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SCHOOL OF GRADUATE STUDIES

"RESEARCH INTO IMPROVING THE BUSINESS PROCESSES OF THE MAINTENANCE AND INVENTORY CONTROL UNIT." (CASE STUDY, GOLDEN TULIP HOTEL, KUMASI CITY.)

A DISSERTATION PRESENTED TO THE INSTITUTE IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN ADVANCED ICT STUDIES

(MANAGEMENT OPTION)

BY

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OCTOBER, 2009

DECLARATION

I hereby declare that, this study was under taken independently and it is my original work.

It is not a replication of any work either published or unpublished. All references made in this study were duly acknowledged. Finally, all aspects of this study have been discussed with and approved by my supervisor, Prof. V. Fournadjiev

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I declare that, this dissertation was written under my supervision and that, the Student has been consistent in his interaction with me for guidance and direction. He has my consent to present it for assessment.

Signature ..... Date .....

PROF. V. FOURNADJIEV

(SUPERVISOR)

DEDICATION

I dedicate this study to my parents, Mr. Raphael K. Asense and

Mrs. Mary A. Asense

ACKNOWLEDGEMENTS

IN THE NAME OF THE ALMIGTHY GOD, THE MOST COMPASSIONATE, who all thanks and adoration shall be given for his guidance and protection. For it was through him that I have been able to sail through this level of education.

There is nothing better doing, than to at this juncture; express my profound gratitude to all and sundry that helped in diverse ways to make the study a success.

Firstly, I wish to render my sincere and countless thanks to my supervisor, Prof. V. Fournadjiev for his constructive criticisms and suggestions. Furthermore, his thoughtfulness and professionalism exhibited in supervising the study to its successful completion.

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ABSTRACT

The need for businesses in Ghana to step up or increase their managerial processes owing to the complexities that has arisen in strategic decision making in recent times cannot be overemphasized. Therefore, there is the need to investigate whether the use of Business Process Reengineering (Optimization of processes) and Automation of some processes in the Maintenance and Inventory Control unit of business organizations will culminate in a corresponding increase or decrease in the quality of services rendered by the unit.

The existing system of the Maintenance and Inventory Control Unit of Golden Tulip Hotel, Kumasi City was modeled using flowchart and activity diagram after a series of interviews with key personalities in that unit and the hotel at large. This model was fully analyzed to elicit bottlenecks therein. A "*to be*" state model was designed bringing into focus the concept of centralized database. The proposed system was checked for its effectiveness and efficiency and it was found that, the known problems of the existing (old) system will to a greater extent, be effectively handled by the proposed system. Furthermore, the proposed system is expected to be more efficient in comparison to the former.

It is recommended that, a software be developed based on the study, since *off-the-shelf* software are mostly seen to under perform or are too complex even-though they may be relatively cheaper.

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CHAPTER 1

INTRODUCTION

1.0 Background Information

In years past, businesses were mainly ran with little or no automated Information systems. However, the *Information Age* has changed the trend, allowing for electronic data/information management. This was required due to the complexity- i.e. in strategic decision making, customer's quest for quality products, quick customer service provision, supplier chain management etc. - which has arisen in modern ways of managing businesses.

With the introduction of electronic data/information management, disparate systems were built to manage various departments in a company as the need arose. For example, the Finance Department may have the payroll system; the Human Resource Department may also have the staff management system etc. This approach worked well but also came with its down side (Ptak & Noel 1998). This had to do with each department financing and deploying its own system and more. There was mostly duplication of effort since some departments could be managing similar data separately. This meant that, there was no sharing of data online.

To break through this problem, the approach of having a centralized database that is accessed by various departments was developed. By this, duplication of effort was curbed and resources were also combined from various departments to manage the common – i.e. centralized- data repository.

There is, however, the growing need to ascertain whether with the approach of Business Process Reengineering (Optimization of business processes) and Automation of some business processes in the Maintenance and Inventory Control Unit, to run on a centralized database will bring about efficiency in that unit and in the organization at large.

Earlier studies have proven that, the Electronic and Centralized database systems have come a long way to mitigate most managerial decision making problems (Bereczki, 2002) and (Blackman et al 2002). Also, Business Process Reengineering is a perfect approach in fine-tuning business processes in achieving efficiency, (Hammer, 1996) and (King, 1996).

The Maintenance and Inventory Control Unit has processes like equipment labeling, task scheduling, probing of faults, repair of equipment, snagging, equipment requisition and purchase etc. These aforementioned processes when undertaken run the Maintenance and Inventory Control Unit. They are therefore deemed business processes. This thesis will perform a research and optimization process on the business processes of the Maintenance and Inventory Control Unit, - case study, ground as the Golden Tulip Hotel, Kumasi City- and ascertain the effects on the unit's service delivery to other departments.

1.1 Problem Definition

As mentioned earlier on in the previous paragraphs, businesses have gone through a series of developments in terms of data management and business process automation. The level of complexity had made it a daunting task- in most cases- for managers of today to take strategic decisions without the help of Decision Support Systems (DSS) and other software which run on centralized databases with Database management software or applications. Business process reengineering (BPR) – i.e. process optimization- and process automation has then become the crux of business growth (Harmon, 2003).

It is observed that, most *off-the-shelf* software applications do not meet the basic needs of the environment they are meant for and the maintenance unit is no exception. The software are seen to be either too complex or may not cater for all requirements, hence, not meeting expectations. In view of this, the project seeks to do a thorough system analysis and design to come out with a perfect solution that meets the environment's specific needs- i.e. a customized product.

This thesis will look at the efficiency level after an optimization process, and the automation of the maintenance and Inventory Control Unit's business processes.

1.2 Objective of the Study

This research seeks to come out with a design and/or recommendation(s) that will help optimize the business processes or activities and hence will be used in the automation of some activities in the Maintenance and Inventory Control Unit -Golden Tulip Hotel, Kumasi City. It is hoped that, the design and/or recommendation(s) and the suggested automation will help bring about efficiency in similar units in other organizations.

The objectives include:

- ✓ Studying the existing system- Maintenance and Inventory Control Unit- and eliciting its bottlenecks.
- ✓ Modeling the existing Maintenance and Inventory Control Unit system
- ✓ Possibly eliminating some activities deemed redundant
- ✓ Identifying processes that can be automated
- ✓ Modeling the proposed or 'new' Maintenance and Inventory Control Unit system
- ✓ Measuring the efficiency of the proposed system as against the existing one

To achieve these objectives, the existing system in the Golden Tulip Hotel, Kumasi City, is to be studied and the bottlenecks in the current system elicited. To do this, the department's reports and other relevant sources will be studied to extract the required information. The outcome of the review will help formulate potent questions for interviewing some managers and other employees deemed relevant to the study.

Alternatively, questionnaires will be designed. Outcome of the review, interview and/or questionnaires will then render a good picture of the "as-is" state of the company. A *flowchart* and an *activity diagram* will then be used to model the current Maintenance and Inventory Control Unit processes to get its "as-is" state.

Optimization will then be performed on each process with the aim of making it efficient, noting which processes that can be automated. This entails a careful study of the "as-is" state and taking out redundant or the undue bureaucratic processes. The output of the optimization process will be the "to-be" state of each process. The bottlenecks when thoroughly analyzed will help model a 'new' system. A *use-case* diagram will also be made to see the interaction between the new system and the users. The proposed system will be subject to scrutiny by management to ensure that, their requirements are met. The efficiency of the 'new' or proposed system will then be measured as against the existing one.

A recommendation will then be made based on the outcome of the study, bringing into focus the efficiency of the 'new' system. Also, a critical analysis will be made on either have the new system implemented or not.

1.3 Research questions

The main research question is:

"How will the optimization and automation process of the Maintenance and Inventory Control Unit's activities impact on the performance of the Unit?"

To answer the aforementioned question, further sub-questions were defined as follows:

- ✓ *what is the current or existing Maintenance and Inventory Control Unit system?*
- ✓ *what are the challenges or bottlenecks in the existing system?*
- ✓ *is the existing system efficient or not?*
- ✓ *did the proposed system mitigate the existing systems bottlenecks?*

The first sub-question will be answered through the use of tools of literature review –i.e. interview or questionnaire research methodologies. The outcome of this will help model the existing system using a *flowchart* and an *activity diagram*. This will also help elicit its challenges or bottlenecks. This invariably answers the second sub-question. Literature review methodologies will also be used to extensively define and explain efficiency pertaining to business. The research will try to know how efficient the existing system is currently.

Lastly, knowing the bottlenecks from previous work, the "as-is" state model will be optimized by removing redundant and undue bureaucratic processes. Also, processes will be checked for possible reengineering and automation. A new model will then be made, termed "to-be" state. A *use-case* diagram will also be developed to indicate *user-system* interaction for better understanding. All these when done will give rise to the proposed system. With the new system modeled, it will be tested for acceptance. A vivid picture will then be gotten of what challenges the proposed system will mitigate.
The Maintenance and Inventory Control Units in various organizations will see this research work to be very useful since they perform similar operations.

1.4 Research design

This research entails both theoretical and analytical study. As shown in figure 1.1, a period of five weeks will basically be for historical review and conducting of interviews to elicit information about the existing system, taking into account the tools and processes they use. Alternatively, questionnaires may be designed if the need arises. This forms the first phase of the study. Literature review will be performed first. This is constituted by the review of the department's reports, reading on related work and on the concept of efficiency. All the above-mentioned will be performed in parallel to help formulate potent questions for interviewing. The departmental heads- approximately seven in number- some users and the general manager will be interviewed. The output of the interview will form the basis for understanding the existing system. In the event that questionnaires are required, the target group shall be the departmental heads, users, suppliers and the general manager. A total of about 15 questions may be required to get the required data. The questionnaire or interview is expected to render data on current bottlenecks in the system, tools and procedures used for the various processes, whether there is a need for change and will the change be met positively.

Phase two, which is modeling and optimization will span the period of fifteen weeks. Analysis on the gathered information will be done in the sixth week to create a model of the existing system. Confirmation is made on the "as-is" model and the remaining weeks in phase two serves as a period for modeling the proposed system. In the last phase, a Unified Modeling Language (UML) diagram will then be created for the proposed system to help explain *user-system* interactions. The proposed model is then scrutinized by stakeholders to finalize the design. The thesis write-up will then be finally compiled.

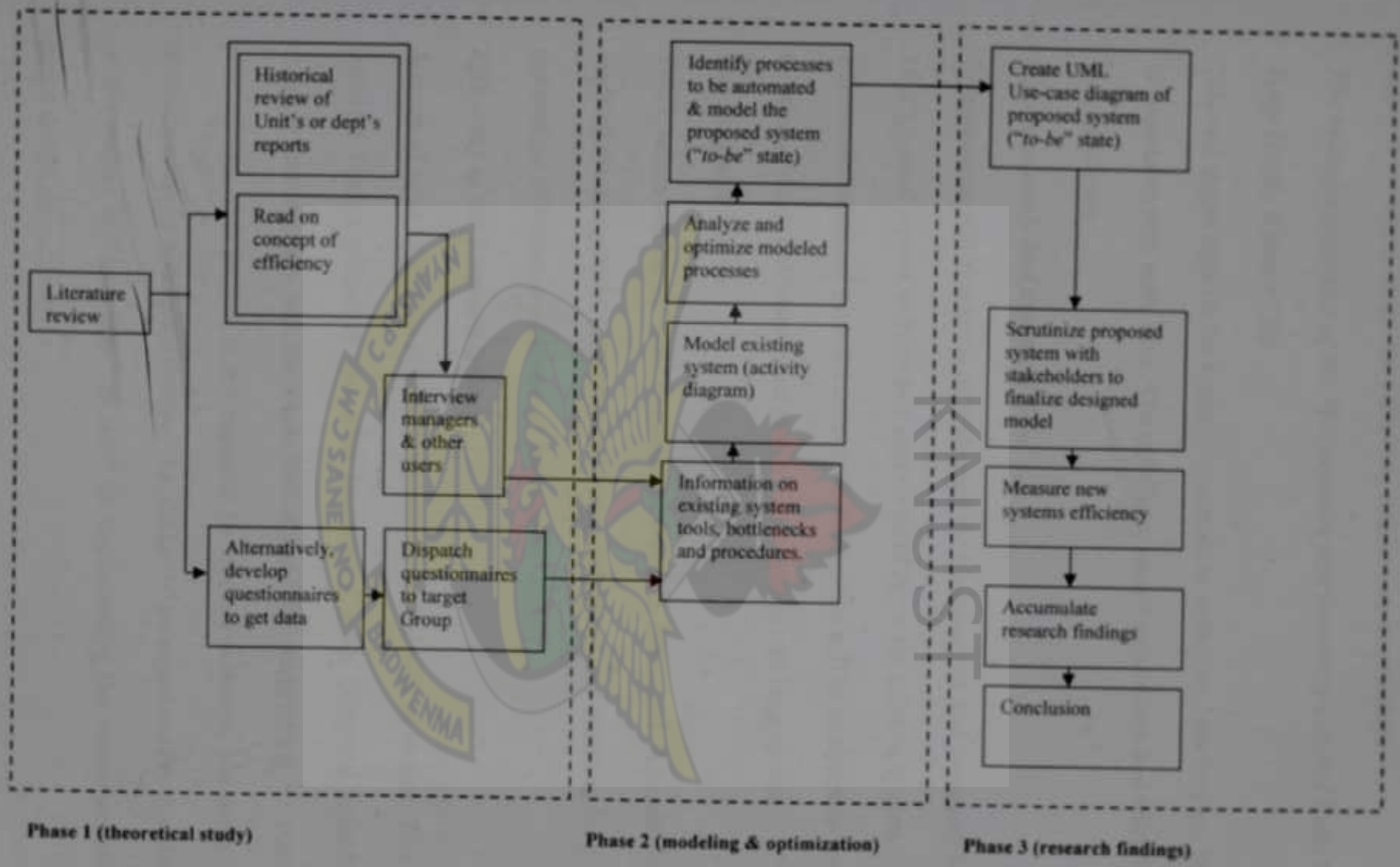


Figure 1.1 : A diagram on the Research Design

1.5 Research scope

To define the research scope, the following outlines are emphasized:

- ✓ ***The business processes of the Maintenance and Inventory Control Unit- Golden Tulip Hotel, Kumasi City***

  This will throw light on the business processes or activities, how they are interrelated or associated with each other. The existing system's subsystems and workflow will then be known.

- ✓ ***System analysis and historical data***

  This research will also focus on reviewing the Maintenance and Inventory Control Unit's annual reports and conduct interviews to know the existing system. Information obtained from the interviews and reports will be analyzed to know the existing systems bottlenecks and hence a new system will be proposed.

- ✓ ***The Proposed system***

  This is where the "to-be" state or proposed system is developed. A model will be made of the subsystems, critically analyzing, optimizing and checking for possible automation of business processes of the existing system.

- ✓ ***Efficiency of the proposed system***

  A study of what efficiency in business generally means will be sought. Theories and concepts behind efficiency and what economical goals (financial considerations) example investments etc the organization may be undertaking to ensure high productivity. This project is not expected to produce software, but come out with recommendations and also a design, - i.e. design of proposed model. Another aspect of this project will look into "the how" of implementing the recommendations and hence design the software.

1.6 Outline of the study

Chapter 1

This chapter covers the changes that arose, in terms of Information Technology (IT) in the management of business organizations. It also gives us what the study is all about.

Chapter 2

This chapter throws light on the earlier work done in the field of equipment maintenance. Also, it talks about the business processes found in the Golden Tulip Hotel, Kumasi City.

Chapter 3

This chapter covered the analysis of the existing system, formal presentation of the business processes and finally, modeling of the existing system.

Chapter 4

This chapter covered the possibility of optimizing and automating business processes of the existing system. Also, a model of the proposed system was developed.

Chapter 5

This chapter will give insight into the effectiveness and efficiency of the proposed system.

Chapter 6

This chapter outlines the added features of the proposed system and also the recommendations given.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Companies spend thousands if not millions of US dollars to invest in machines and other equipment that together with their staff ensure the churning out of services meant for their valued customers. However, since machines may not be in shape all the time as were bought, there is the need to restore them to shape through maintenance mechanisms. Just think of the situation where machines are not maintained but are discarded for new ones. This to a greater extent will be very costly than maintaining them in most cases. The work of the maintenance unit in every organization then becomes paramount, ensuring a cut down in cost incurred in investing in new machines. The overwhelming nature of tasks handled by the maintenance units each day has called for the use of Information Technology to lessen the burden by developing automated system to assist in their operations. Hence, the development of maintenance application software.

2.1 Related work

Latest developments in the software industry zooms in on strengthening technology for hybrid reasoning, explaining answers from heterogeneous applications, Semantic Web, deductive question-answering, representing and reasoning with multiple contexts, ontology engineering, knowledge aggregation, and knowledge-based technology for intelligence analysts and other knowledge workers.

It is therefore seen that, software are becoming more and more intelligent, analyzing trends and subsequently rendering possible solutions. All these are geared towards enhancing business processes.

A business process is a collection or group of activities designed to produce a specific output for a particular customer or market. It implies a strong emphasis on how the work is done within an organization. A process is thus a specific ordering of work activities across time and place, with a beginning, an end, and clearly defined inputs and outputs: a structure for action.

Available online at: *www.sparxsystems.com.au* [accessed 11th April, 2009]

There are three types of business processes:

1. Management processes, the processes that govern the operation of a system. Typical management processes include "Corporate Governance" and "Strategic Management".
2. Operational processes, processes that constitute the core business and create the primary value stream. Typical operational processes are Purchasing, Manufacturing, Marketing, and Sales.
3. Supporting processes, which support the core processes. Examples include Accounting, Recruitment, and Technical support.

Available online at: http://en.wikipedia.org/wiki/Business_process

[Accessed 11th April, 2009]

It will be noticed that, business processes are vital to the existence of business organizations. In view of this, business process simulation was developed to help managers better understand their businesses and business process automation was also brought about to enhance the workflow by cutting down lots of human interventions thereby reducing errors and bringing about efficiency.

Business Process Simulation

Business processes simulation aids in understanding, analyzing, and designing processes. With the use of simulation, the (re)designed processes can be evaluated and compared. Simulation gives or renders quantitative estimates of the impact that a process design is likely to have on process performance and a quantitatively supported choice for the best design can be made (Jansen – Vullers & Netjes 2006).

Business Process Automation

Business Process Automation is the practice of analyzing, documenting, optimizing and then automating business processes. The business process is the flow of information, modified by value-added tasks, that begins with the first contact with a prospective customer and continues through delivery of a finished product. Well-developed business processes can create a seamless link from initial customer interface through the supply chain. Automation of those processes improves the accuracy of the information transferred and ensures the repeatability of the value-added tasks performed.

Available online at: *http://www.pele-sol.com/pele_factsheet_new.pdf* [accessed 11th April, 2009]

Manual business activities are cumbersome, time-consuming, error-prone, and can place a huge strain on both human and financial resources. By automating these processes – and ultimately, streamlining and accelerating them – organizations can increase agility, boost staff productivity, and reduce overhead.

Recent work in the maintenance and inventory control units point to preventive and predictive maintenance. The intelligent predictive decision support system (IPDSS) for condition-based maintenance (CBM) supplements or adds on to the conventional CBM approach by adding the capability of intelligent condition-based fault diagnosis and the power of predicting the trend of equipment deterioration (Yam et al 2001). Some known *off-the-shelf* maintenance application software that have been developed include:

- ✓ IMS, fleet *maintenance software* for vehicles and *equipment*,-Windows *software* for fleet and vehicle *maintenance* by Innovative *Maintenance* Systems.
  Available online at: *www.mtcpro.com* [accessed 11th April, 2009]

- ✓ CMMS - Preventative *Maintenance Software* for *Equipment*, Fleet...
  EZ *Maintenance* CMMS / preventative *maintenance software*; provides total preventive *maintenance* management for *equipment*, vehicle, and fleet.
  Available online at: *www.ez-maintenance.com* [accessed 11th April, 2009]

- ✓ KeepTrak Preventive *Equipment Maintenance* Business *Software:* Preventive *maintenance* management business *software* products to manage workflow schedules, inventory, suppliers, parts ordering,…

  Available online at: *www.keeptrak.com*[accessed 11th April, 2009]

- ✓ *Equipment Maintenance Software*: vehicle *maintenance software* ...

  Free interactive directory to quickly narrow your choices and contact multiple vendors.

  Available online at: *www.capterra.com* [accessed 11th April, 2009]

- ✓ TATEMS Fleet *Maintenance Software Equipment*

  Available online at: *www.tatems.com* [accessed 11th April, 2009]

In view of all these, management of Golden Tulip Hotel, Kumasi City had not been successful in acquiring for their maintenance and inventory control unit, suitable software. This is so owing to the fact that, most *off-the-shelf* software are either too complex or under perform.

2.2 Comparison to this work

Lots of software applications have been developed over the years geared towards enhancing the efficiency of the maintenance units, e.g. - ***TATEMS Fleet Maintenance Software Equipment*** and ***KeepTrak Preventive* Equipment Maintenance *Business Software***. The maintenance units in all organizations have similar goals and to a greater extent perform similar functions, but the workflows differ from organization to organization, hence making the development of software applications not becoming a-once-size-fit-all.

However, concepts and functionalities - i.e. predictive and preventive maintenance - in the existing software applications are still relevant and will be part of the proposed design. The main differentiation comes at the point of organizing the modules to streamline and also fit well with the organizations workflow. This project seeks to come out with a customized design that will be later developed into application software. Earlier ideas of predictive and preventive maintenance will be looked at and made part of the design.

2.3 A brief review of the business processes in the hotel, Golden Tulip Kumasi City

The hotel is made up of a number of departments, some of which are; the Experience department, Maintenance and Inventory Control Unit, Information Technology department, Human Resource department, Accounts, Catering etc. These abovementioned units or departments have business processes that operate within and amongst the departments harmoniously to achieve outputs.

For instance, the maintenance and inventory control unit, possesses many business tasks like, equipment labeling, task scheduling, repair of equipment, equipment requisition and purchase, Snagging etc. They basically ensure that, all the pieces of equipment used in the organization are always in good shape.

This unit in Golden Tulip Hotel also ensures that, there is available; water, Liquefied Petroleum gas and electricity. Their work is characterized by lots of record keeping and reporting. Every unit in the hotel serves them with maintenance problem or task, making the unit one of the busiest.

Looking at the array of tasks or problems needed to be handled by the maintenance unit each day, there was the need to automate some of their business processes and also streamline their workflow. To do this, it is necessary to delve deep into what automation and optimization is, what methodologies are available and finally, what is efficiency pertaining to business. The subsequent sub-sections will be used to expatiate on the above-mentioned terminologies.

2.4 Definitions of Optimization:

- ✓ In mathematics, the term optimization, or mathematical programming, refers to the study of problems in which one seeks to minimize or maximize a real function by systematically choosing the values of real or integer variables from within an allowed set.

  Available online at: *http://en.wikipedia.org/wiki/Optimization_mathematics*

  [Accessed 15th April, 2009]

- ✓ In computing, optimization is the process of modifying a system to make some aspect of it work more efficiently or use fewer resources.

  Available online at: *http://en.wikipedia.org/wiki/Optimization_computer_science*

  [accessed 15th April, 2009]

- ✓ The design and operation of a system or process to make it as good as possible in some defined sense.

  Available online at: *http://en.wiktionary.org/wiki/optimization*

  [accessed 15th April, 2009]

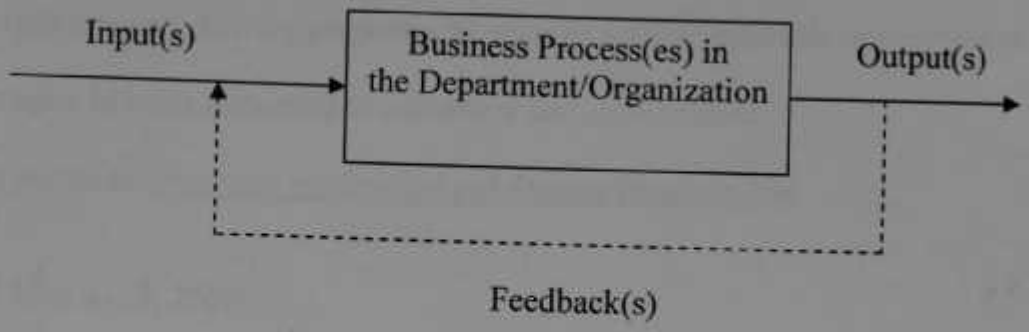


Figure 2.1: A diagram indicating a Process's Input, Output and Feedback interactions

Clearly, from the above definitions, process optimization is a means to ensuring that, a particular process gives off its best, by using less inputs and rendering more outputs –i.e. the process then becomes very efficient. Feedbacks from the output gate helps to get data/information, based on which analysis is made to optimize the business process(es). Business Process Reengineering is one means of achieving optimization.

2.5 Definitions of Business Process Reengineering:

- ✓ Business Process Reengineering (BPR) is a management approach aiming at improvements by means of elevating efficiency and effectiveness of the system. Available online at: *http://en.wikipedia.org/wiki/Business_process_reengineering* [accessed 15th April, 2009]

- ✓ A systematic, disciplined improvement approach that critically examines, rethinks, and redesigns mission-delivery processes in order to achieve dramatic improvements in performance in areas important to customers and stakeholders.

  Available online at: *www.gao.gov/special.pubs/bprag/bprgloss.htm*

  [accessed 15th April, 2009]

- ✓ Business process reengineering (BPR) is, in *computer science* and management, an approach aiming at improvements by means of elevating efficiency and effectiveness of the business process that exist within and across organizations. The key to BPR is for organizations to look at their business processes from a "clean slate" perspective and determine how they can best construct these processes to improve how they conduct business.

  Available online at: *http://en.wikipedia.org/wiki/Business_process_reengineering*

  [accessed 15th April, 2009]

This process possesses a life cycle as shown in figure 2.2

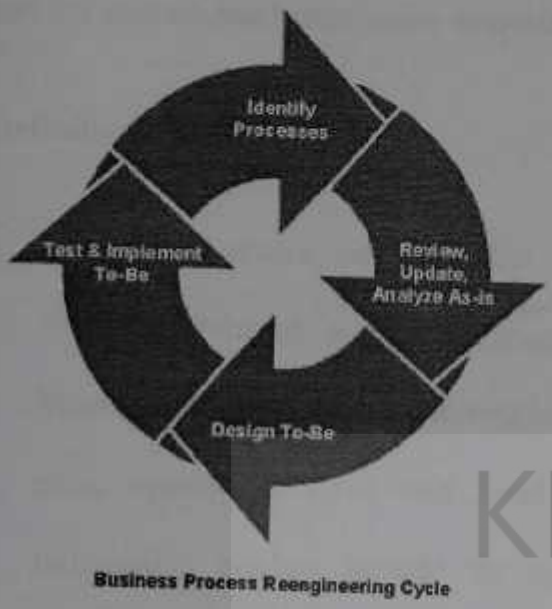


Figure 2.2 : Business Process Reengineering Cycle

Available online at: *http://en.wikipedia.org/wiki/Business_process_reengineering*

[accessed 15th April, 2009]

2.6 Definitions of Automation

- ✓ To replace or enhance human labour with machines.

  Available online at: *http:// en.wiktionary.org/wiki/automate*

  [accessed 18th April, 2009]

- ✓ Methods of production that rely on mechanical or electronic technologies as a replacement for human labour.

  Available online at: *http:// bitbucket.icaap.org/dict.pl*

  [accessed 18th April, 2009]

2.7 What is efficiency?

To know what efficiency is, we have to take a look at some known definitions that will suit our context and hence, some examples to make the definitions clearer.

Definitions of efficiency:

- ✓ Is a measure of time, cost and effort.

  Available online at: *www.Wikianswers.com* [accessed 14th April, 2009]

  Measures of an efficient information system include its productivity, processing time, operational costs and level of automations. Measures of an efficient information product include the speed of processing, the functionality of the solution, the ease of use of the solution and output, and the cost of information processing.

- ✓ The ratio of the output to the input of any system.

  Available online at: *http://wordnet.princeton.edu/perl/webwn*

  [accessed 11th April, 2009]

- ✓ Efficiency is a measure of how much effort is required to achieve a required outcome.

Available online at: *www.housingcorp.gov.uk/upload/ppt/What_is_Efficiency.ppt*

[accessed 11th April, 2009] –secondary source

Two different cars, A and B travel the same distance –say100km - with car A using 8 litres of fuel and B using 12 litres. Car A will then be said to be efficient than B.

- ✓ Making the best use of the resources available for the provision of public services (Gershon n.d.)

2.8 What is Snagging?

Snagging is the work of inspection, faultfinding, making an inventory of, and rectifying defects in a house, apartment, duplex or any building construction Available online at: *http://www.snagbook.com/pages/what_is.htm*

[accessed 11th April, 2009]

CHAPTER 3

ANALYSIS OF THE EXISTING SYSTEM

3.0 Introduction

In Section 2.3 of chapter 2, we outlined some departments in the hotel. It was also indicated that, these departments or units had business processes which operated within or across the department(s). Paragraphs in chapter 3 will generally be used to expatiate on the business processes; what it's function(s) is/are, it's actor(s), it's link(s) with other business processes, it's input(s) and finally what it's output(s) is/are.

From the historical review on the hotel, it was noticed that, the purchasing department has business processes such as; *"Fill purchase requisition form"," Create purchase order", "Contact suppliers"," Receive goods' waybill and invoice"," Check goods' quantity"," Check goods' quality" etc.* The security department has *"Book waybill"* business process and a lot more. With departments like Catering, Experience, Information Technology, Accounts, Human Resource, a clear picture is painted of the array of business processes we should expect in each department.

Firstly, a general concept will be created which underlines the characteristics of the business processes in the hotel. Secondly, an indication will be given on how the concept operates by using business processes of the maintenance and inventory control unit and finally, this will be summarized in a tabular form. In view of the fact that, the maintenance unit is our core concern or in other words, since this project considers investigating the possibility of enhancing the maintenance and inventory control unit's business processes, the subsequent sub-sections in this chapter will introduce us to the model of the existing subsystems. This model will serve as the basis for rendering an analysis to elicit the bottlenecks inherent in the system.

3.1 A formal presentation of business processes

As indicated in figure 3.1, a business process has parameters such as Function(s), Actor(s), Link(s), Input(s) –i.e. internal or external to the process- and finally Output(s). Each business process has one or more function(s) that operate(s) on internal or external input(s) of the business process.

An input is deemed internal if the input to the business process is not generated by a preceding business process as an output. However, it is considered an external input if it was generated by another business process as an output. In other words, an output of a preceding business process that serves as an input to another business process qualifies as an external input.

The corresponding actors work towards the aim of a particular business process by executing a set of functionalities the business process possesses. The output of a particular business process may serve as an input to the succeeding one. By this way, a link is created between the preceding and succeeding business processes.

Let P_i be a business process defined by

$$P_i(F_i, A_i, L_i, I_i, O_i)$$

Where F_i, A_i, L_i, I_i and O_i are parameters of the business process P_i respectively.

Hence the set of business processes is given by

$$P=\{ P_1, P_2, P_3, \ldots, P_k \}$$

The set of functions belonging to P_i can be defined as

$$F_i = \{ F_{i1}, F_{i2}, F_{i3}, \ldots, F_{iu} \}$$

The set of actors belonging to P_i can be defined as

$$A_i = \{ A_{i1}, A_{i2}, A_{i3}, \ldots, A_{iv} \}$$

The set of Links belonging to P_i can be defined as

$$L_i = \{ L_{i1}, L_{i2}, L_{i3}, \ldots, L_{iw} \}$$

The set of inputs (external or internal) belonging to P_i can be defined as

$$I_i = \{ I_{i1}, I_{i2}, I_{i3}, \ldots, I_{ix} \}$$

And finally, the set of outputs belonging to P_i can be defined as

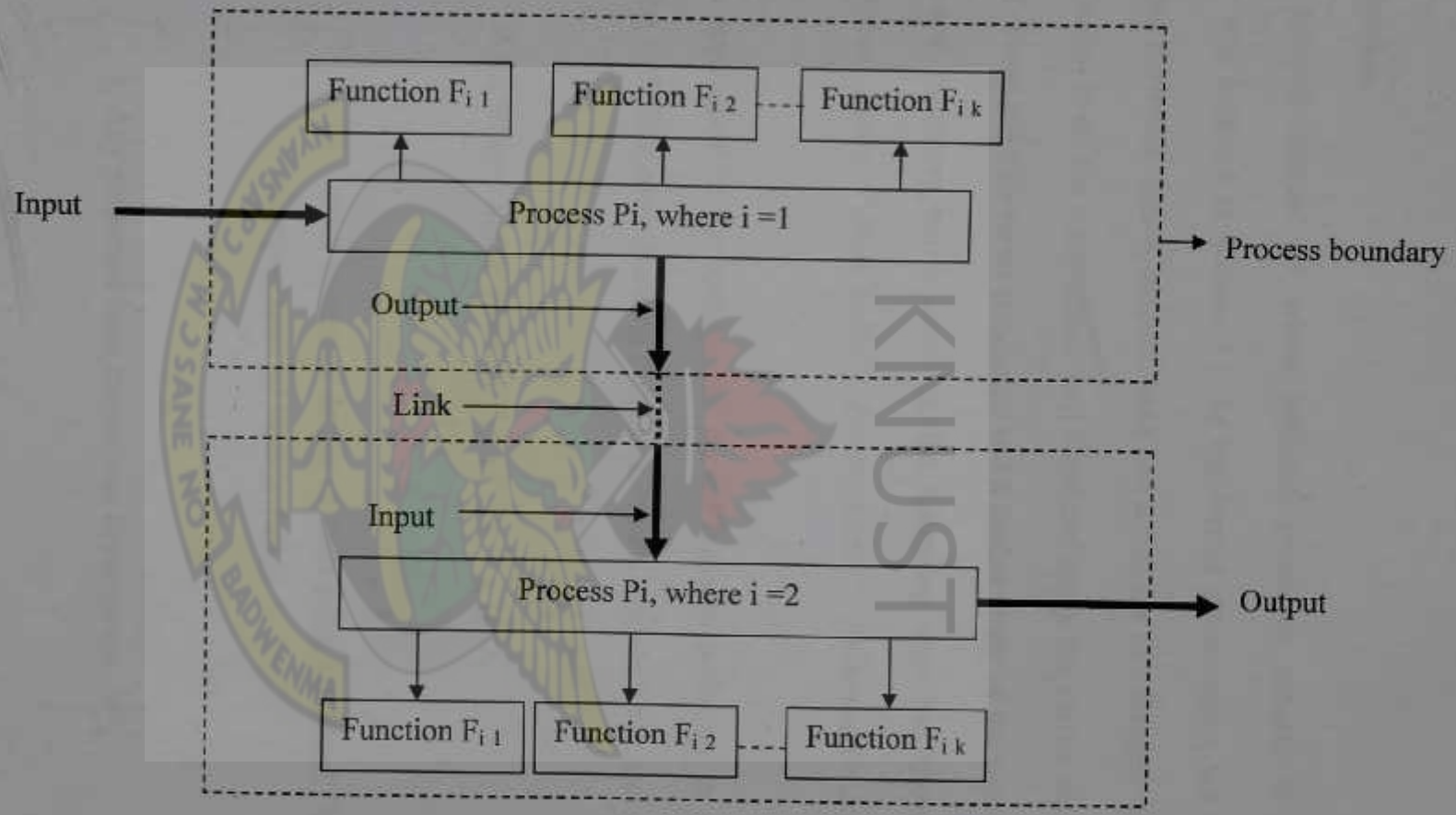
$$O_i = \{ O_{i1}, O_{i2}, O_{i3}, \ldots, O_{iy} \}$$

A business process may be linked to other business processes and hence a link belonging to P_i can be further defined as

$$L_{i1}(P_i, P_{i+1})$$

Note [i , k, u, v, w, x, y are integers >=0]

Figure 3.1 shows the parameters or components of a business process and its possible link(s) or interaction(s) with other business processes.



Note [i , k are integers >=0]

Figure 3.1 The parameters or components of a business process

3.2 Modeling the existing system- maintenance and inventory control unit

3.2.1 Introduction

The general concept on which business processes operate in a business organization was outlined in section 3.1. In the formal presentation, we had a clear picture of what attributes, inputs, outputs, links and actors are of a business process. It is now time to zoom in on the maintenance unit itself and apply the earlier definition seen in section 3.1. From the interviews conducted and a further study of the workflow of the maintenance and inventory unit's activities, the following were the known business processes: *"Report faults" "Book faults" "Review faults" "Assign technician" "Work on fault"*.

In the application of the concept, the carved business processes as seen above will be outlined with their corresponding functions, inputs, outputs, links and actors.

P_1= {"Report faults"}; where P_1= {F_1, A_1, L_1, I_1, O_1}

F_1= { 1. enter necessary details of fault using Microsoft Outlook or report fault by Walkie Talkie }

A_1= { 1. Any personnel from the various departments }

I_1= { 1. fault's priority and status (internal)
2. fault's owner and department/section (internal)
3. fault's description and reporter (internal) }

O_1= { 1. Fault's report }

$L_1 = (P_1, P_2)$

P_2= {"Book faults"}; where P_2= {F_2, A_2, L_2, I_2, O_2}

F_2= { 1. Enter submitted parameters of fault into MS Outlook if Walkie Talkie was used
2. Check for correctness of sent information }

A_2= { 1. Technical Service Coordinator }

I_2= { 1. Sent information from various departments (external) }

O_2= { 1. List of reported faults }

$L_2 = (P_2, P_3)$

P_3= {"Review faults"}; where P_3= {F_3, A_3, L_3, I_3, O_3}

F_3= { 1. Go through the list of reported faults and prioritize them }

A_3= { 1. Technical Service Coordinator or
Assistant Maintenance Manager or
Chief Engineer }

I_3= { 1. List of faults }

O_3= { 1. Reviewed list of faults for the day }

L_3 = (P_3, P_4)

P_4= {"Assign technician"}; where P_4= {F_4, A_4, L_4, I_4, O_4}

F_4= {
1. Go through the list of reviewed faults for the day
2. Check the list of available staff and their corresponding skill(s)
3. Assign staff based on required skill or experience for the task
}

A_4= { 1. Technical Service Coordinator or Assistant Maintenance Manager or Chief Engineer }

L_4= { 1. Reviewed list of faults for the day }

O_4= { 1. List of staff with their corresponding task(s) for the day (i.e. Assignment list or Schedule). }

$L_4 = (P_4, P_5)$

P_5= {"Work on fault"}; where P_5= {F_5, A_5, L_5, I_5, O_5}

F_5= {
1. Read through the reported fault's document
2. Inspect the faulty object on site
3. Report on the acquisition of a new component (partly or wholly) if needed.
4. Place a request to acquire a new component if needed
5. Book new component when bought
6. Create a report on state of work
7. Approve order form
}

A_5= {
1. Technician
2. Technical Service Coordinator or Assistant Maintenance Manager or Chief Engineer
3. General Manager
4. Accountant
}

I_5= {
1. Document on reported fault(s)
2. New components specification
}

O_5= {
1. Fault diagnosis report
2. Requisition report of new component
3. Report on successful or unsuccessful work done
}

Table 1 : A demonstration of Function(s), Actor(s), Input(s), Output(s) and Link(s) of businesses processes in a tabular form

#	Business Process	Function(s)	Actor(s)	Input(s)	Output(s)	Link(s)
1	Report faults (P_1)	1. Enter necessary details of fault using Microsoft Outlook or report fault by Walkie Talkie	1. Any personnel from the various departments	1. fault's priority and status (internal) 2. fault's owner and department/section (internal) 3. fault's description and reporter (internal)	1. fault's report	$L_1 = (P_1, P_2)$
2	Book faults (P_2)	1. Enter submitted parameters of fault into MS Outlook if Walkie Talkie was used 1 check for correctness of sent information	1 Technical Service Coordinator	1 Sent information from various departments (external)	1 list of reported faults	$L_2 = (P_2, P_3)$
3	Review faults (P_3)	1. Go through the list of reported faults and prioritize them	1. Technical Service Coordinator or Assistant Maintenance Manager or Chief Engineer	1. List of faults	1. Reviewed list of faults for the day	$L_3 = (P_3, P_4)$
4	Assign technician (P_4)	1. Go through the list of reviewed faults for the day 2. check the list of available staff and their corresponding skill(s) 3. assign staff based on required skill or experience for the task	1. Technical Service Coordinator or Assistant Maintenance Manager or Chief Engineer	1. Reviewed list of faults for the day	1. List of staff with their corresponding task(s) for the day (i.e. Assignment list or Schedule).	$L_4 = (P_4, P_5)$

5	Work on fault (P_5)	1.Read through the reported fault's document 2.Inspect the faulty object on site 3. Report on the acquisition of a new component (partly or wholly) if needed. 4. Place a request to acquire a new component if needed 5. Book new component when bought 6. Create a report on state of work 7. Approve order form	1. Technician 2. Technical Service Coordinator or Assistant Maintenance Manager or Chief Engineer 3.General Manager 4. Accountant	1. Document on reported fault(s) 2. New components specification	1. Fault diagnosis report 2. Requisition report of new component 3. Report on successful or unsuccessful work done	

Table 2 : A summarized form of table 1

#	Business Process	Function(s)	Actor(s)	Input(s)	Output(s)	Link(s)
1	Report faults (P_1)	$F_{1\,1}$	$A_{1\,1}$	$I_{1\,1}, I_{1\,2}, I_{1\,3}$	$O_{1\,1}$	$L_1 (P_1, P_2)$
2	Book faults (P_2)	$F_{2\,1}, F_{2\,2}$	$A_{2\,1}$	$I_{2\,1}$	$O_{2\,1}$	$L_2 (P_2, P_3)$
3	Review faults (P_3)	$F_{3\,1}$	$A_{3\,1}$	$I_{3\,1}$	$O_{3\,1}$	$L_3 (P_3, P_4)$
4	Assign technician (P_4)	$F_{4\,1}, F_{4\,2}, F_{4\,3}$	$A_{4\,1}$	$I_{4\,1}$	$O_{4\,1}$	$L_4 (P_4, P_5)$
5	Work on fault (P_5)	$F_{5\,1}, F_{5\,2}, F_{5\,3}, F_{5\,4}, F_{5\,5}, F_{5\,6}, F_{5\,7}$	$A_{5\,1}, A_{5\,2}, A_{5\,3}, A_{5\,4}, A_{5\,7}$	$I_{4\,1}, I_{4\,2}$	$O_{4\,1}, O_{4\,2}, O_{4\,3}$	

To model the maintenance and inventory control unit's existing system, this section will be used to give an overview of what generally transpires at the unit as was gotten from a series of interviews conducted.

The unit, on daily basis, undertakes these transactions:

- Reporting of Faults
- Take action on reported Faults
- Snagging
- Control the issuance of equipment for repairs

It must be noted that," *Report faults" "Book faults" "Review faults" "Assign technician" "Work on fault"* were the business processes created from the known earlier on mentioned daily transactions and hence must not be confused.

The maintenance unit is generally tasked with maintaining reported faults and also rendering routine maintenance of items/equipment in the hotel. They have plumbers, electricians, mechanics, and carpenters as skilled labours.

- **Reporting of Faults**

  Faults are reported via the use of Walkie Talkie or Microsoft Outlook (MSO) – i.e. create tasks. Some Personnel in the hotel can report fault(s) in a room or elsewhere to the appropriate authorities. Properties of the fault include its priority, status, owner etc. These must be indicated to allow for unique identification of venue and progress of work.

- **Take action on reported Faults**

  When a fault is reported via Walkie Talkie from a department, it is booked in the Microsoft Outlook by the Technical Service Coordinator (TSC). In an event that the reporter of the fault(s) uses MSO in the reportage, then booking is skipped, but it will be noticed by the TSC since the MSO runs in a networked environment. The Chief Engineer (CE) or Assistant Maintenance Manager (AMM) or the Technical Service Coordinator (TSC) assigns staff to the reported faults (tasks) based on the skill required. In an event that the fault is repaired, the technician notifies the TSC to double check. If that is done and the user –i.e. the head of where the problem was found- is satisfied, the status of the fault is then changed in the MS Outlook to ***completed***.

  A report of solved tasks is created daily by the TSC.

- **Control the issuance of equipment for repairs**

  The technician ascertains the faults and if need be, replaces the item/component. In an event that the item/component needs replacement, the new one picked from the Maintenance Unit's store is log in a book meant purposely for that. The logging is done by the technician in conjunction with the TSC.

- **Snagging**

  This activity is performed occasionally to know the state of equipment in each of the rooms. A report is generated at the end of the activity for assessment.

  Figure 3.2 summarizes what has been discussed above.

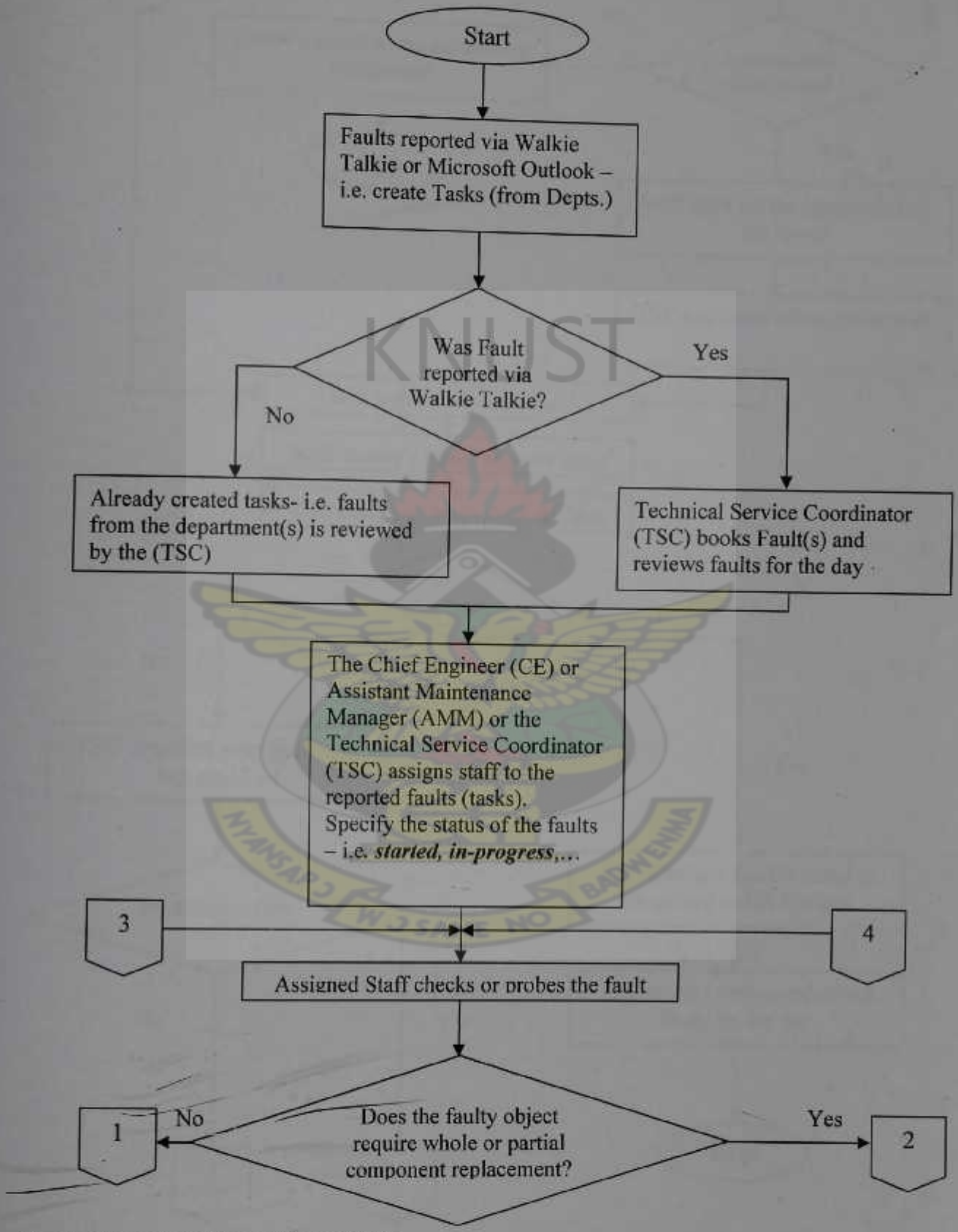
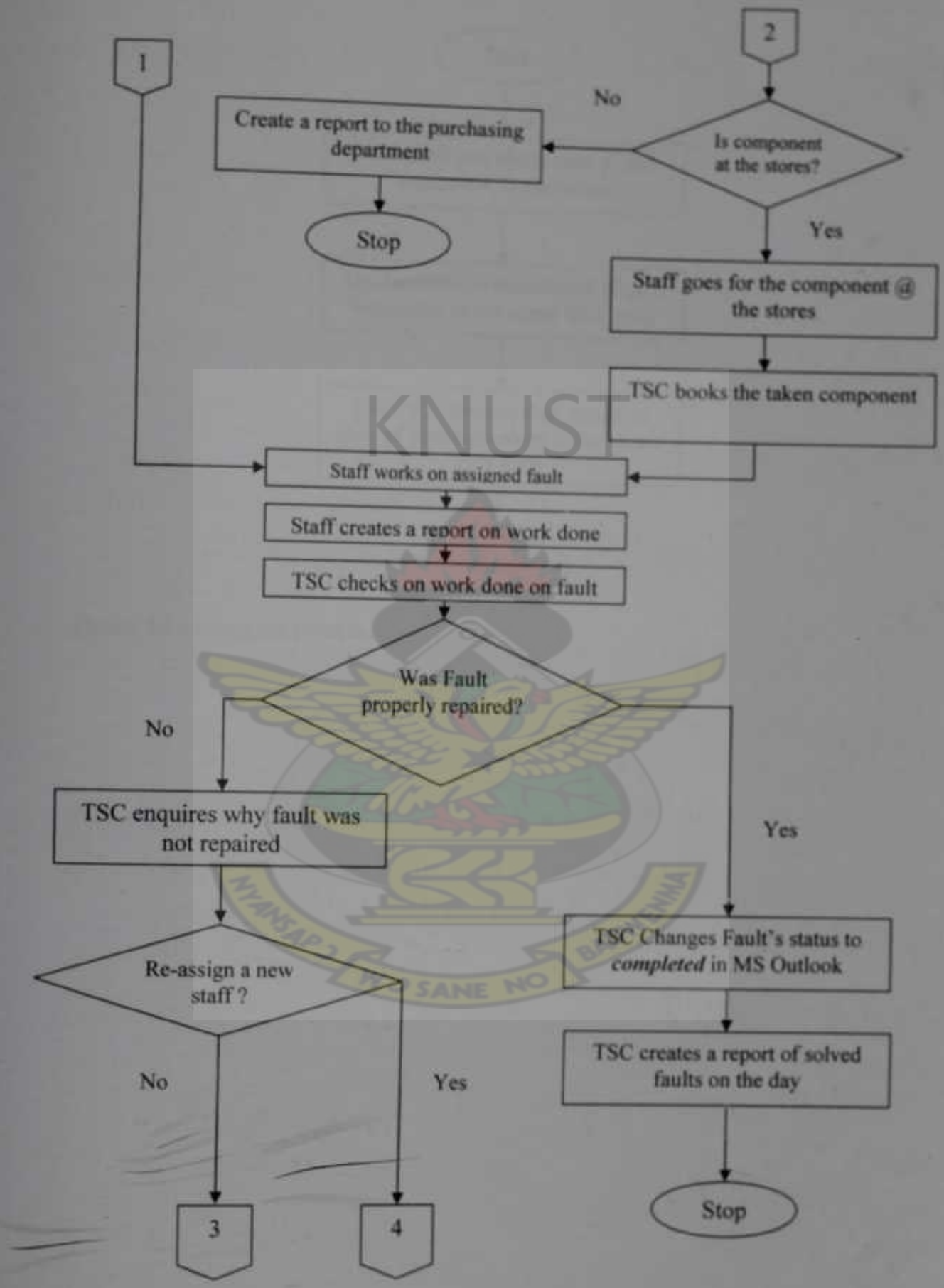


Figure 3.2 : Flowchart of the existing


1
2
No
Create a report to the purchasing department
Is component at the stores?
Stop
Yes
Staff goes for the component @ the stores
TSC books the taken component
Staff works on assigned fault
Staff creates a report on work done
TSC checks on work done on fault
Was Fault properly repaired?
No
TSC enquires why fault was not repaired
Yes
TSC Changes Fault's status to *completed* in MS Outlook
Re-assign a new staff ?
TSC creates a report of solved faults on the day
No
Yes
Stop
3
4

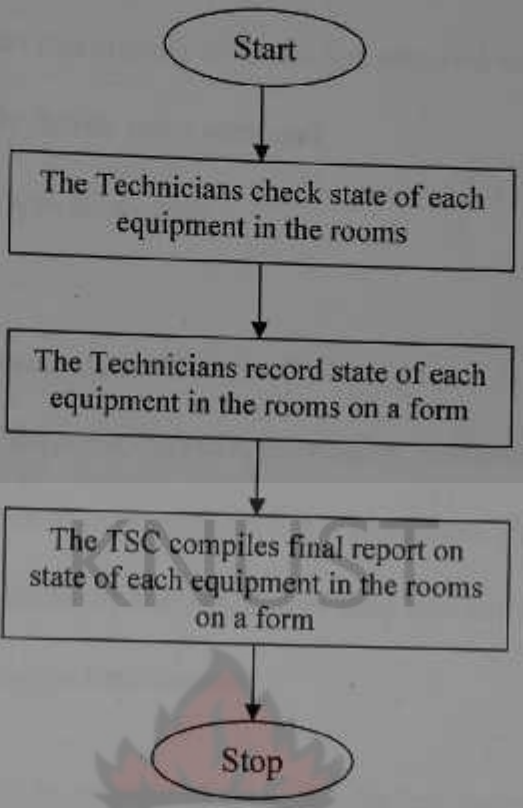


Figure 3.3 : Snagging process

Activity diagram on the existing Maintenance and inventory control unit system

The maintenance unit's system can broadly be classified into two subsystems known as:

- planned or periodically driven subsystem and
- unplanned or event driven subsystem

Planned or periodically driven subsystem

In the planned or periodically driven subsystem, preventive maintenance is carried out according to a fixed plan. Preventive maintenance is a systematic inspection, detection, correction, and prevention of incipient failures, before they become actual or major failures. Contrasted with corrective maintenance.

Available online at: http://www.businessdictionary.com/definition/preventive-maintenance.html. [accessed 25th April, 2009]

Unplanned or event driven subsystem

In the unplanned or event driven subsystem, reactive maintenance is carried out. That is to say maintenance including both reactive and emergency maintenance activities.

Available online at: *projgrid.osfc.state.oh.us/download.cgi*

[accessed 25th April, 2009]

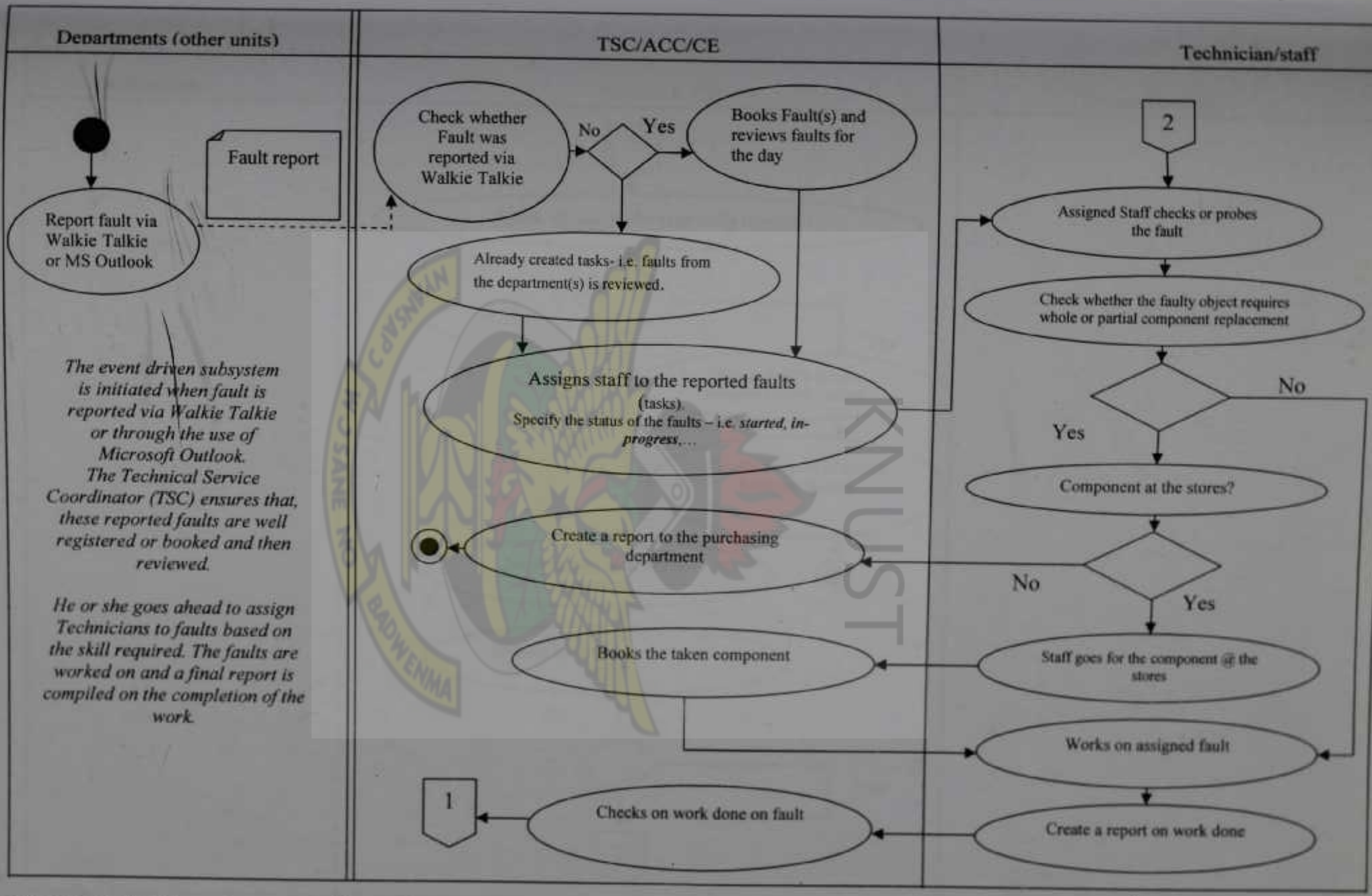
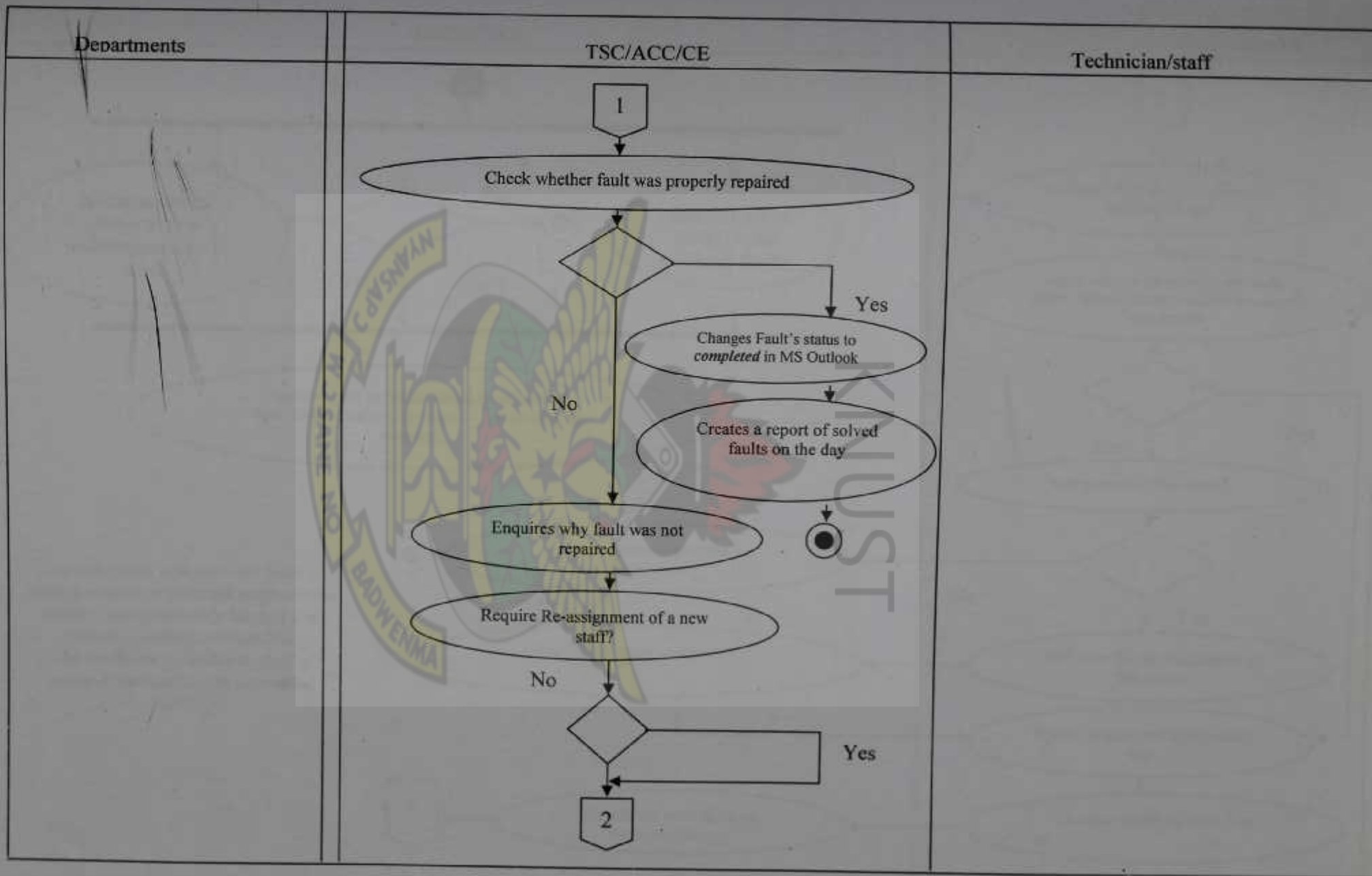


Figure 3.4: Existing system –event driven subsystem


Departments
TSC/ACC/CE
Technician/staff
1
Check whether fault was properly repaired
Yes
Changes Fault's status to completed in MS Outlook
No
Creates a report of solved faults on the day
Enquires why fault was not repaired
Require Re-assignment of a new staff?
No
Yes
2

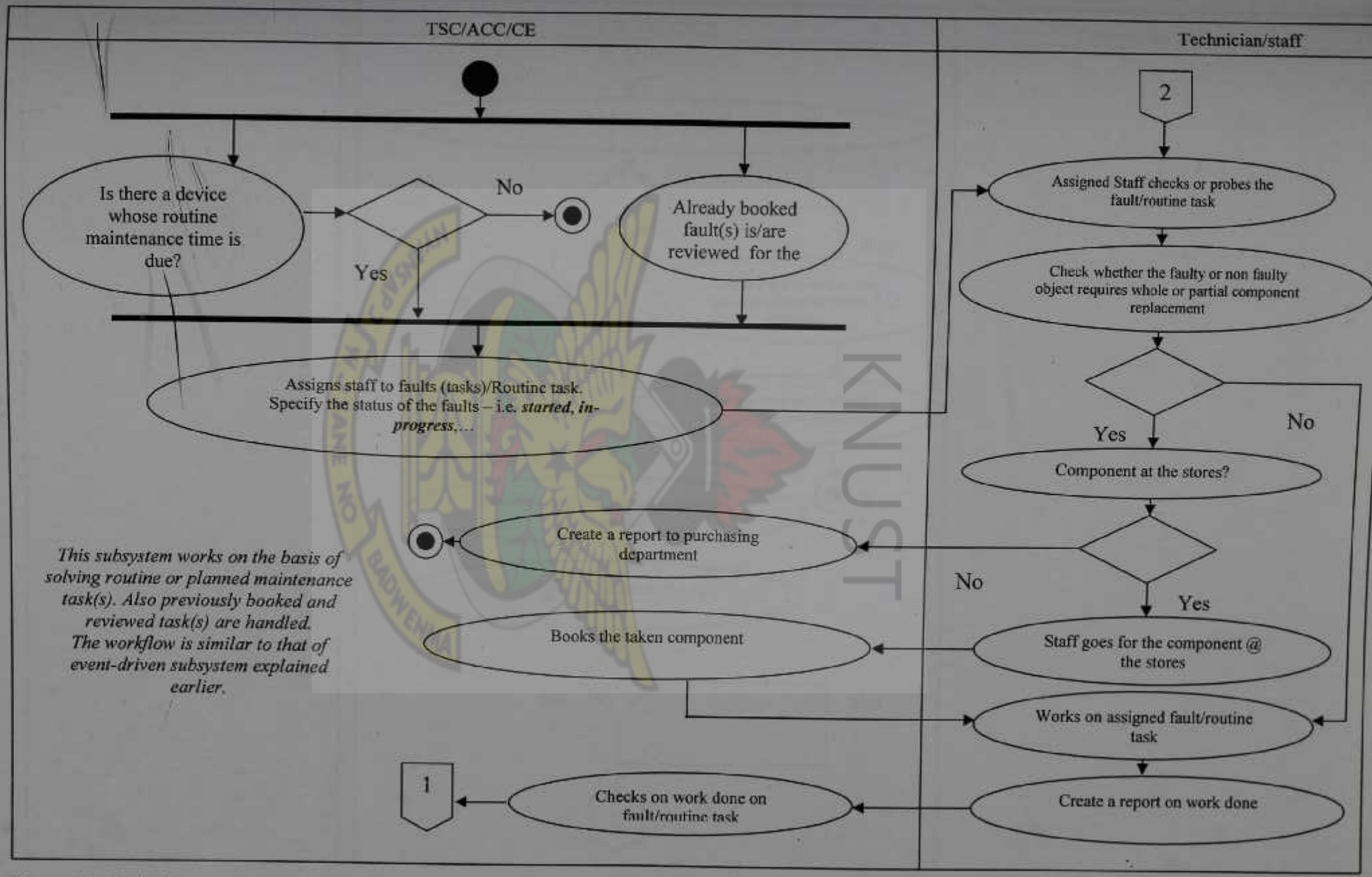
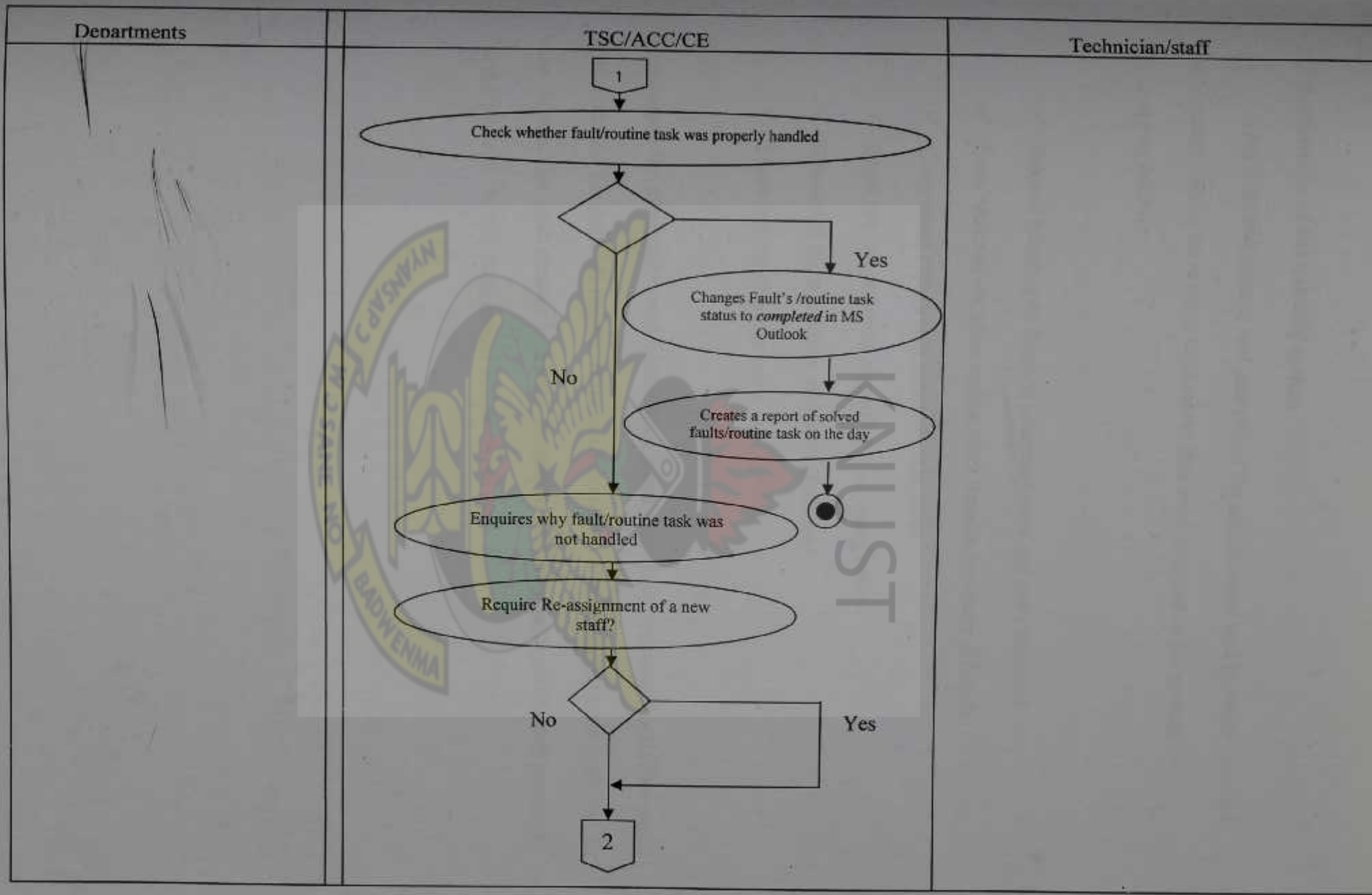


Figure 3.5: Existing system- periodically driven subsystem


Departments
TSC/ACC/CE
Technician/staff
1
Check whether fault/routine task was properly handled
Yes
Changes Fault's /routine task status to completed in MS Outlook
No
Creates a report of solved faults/routine task on the day
Enquires why fault/routine task was not handled
Require Re-assignment of a new staff?
No
Yes
2

3.3 Bottlenecks of the existing system

After a careful perusal and analysis of the maintenance and inventory control unit's system, there were some bottlenecks that were inherent in the system. These are as follows:

- ✓ Record keeping on items is generally poor and not structured
- ✓ Data retrieval on items and/or work done is generally difficult
- ✓ Generating report(s) is generally laborious
- ✓ Items are not uniquely identified – i.e. using codes.
- ✓ Schedules are not drawn and hence followed
- ✓ There is a lot of paper work

To mitigate the aforementioned bottlenecks, some previously mentioned activities ought to be checked for possible optimization and automation and redundant once removed. In view of this, the next chapter will be dedicated to detailing these mentioned processes. Furthermore, a "to-be" state model will be developed.

CHAPTER 4

POSSIBILITY OF CREATING AUTOMATION

4.0 Introduction

In this chapter, each business processes will be checked for possible optimization and automation. At the end of this process, the outcomes will help develop the 'new" or proposed system's model termed "to-be" state. A use-case diagram will also be designed showcasing the user-system interactions.

4.1 Optimization and Automation of the processes

In Section 3.1, the following business processes were identified:

Process One (P1) - *"Report faults"*, **Process Two (P2)** -*"Book faults"*, **Process Three (P3)**- *"Review faults"*, **Process Four (P4)** - *"Assign technician"*, *and* **Process Five (P5)** -*"Work on fault"*.

This section will be used to explain the possibility of optimization and automation of the processes. It will be done by critically analyzing each process and its functions.

Process One (P1) -*"Report faults"*

This process allows for fault reportage. The functionality of the process in the existing system is:

i. Enter necessary details of fault using Microsoft Outlook or report fault by Walkie Talkie.

This functionality can be optimized by allowing a user to specify the properties of the fault –i.e. status, owner, department/section etc. - from possible options on the application software interface. In an event that a walkie talkie is used, the Technical service coordinator does that. Selecting the possible options from an interface without doing extensive typing reduces errors and expedites the way of reporting faults. Hence the process is optimized in the proposed system.

Process Two (P2) - *"Book faults"*

This process helps in registering faults when a walkie talkie is used in the fault reportage.

The functionalities of the process in the existing system are:

i. Enter submitted parameters of fault into MS Outlook if Walkie Talkie was used

ii. Check for correctness of sent information

Functionality (i) can be automated as explained in Process one (P1). In an event that a fault is reported via the proposed system, it is automatically booked.

Functionality (ii) cannot be automated since the user –i.e. Technical Service Coordinator- has to specifically check the reported faults and ensure their validity.

Process Three (P3) - *"Review faults"*

The aim of this process is to generate a prioritized list of faults for the day.

The functionality of the process in the existing system is:

i. Go through the list of reported faults and prioritize them

This functionality can be automated. The proposed system will generate a report of reported faults for the day and allow the user –i.e. TSC - to specify the fault's priority level. This will be done by simply selecting an option from a list. With this mechanism, the functionality is optimized.

Process Four (P4) - *"Assign technician"*

The aim of this process is to come out with a *task-staff* assignment list or task schedule for the day.

The functionalities of the process in the existing system are:

i. Go through the list of reviewed faults for the day
ii. Check the list of available staff and their corresponding skill(s)
iii. Assign staff based on required skill or experience for the task

The proposed system will handle all the three functionalities by checking or scanning through the system and noting the available staff and their corresponding skills. It will then map the staff to the reported faults for the day based on his/her skill and then generate a final report for confirmation by the user. Furthermore, the system may also use previous successfully executed task report to achieve the same report for confirmation. There is a clear indication of shorter reporting time, hence the optimization in the functionalities. These three functionalities however can be automated.

Process Five (P5) - *"Work on fault"*

The aim of this process is to work on the fault and come out with a report on the state of the fault after it has been worked on.

The functionalities of the process in the existing system are:

i. Read through the reported fault's document

ii. Inspect the faulty object on site

iii. Report on the acquisition of a new component (partly or wholly) if needed.

iv. Place a request to acquire a new component if needed

v. Book new component when bought

vi. Create a report on state of work

vii. Approve order form

Functionalities (i), (ii), (iii), (iv) and (vii) cannot be automated. However, functionalities (v) and (vi) can be automated. In an event that a new component is bought, the proposed system can offer a platform to store such a record. Furthermore, changing the status of the fault to *in progress, completed, uncompleted* will help report on the state of the work.

4.2 Activity diagram on proposed Maintenance and inventory control unit system "to-be" state

This sub-section will showcase the improvements – i.e. possible optimization and automation- made on the existing system. Subsequently, we will outline the user-system interactions via *use-case* diagram.

✓ Proposed system-event driven subsystem

As shown in figure 4.1, the event driven subsystem is triggered by reporting faults with the use of a Walkie Talkie or through the developed software application. The reported fault is immediately stored in the database in the event that the software application is used. On the contrary, the Technical Service Coordinator stores it on behalf of the reporter. The day's reported faults are automatically generated and reviewed upon request pending confirmation.

The software further generates the *staff-fault* list automatically. This is done as a result of using available staff and their corresponding skills together with the reported faults for the day. A report is printed and given the technicians to work on the faults.

✓ Proposed system-periodically driven subsystem

A similar procedure is seen in figure 4.2. The difference only exists at the starting point where the system automatically generates a report of items whose maintenance time is due. This follows the planned maintenance approach where the system constantly checks its database for items with maintenance schedules. Also existing faults which have not been worked on previously are also reported. The flow then continues as in the event-driven subsystem.

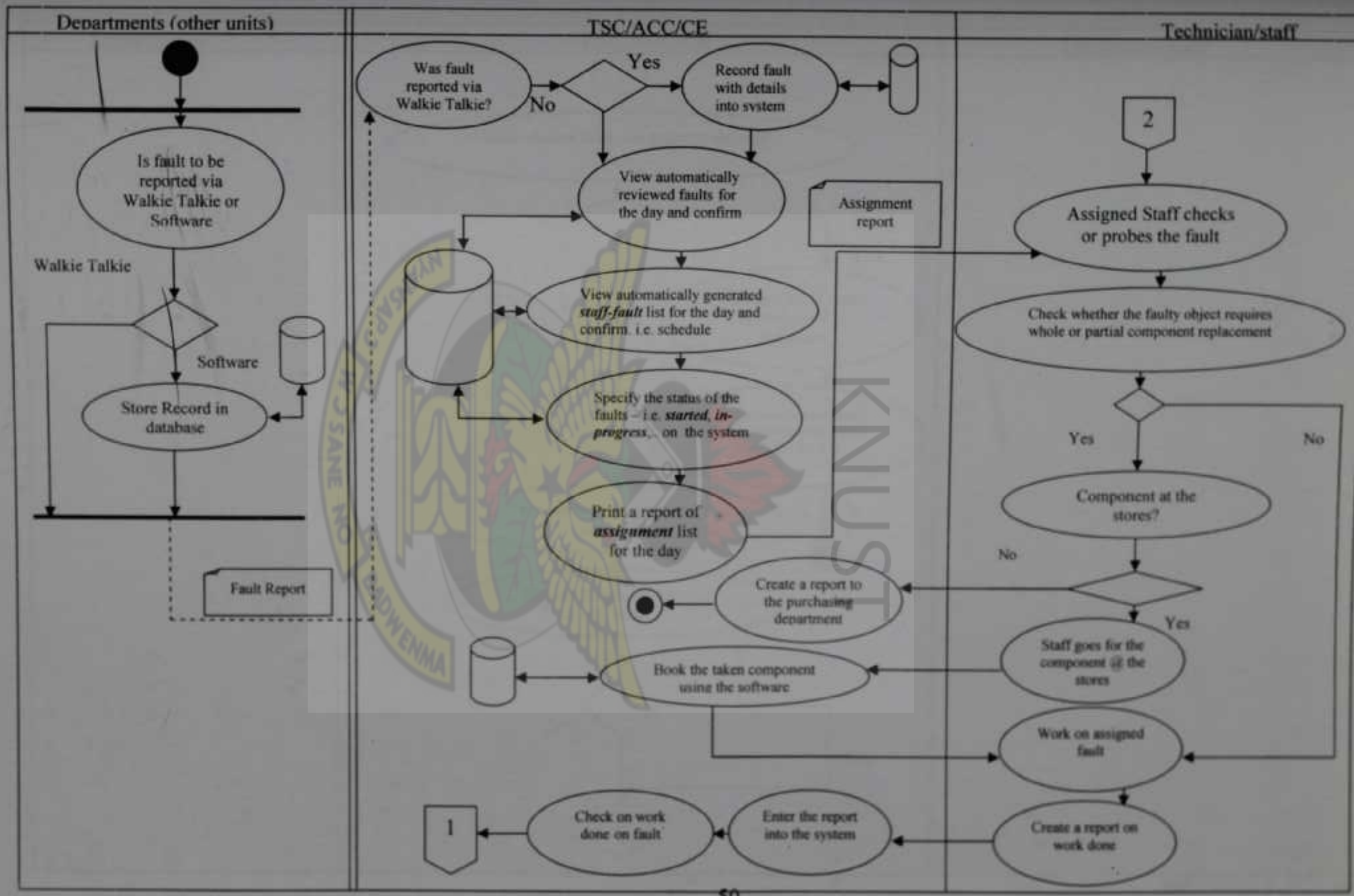
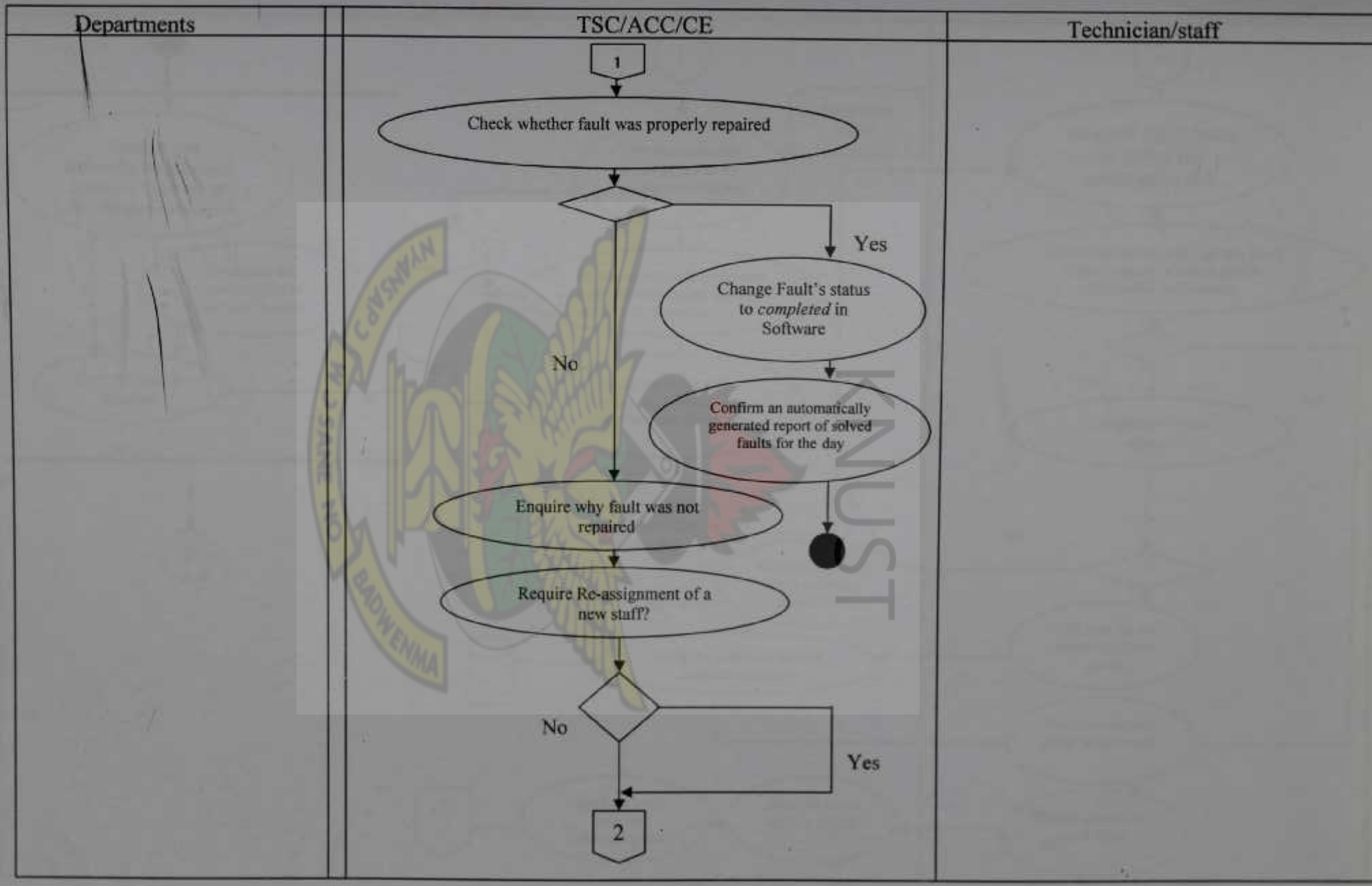


Figure 4.1: Proposed system –event driven subsystem


Departments
TSC/ACC/CE
Technician/staff
1
Check whether fault was properly repaired
Yes
Change Fault's status to *completed* in Software
No
Confirm an automatically generated report of solved faults for the day
Enquire why fault was not repaired
Require Re-assignment of a new staff?
No
Yes
2

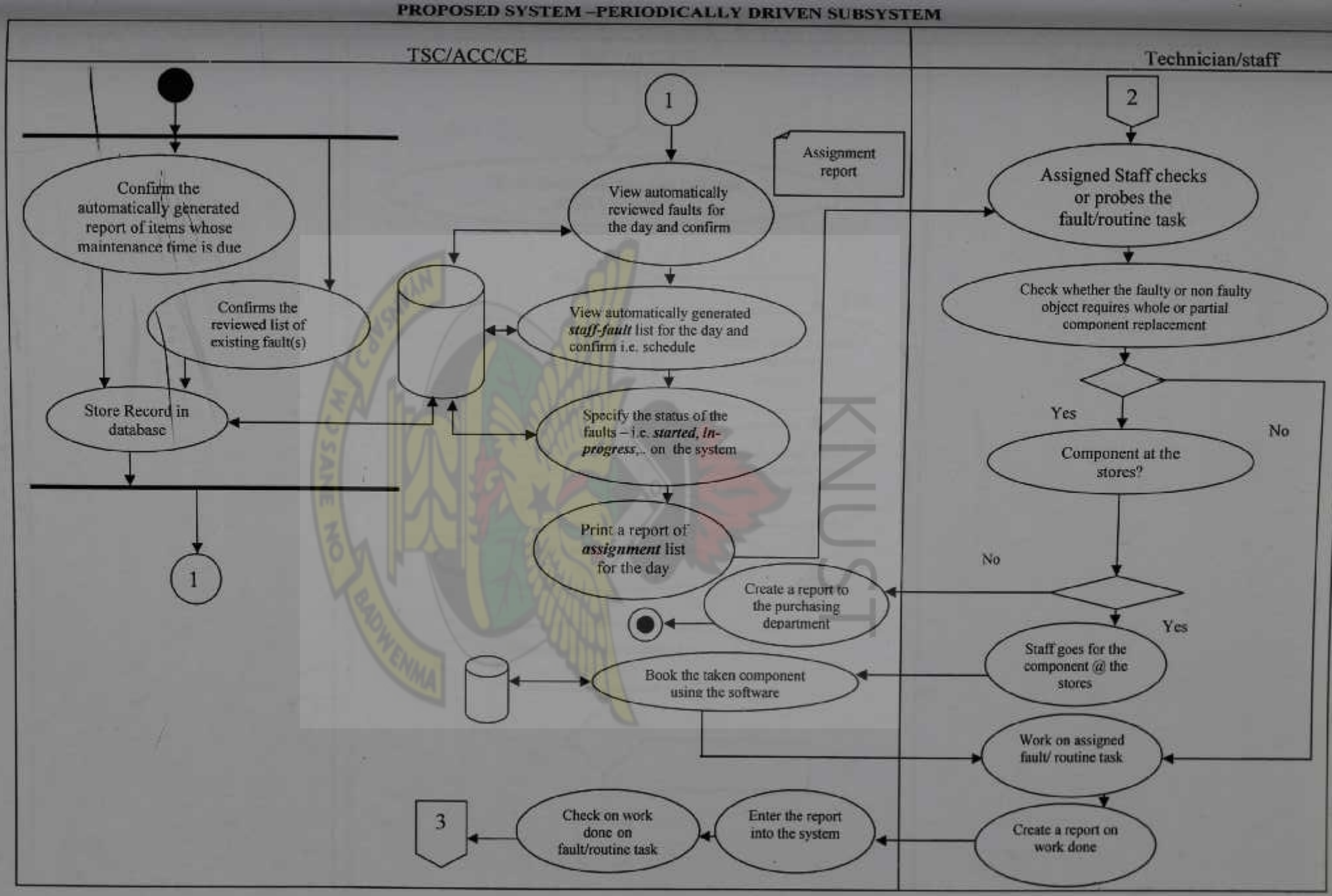
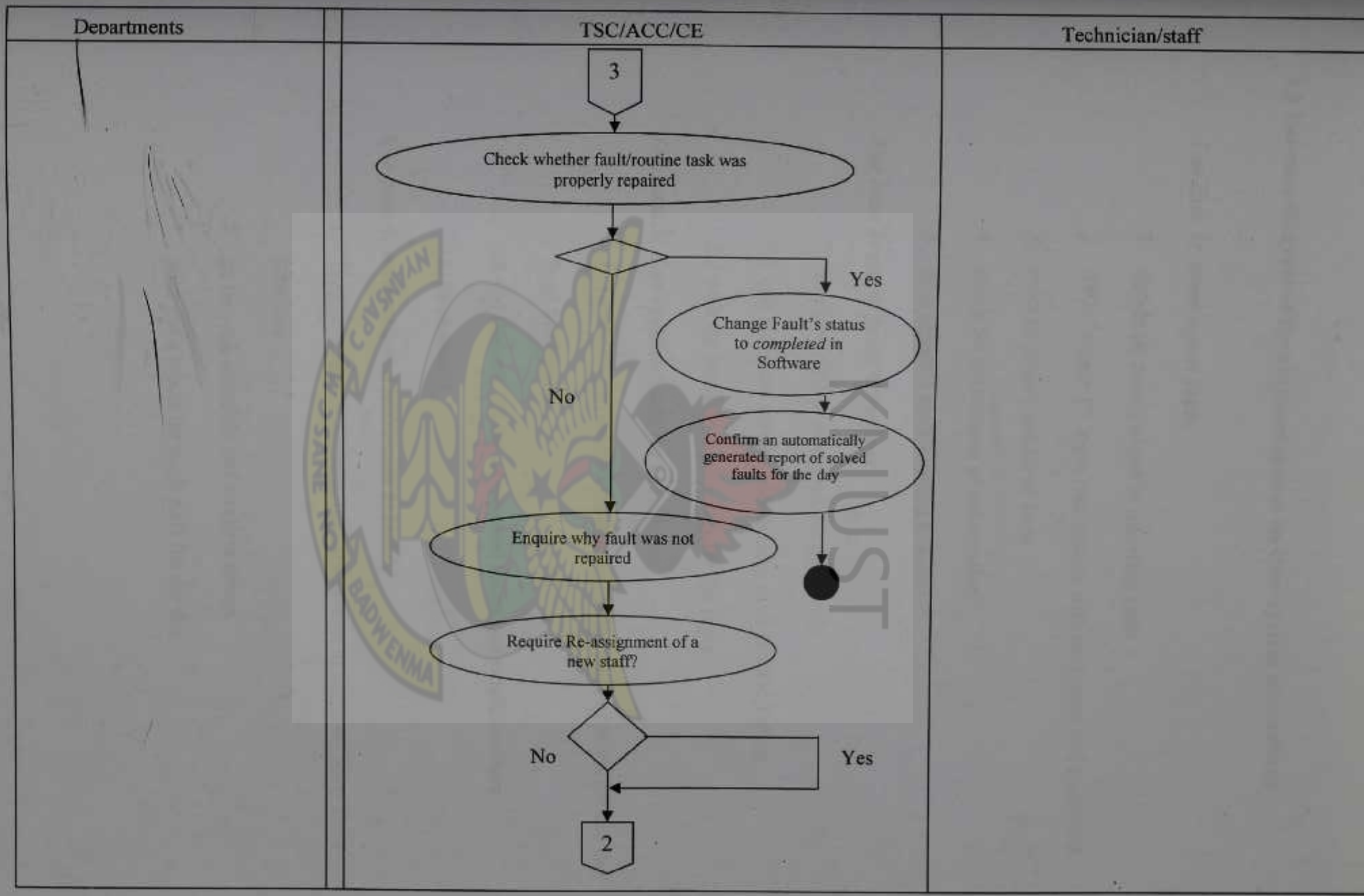


Figure 4.2: Proposed system –periodically driven subsystem


Departments
TSC/ACC/CE
Technician/staff
3
Check whether fault/routine task was properly repaired
Yes
Change Fault's status to *completed* in Software
No
Confirm an automatically generated report of solved faults for the day
Enquire why fault was not repaired
Require Re-assignment of a new staff?
No
Yes
2

4.3 Use-case diagram of the proposed system on User-system interactions

Use case 1: users report faults

1. decide on means to use in reporting fault
2. XP2: "means 1", login into system with username and password
3. enter necessary details of fault
4. check for correctness of information
5. save reported fault's record to send

Use case 2: report fault "2" means

2. Replace XP2 of extended use case with:

2.1 call technical service coordinator over Walkie Talkie

2.2 wait for him/her to get ready for the report

Use case 3: user reviews faults for the day

1. Technical service coordinator generates a list of faults for the day from the system
2. Go through the list of reported faults and prioritize them
3. Save record

Use case 4: user assigns a technician to task(s)

1. Technical service coordinator uses system to generate *Staff-Task* schedule
2. go through schedule and confirm report
3. print out a report for each staff for the day

Use case 5: technician works on fault

1. Read through the given report and get to problem site/destination
2. check on fault and determine faulty components
3. XP3: repair faulty –i.e. the old – component(s)
4. report to the Technical service coordinator (TSC)

Use case 6: Get approval for new component

1. Replace XP3 of extended use case with:
2. Technician places a request to acquire a new component
3. TSC sends a requisition form on the component to the accounts department
4. Accounts department creates an order form and gets approval from the General manager
5. item/component is bought and booked
6. technician replaces faulty component with new one

Use case 7. Monitor progress of work

1. continually, visit site of the fault
2. check on the current state of work done
3. Use observations on site and technicians report to determine the state of the assigned work.

Use case 8. Generate other reports

1. login into system
2. retrieve the appropriate form and submit the require parameters for the report
3. generate report and print

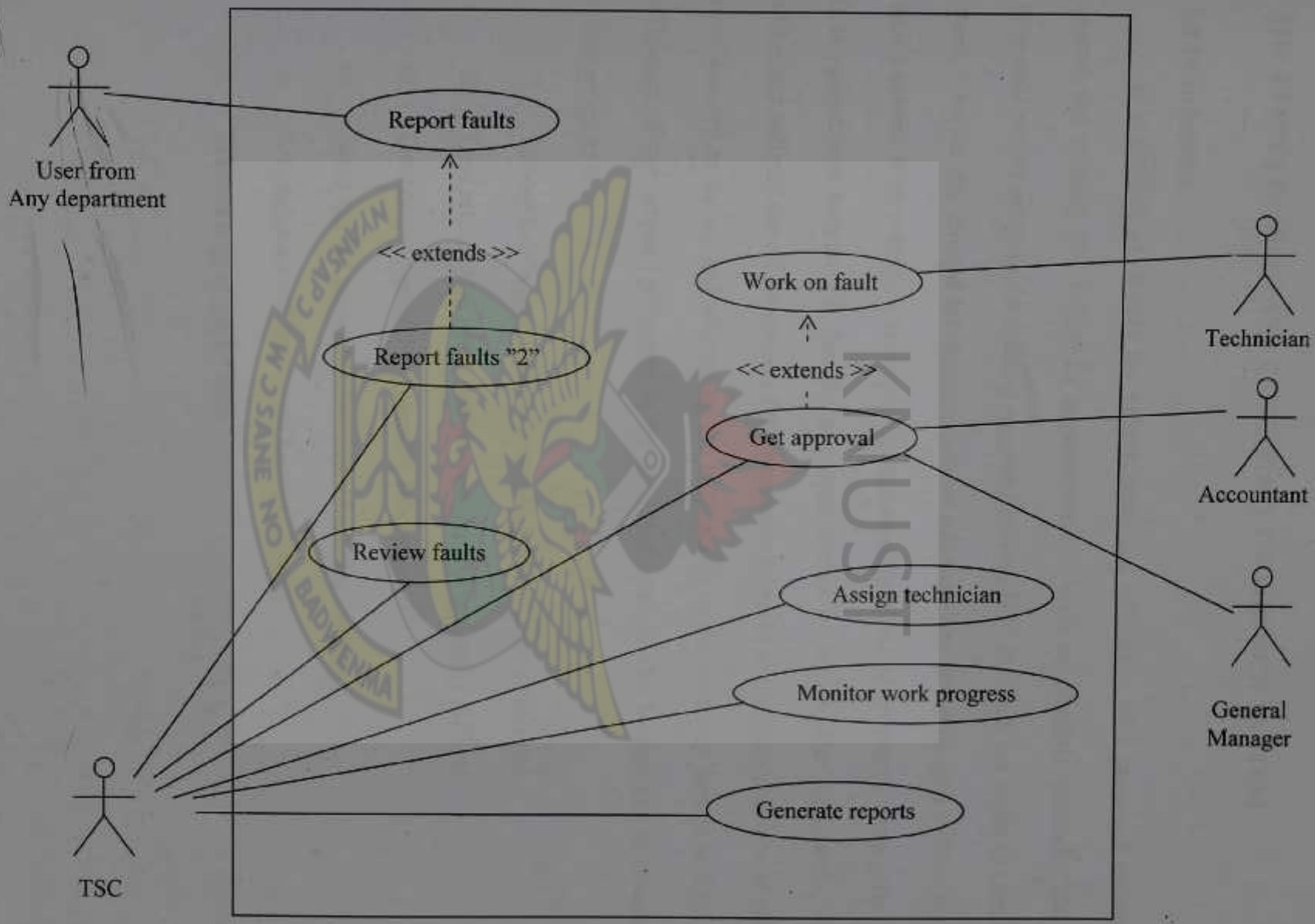


Figure 4.3: Use- case diagram of proposed system

CHAPTER 5

THE EFFECTIVENESS AND EFFICIENCY OF THE NEW SYSTEM

5.0 Introduction

It is prudent to analyze the effectiveness and efficiency of a proposed system as against the existing one before its implementation. With the famous question "*did the proposed system mitigate the existing systems bottlenecks?*" in mind, we ought to carefully check whether the elicited bottlenecks will be addressed by the proposed system and to which extent. With reference to chapter 2, various definitions of efficiency were given and it is against this background that the proposed system be tested. The bottlenecks when addressed indicate the effectiveness of the processes inherent in the proposed system which were tailored to do so, and addressing the bottlenecks in the best way brings to light the efficiency of the inherent processes in the proposed system. The bottlenecks as discussed earlier on include:

i. Record keeping on items is generally poor and not structured
ii. Data retrieval on items and/or work done is generally difficult
iii. Generating report(s) is generally laborious
iv. Items are not uniquely identified – i.e. using codes.
v. Schedules are not drawn and hence followed
vi. There is a lot of paper work

5.1 The proposed system's effectiveness

This sub-section is very vital owing to the fact that, a proof is given of the proposed systems effectiveness, without which there is no sense in considering the implementation of the new system. It will be shown how the enumerated bottlenecks will be effectively handled by the proposed system.

i. **Record keeping on items is generally poor and not structured**

This menace will be overcome as the proposed system offers a means of uniquely identifying each item via the use of a chosen scheme that generates unique codes. Manufacturers' and other maintenance details on a particular item/equipment can also be captured for future reference. With a well designed database –i.e. well structured data storage- reporting of all sought or forms will be supported.

ii. **Data retrieval on items and/or work done is generally difficult**

The proposed system will remedy this situation by offering various search engines. Details on an item can be easily retrieved by the use of item names, codes etc. Just enter the required information and results will be rendered at the instance of a button click.

iii. **Generating report(s) is generally laborious**

The current (old) system's way of record keeping generally makes it difficult to retrieve information and hence create reports as mentioned earlier on. The proposed system will keep track of daily transactions such as fault reportage, staff assignment, fault's details and owners, fault priority etc. These pieces of data will serve as the source of reporting.

Assess to these pieces of data will be real-time since the user's request point is online with the data source. Various reports like, item's current state, repair history of items, staff repair history etc. will be given. These vital reports can serve as a basis of making informed decision such as discarding an item or retraining of staff in a particular domain.

iv. **Items are not uniquely identified – i.e. using codes.**

Currently, it has been observed that, items are not uniquely coded. The proposed system will offer a means of uniquely identifying each item via the use of a chosen scheme, that generates unique codes for each item.

v. **Schedules are not drawn and hence followed**

The current system lacks schedules which ought to be followed. Owing to this fact, service delivery –i.e. by the maintenance and inventory control unit- to other departments is some times difficult. The proposed system will addresses the problem by rendering a tentative schedule –i.e. the schedule is generated from the system- which ought to be confirmed by the head of the unit or any other person responsible.

vi. **There is a lot of paper work**

Lots of paper work is a conspicuous characteristic of the current system. This sole way of record keeping brought about problems (ii) and (iii). The proposed system merges both paper and electronic based record keeping with electronic record keeping taking a bigger chunk. The advantages of electronic record keeping cannot be overemphasized. Furthermore, when the data base is well structured and efficiently supported by a powerful database management system (DBMS) as will be in the proposed system, you can be assured of excellent results.

5.2 The proposed system's efficiency

As defined earlier in chapter 2, efficiency *is a measure of time, cost and effort.* Available online at: www.Wikianswers.com [accessed 14th April, 2009]

Comparing figure 5.1 and figure 5.2, it can be observed that, some processes –i.e. in figure 5.1- have been merged into a single process. Furthermore, most of the processes have been automated, as described under the section 4.1 of chapter 4, dubbed "*Optimization and automation of the processes*". Similar observations can be made on figure 5.3 and figure 5.4. With some processes now aided with software and computer(s), it is expected that, the time and effort spent in executing processes in the proposed system will drastically reduce in comparative terms with the existing system. Information retrieval and reporting processes, for instance, will now be at a touch of a button, saving lots of time.

Clearly, from what had been discussed so far under the evaluation of the proposed system's effectiveness and efficiency, the proposed system had proven to be effective and also promises to be more efficient than the existing system.

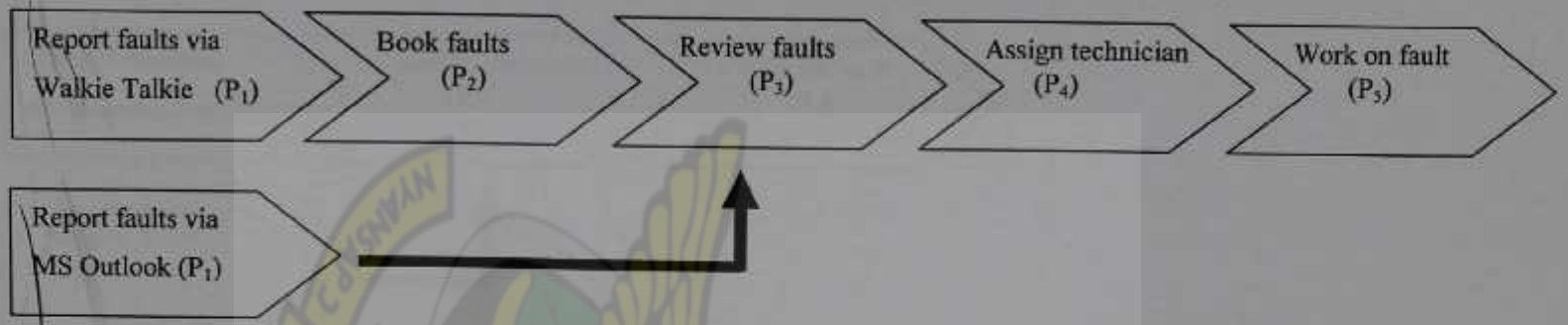


Figure 5.1: Existing system –event driven subsystem workflow

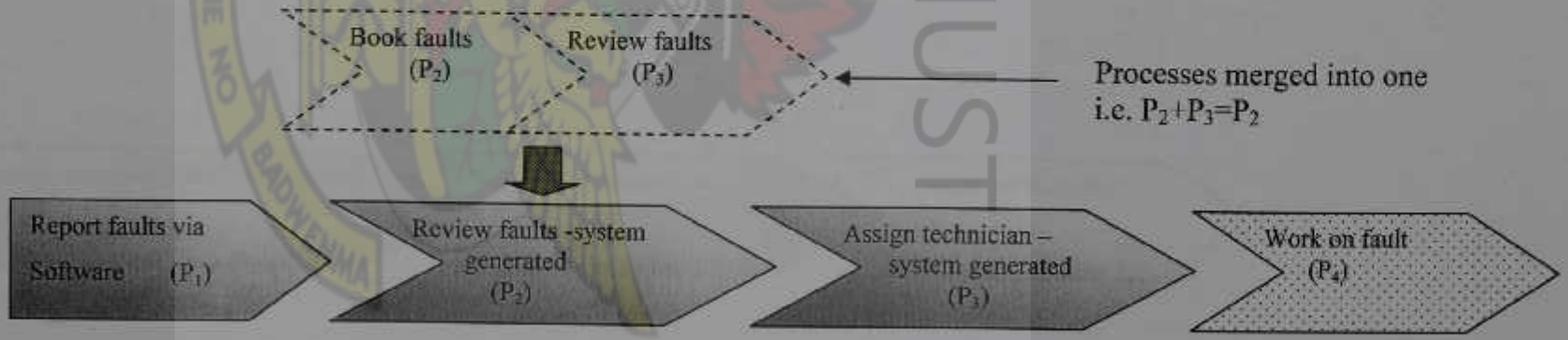


Figure 5.2: Proposed system –event driven subsystem workflow

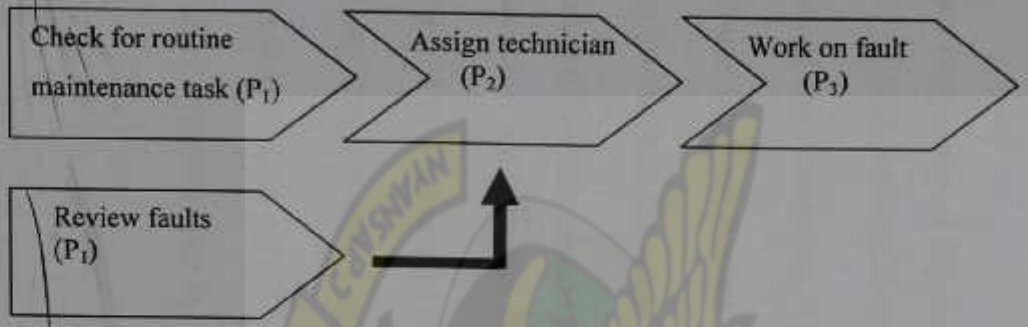


Figure 5.3: Existing system –periodically driven subsystem workflow

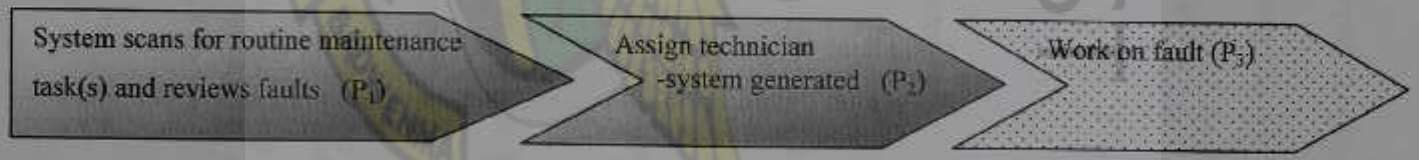


Figure 5.4 : Proposed system –periodically driven subsystem workflow

CHAPTER 6

CONCLUSION

6.0 Introduction

This chapter will take a look at the new features the proposed system possesses and further, the recommendations herein. The added features enhances the workflow ensuring better decision making, timely reporting and better documentation.

6.1 New or added features of the proposed system

- ✓ **Reports on frequency of repairs of items –i.e. trend analysis**

  At the end of each successful repair of an item/component, the proposed system will take an account of the transaction. This will be used to determine the frequency of repairs of that particular item/component. Based on this, an informed decision could be taken on whether to discontinue the usage of that particular item or otherwise.

- ✓ **Reports on staff repair capability**

  It is known from the previous discussions that, a staff is assigned a task based on his/her skill. At the end of a successful repair, the system is updated on the new status of the task – i.e. *completed*. There is also a section for remarks where it will be indicated that, work has been satisfactorily done etc. All these acquired inputs, will help generate a report on a particular staff's performance in the field. This report can be vital for management decision making.

- ✓ **Automatic staff-task schedule generation**

  The proposed system will automatically generate a *staff-task* schedule and possibly other schedules based on staff skill, successful repairs made and the available tasks. What is then required by the user is editing if necessary and confirmation.

- ✓ **Unique identification of items/components**

  This feature will be achieved by generating unique codes for each item/component through a chosen scheme. With the unique codes, items/components can be easily identified and it will also make the data well structured.

To a greater extent, it has been proven that, the existing system's problems can be solved by the proposed system. The workflow is expected to be streamlined thereby, raising the unit's quality of service.

6.2 Recommendations

From the study, it has been observed that, most off-the-shelf software on the market today may not necessarily be able to solve the prevailing problems of the various maintenance units due to differences in their workflows. The initial capital investment in having a customized software application may be sometimes high but the future benefits are enormous. On the other hand, off-the-shelf software applications may be cheap but could lack after sales support and if present at all, it is expensive to access.

On that score, it is better for management to consider developing application software that is customized or built to solve problems of their environment. This thesis work however, can be considered to be the basis for such software development.

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