

Node Auditing and Analysis in Document Workflows

By

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2006 NUST-BIT-27

Zuha Ahmed Cheema

2006 NUST-BIT-29



A Project report submitted in partial fulfillment
Of the requirement for the degree of
Bachelors of Information Technology

*NUST School of Electrical Engineering & Computer
Science*

National University of Sciences & Technology

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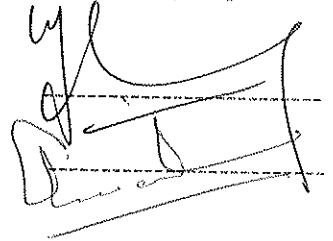
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1 INTRODUCTION AND MOTIVATION	4
1.1 BACKGROUND.....	4
1.2 PROBLEM STATEMENT	4
1.3 HYPOTHESIS	4
1.4 CONTRIBUTION	5
2 LITERATURE REVIEW	6
2.1 DOCUMENT MANAGEMENT SYSTEMS	6
2.1.1 Services Provided by DMS	6
2.1.2 Document Management Systems Key Standards	8
2.2 COMPARISON OF DMS.....	8
2.3 WORKFLOW AUTOMATION	11
2.3.1 Essential Features and Capabilities.....	11
2.3.2 Benefits of Workflow Automation	13
2.4 DOCUMENT WORKFLOWS.....	14
2.5 TRANSPERANCY IN DOCUMENT WORKFLOWS	15
3 TRANSPARENT EVALUATION THROUGH RUBRICS AND CHECKLIST	17
3.1 CONCEPTUALIZATION OF RUBRIC	17
3.1.1 Scoring Rubrics	18
3.1.2 Weighted Rubric.....	18

3.1.3	Advantages of rubric	19
3.2	DESIGNING OF RUBRIC	20
3.2.1	Step by step procedure:	21
3.2.2	Evaluation checklist	22
3.3	MS THESIS USE CASE.....	24
3.3.1	Workflow	24
3.3.2	Evaluation.....	25
3.4	THESIS RUBRIC.....	27
4	SYSTEM ARCHITECTURE AND DESIGN	30
4.1	DATABASE DESIGN	30
4.2	ENTITY RELATIONSHIP DIAGRAM	32
4.3	System Architecture.....	34
4.3.1	USER INTERFACE	34
4.3.2	USE CASE LOGIC.....	34
4.3.3	CHECKLIST PROCESSING LAYER	36
	Node auditing.....	37
	Reporting component	37
	Rubric design interface.....	37
4.4	WORKFLOW MANAGEMENT COMPONENT	37
5	Implementation	39
5.1	Eligibility Criteria for MS-Thesis.....	39
5.2	MS-Thesis Forms:	40
5.2.1	TH-1 Form.....	41
5.2.2	TH-2.....	44
5.2.3	TH-3.....	46
5.2.4	TH-4 Form.....	47
5.3	Start of Proposal Defense.....	48
5.3.1	Evaluation Sheets.....	50
5.3.2	Flexibility	52
5.3.3	Evaluation.....	53

5.3.4	Result Sheet and Observation Sheet	56
5.4	Internal Defense	58
5.5	Final Defense	58
6	CONCLUSION	59
7	References.....	60

1 INTRODUCTION AND MOTIVATION

1.1 BACKGROUND

Workflow system comprises of a series of interrelated steps. It represents sequence of operations that are responsibilities of a person or a group. The manual flow of documents is error prone. The documents can be lost, misplaced or be in wrong place at the wrong time. In case of a business process, all requirements at a particular node may not be fulfilled before passing the document up the hierarchy. As one individual or group is responsible for a particular task, hence after completing the task, the next sets of individuals are reported and they receive the data that they will be dealing with. By using the services of a workflow system, the problem regarding the misplacement of the document can be solved. However, the problem about fulfillment of requirements by former node is still unhandled.

1.2 PROBLEM STATEMENT

Traditional workflow systems do not allow us to gain insight to the activities or changes that are occurring in the document being processed at each node. As a result, nobody is accountable for the actions they perform. However, traditional workflow systems do provide us information related to the time of modification or the user who is modifying it though there is a need of a workflow system that allows us to perform node level processing. Therefore, a mechanism needs to be added that allows a particular node with reasons to support his decision.

1.3 HYPOTHESIS

Automating document workflows and analyzing node level processing by employing use of checklists and scoring rubric to bring transparency in evaluation and provide concrete and useful feedback to stakeholders

1.4 CONTRIBUTION

We intend to create a document workflow system that will allow us to carry out node level processing by making a semantic checklist which is a kind of rubric. This rubric will contain a list of activities that will be performed at each node. As a result, reveal semantic behavior of each node towards the document will be revealed. Hence, our end system will be an extension of an existing workflow system with additional node level processing capabilities.

2 LITERATURE REVIEW

This chapter will be giving insight to services provided by document management system and how these provided services will provide benefit to the organization. Document management systems allow an organization to manage documents in a streamlined way. Document management systems follow certain standards. Automating workflows can significantly reduce the errors faced by manual workflows. Features of automated workflows will be discussed below and what benefits are achieved from them. If document management system is combined with automated workflow system, then document workflow systems are achieved which contain the benefits of both automated workflow systems and document management systems.

2.1 DOCUMENT MANAGEMENT SYSTEMS

A document management system is an integrated network of interoperable programs or computer systems that reliably handle information for accurate records and usability.

2.1.1 Services Provided by DMS

Document management systems provide features that make management of document very easy and reliable. Their main services include lifecycle management, content and application independence, access control, check in and checkout tracking, auditing and retrieval.

Lifecycle Management

Document management system controls the document throughout its life cycle. It manages all the changes that occur from its creation to deletion. Managing the lifecycle of a document makes sure that the changes are in accordance with the business goals of the organization. Hence, the document accomplished at the end of the lifecycle is precise and informed.

Content and Application Independence

A document can have different formats and contents. It can have pictures, diagrams or text. As different applications process different types of data, thus converting the document into standard forms before processing is really an overhead. Most of the time of the organization will be consumed in pre-processing the document rather than examining it for business purposes. Therefore, document management system handles all types of contents and various applications that process these different types. A document is no longer needed to be converted into a standard format; the DMS will be responsible for all pre-processing.

Access Control

A document is processed at various nodes in its lifecycle. So access control rights need to be put into practice. Some documents are always more critical than others, they contain information that is highly confidential. For this reason, different users have access to different documents. Some users are allowed to only read the document but they cannot modify it. This feature is very important for organizations dealing with critical data for example banks. Banks store personal information related to a customer which can be exploited if access rights are not established. Government agencies also use this feature to protect confidential information from unauthorized users. Hence, document management system manages who can edit and read a document.

Check In/Check out

A very common situation in an organization is when more than one user tries to edit the document simultaneously. Integrity of data is compromised in this case. Each user has different contents for the same document. Therefore, edit rights are granted to one user at one time. Although others users can view it but the attempt for modification is not acknowledged.

Tracking and Audit

Documents are subjected to change in each step. Thus, there is a need to track what kinds of changes are occurring. Storing the changes only is not sufficient; the user who made these changes also needs to be tracked. Mistakes can occur in the document at any time. Tracking

can help to identify the step at which the mistake took place. It also points out the user who made the change. Hence, it saves the organization from exhaustive search.

Workflow Automation

Authors and the reviewers are notified about the document during its lifecycle. It is very important that the document does not deviate from its topic. The changes that are occurring might not be correct. Hence, the authors need to be informed whenever the change occurs.

Retrieval and Security

Security of the document is an important issue in organizations. Business users can not inspect the documents they are unauthorized to view. A document is linked to relevant documents in the DMS. So whenever the business user requests a related document, the DMS extracts that document for him. Documents that are more relevant should be on top of the results when retrieved.

2.1.2 Document Management Systems Key Standards

Document management systems follow two main standards, open document management API and web distributed authority and versioning. ODMA is an API that simplifies the interaction between the desktop application and the document management system. ODMA simplifies the access problems of the user. These problems become so simplified that the user is unable to distinguish whether the file is located remotely or locally.

WebDAV provides data management services for web. It locks the resource so that it cannot be overwritten by another person. Information about the author and the modified date is also provided. The document or the page can move within the server's namespace. It can create, remove and list resource.

2.2 COMPARISON OF DMS

A list of DMS was compared. They were compared with respect to programming language they used, complexity, features and whether they were open source and extendible or not.

Following is the table of comparison.

	Programming Language	Complex	Features	Open Source	Provision for extension
Alfresco	java	yes	<ul style="list-style-type: none"> • Workflow • Content life cycle management • J2ee architecture • Social tagging • Integration with portals • Open search • Synchronization 	yes	yes
Logical doc	java	Yes	<ul style="list-style-type: none"> • Document importing • Synchronization • Doc profiling • Document log • Indexing 	yes	yes
Google doc	<ul style="list-style-type: none"> • Java • .net • php 	Yes	<ul style="list-style-type: none"> • creation of forms, spreadsheets etc can be included in application • can be saved in a variety of formats • automatic saving of docs • docs can be shared , edited and opened among multiple users • changes notified to user via email 	no	yes

NUEXO 5	Python	Yes because DMS is a part of NUEXO. There is much other functionality other than DMS provided by NUEXO 5.	<ul style="list-style-type: none"> • Nuxeo core provides all the storage services for managing documents. • Schema service • Lets you register XSD schemas and document types based on schemas. • Repository service • Lets you define one or more repository for storing your documents. • Versioning service • Lets you configure how to store versions. • Security service • Manages data level security checks • Lifecycle service • Manages life cycle state of each document 	Yes	Yes
BONITA	Java	Yes	<ul style="list-style-type: none"> • Innovative process design studio • Connect easily with existing Information System 	YES	Yes

Bonita was selected as it was built in java, had less complexity and consists of easy to use designer interface.

2.3 WORKFLOW AUTOMATION

Workflow automation employs email based software technology in order to increase the efficiency of a workflow. Efficiency is increased by improving the coordination of the activities of the people involved. Each organization has some policies and workflow automation tracks information based on these policies and also tracks the routes these documents follow. Data is collected as documents route along various paths and this data can help the system interpret the subsequent routes. Humans are not the only participants in the workflow automation systems; it involves other applications such as databases and spreadsheets. The participants are compelled to complete their task so that the goal can be achieved in time.

2.3.1 Essential Features and Capabilities

Workflow automation makes it easy to understand and manage activities involved in workflows. It allows workflows to be designed and understood by using a simple designing program. Roles and rules can be assigned to nodes and reports can be generated. Therefore, all the essential features of automated workflows are discussed below.

Designing Graphical Workflow

Workflow automation can graphically create workflow process maps that define the course of work that needs to be done from beginning till end. Therefore, outlining the activities before time. Defining the workflow in a graphical manner is more user-friendly and it reduces misunderstanding regarding the process.

Roles

Management of roles is very important. It must provide the ability to allocate responsibilities to "roles" as a replacement for individuals. This creates the independence between the user and the role. The role remains the same even if the user changes his job. Hence, the new user when designated can have the same authority and duties as the previous user. Duties are assigned to role in the beginning, thus saving the time from assigning tasks to the new users.

Rules

Every organization has a set of rules which help in decision making throughout its lifetime. It should implant business logic and rules in the workflow. Consequently every decision taken is first validated and then applied to the business process. This results in recognizing the special cases that may occur in the organization. If these special cases are recognized, then their remedies can also be developed.

Monitoring

Monitoring is a very important aspect in the workflow automation. It must monitor the status of the workflow events. Monitoring makes sure that the work is being performed on schedule, hence decreasing the chances of delay in the process. Organizations that have close customer relations pay more attention to monitoring. For example organizations that provide delivery services need to monitor the status of their process. Any mistake can cost them loss of their customers, hence effective the organizations name.

Reports

Reports inform the company about their performance. So the company can make changes if it does not achieve desired results. Formal documentation of the performance of the company is formulated which can be preserved for future use. These reports can help the organization understand how they are progressing from year to year. Managers can use these reports in decision making. They can calculate the time and the cost of the workflow process.

Simulation

The workflow should be thoroughly checked before it is installed. If the bugs are detected after the system is put into use, then the entire workflow is disturbed. All the activities are halted. Therefore, it incurs the business huge loss with respect to time. The best technique is to test the system in modules and then integrate these modules. The whole system is tested on a single computer first and then deployed on multiple machines.

Proactive Approach

Workflow system should be proactive. It should inform the business user of fresh task, notify them if their task is getting late and re-route the task if some problem occurs with the designated user. Proactive approach saves the user from problems by periodic notifications. It keeps the user informed and alert so that he looks out for problems.

Document Attachments

It should allow the documents to be attached as a part of the workflow. It is a common practice that one needs to read one document as a pre-requisite of another. So document attachment can help build better understanding of the problem.

2.3.2 Benefits of Workflow Automation

Responsiveness

It keeps the tasks on the right track and make sure that they don't deviate from their goals. It provides responsive by performing following functions:

- Indicate task times.
- Notification for delayed tasks
- Escalate mechanism if the task lags the deadline.

Automatic Status Monitoring

An automated workflow system provides the user with the status of any case at any instance of time. It abolishes the use of telephones to detect status of a task. The use of telephones can make mistakes. The information may not be understood properly and the business process relies on the status of the channel. Automatic notifications about the status can remove the burden of monitoring the status from the user and he can concentrate only on his work.

Workflow Reports

A workflow system can provide important information which identifies its benefits and costs. Cost and time statistics about each step in a workflow process are reported by these systems. It can help the managers to get to the root cause of problems and straighten out the

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root path to the goal. Reports are helpful to evaluate the process. Previous reports can be used as a mechanism to set new goals, the goals that have not yet been achieved.

Consistency and Reliability

Workflow automation reduces human errors and mistakes. It makes sure that business process is carried out consistently and reliably. It also ensures that all steps carried out in the process conform to business rules. Consistency and reliability are very important when annual reports about an organization are being made. The information added to the annual report must be correct because it reflects the performance of the organization. Various financial statements are made in the annual report which point out whether the company was in profit or loss.

Reduce Paper Usage

Manual execution of processes requires a lot of paper work. Therefore, workflow automation reduces the usage of paper, making it more manageable and convenient. Paperwork has consistency issues; the paper may get lost or misplaced. As a result, all work is all work is work and the effort and man hours are wasted. Managing the process through an automated system makes it easy to manage the resources. The resources are arranged accurately, thus providing quick access. Backup of the resources can also be made which requires less management as compared to management of papers.

2.4 DOCUMENT WORKFLOWS

Document workflow system refers to precise tracking of the document's progress from its creator through to its final destination.

Every organization has some documents that flow through some hierarchy or work process. As the document moves from one person to another or from one department to next, the destination person acts on these documents and further processes it for review or future action. Many business processes are repetitive and time-consuming.

Let's examine a purchase requisition. The form is first taken to accounting after making sure that some standards are met. Next a purchase order is produced and returned. The purchase order is approved for the item to be acquired up to a specific cost.

Its workflow comprises of following points:

- The individual who created the requisition.
- This requisition is then passed to the purchasing authority in accounting.
- This acquisition lands at the source again.

This process is simple when done with the help of some document workflow system, however if it is done manually then it may cause many problems such as misplacing the file or a lot of paper work.

An effective work flow system should compile the functionalities of a document management system and a workflow automation system. It should provide version support as well as file tracking. The system should provide where the file is located and track the changes that have occurred in terms of the author, the date and time of modification and the type of change. These changes are not only tracked but also stored in a repository for future use.

2.5 TRANSPERANCY IN DOCUMENT WORKFLOWS

If we summarize the sections above, we come to a conclusion that automating workflows can greatly reduce the errors in management and documents in a workflow. Information regarding who changed the document and time can be attained using traditional workflow systems, however if a document moves through a number of nodes then having information regarding what type of changed occurred along with the authors name and time of modification cannot be attained using traditional workflows systems. Therefore, the systems are not yet enough transparent. This raises a question that why do we need this information? Node auditing will make a user accountable for his actions. It can provide the system with information that can save the time and resources of the organization as well as the user. Flaw is determined at the point of occurrence rather than after submission.

Therefore, this saves the next node from processing the document for completeness and correctness. The new node can proceed straight to its duties and skip examining the document for pre-requisites. It saves valuable assets for the organization and provides more informed and precise documents. Auditing when combined with file tracking maintains history of the changes that have occurred in the document throughout its lifecycle providing a detail of events occurring at each node.

3 TRANSPARENT EVALUATION THROUGH RUBRICS AND CHECKLIST

Transparency involves having insight to the activities performed at each node. In case of evaluation, transparency means having knowledge of how an evaluation is taking place, why a certain student has more marks than other and having the ability to support their decision. Rubric is a concept which makes the assessment more subjective. As a result, subjectivity supports the decisions of an individual. Rubric has two types, so both of these types will be analyzed in this chapter. The main points of the rubric when transformed into a checklist make evaluation more understandable and transparent.

3.1 CONCEPTUALIZATION OF RUBRIC

A rubric is a scoring tool for subjective assessments. It comprises of a set of criteria and standards linked to learning objectives that can be employed to evaluate decisions. Rubric follows standards so evaluation easy and simplified.

Rubric is an effort to lay down a clear and consistent evaluation criteria. It provides assistance to evaluation authority for evaluating complex problems and also provides arguments for self evaluation, reflection and peer review.

There are three main characteristics of rubric according to Bernie Dodge:

- Focus on measuring a stated objective(performance, behavior, quality)
- Use a range to rate performance
- Certain specific performance characteristics arranged in levels indicating the degree to which a standard has been met.
- Rubrics are also scoring criteria that are:
 - Summative- provide information about a student's knowledge
 - Informative- provide information about a student's strengths and weaknesses
 - Evaluative- provide ways to create instruction that better fits each student's needs

- Educative- provide students with an understanding of how they learn science

3.1.1 Scoring Rubrics

There are two approaches in making a rubric,

1. Holistic scoring. In holistic scoring, an overall judgment of the work is made by the rater about the quality of the performance.
2. Analytical scoring. In analytical scoring, scores are assigned to each factor contributing to the task being evaluated by the rater.

A holistic rubric does not cater for each factor contributing to overall performance. Hence, there are no levels of performances. In the end, it assigns level of performance by assessing performance across multiple criteria as a whole. Whenever a quick judgment is required, holistic rubric tends to be the favorable one. Minor assessments do not require much level of evaluations, therefore holistic scoring can aid the evaluator in such scenarios.

Tolerance for error is another important factor that can be considered while adopting holistic scoring rubric. For this reason, small number of errors can be tolerated given that the overall quality of the work is high.

Analytical rubric is more focused towards task responses as compared to holistic. So analytical rubric is applicable when one or two particular responses are expected. Analytical scoring comprises of several small score which are then assembled into an overall score. Thus, using numerous scoring levels causes analytical rubric to be comprised slowly as compared to holistic rubric.

3.1.2 Weighted Rubric

A weighted rubric is an analytic rubric in which certain concepts are judged more heavily than others. Naturally, all factors do not have the same importance; hence, it becomes more logical to not have same weights for all factors. The important factors are assigned more

weight, which highlights their importance. It provides guideline to sample about the how much effort should be given to each factor.

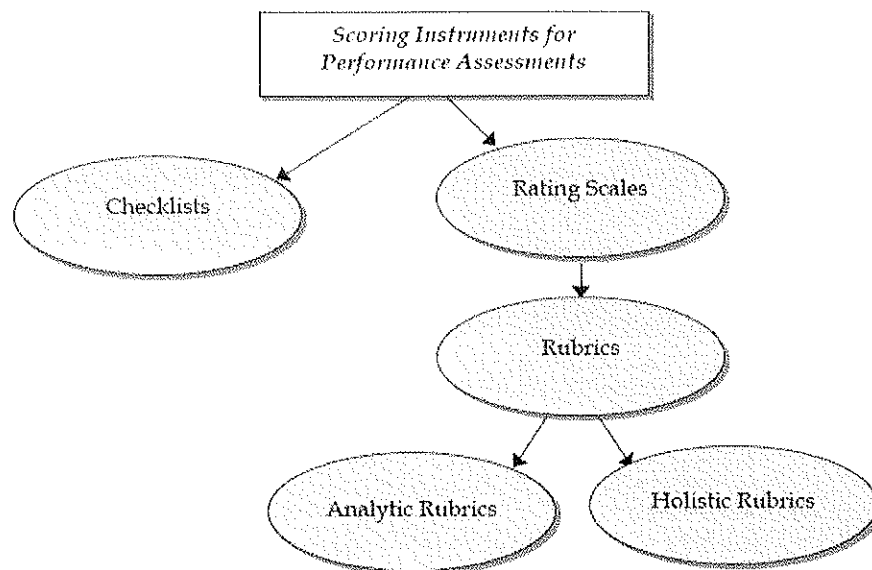


Figure 1 Types of Rubric

3.1.3 Advantages of rubric

- Enhance stake holder's performance by clearly showing the stakeholder the criteria for their evaluation.
- Stakeholders are more aware of the critical factors.
- Evaluation becomes more objective and consistent.
- Compels evaluation authority to clarify their criteria for assessment.
- Provides feedback mechanism to stake holders about helpfulness of the instruction.
- Presents a range of quality levels
- Easy to use and explain.

3.2 DESIGNING OF RUBRIC

Before designing a rubric, the most important thing to do is to decide how the performance or the product will be scored. Whether, holistic or analytical approach is going to be utilized. Evaluation criteria and observable factors must be made in advance regardless which scoring technique is going to be used. The evaluator needs to define how he wants to use the result in order to come into a conclusion about the scoring technique to be deployed. If a summary of the result is required then holistic is useful however, if determining feedback is the main task, then analytical comes across as the better method.

Levels of performance need to be defined. They can be defined by employing quantitative or qualitative labels. Following is an example of qualitative descriptors:

Lowest ←————→ Highest

Novice	Apprentice	Proficient	Master
Attempted	Acceptable	Admirable	Awesome
Lead	Bronze	Silver	Gold
Amateur	Semi-pro	Professional	Hall of fame

Table 1 Qualitative Descriptors

Next step in developing a rubric is to determine how score will be converted to a result in case of an academic institution. The process of converting a score to grade is more inclined towards being logical than being mathematical. Following is an example of converting rubric to a grade:

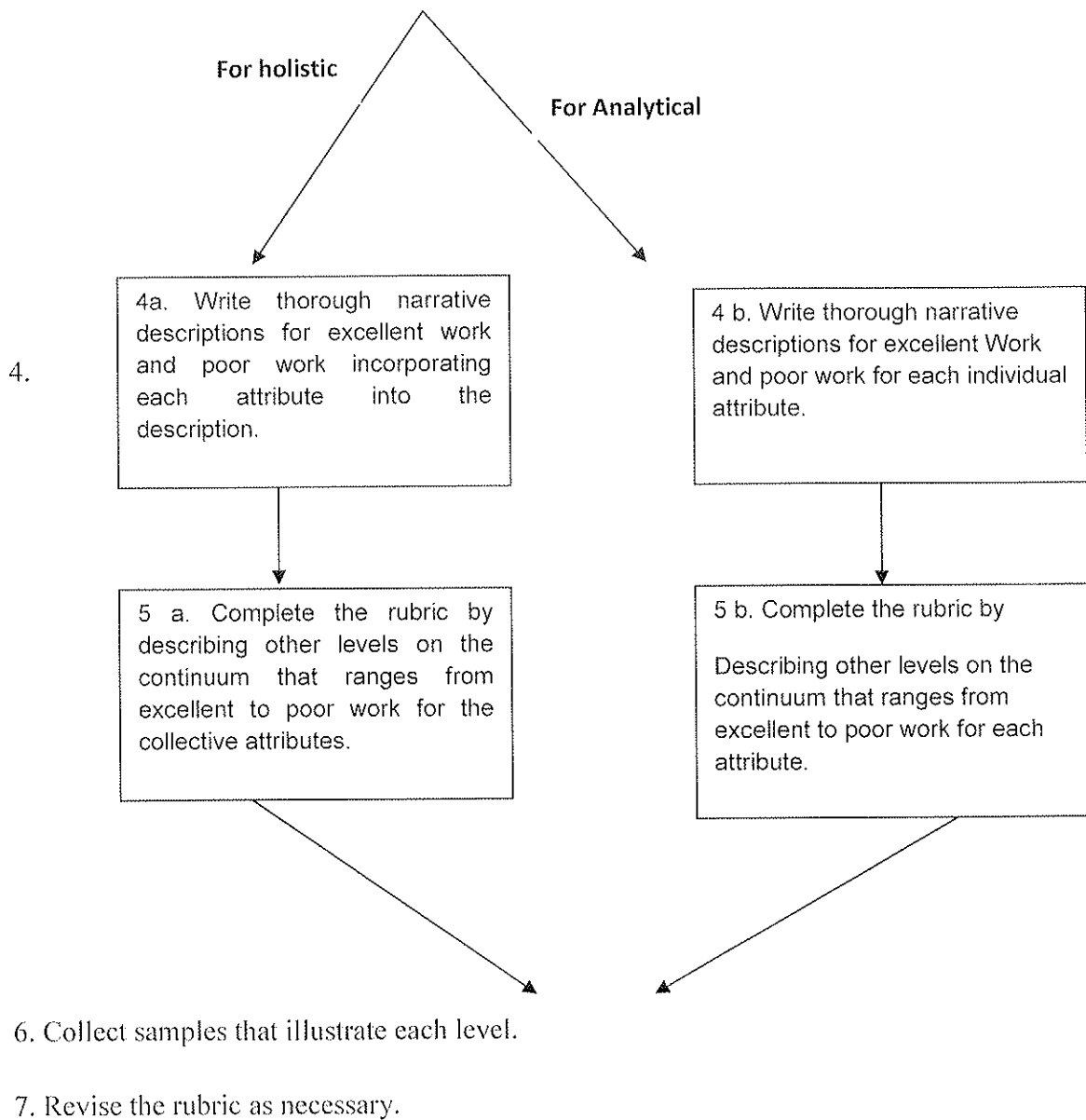
Rubric score	Grade	Category
8	A+	Excellent
7	A	Excellent
6	B+	Good
5	B	Good
4	C+	Fair
3	C	Fair
2	U	Unsatisfactory
1	U	Unsatisfactory
0	U	Unsatisfactory

Table 2 Conversion of Rubric to Grade

There is not a concrete way to convert rubric score into grades. It is developed through close meetings between different members of the evaluation meeting so that it fits perfectly with the system of reporting students or concerned authorities performance.

3.2.1 Step by step procedure:

1. Re-assessment of the objectives of the task.
2. Categorization of the factors to be analyzed.
3. Brainstorming characteristics that describe each attribute.



3.2.2 Evaluation checklist

A rubric comprises of set of aspects of evaluation that are graded according to some scale. However, these scales are very abstract. They allow concerned authority to know the evaluation but not the factors that contributed to the evaluation. Hence, an evaluation checklist lists the detailed factors of the aspects. These factors sum up to the overall score.

Individual weights are assigned to each factor and their combination cumulates to a score which is graded according to the percentile in which the result lies for academics. Certain groups can also be made in a rubric, it groups certain factors that share a common criteria. This checklist acts as a primary actor in verification of the evaluation. It provides insight to the evaluation mechanism and allows node level analysis to become more transparent. Transparency is the key factor that makes sure that a particular node performs the designated task and avoids wasting time in unnecessary activities.

3.3 MS THESIS USE CASE

3.3.1 Workflow

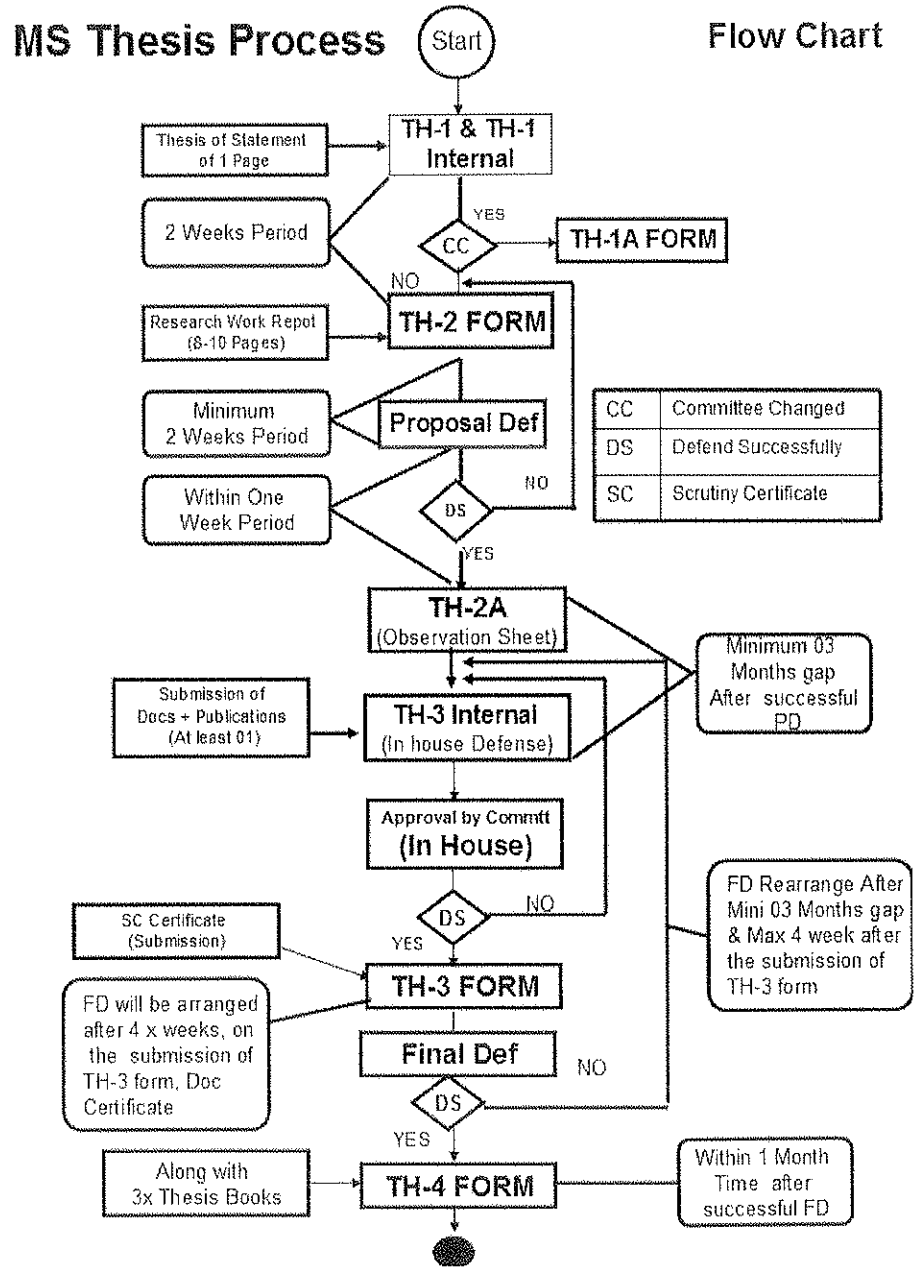


Figure 2 MS Thesis Workflow

MS Thesis consists of number of forms and documents that are too submitted to the concerned authorities. The first of these forms is TH-1 and TH-1 internal, which comprises of the details of the student and the committee members. TH-1 internal is submitted to SEECs and TH-1 is submitted to NUST head quarter.

Thesis statement is to be submitted along th1 and th1 internal form. If the committee members of the student change then TH-1A form is submitted with the details of the new committee member. However, if the committee members do not change then after 2 weeks TH-2 form is submitted along with research work report of 8-10 pages. TH-2 form is for approval of the research topic. Next the proposal defense must take place after 2 weeks. If the student defends successfully, then observation sheet must be submitted within one week after the proposal defense. If the student fails to defend his idea then he needs to select new research topic. The observation sheet is handed to the student for improvements. The in house defense must take place after 3 months of handing observation sheet to student. For in house defense, TH-3 internal must be submitted along with documentation and one research paper. If the committee does not approve the in house defense, then it must take place again. Whereas, if the in house defense is approved then scrutiny certificate is submitted by the student along with TH-3 form. The final defense must take place after 4 weeks on the submission of TH-3 form. On successful completion of final defense, TH-4 form along with 3 thesis books must be submitted within 1 month time after successful final defense. In the case if unsuccessful final defense, in house must be taken again and same process continues.

3.3.2 Evaluation

Ms Thesis is evaluated based on three criteria's.

- Oral presentation evaluation
- Document evaluation
- Research evaluation

These criteria's are evaluated using analytical scoring model where different aspects of evaluation are evaluated with different labels. Following is the set of marks assigned to each label and same labels and scores are used for all criteria's.

Qualitative Labels	Rubric Score
Fail	2
Satisfactory	3
Good	4
Excellent	5

Table 2 Score assigned to each label

Each criterion is evaluated on the basis of a number of aspects.

For oral presentation evaluation the aspects are:

- Definition and importance of work clearly specified
- Reasons put forward in support of arguments sound enough and indicate continuity
- Use of charts, graphs, slides , etc to explain salient points
- Project procedure stated briefly and to the point
- Literature Survey/Results
- Conclusion Drawn well explained
- Answers given to the questions put forward by the audience

For document evaluation:

- Style and report format
- Grammar
- Problem statement
- Theoretical background
- Details of procedures followed
- Graphs and pictures
- Derivation and discussions
- Conclusion and recommendations

For research evaluation:

- Problem significance
- Development of method/ techniques
- Validation /evaluation

3.4 THESIS RUBRIC

For evaluation criteria's to be transparent, each aspect needs to be elaborated in detail. Therefore, the factors contributing to each aspect are listed below.

For oral presentation evaluation, following are the factors that contribute to the score:

- Use of charts, graphs, slides , etc to explain salient points
- Placement of Image
- Clarity of image(concept related clarity)
- Relevance
- Project procedure stated briefly and to the point
- Selection criteria
- Description of selected procedure
- Description of activities involved in selected procedure
- Literature Survey/Results
- Comprehensiveness of survey
- Knowledge level of the participants in the survey
- Techniques employed for evaluation of survey
- Precision of the Results
- Conclusion Drawn well explained
- Precise Conclusion
- Conclusion well explains the proposal
- Answers given to the questions put forward by the audience
- Clarity in verbally conveying of idea
- Supporting answers with examples from the industry

Document Evaluation checklist:

- Style and report format
- Student's name and registration number is written.
- Supervisor's name is mentioned.
- Title of the degree is written correctly.
- University and school's name are written correctly.
- Date of completion/defense (only Consistent font (Times New Roman) is used throughout the thesis.
- Page numbering is done appropriately.
- Figures are readable and are aligned correctly.
- Captions for tables and figures use consistent format and style.
- Table of Contents/Figures/Tables follow proper indentation/styling.
- Chapter name and numbering follows consistent style. Year and month) is mentioned.
- References are sorted on last name of authors (or in the order of citation in the text).
- References follow consistent style such as ACM or IEEE-Tran.
- Mandatory slots of references are filled correctly (such as Author, Title, Journal, and Year).
- Grammar
- Problem statement
- Background to problem statement is also explained.
- Problem statement is clearly mentioned.
- Problem Explained with Examples
- Implication of the startling statement is demonstrated briefly.
- Theoretical background
- Use of comparison framework
- Time dimensions of background work (current work or prior work)
- Flow of information through this section (wart time and relevance)

- Summarization of Background knowledge
- Details of procedure following
- Selection criteria
- Description of selected procedure
- Description of activities involved in selected procedure
- Graphs and pictures
- Image conveying the message clearly
- Image source authenticated (not copied)
- Relevance
- Labeled Image (image title, reference, numbered)
- Derivations and discussions
- Completeness
- Conclusion and recommendations
- Well written
- Precise

Research Evaluation checklist:

- Problem significance
- Problem aligned with the country
- Problem provided by the Industry as opportunity
- Future value of solution
- Development of method/ techniques
- Does method follow standards?
- Reasons for selection criteria of method
- Details of Steps involved in the method
- Validation /evaluation
- Theoretical technique followed
- Survey performed

- Description of Techniques used to evaluate the survey **Chapter 4**

4 SYSTEM ARCHITECTURE AND DESIGN

4.1 DATABASE DESIGN

The database requires for storing all the information regarding evaluation criteria's, aspects and factors. It is essential to store all the information regarding evaluation so that more evaluation aspects can be added in runtime. This will give additional flexibility to the evaluator.

The database consists of following tables:

Evaluation_criteria:

Column name	Data type	Constraints	Null allowed
Criteria_id	Varchar	Primary key	No
Criteria_name	Varchar	None	No

Table 3 Evaluation_criteria

Aspects_of_evaluation:

Column name	Data type	Constraints	Null allowed
Aspect_id	Varchar	Primary key	No
Aspect_name	Varchar	None	No
Weight	Decimal	None	NO
Criteria_id	Varchar	Foreign key	No

Table 4 Aspects of evaluation

Evaluation_factors:

Column name	Data type	Constraints	Null allowed
factor_id	Varchar	Primary key	No
factor_name	Varchar	None	No
Weight	Decimal	None	No
aspect_id	Varchar	Foreign key	No
Criteria	Varchar	Foreign Key	No

Table 5 Evaluation Factors

Student aspect:

Column name	Data type	Constraints	Null allowed
ID	Decimal	Primary key	No
Evaluation_Criteria	Varchar	None	No
Evaluation aspect	Varchar	None	No
Aspect_weight	Decimal	None	No
Label_weight	Integer	None	No
Marks_aspect	Decimal	None	No
Role	Varchar	None	No
Name	Varchar	None	No
Type of Defense	Varchar	None	No

Table 6 Student_aspect

Student_Evaluation_Criteria:

Column name	Data type	Constraints	Null allowed
ID	Decimal	Primary key	No
Evaluation_Criteria	Varchar	None	No
Marks_Criteria	Decimal	None	No
Role	Varchar	None	No
Name	Varchar	None	No
Type of Defense	Varchar	None	No

Table 7 Student_evaluation_criteria

4.2 ENTITY RELATIONSHIP DIAGRAM

All the criteria are placed in evaluation_criteria table; criteria can have multiple aspects. So one to many relationship will occur between evaluation_criteria and aspects_of_evaluation. So every aspect will contain Criteria id which will indicate which aspect belongs to which criteria. A single aspect contains multiple factors. So one to many relationship occurs between aspects_of_evaluation and evaluation_factors. Each aspect and factor has a weight which will contribute towards total result of the student. The marks of an aspect will be placed in the table student_aspect. It will contain information such as the name and id of aspect and criteria, the weight that has been assigned to the aspect as a result of the sum of factors. It also stored the label that is assigned to it and the marks obtained according to label. For example if the sum of factors is 0.25, and the label is 4 then the marks will be $0.25 \times 4 = 1.00$. Alongside with this information, the information regarding who was

evaluating such as advisor or committee member is also placed. The name of the evaluation authority is also inserted into this table and the type of defense. The defense can either be proposal or final defense. The sum of marks of all aspects of a particular criterion is placed into the student_evaluation_criteria along side with the name and role of the evaluator and type of defense. One to many relationship occurs between student_aspect and student_evaluation_criteria. A single criterion will have multiple aspects that have been evaluated. The values of name of evaluator are obtained from evaluator table which stores information about the evaluators of a typical applicant.

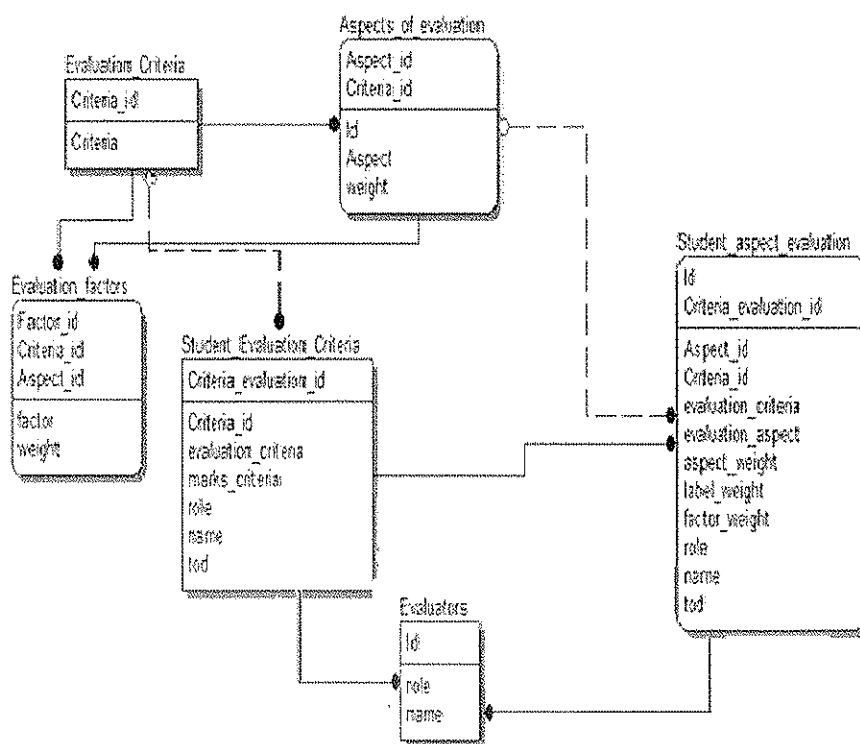


Figure 3 ERD

4.3 System Architecture

There are four architectural layers:

- User interface
- Use case logic
- Checklist processing
- Workflow management component

4.3.1 USER INTERFACE

The user interface consists of two parts:

- Workflow definition Component
- Checklist definition

The workflow management component used is Bonita open source solution. Bonita provides detailed solution to managing workflow. Easy to use graphical workflow component is defines, which is very beneficial for both technical and non technical users.

Checklist definition is achieved through user interface provided by Bonita. It provides its own extensive user interface, where a user can define checklist parameters and these parameters will be stored in the database.

4.3.2 USE CASE LOGIC

Use case logic layer is the layer where the use case will be plugged in. Certain parameters need to be defined that are use case specific. They provide the initial requirements of the use case. Let's consider the example of MS-thesis use case; the following requirements need to be met.

- Evaluation Rubric needs to be defined.
- Score assigned to each weight must be defined.

- User only needs to define evaluation criteria, aspects and factors which will be plugged in the system.

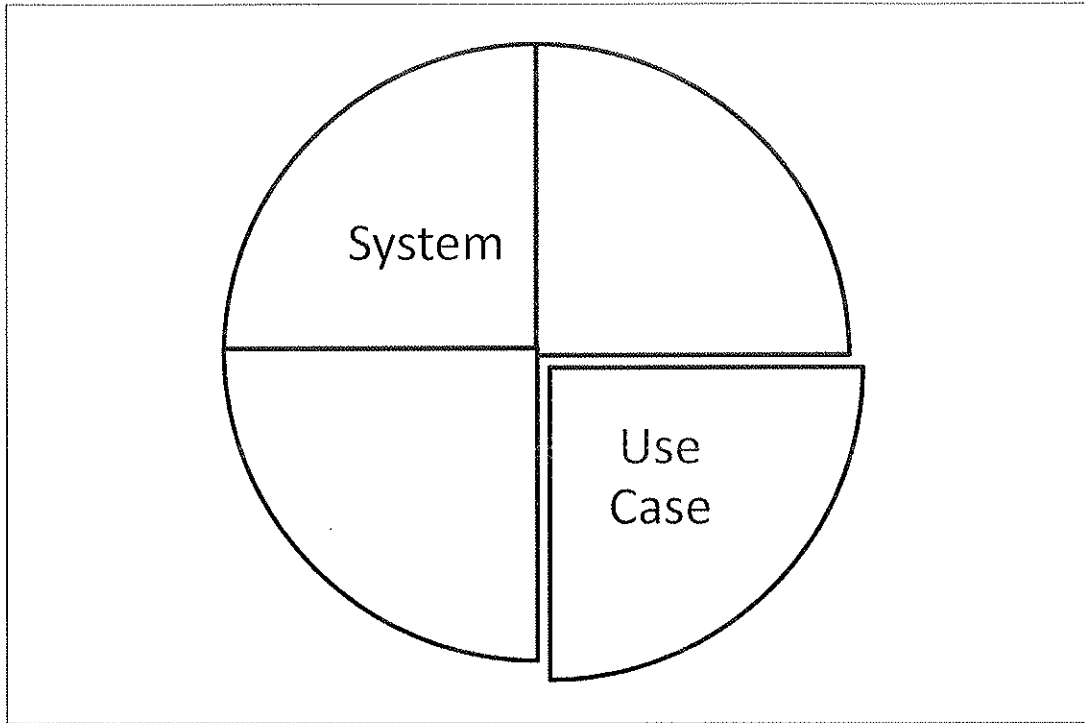


Figure 4: Pluggable System

4.3.3 CHECKLIST PROCESSING LAYER

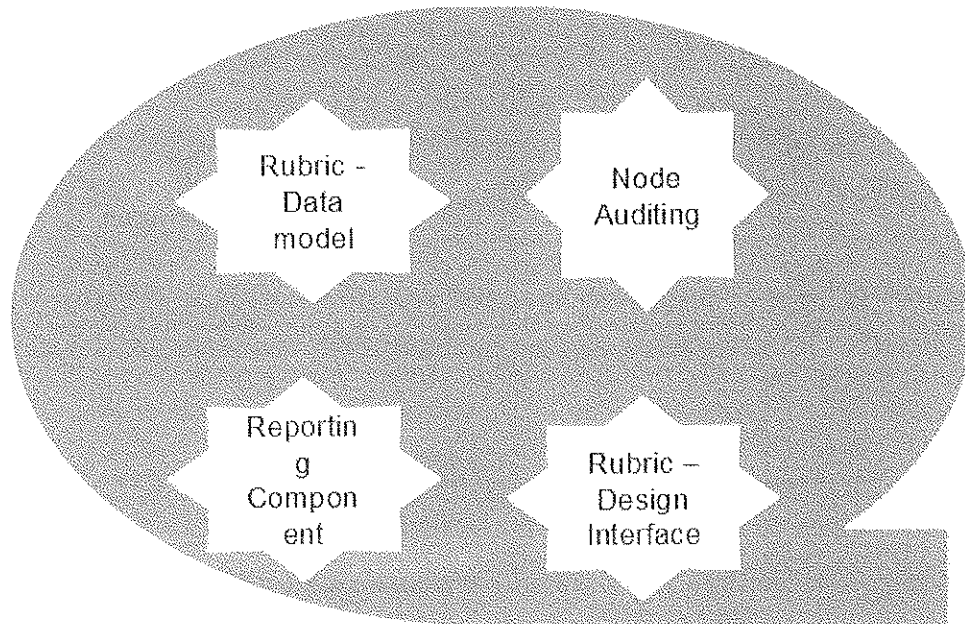


Figure 5 Checklist Processing Layer

There are four attributes of this layer.

- Rubric data model
- Node auditing
- Reporting component
- Rubric design Interface

Rubric Data model

Basic rubric data model is already defined. Whatever use case is being used, it will have criteria's, aspects and factors. Therefore, this feature makes the system portable. These attributes are defined in the use case layer, and then they are stored in the database. Hence, any use case can be converted into a fully functioning system. This underlying mechanism aids in the evaluation effort. No need to define data model for every single use case.

Node auditing

Node auditing is the key task of the system. The user will define his checklist which will be stored in the database. Whenever, a user is evaluating a task, he will check certain factors. As scores have already been defined to each factor, a cumulative score will be made. As the user selects certain factors in the checklist, so if he tries to support his decisions then this is possible by using checklist. The user can clearly identify the factors which he checked and how they contributed to the score. Therefore, transparency is achieved in node auditing. It clearly shows which factors were responsible for a particular score.

Reporting component

Reporting component shows the graphical representation of the results. It will clearly show how a particular result occurred and where does a student lie. A complete report of the student's performance will be displayed. It provides better understanding of the evaluation and it is easily understandable by the third party.

Rubric design interface

Rubric design interface gives some power to the user. Context is generated dynamically, meaning all the aspects, factors and criteria's are read from the database or an external, file so that if they are updated, then the updated copy is loaded next time. The evaluation authority is given a chance to add the following attributes:

- Evaluation criteria
- Aspect groups
- Aspects of evaluation
- Evaluation factors

4.4 WORKFLOW MANAGEMENT COMPONENT

We have used the Bonita as the underlying workflow management system. It is equipped with all the necessary capabilities. It has the following capabilities.

- Designing graphical workflow
- Roles
- Rules
- Monitoring
- Reports
- Simulation
- Proactive approach
- Document attachment

5 Implementation

To test our idea and generic database, MS-Thesis of SEECs is used as use case to test insight to node level using rubric and checklist. MS-Thesis is a process which contains many steps and conditions. Decisions are dependent on Conditions. MS-Thesis Process is a dynamic process. To move to next step, certain conditions need to be fulfilled. Evaluation of Student is accomplished by using Rubric and checklists. Roles and activities are assigned to an actor according to MS-Thesis workflow and process. Postgresql Database is used at back-end. Generic Database which is described in System design is implemented and used in MS-Thesis workflow. A detail of each step is given below. The process starts with taking the input of the user cgpa. If the cgpa is greater than 3.0 then he is eligible for applying to MS Thesis. After passing the eligibility criteria, student has to submit and get approved multiple forms which are listed below. TH1 form is approved first and then TH2. After the approval of TH2 form, the evaluation of proposal defense takes place and then student has to submit TH3 internal form which is forwarded to the advisor and committee members. If the in-house defense is successful then student has to submit the TH3 form which is approved by the advisors, committee members, HOD, DG and DEAN. After TH3 is approved, student's final defense takes place and same procedure is repeated for evaluation. Oral presentation form and research evaluation form are evaluated during proposal defense and document evaluation, oral presentation and research evaluation are evaluated during final defense.

5.1 Eligibility Criteria for MS-Thesis

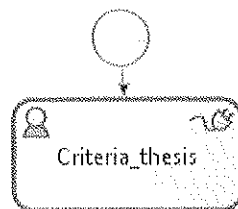
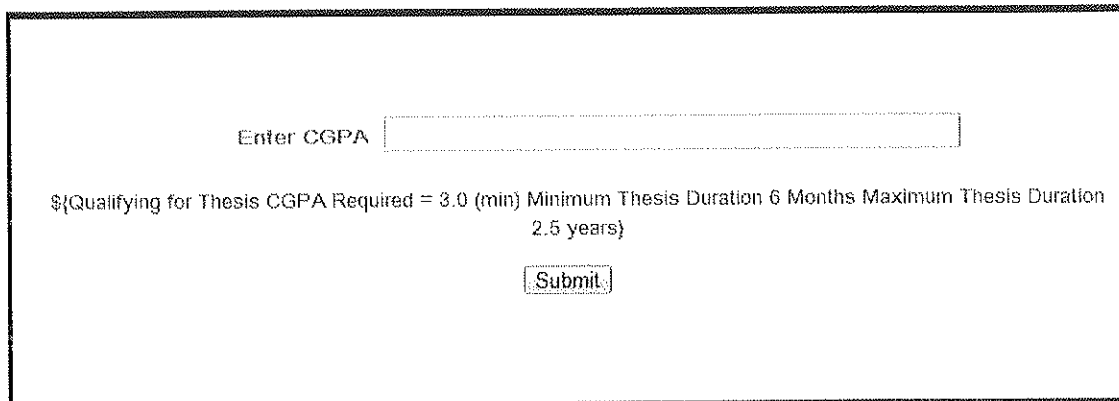


Figure 6: Eligibility Criteria Node

First Step of MS-Thesis is to fulfill the criteria of CGPA which is CGPA equal or greater than 3.0. If Student's CGPA is less than 3.0 than he will not be able to proceed further. If CGPA is equal or greater than 3.0 than TH-1 Form will be visible to Student.



Enter CGPA

{Qualifying for Thesis CGPA Required = 3.0 (min) Minimum Thesis Duration 6 Months Maximum Thesis Duration 2.5 years}

Figure 7: Eligibility Criteria Form

5.2 MS-Thesis Forms:

There are 4 forms which student has to submit in the MS-Thesis Process. These Forms are

- 1. TH-1 (TH-1 and TH-1 Internal Combined)**
- 2. TH- 2 (TH-2 and TH-2 Internal Combined)**
- 3. TH -3**
- 4. TH -4**

Details are given below

5.2.1 TH-1 Form

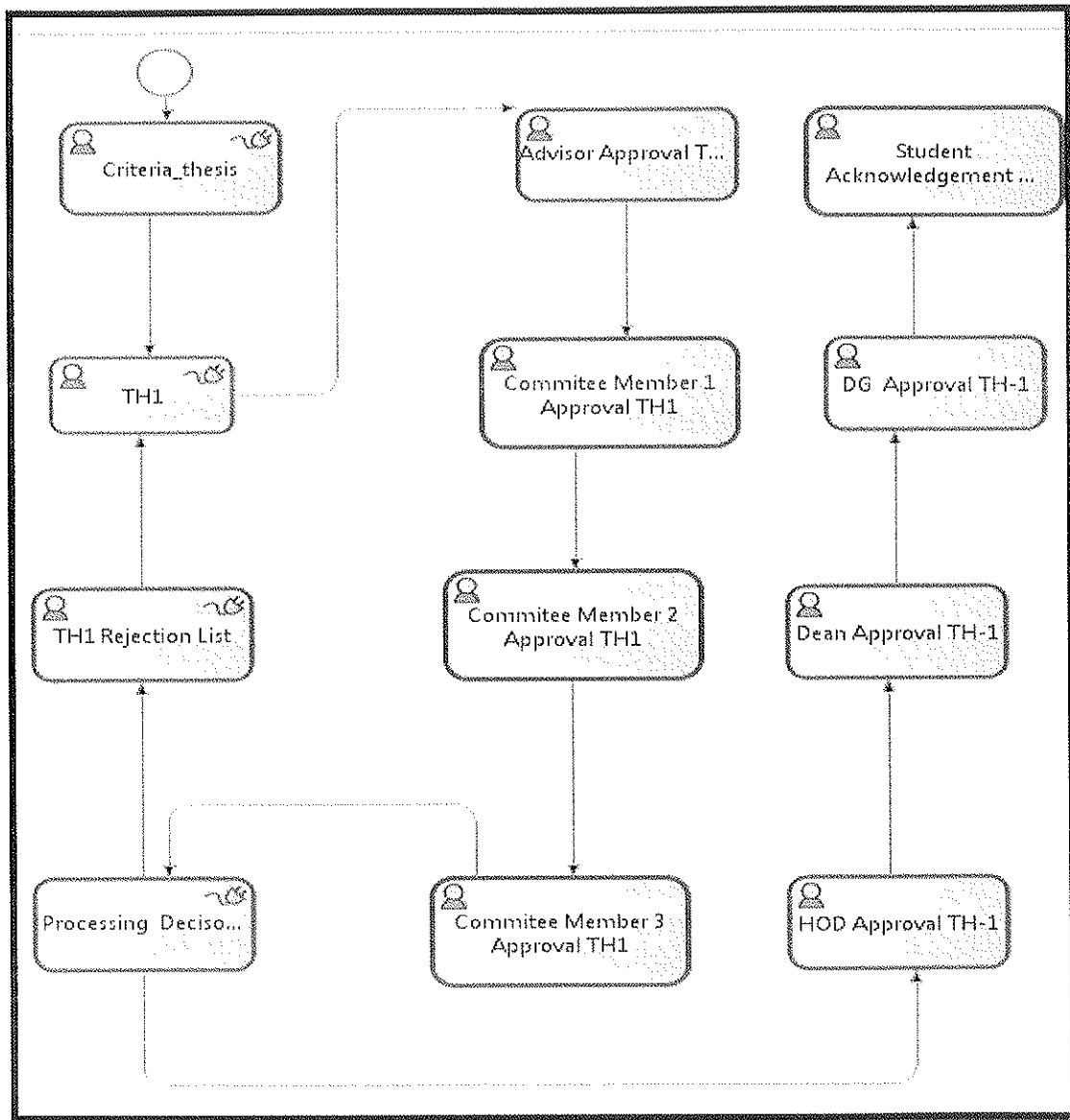


Figure 8: TH1 approval Process

TH-1 is assigned to Initiator i.e. Student who has fulfilled the criteria of CGPA. In TH-1 Form Student has to enter all the details of Advisor, Committee Members and the details shown in the figure given below.

It will show Flow of TH-1 Form from Advisors to DCE. Student enters Name, Reg No and Department. CGPA is forwarded from criteria step.

Student enters Details of Committee Guidance Members i.e. Advisor and 3 Committee Members. Details include Name, Department, Experience and Contribution in Relevant Areas.

In the end of this form, Student has to attach Research document. TH-1 will be forwarded to the given below authorities for approval:

- Supervisor
- Committee Members

If they approve then it will be forwarded to given below authorities for approval:

- Head of the Department
- Dean
- Director General
- DCE

If any of the guidance committee rejects the TH-1 Form, then it will be visible to Student and Student has to re-submit the TH-1 form again. Committee Members and Advisor can also add comment as reason for rejection.

All details entered by Student will be shown in 'read-only' format to Guidance Committee Members, Dean, DG, HOD and DCE to help them in decision making.

5.2.2 TH-2

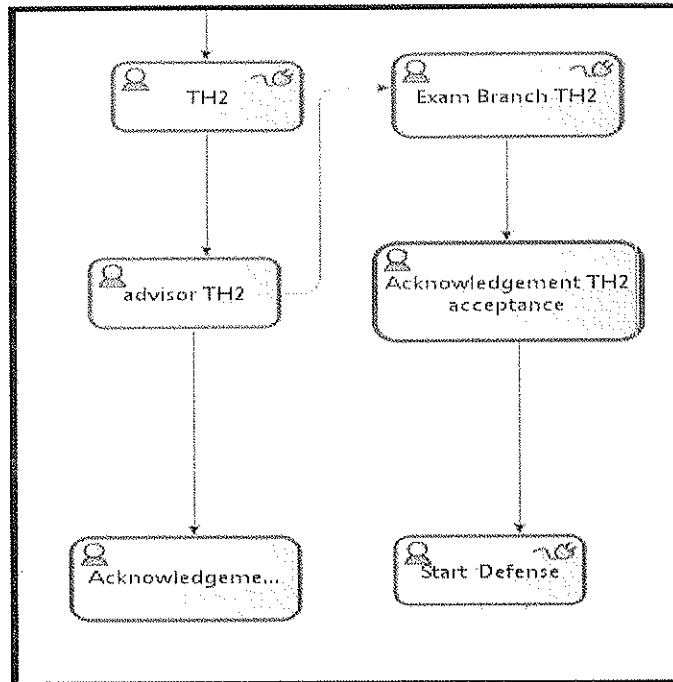


Figure 10: TH2 Approval Process

TH-2 form is submitted by Student. It includes Project Title and Proposed Date for Proposal Defense.

This form is forwarded to given below authorities for approval:

- Advisor
- Exam Branch

TH2Form

Name Of Student Sobia Javed

Course Name BIT-8

Registration Number 2006-NUST-BIT-27

Project Topic

Target Date for Proposal
Defense

Advisor Khalid Latif

Figure 11: TH2 Approval Form

5.2.3 TH-3

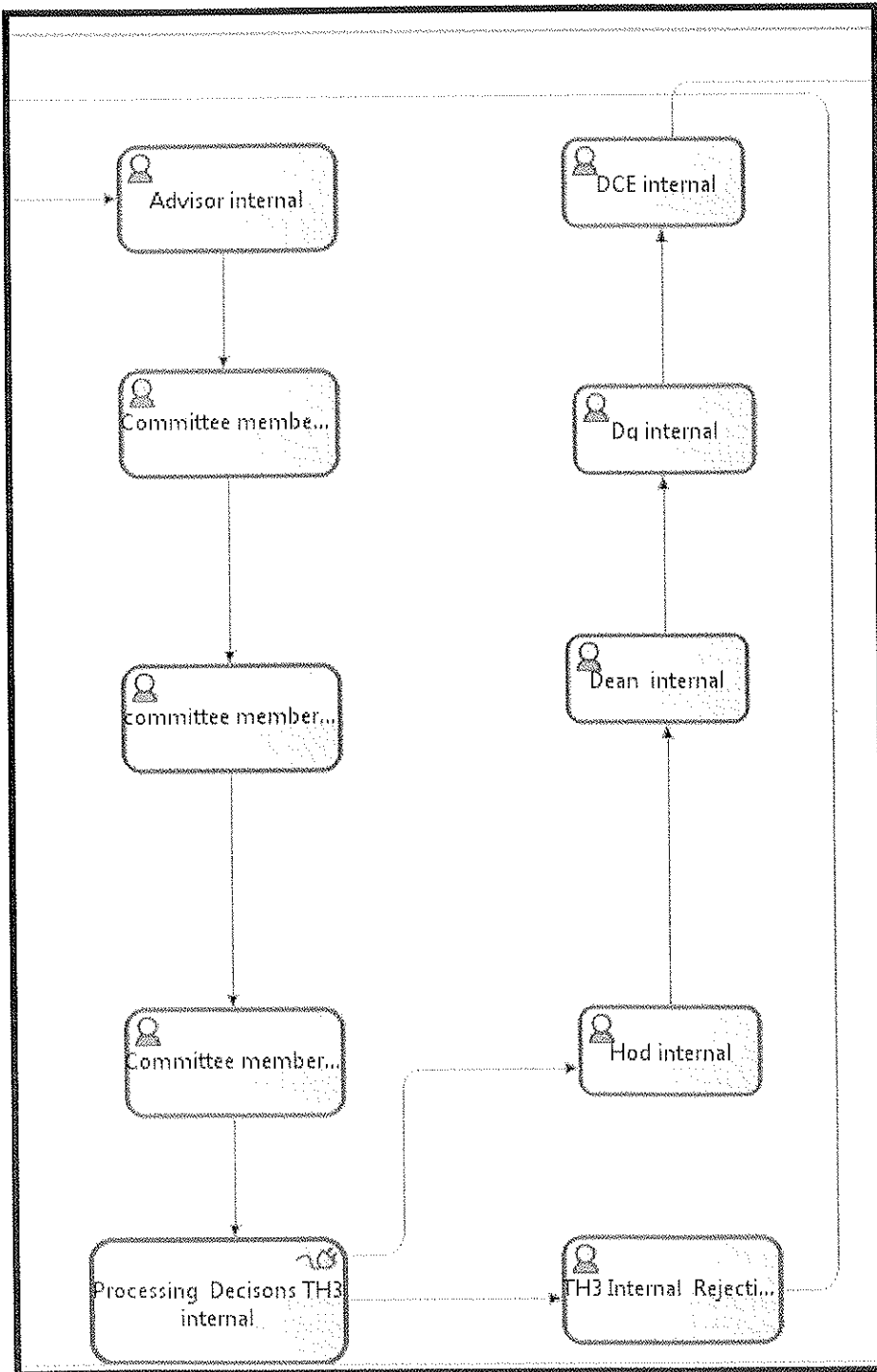


Figure 12: TH3 Internal Approval Process

TH-3 Form includes Abstract of Student and Location, Time and Date of Proposal Defense.
This form is for Record.

TH3 InternalForm

Name Sobia Javed Course BIT-8

Reg No 2006-NUST-BIT-27 Department Department of Computing

Abstract (Complete 1/2 page abstract of thesis) []

Location [] Time [] Date June 15, 2010

Figure 13: TH3 internal Form

5.2.4 TH-4 Form

It is just an official certificate which shows that Student Research work is accepted by Authorities.

We hereby recommend that research work carried under our supervision by: Sobia Javed
Entitled: Node Auditing And Analysis in Document Workflows
Be accepted in the partial fulfilment of the requirement for the Degree of Masters in Information Technology

Figure 14: TH4 form

TH-4 is forwarded to given below authorities for approval/record:

- Advisor
- Committee Members
- HOD
- Dean
- DG
- DCE
- Exam Branch

If any of the given above authorities reject then user has to re-submit the TH-4 Form. If all approve than Acknowledgment of Approval of TH-4 is forwarded to Student.

5.3 Start of Proposal Defense

After the user approves the TH2 form, the next step is proposal defense evaluation. Proposal defense is evaluated by the advisor and the committee members. The total weight age proposal defense is 40%. The advisor is assigned 40 % marks of proposal defense and the committee members are assigned 20 % respectively.

The step “Start Defense” is responsible for setting up the parameters for displaying the evaluation form for evaluation.

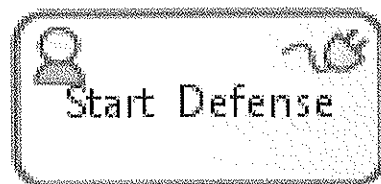


Figure 15: Start Defense Node

Four actors are assigned to this step.

- Advisor
- Committee member 1
- Committee member 2
- Committee member 3

The same node is called for proposal defense and final defense, but different forms are evaluated for each type of defense.

There is a variable named "set_criteria_type". This variable is assigned a value which determines which form will be evaluated. As all the forms are evaluated sequentially, therefore its value is incremented and based on incremented value evaluation criteria is changed.

The following snippet is executed during this step. Type of defense is set which decides whether it is proposal defense or not. The value of "type_of_defense" is set to "Proposal Defense in the beginning.

Create a sql connection to PostgreSql through bonita.

Check the value of type_of_defense,

If (type_of_defense equals "Proposal defense")

{

Create a sql connection to get count of all factors which does not belong to Criteria "Document Evaluation"; // This counter is used to display all the factors of all aspects of criteria oral presentation and research evaluation.

}

Else if (type_of_defense equals "Final defense")

{

*Create a sql connection to get count of all factors // This counter
is used to display all the factors of all aspects of all criteria.*

}

5.3.1 Evaluation Sheets

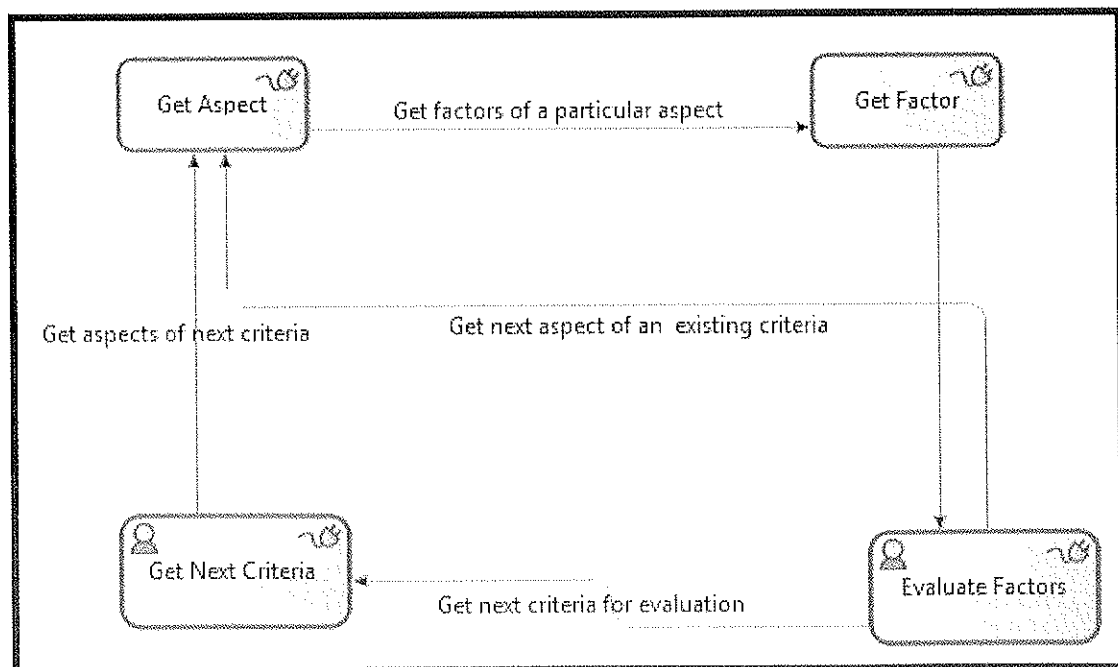


Figure 16: Evaluation Sheet Generation

Get Aspect will get the factors of the current criteria. For proposal defense its initial value will be "Oral Presentation Evaluation". It will get all the aspects of "Oral Presentation

Form”, and then get the factors of each aspect one by one. After all the aspects of the “Oral Presentation Form” have been evaluated, next criteria will be evaluated later. Therefore, after evaluating “Oral Presentations”, “Research Form” will be evaluated. The same procedure will continue, until all the factors of all aspects have been evaluated.

The evaluation sheet will appear in the following form.

Oral Presentation Evaluation Form

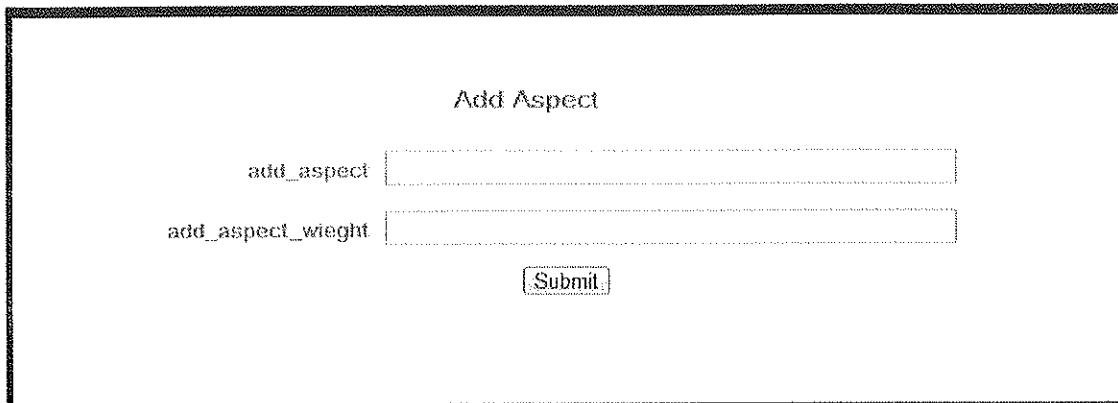
Aspect (1/7)	Definition and importance of work clearly specified	Weight 0.5	<input type="button" value="Add Aspect"/>
Factor (01/2)	Adequacy Of work Clearly Specified(information about details)	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 1 ▾ </div> 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0	<input type="button" value="Add Factor"/>

Figure 17: Evaluation Sheet

Title of the page displays the criteria. Aspects of the criteria are evaluated sequentially, showing its numbering, name and weight. For factors, each factor of the aspect is evaluated and is assigned a score from 0 to 1.

5.3.2 Flexibility

System is made flexible by enabling the advisor or committee member to add factors or aspects.



Add Aspect

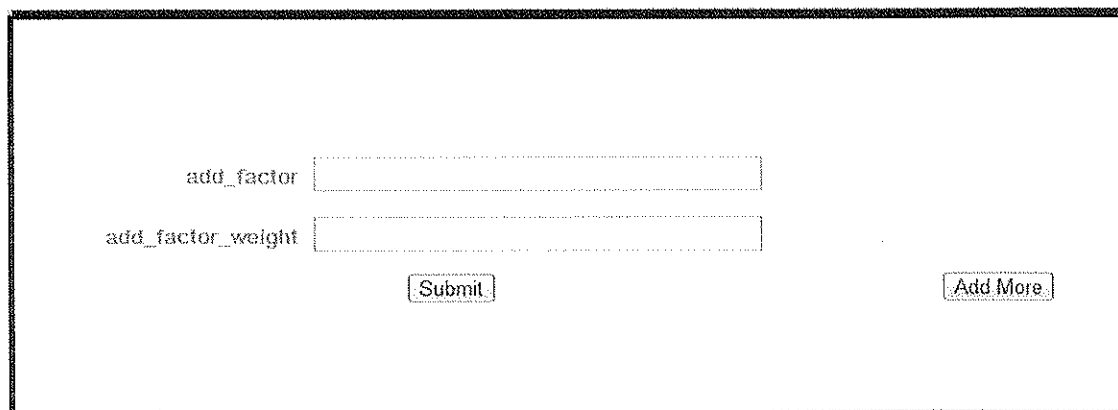
add_aspect

add_aspect_wieght

Figure 18: Add Aspect Form

The user inserts the name of the aspect and aspect weight and the values are inserted into the table “aspects_of_evaluation”.

The user can also add factors to aspects.



add_factor

add_factor_weight

Figure 19: Add Factors Form

Therefore, the user can add as many aspects as he would like.

5.3.3 Evaluation

The selected values of the user are inserted into the database to maintain a repository as soon as he submits the evaluation.

Firstly, it creates a sql connection, and then gets all the aspects, their weight, factor and its weight from aspects_of_evaluation and evaluation_factors respectively.

It has a process variable “aspect_local” and “factor_name” which corresponds to the aspect and factor being evaluated. So for every aspect and factor being evaluated, it gets all the factors and aspects from the database from tables, evaluation_factors and aspects_of_evaluation. Then it transverses through the result set to get the weight of the desired factor and aspect. After the weight of aspect and factor have been taken, it inserts the values into the database in the table “student_evaluation”, which is a dummy table from which values are then sorted and placed in the correct table.

Create a sql connection to PostgreSQL through bonita.

Get Weights and name of all aspects from table aspects_of_evaluation into array aspect weight and aspect name

Get weights and name of all factors from table evaluation_factors into array factor weight and factor name.

For(from i=0 to total number of aspect)

```

{
  If(aspect being evaluated == aspect name [i])
  {Weight of aspect=aspect weight[i];}
}

For( from i=0 to total number of factors)
{
  If(factor being evaluated == factor name [i])
  { Weight of factor=factor weight[i]; }
}

Create a sql query to insert the factor name, factor weight, aspect
name, aspect weight,role of the evaluator, name of the evaluator
and type_of_defense into student_evaluation table.

```

After all the aspects of the criteria have been evaluated, the values stored in the student_evaluation are sorted, weights of aspects are calculated and then weights of aspects are stores in student_Aspect table and marks of the criteria is stored in student_evaluation_criteria.

Create a sql connection to PostgreSql through Bonita.

Get all Distinct Criteria from table student_evaluation

While(more criteria occur)

```
{
```

Get all the aspects that have been evaluated and placed in table student_evaluation where certain criterion exists.

Define a variable that sums up the weights of all the factors eg. Cumulative weight.

For(int i=0 to total aspects in student_evaluation)

{

Get all factors for aspect[i];

For(int test=0 to total factors)

{

Cumulative weight of factors=cumulative weight+(weight of factor weight of aspect);*

}

Get ratio of cumulative weight attained by the student by maximum weight of the aspect.

If ratio is less than 0.2, then multiply 2 with cumulative weight.

If ratio is less than 0.5 and greater than 0.2, then multiply 3 with cumulative weight of factors.

If ratio is less than 0.8 and greater than 0.5, then multiply 4 with cumulative weight of factors.

If ratio is less than 1 and greater than 0.8, then multiply 5 with cumulative weight of factors.

*Student marks of a given aspect are label * cumulative weight of factors.*

}

*Cumulative marks of aspects=cumulative marks of aspect+(label
cumulative weight of factors);

}

*Create a sql query to insert aspect marks, label, weight, aspect
name, criteria, role and name of the evaluator and type of defense
into the table Student_aspect.*

*After all the aspects of a particular criterion have been assigned
by marks, using the above algorithm, the cumulative marks of
aspects sum up to be the marks of the criteria.*

*Create a sql query to insert marks of criteria, role and name of the
evaluator and type of defense into the table Student_aspect into
table evaluation_criteria.*

5.3.4 Result Sheet and Observation Sheet

The result sheet will appear as follows. It shows the criteria that is being evaluated and maximum marks a student can get and marks obtained by the student

ResultSheet

Thank You Your evaluation is complete

Evaluation Criteria	Maximum Marks	Marks Obtained
Oral Presentation Form	25	15.455
Research Evaluation Form	65	30.4

Figure 20: Result Sheet

The observation sheet shows the student his weak areas. It appears as follows.

Observation Sheet

Satisfactory Areas	Areas that need improvement
Oral Presentation Evaluation	
<ul style="list-style-type: none"> * Definition and importance of work clearly specified * Literature or survey Results * Conclusion Drawn and well explained 	<ul style="list-style-type: none"> * Answers given to the questions put forward by the audience * Project procedure stated briefly and to the point.
Research Evaluation	
<ul style="list-style-type: none"> * Problem Significance *Development Method and technique 	<ul style="list-style-type: none"> * Validation and evaluation

Figure 21: Observation Sheet

5.4 Internal Defense

After TH-3 Form, Internal Defense is evaluated. Score of Internal Defense is not added into total score. Only passing or failure status is important. According to this further decision will be made. If Student has passed inner internal Defense then he can apply for final defense otherwise he has to give Internal Defense again.

5.5 Final Defense

After Student has passed Internal Defense, Final Defense Evaluation will be executed. Process will be same as explained above in the Proposal Defense

6 CONCLUSION

In the modern world where technology is evolving an organization cannot exist without automating its processes. The organizations are expanding day by day, so it is very difficult to manage operations manually which are interlinked. One user needs to complete his tasks before the next user can execute his.

Various workflow management systems exist that perform file tracking. They provide information regarding the time of editing, the user who edited the document and some statistical information. This statistical information cannot improve the efficiency of the organization. They provide raw facts about the history of the document, the types of changes that have been occurring in the document are not catered for. Thus there is a need to determine how that document is being processed at each node, how the information is being altered, is the altered information in alliance with goals of the organization and has the concerned individual completed his processing on the document before forwarding it. These valuable questions need to be answered for the smooth flow of operations.

For these reasons, a checklist is required which lists the responsibilities of the user and status of these responsibilities. This ensures that the document is fully processed. A document management system can aid in managing these documents. So a workflow management system when combined with a document management system can lay a good foundation for nodal processing of these documents. This infrastructure can be adapted by several use cases and used by a broad range of organizations.

Checklist introduces transparency, which makes the overall system more reliable. Reliability accounts for less margin of error and hence, the organization can attain positive results from the use of checklist.

A standardized system is introduced by using a workflow in the organization. All the activities are predefined and every individual has knowledge about the tasks expected from

him. As a result, the flows of activities become more uniform and punctual. A lot of organizations are using BPM in their organization to streamline the activities.

According to an AIIM report:

- 63 % of the organizations consider BPM to be an important success factor.
- 35% report that they have applied BPM to scanning all incoming mail
- Just 4% of organizations are currently outsourcing BPM-enabled processes but this is set to rise to 18% in the future.

These increasing trends suggest that for an organization to be in sync with the global organizations needs to make use of BPM so that they can compete with the market leaders.

Chapter 7

7 References

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- <http://www.aiim.org/What-is-Document-Management-Systems-DMS.aspx>
- <http://www.computhink.com/products/document-workflow/>
- <http://www.cabinetng.com/solutions/document-workflow-management.php>
- http://www.barrsystems.com/document_workflow_management.asp
- <http://www.quask.com/workflow/document-management-workflow.asp>
- http://www.documentlocator.com/Solutions/Workflow_Management/
- http://www.ebizq.net/blogs/bpm_insights/2009/12/-pdrjts-settings-159850-post-1700-id.php
- <http://bpmfundamentals.wordpress.com/2008/11/21/bpm-adoption-and-delivered-value-market-research-and-analysis/>