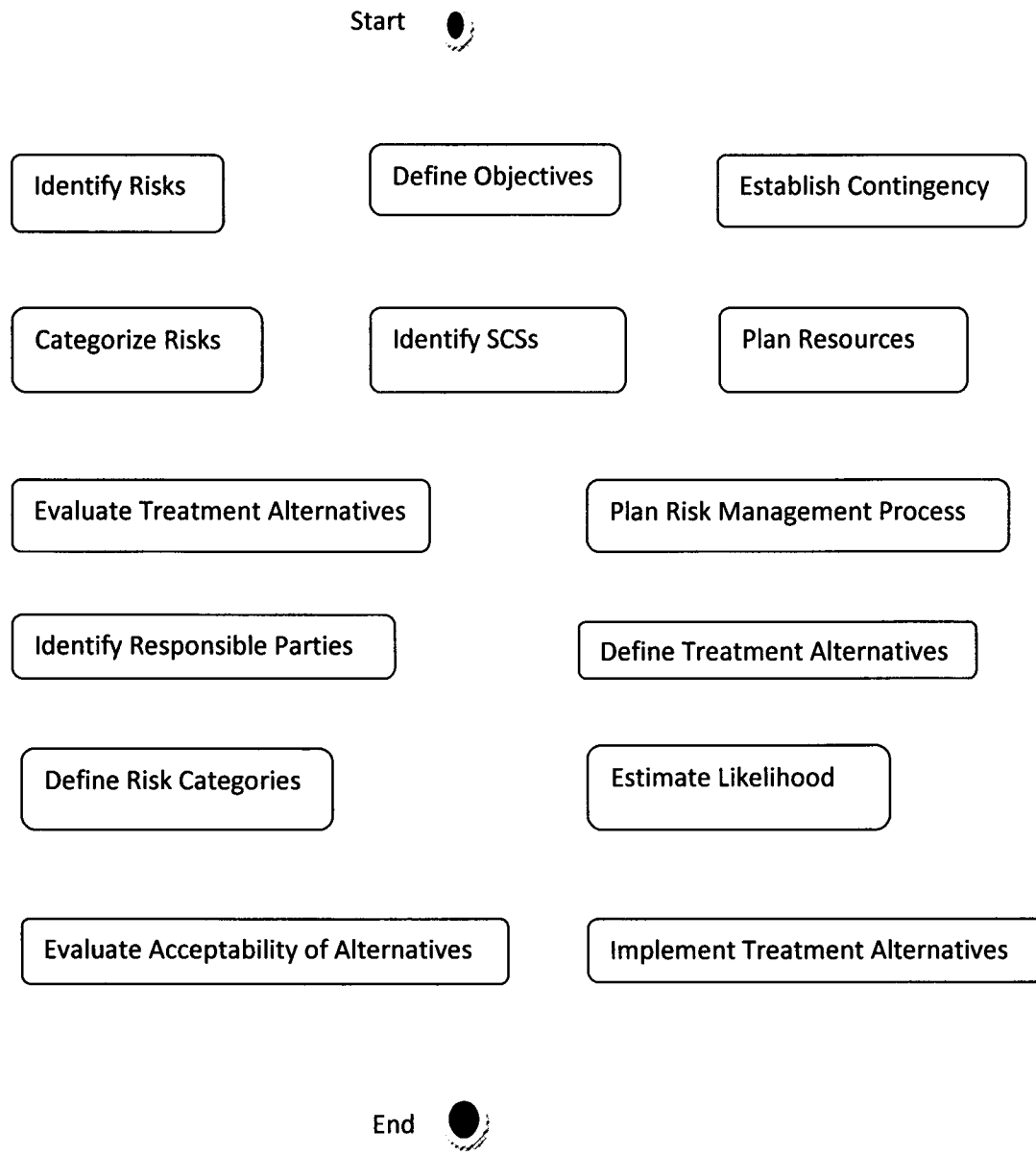
Plan	Treat	Analysis

Plan is executed when the risk presents itself. The purpose of the plan is to lessen the damage of the risk when it occurs.

Plan of selecting and implementing risk control options.

A Plan of how the elements and resources of the risk management process will be implemented within an organization or project.

Question 5: Interrelate the activities according to flow of VRRM process model.



Annexure C:

Student Assessment Questionnaires

The questionnaire is focused on listing your experience of experiment execution. Kindly provide answers to the below given questions. The information will be used for measuring the understandability of the participants.

Name: ..... **Process Model:** .....

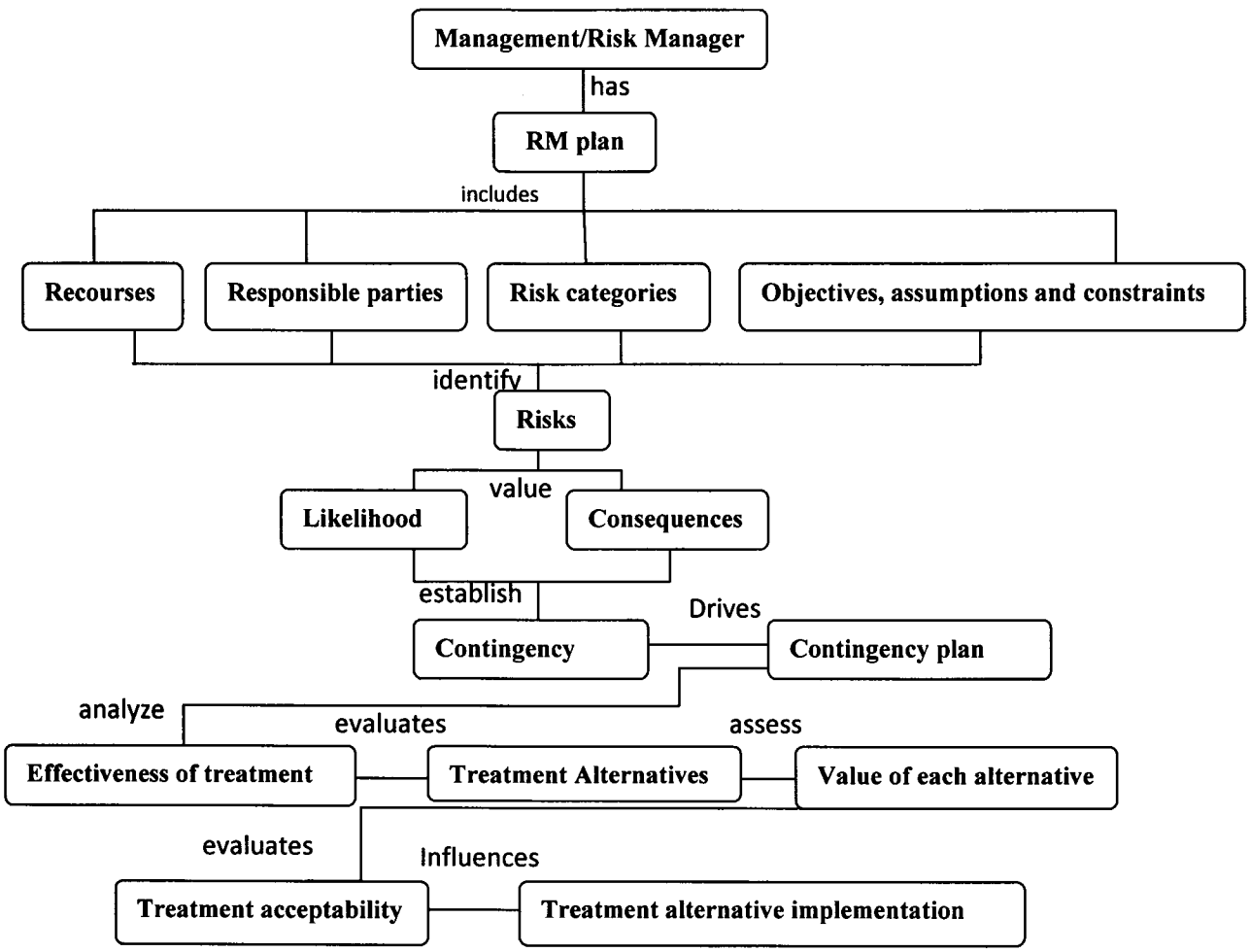
Role: .....

Process model used: ☐ With "EPG with Role Specific Views" Support

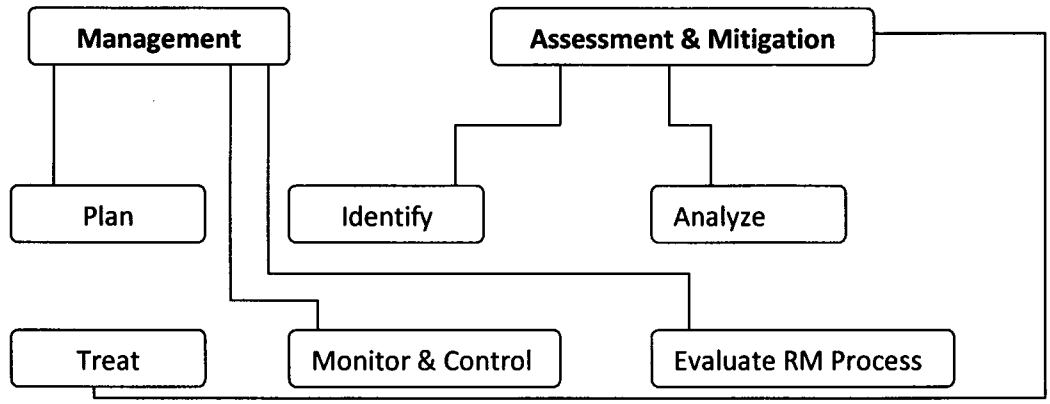
☐ Without "EPG with Role Specific Views" Support

Question 1: Use some or all of the following verbs to link the sixteen nodes with arrows.

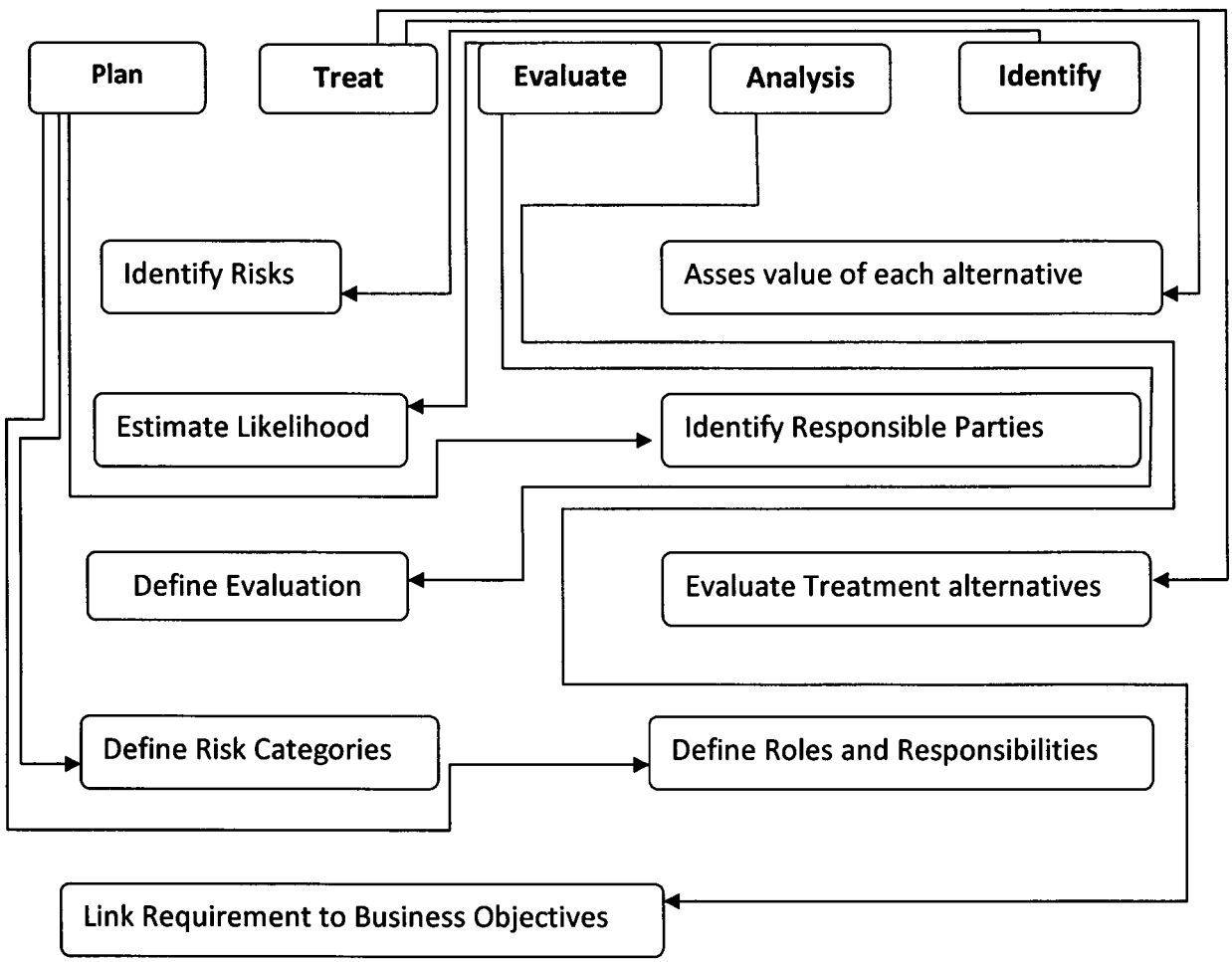
***Verbs**: Drives, evaluates, has, includes influences, identify, access, analyze, value, establish*



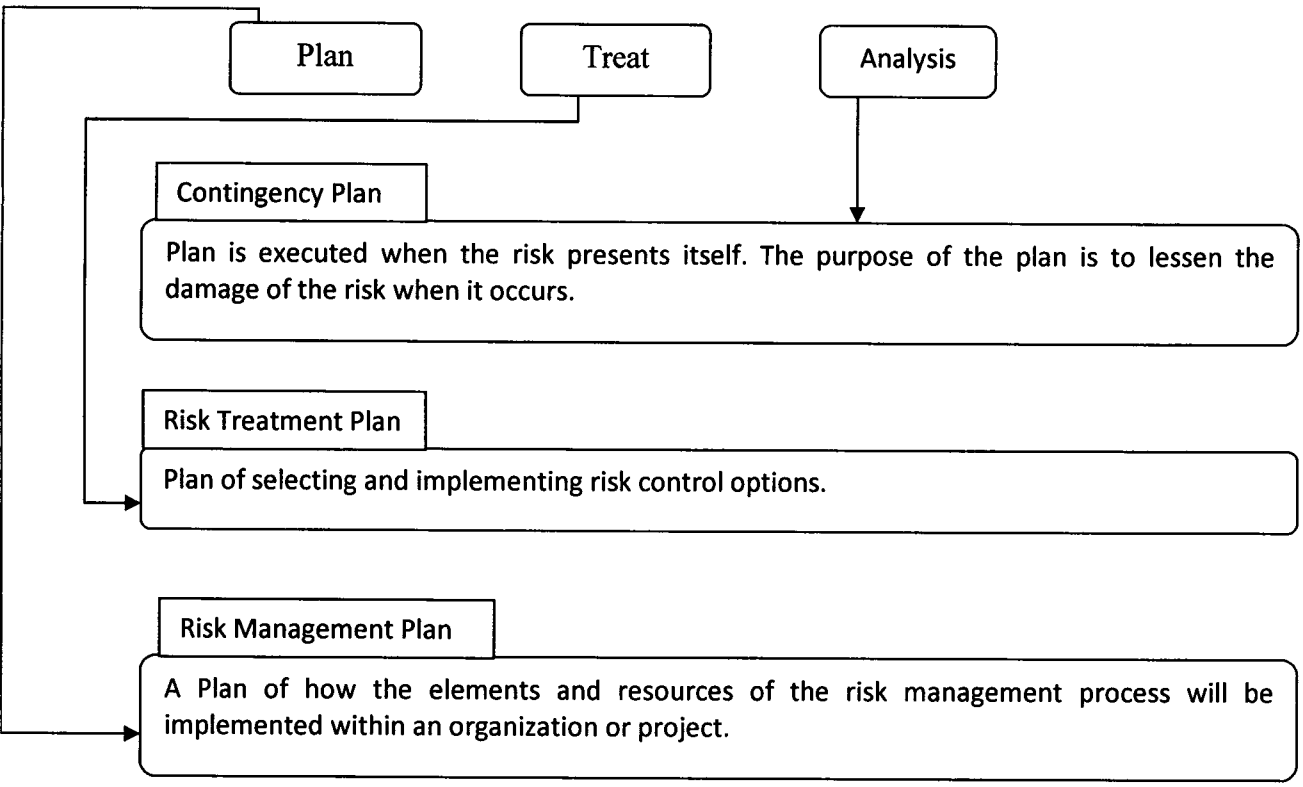
Question 2: Link the management and assessment & mitigation activities of VRRM process model separately.



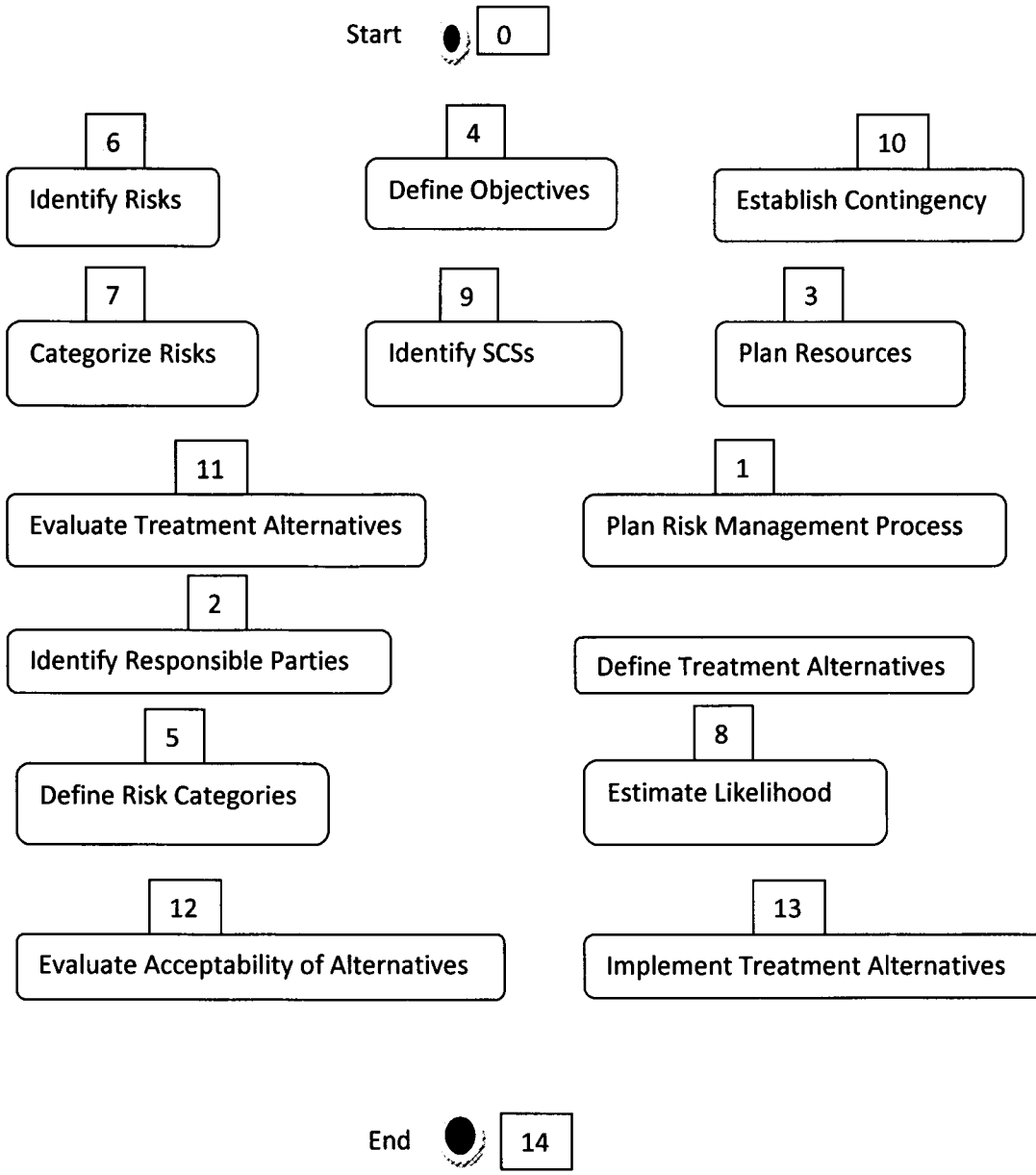
Question 3: Link the activities to their sub activities.



Question 4: Name the artifacts and link it to the associated activity of VRRM Process model.



Question 5: Interrelate the activities according to flow of VRRM process model.



Annexure D:

Student Assessment Questionnaires

The questionnaire is focused on listing your experience of experiment execution. Kindly provide answers to the below given questions. The information will be used for measuring the understandability of the participants.

Name: ..... **Process Model:** .....

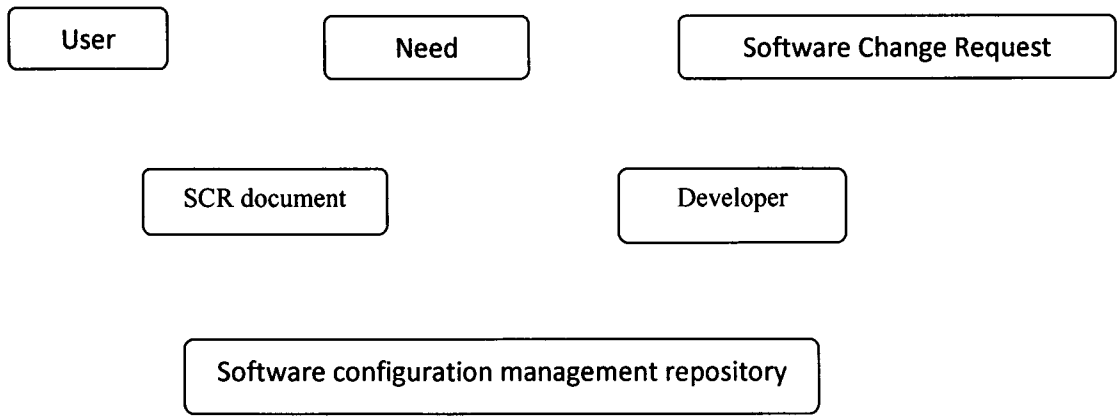
Role: .....

Process model used: ☐ With "EPG with Role Specific Views" Support

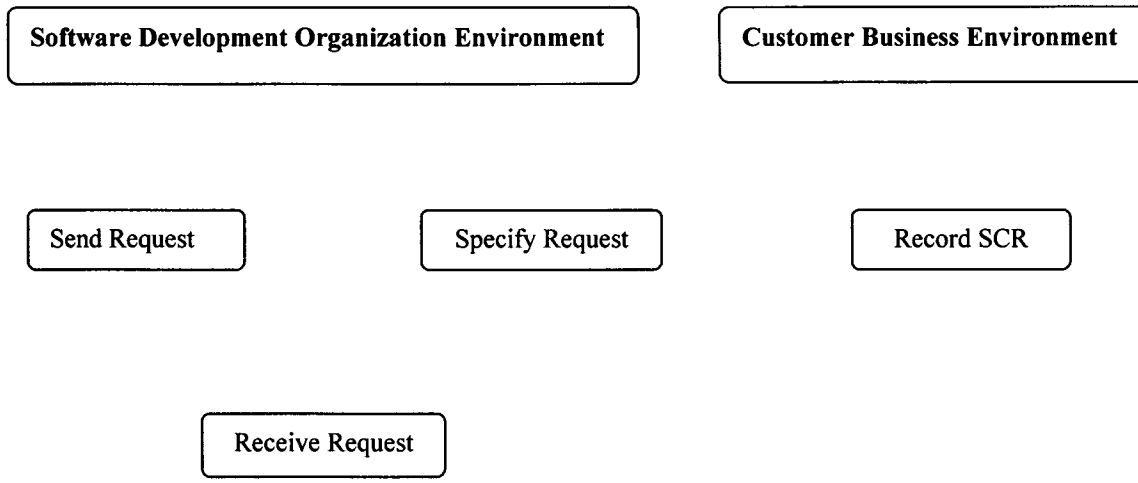
☐ Without "EPG with Role Specific Views" Support

Question 1: Use some or all of the following verbs to link the six nodes with arrows.

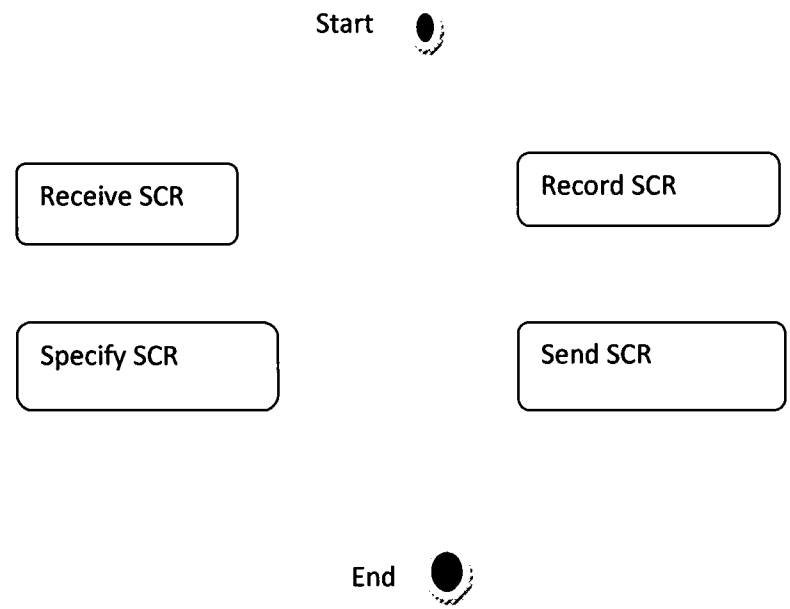
***Verbs**: Drives, has, receive, record and specify*



Question 2: Link the activities to their respective environment.



Question 3: Interrelate the activities according to flow of SCR submission phase process model.



Annexure E:

Student Assessment Questionnaires

The questionnaire is focused on listing your experience of experiment execution. Kindly provide answers to the below given questions. The information will be used for measuring the understandability of the participants.

Name: ..... **Process Model:** .....

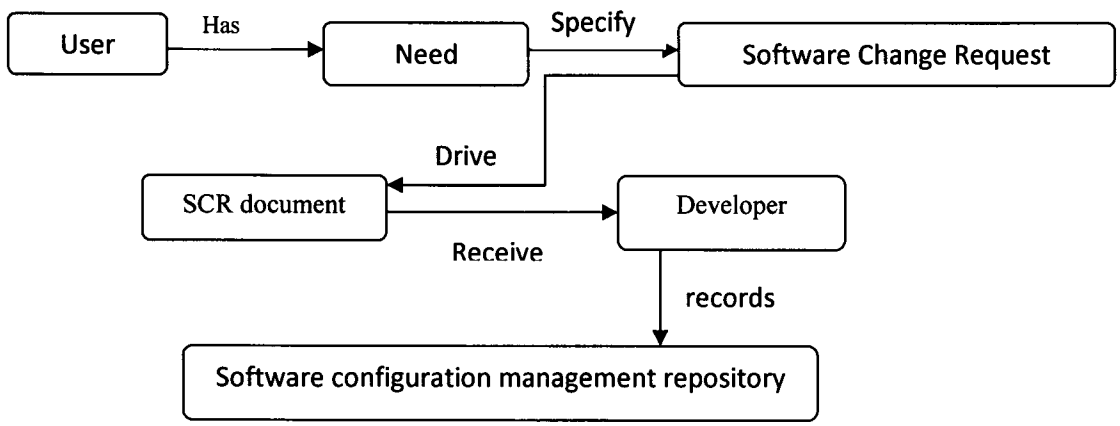
Role: .....

Process model used: ☐ With "EPG with Role Specific Views" Support

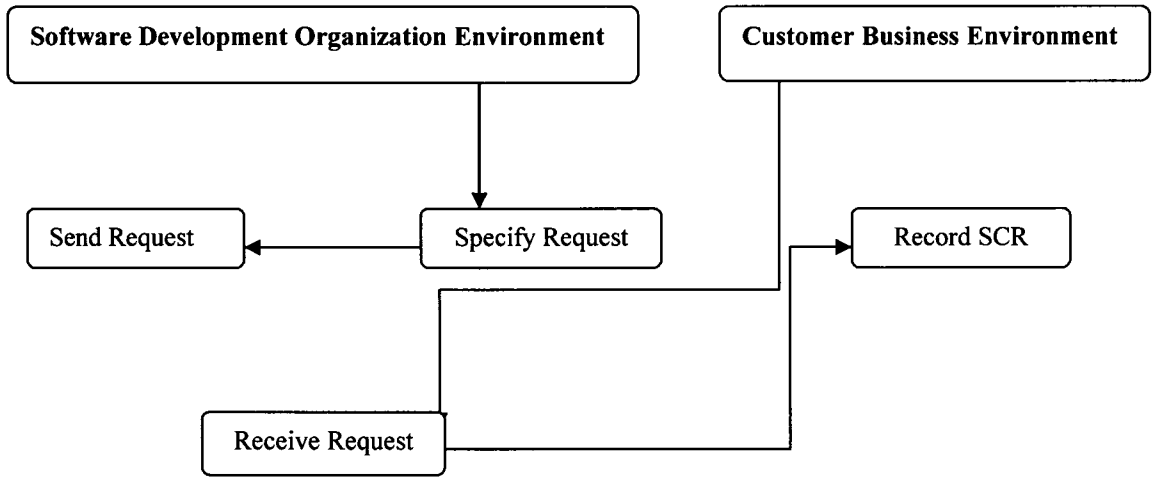
☐ Without "EPG with Role Specific Views" Support

Question 1: Use some or all of the following verbs to link the six nodes with arrows.

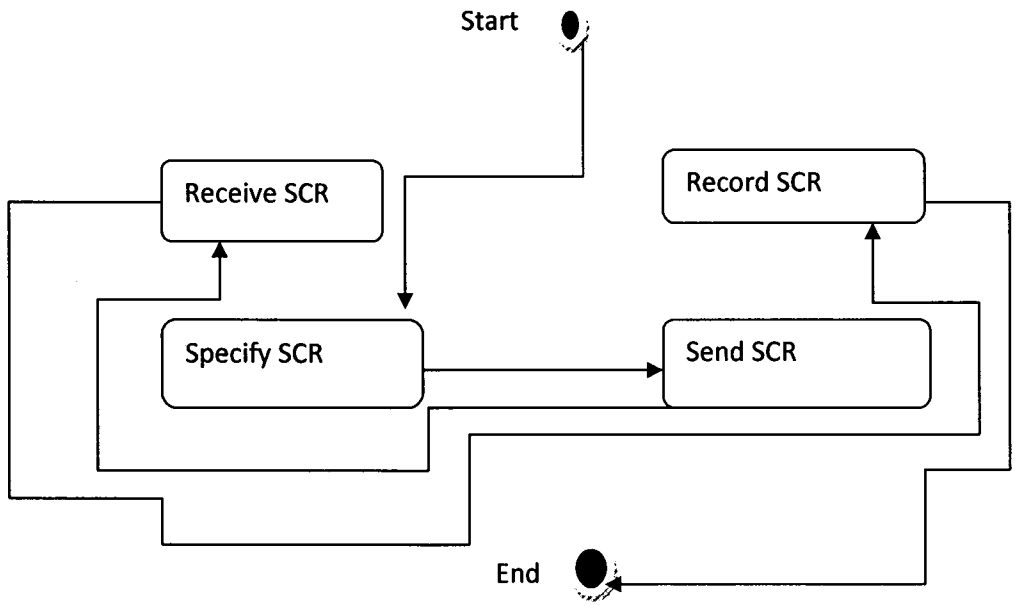
***Verbs**: Drives, has, receive, record and specify*



Question 2: Link the activities to their respective environment.



Question 3: Interrelate the activities according to flow of SCR submission phase process model.



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Ihr Zeichen	Ihre Nachricht vom	Unser Zeichen

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Yours sincerely

Ilona Würtz
Contract Manager

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Contract

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Chairman/Associate Professor

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Department of Software Engineering
International Islamic University
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Kaiserslautern, den 09. Feb. 2011

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Prof. Dr. Dr. h.c. D. Rombach
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