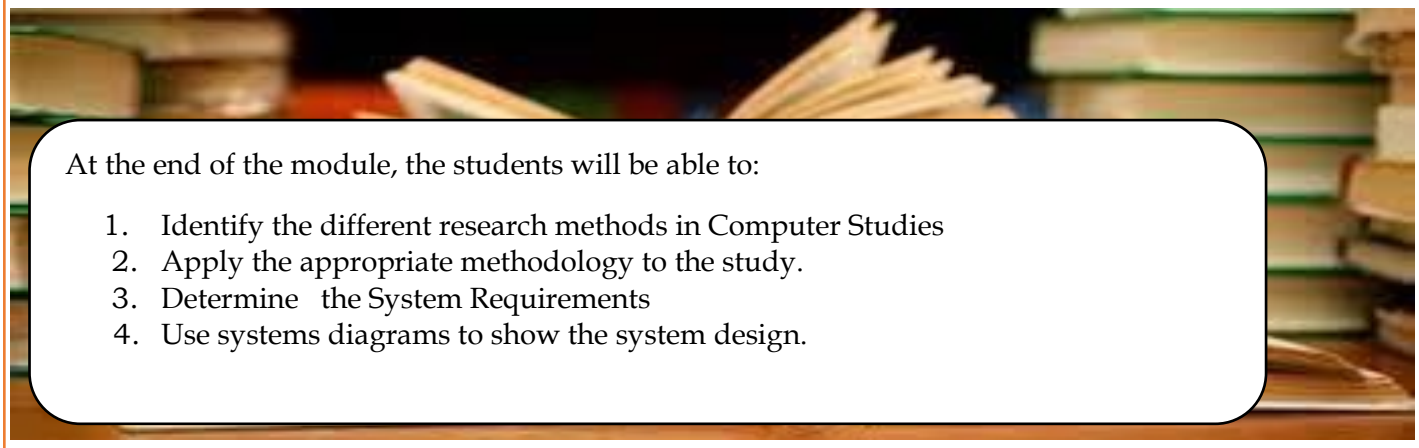
Module III
Methodology

At the end of the course, the students are expected to:

- **Design the development methodology of the capstone project.**



At the end of the module, the students will be able to:

1. Identify the different research methods in Computer Studies
2. Apply the appropriate methodology to the study.
3. Determine the System Requirements
4. Use systems diagrams to show the system design.

Unfreeze your mind

Search for the words listed below

D	G	T	E	I	O	D	N	I	S	H	R	Z	D	Y
C	O	P	E	V	T	D	N	K	C	D	E	S	X	G
T	S	H	J	C	I	F	Q	B	I	P	S	P	H	O
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Z	G	S	X	P	M	V	W	T	L	C	W	Q	R	Q
C	X	I	M	E	N	G	U	L	F	S	E	O	V	O
S	M	T	V	U	S	E	R	H	I	Z	G	S	V	K
H	C	A	O	R	P	P	A	P	F	T	N	X	R	P

APPROACH
METHOD
QUALITATIVE
TECHNIQUE

DEVELOPMENTAL
METHODOLOGY
QUANTITATIVE

ETHICS
MIXED
RESEARCH

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Let us Learn

Research Method: refers to the manner in which a particular research project is undertaken.
The purpose of the research determines the method to use
There is no single research method Many methods are available and have to be combined.
Research Technique: refers to a specific means, approach, or tool-and-its-use, whereby data is gathered and analysed, and inferences are drawn.
Research Methodology: refers to the study of research methods and seeks to answer: how did the researcher complete the study. It also explains and justifies the techniques and tools by which you may proceed with your research. (J. Gamper,2016)

In each phase of Systems Development Research Process, there are specific research issues that should be addressed in each stage as mentioned in the study of (Nunamaker & Chen, 1990)

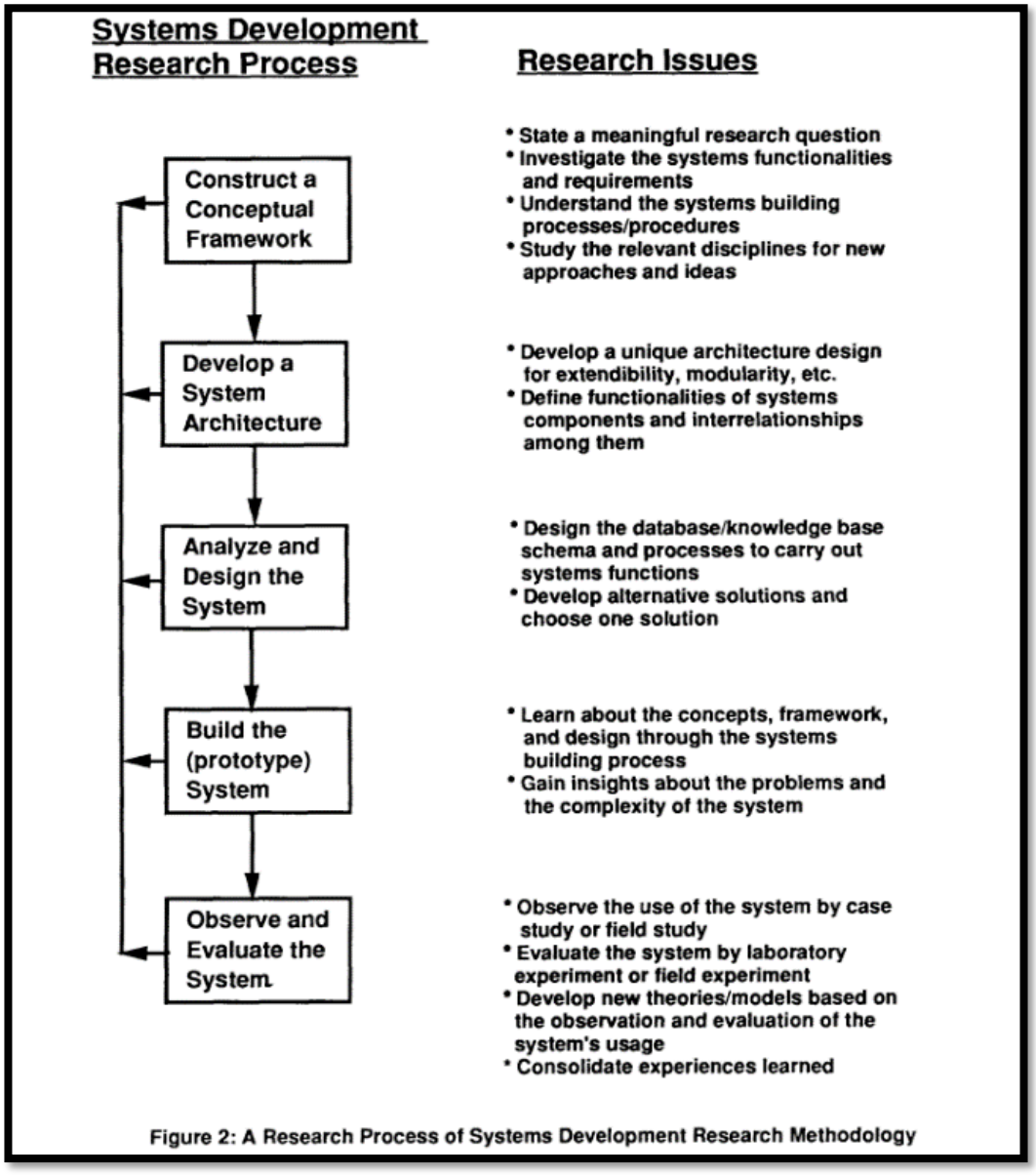

Figure 2: A Research Process of Systems Development Research Methodology

For Software Engineering there are various research methods that can be utilized as shown in the table below from the study of (Fitzgerald, 2018) and each phase of software development there are research methodologies can be utilized as suggested in the study of (Richey & Klein, 2005)

Table 1. A "Mixed Bag": Alternative Research Methods in Software Engineering According to a Selection of Sources

Glass et al. [63]	Zannier et al. [230]	Sjøberg et al. [190]	Höfer and Tichy [75]	Easterbrook et al. [48]
Action research	Controlled experiment	Controlled experiment	Case study	Experimentation
Conceptual analysis	Quasi experiment	Surveys	Correlational study	Case study
Concept implementation	Case study	Case studies	Ethnography	Survey
Case study	Exploratory case study	Action research	Ex post facto study	Ethnography
Data analysis	Experience report		Experiment	Action research
Discourse analysis	Meta-analysis		Meta-analysis	
Ethnography	Example application		Phenomenology	
Field experiment	Survey		Survey	
Field study	Discussion			
Grounded theory				
Hermeneutics				
Instrument development				
Laboratory experiment (human/software)				
Literature review				
Meta-analysis				
Mathematical proof				
Protocol analysis				
Phenomenology				
Simulation				
Descriptive/expl. survey				

Function/Phase	Research Methodologies Employed
Product Design & Development	Case Study, In-Depth Interview, Field Observation, Document Analysis
Product Evaluation	Evaluation, Case Study, Survey, In-Depth Interview, Document Analysis
Validation of Tool or Technique	Evaluation, Experimental, Expert Review, In-Depth Interview, Survey
Model Development	Literature Review, Case Study, Survey, Delphi, Think-Aloud Protocols
Model Use	Survey, In-Depth Interview, Case Study, Field Observation, Document Analysis
Model Validation	Experimental, In-Depth Interview, Expert Review, Replication

In this chapter, the researcher must be able to identify methods used and describe the research methodology. In IT Capstone Project, the most common research design is ***developmental research.***

Developmental Research Design involves several steps depending on the Process Model appropriate to the development of the system. There are several process models that can be utilized in software development. Software Processes is a cohesive collection of software systems specification, design, implementation and testing activities. A software process model is an abstract representation of a system that presents a process definition from a specific perspective.

- *Waterfall Model* - The waterfall model is a breakdown into linear sequential phases of the project tasks, where each step depends on the previous one's deliverables and corresponds to a task specialization.

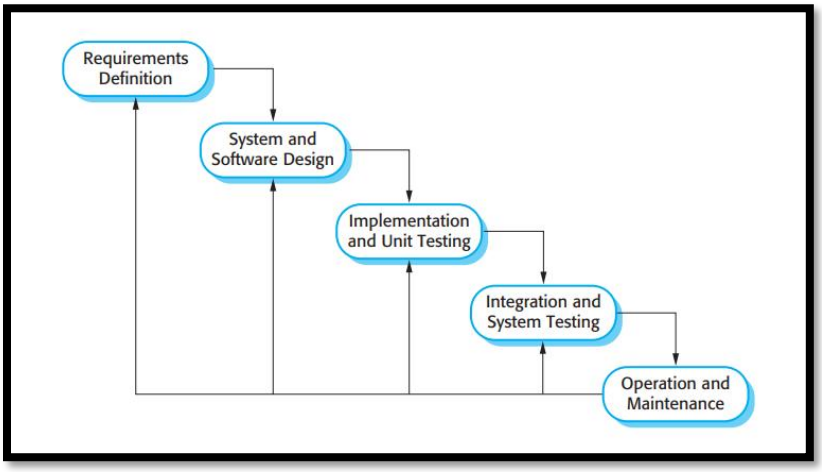

*Figure3.**Error! No text of specified style in document.**-1 Waterfall Model (adapted from Sommervile,2009)*

- *V model*- The process steps are bent upwards after the coding phase instead of going down in a linear way, to form the typical V shape. The V-Model shows the interactions between each stage of the life cycle of production and its related testing process.

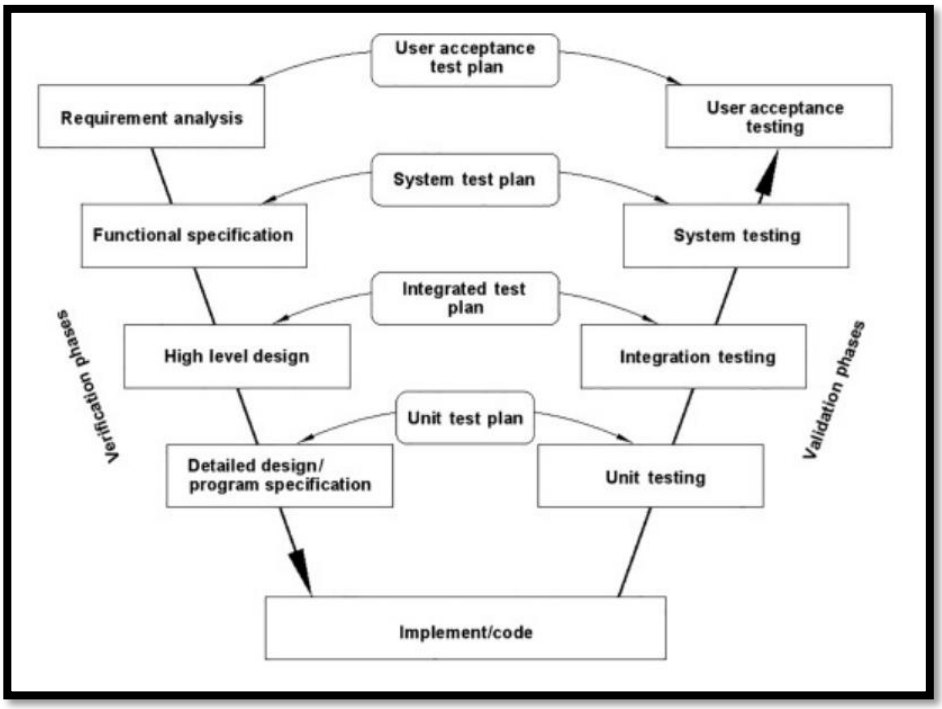

*Figure 3-**Error! No text of specified style in document.**-2 V Model (adapted from Oriako and Okeke,2014)*

- Iterative Model - The theory of gradual growth can also frequently be used liberally and interchangeably when following the iterative approach. By first focusing on an original, simpler collection of user features, an iterative life cycle model does not attempt to start with a full specification of requirements, which then eventually gains more complexity and a wider set of features until the target framework is complete.

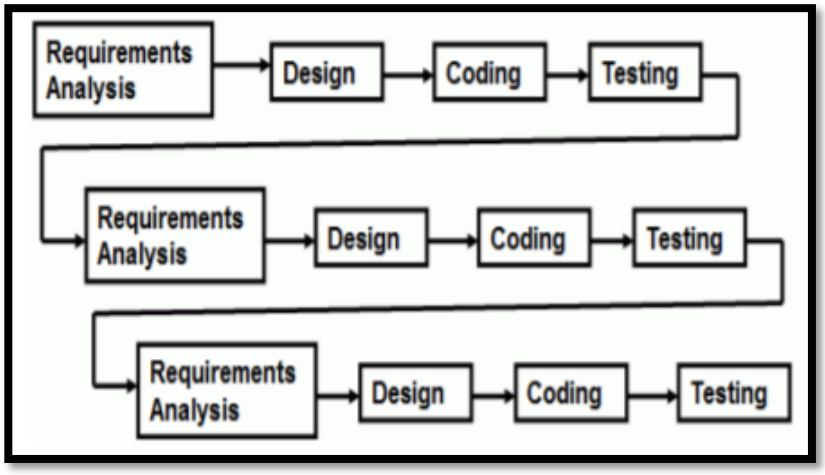

Figure 1-2 Iterative Model (adapted from Yu,2018)

- Spiral Model - The spiral model blends the concept of iterative development with the waterfall model's systematic, controlled aspects that focus on risk analysis. Incremental product launches or incremental refinement through each iteration around the spiral are enabled.

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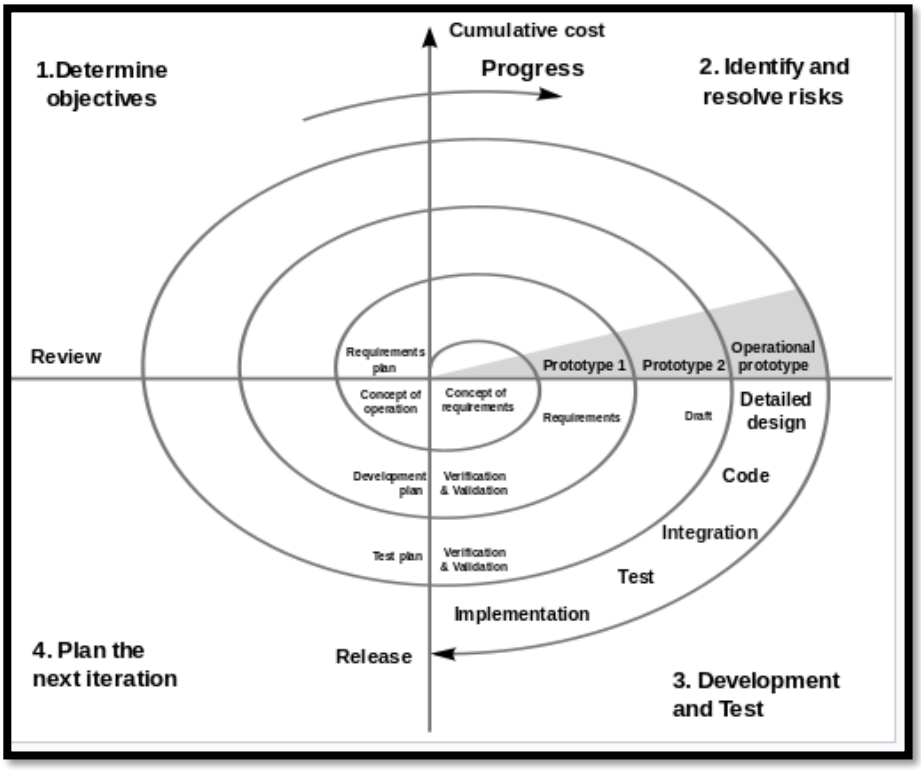


*Figure 3-**Error! No text of specified style in document.**-3Spiral Model (Boehm, 1988)*

- Agile methods - a subset of iterative and evolutionary software development methods. Iteration is a mini-project, self-contained, with tasks that Analysis, design, execution, and test of span requirements. Each iteration leads to the release of an iteration. Frameworks available such as Scrum, Kanban, Lean, Extreme Programming (XP) and etc.

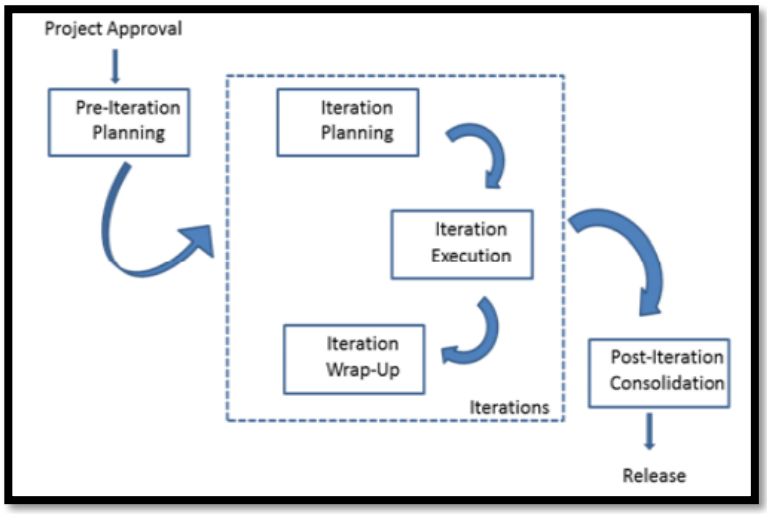


*Figure 3**Error! No text of specified style in document.**-4 AgileModel (adapted from Oriako and Okeke,2014)*

Once the proponents are able to decide on the Research design, an introductory paragraph for methodology can be written as shown in the sample.

Chapter 3

RESEARCH METHODOLOGY

The study used a deployment and customization of an electronic document management system using a free open source software. The problems encountered during the preparation for accreditation of Bukidnon State University was analyzed and an electronic document management system was designed and implemented as a solution to the problems encountered. The development framework is based in the model described by Cassidy's (2006) model of Information System, Planning & Implementation.

You may specify the process model that will be adapted in the software development

CHAPTER III
METHODOLOGY

This chapter presents the general method in designing the overall system developed in this study. Specifically, it discusses how the software and hardware are configured and developed to come up with a real-time automated vehicle-collision and prevention with incidence tracking and reporting system. The ultimate output of this study is identified base on the implemented results and procedures.

Among the process models, the common steps are the

- System Requirement
- System Design
- System Development
- Testing and Evaluation

System Requirement – Specifies what are the software, hardware resources in developing the system. It also specifies the functional and non-functional requirements.

3.1.1 Software

The study used MATLAB Version R2016a to implement the image steganography using the novel puzzle, calculation of the PSNR, SSIM, hamming distance and the simulation of the salt and pepper attack. The study also utilized PHP version 5.4.27 in compiling codes for simulation and employed Notepad++ for encoding the PHP-based codes for the implementation of the digital signature.

3.1.2 Hardware

All the computational were run on a laptop computer with a processor Core i7 2.7GHz CPU, 8GB DDR4 RAM and Windows 10 Operating System.

3.1.3 Data

In the simulation, images from University of Southern California – Signal and Image Processing Institute image database are utilized for testing. Six color images with sizes of *512 × 512* are used as test images and the secret messages are generated randomly of size 160 bits

Table 3.1 – Hardware and Software Requirements

Hardware Requirement	Software Requirement
Personal Computer	Windows Operating System
WeMo's D1 R1 Arduino board	WeMo's D1 R1 Arduino Library
MPU 6050 Sensor	MPU 6050 Library for Arduino board
680µF capacitor	ESP 8266 community library
Buzzer	Arduino Software (IDE)
Lidar-lite V3	Arduino library for Lidar-lite V3

*Fig-3-**Error! No text of specified style in document.**-5 Sample System Requirement*

Functional Requirements - These are the requirements explicitly requested by the end user as essential facilities to be provided by the system. As part of the deal, all these features need to be built into the system. In the form of input to be given to the device, the operation performed and the output predicted, these are expressed or specified. They are essentially the specifications defined by the customer that can be seen directly in the final product.

Learning Checker

System Requirements Activity: (for individual work -problem with the farmer; group activity – capstone project
In your research study, Write the introductory paragraph of your methodology and the system requirements by specifying what are the hardware, software and data (if needed) needed to implement your study .

Writing system software is like planning a family.
If you make a mistake you have to live with it for 20 years.
Richard Marshall, Software Engineer

System Design – Describes the overall system architecture. It will include the discussion of the interaction of the different components and module of the system. Tools in describing the system design may include use case, diagram, data flow diagram, process flowchart, swim lane diagram, activity diagram and the likes.

From the functional requirements specified, the design of the system is best described using the different diagrams mentioned. The sample below is a process flowchart with swim lane diagram for the study "Electronic Document Management System to Support Accreditation" through the diagram the user of the system and the activities that they can perform in the system are shown.

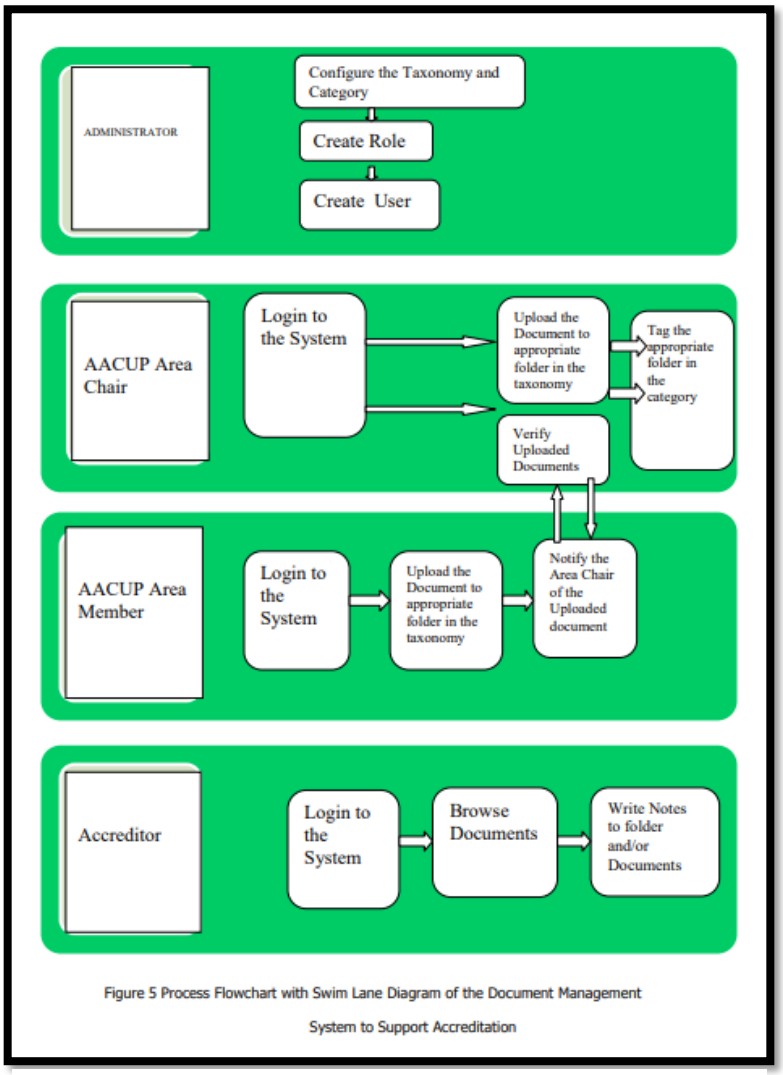


Figure 5 Process Flowchart with Swim Lane Diagram of the Document Management System to Support Accreditation

*Figure3-**Error! No text of specified style in document.**-6 sample system design using process flowchart and swim lane diagram*

"The best insurance policy for the future of an industry is research, which will help it to foresee future lines of development, to solve its immediate problems, and to improve and cheapen its products."

Sir Harold Hartley

Fig 3.7 is a sample sequence diagram and Fig 3.8 is a sample activity diagram for the Automated Entrance Authoring Tool

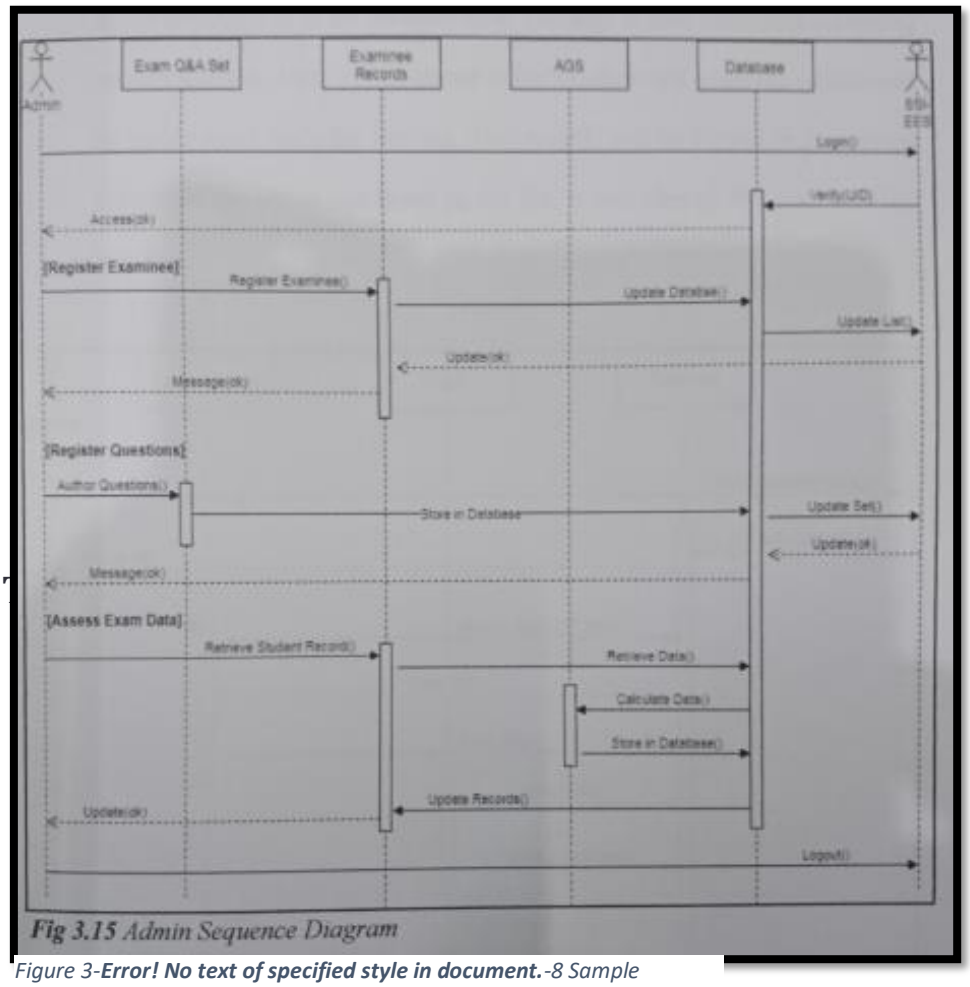


*Figure 3-**Error! No text of specified style in document.**-8 Sample Sequence Diagram*

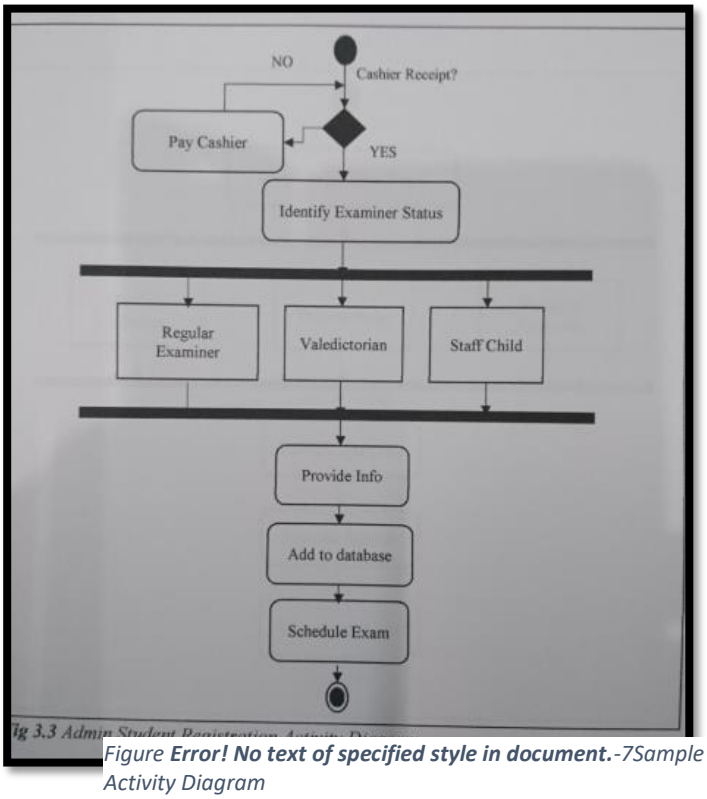


*Figure **Error! No text of specified style in document.**-7Sample Activity Diagram*

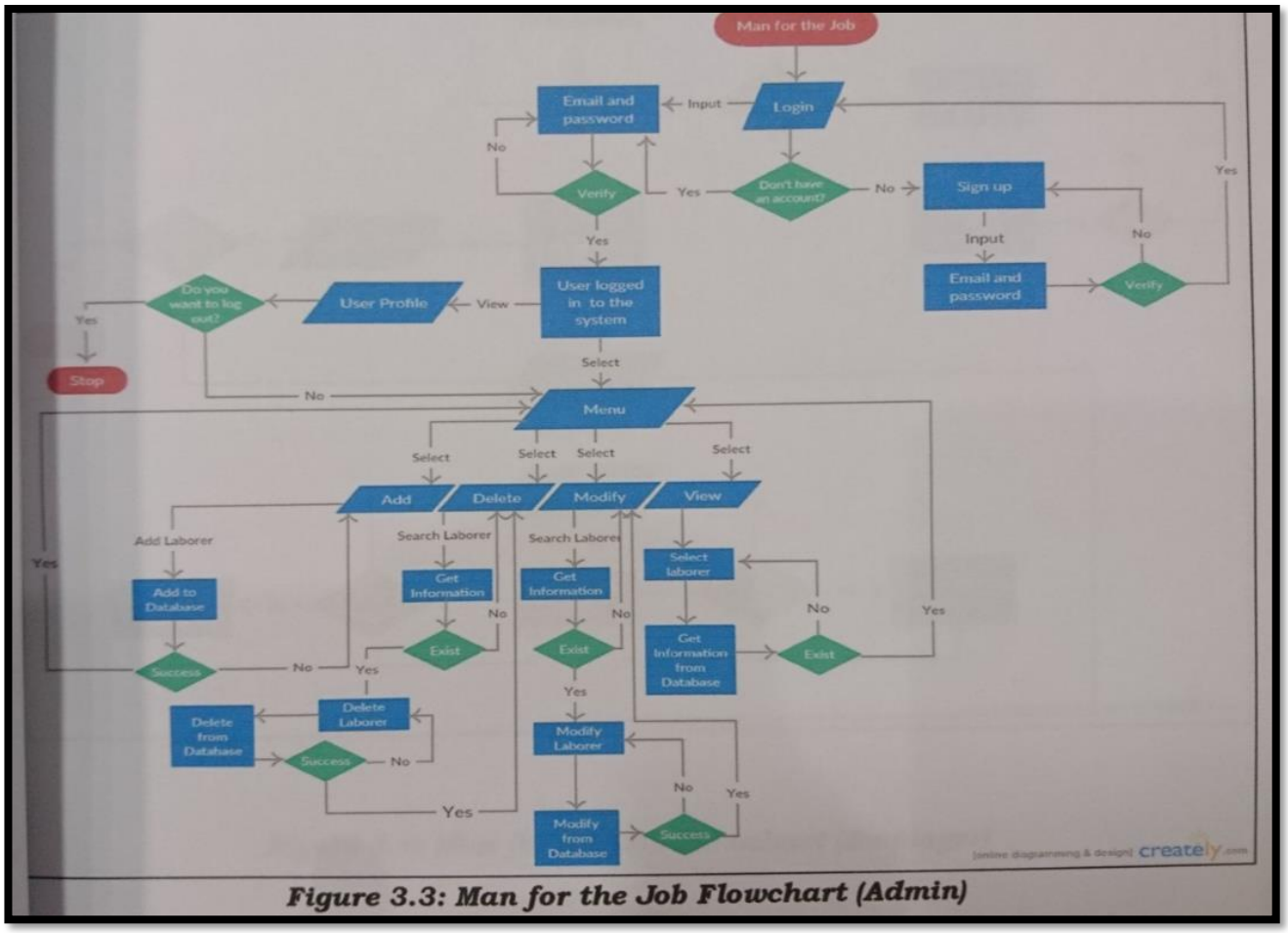


Figure 3.3: Man for the Job Flowchart (Admin)

Learning Checker

System Designs Activity: (for individual work -problem with the farmer; group activity – capstone project In your research study, Use the appropriate diagrams in designing the system base on the functional requirements.

"Software architecture is the set of design decisions which, if made incorrectly, may cause your project to be cancelled."
— **Eoin Woods**

Testing and Evaluation - Specify what method will be utilized in testing and evaluation, it is an evaluation on the attainment of the functional and non-functional requirements. it could be done through an experiment, interview or conduct of survey to the users of the system.

In chapter 3 of your paper, the proponents must be able to describe in detail the method in conducting the testing and evaluation. If it is through an experiment, a description of the experiment setup and the unit of measurement in the testing and evaluation. Like if it is in terms of accuracy it could be measured in terms of percentage

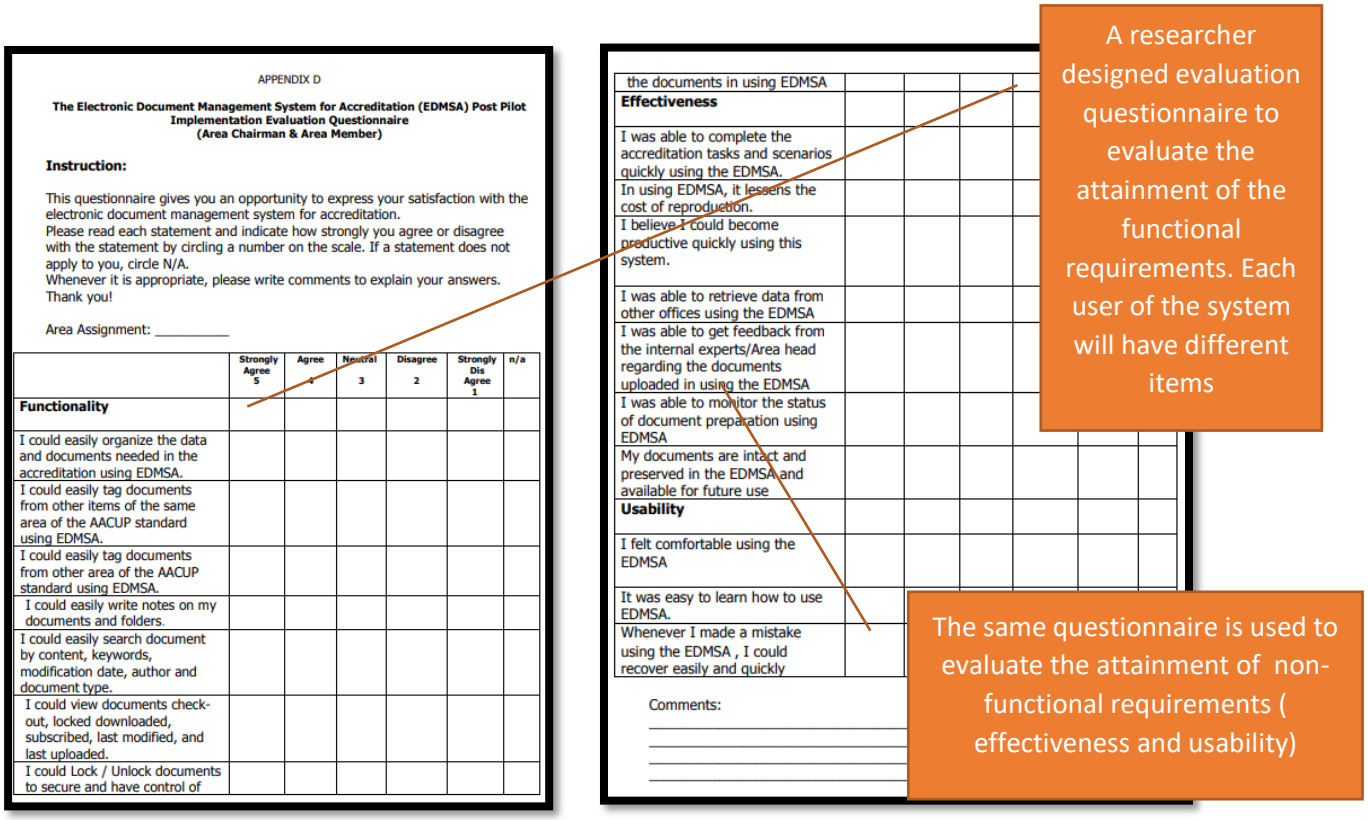
If the method is in a form of interview or survey. This portion will explicitly describe the guide or survey questions.

T

Evaluation

A Post pilot implementation test which is an adaptation of Alshish (2010) evaluation questionnaire was given to seven (7) users of the electronic document management system to support the accreditation of Bukidnon State University – Information Technology Department. The proponent used a simple feedback questionnaire (see appendix D) to measure the effectiveness of the system. This feedback questionnaire contains questions related to the functionality, effectiveness, and usability of the system. To enrich the data for evaluation an interview is also conducted to the same respondents. The data gathered in the evaluation phase is processed and descriptive analysis of the result is utilized.

*Figure **Error! No text of specified style in document.**-9 Sample discussion on how to evaluate the system*



APPENDIX D

The Electronic Document Management System for Accreditation (EDMSA) Post Pilot Implementation Evaluation Questionnaire (Area Chairman & Area Member)

Instruction:

This questionnaire gives you an opportunity to express your satisfaction with the electronic document management system for accreditation.
Please read each statement and indicate how strongly you agree or disagree with the statement by circling a number on the scale. If a statement does not apply to you, circle N/A.
Whenever it is appropriate, please write comments to explain your answers.
Thank you!

Area Assignment: _____

	Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Dis Agree 1	n/a
Functionality						
I could easily organize the data and documents needed in the accreditation using EDMSA.						
I could easily tag documents from other items of the same area of the AACUP standard using EDMSA.						
I could easily tag documents from other area of the AACUP standard using EDMSA.						
I could easily write notes on my documents and folders.						
I could easily search document by content, keywords, modification date, author and document type.						
I could view documents check-out, locked downloaded, subscribed, last modified, and last uploaded.						
I could Lock / Unlock documents to secure and have control of						

the documents in using EDMSA						
Effectiveness						
I was able to complete the accreditation tasks and scenarios quickly using the EDMSA.						
In using EDMSA, it lessens the cost of reproduction.						
I believe I could become productive quickly using this system.						
I was able to retrieve data from other offices using the EDMSA						
I was able to get feedback from the internal experts/Area head regarding the documents uploaded in using the EDMSA						
I was able to monitor the status of document preparation using EDMSA						
My documents are intact and preserved in the EDMSA and available for future use						
Usability						
I felt comfortable using the EDMSA						
It was easy to learn how to use EDMSA.						
Whenever I made a mistake using the EDMSA , I could recover easily and quickly						

Comments:

A researcher designed evaluation questionnaire to evaluate the attainment of the functional requirements. Each user of the system will have different items

The same questionnaire is used to evaluate the attainment of non-functional requirements (effectiveness and usability)

3.3 Evaluation

3.3.1 Performance Evaluation

The performance of the proposed algorithm can be analyzed in terms signal-to-noise ratio (SNR), peak-signal-to-noise-ratio (PSNR) and Structural SIMilarity (SSIM) index.

3.3.1. a Distortion Measurement

The changes to the stego image must be unnoticeable, which means that there should be no visible distortion. The distortion of an image can be measured by Mean Square Error(MSE) SNR,PSNR, and Structural SIMilarity (SSIM) index (Pradhan, Sahu, Swain, & Sekhar, 2016) which were calculated using equation 1, equation 2 , equation 3 and equation 4 respectively.

$$\text{MSE} = \frac{1}{mxn}\sum_{i=1}^{m}\sum_{j=1}^{n}\left(I_{ij} - SI_{ij}\right)^2 \quad (1)$$

The I_{ij} is the original image pixel value and SI_{ij} is the stego-image pixel value at i^{th} row and j^{th} column. The m and n are the number of rows and columns in the digital image. The MSE should have a small value as possible. Having a value of zero for the MSE means that the original image and the stego image are the same (Pradhan et al., 2016).

$$\text{PSNR} = 10 \text{ x } \log_{10}\frac{255x255}{MSE} \quad (2)$$

A measurement to evaluate the non-functional requirement of the study

The evaluation metrics will be dependent on the study

Learning Checker

System Evaluation Activity: (for individual work -problem with the farmer; group activity – capstone project
In your research study, Write on how you are going to evaluate the system, design a questionnaire if needed.

Ethical Considerations

If the research involves humans and animals the researchers must have ethical considerations. It is important that an agreement is formed between the research team and consenting subject.

Let us reflect

- Which parts of the activities are easy for me? why
- Which parts of the activities are challenging for me? Why
- What have I learned from the activities?

Congratulations!

You are now done with Chapter three of your Research Proposal. Way to go !!! and You are now ready to present your study to the panel