KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

INSTITUTE OF DISTANCE LEARNING

DEPARTMENT OF COMPUTER SCIENCE

INVESTIGATION INTO THE OPERATIONS OF FUEL MARKETING COMPANIES IN GHANA

(A STUDY OF TOTAL PETROLEUM GHANA LIMITED)

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DECLARATION

I hereby declare that this submission is my own work towards the award of a Master of Information Technology and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ABSTRACT

The objective of this research is to investigate the operations of TOTAL Petroleum Ghana Limited and the challenges faced by fuel stations in their operations. The study also examines the use of a fuel management system to achieve business competitiveness and organizational performance. A web-based application was developed labeled "Fuel Manager" using Microsoft visual studio environment using SQL server that connects as the database. Design research is the methodology used for this thesis because the purpose of this research is to investigate the operations of TOTAL Petroleum fuel stations and all those design components of fuel station management system which influence the overall productivity of the system and propose a new improved framework for the fuel station enterprise systems. Agile development approach was adopted together with Unified Modeling Language (UML) techniques and analysis which are useful in analysing and building information system. The study uses primary data collected through interviews with station managers and supervisors. Questionnaires were also distributed to managers and supervisors of TOTAL Petroleum fuel stations. The data was analysed using SPSS. The findings indicate that even though these fuel stations are aware of the importance of a fuel management system, their knowledge about fuel management systems is limited. Once TOTAL Petroleum Ghana Limited have clearly recognized and defined these opportunities, they must then implement the tools and methodologies to help develop an information system which will assist them in enhancing their competitive strategy. The fuel station management system allows for monitoring and enables TOTAL Petroleum Ghana Limited to track various petroleum products at each fuel station, produce sales reports, stock level reports and supply reports. Future work will explore in more detail a broader set of advanced technology for fuel management system.

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DEDICATION

This research work is dedicated to the glory of God the almighty, the creator, my Protector, my Teacher, the giver of life and to my beloved mother of blessed memory, Madam Comfort Nyamekye, who through her grace, love and compassion transformed my life from a mere existence into an experience.

TABLE OF CONTENTS

CHAPTER 4: ANALYSIS AND IMPLEMENTATION OF DEVELOPED SYSTEM

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.0 Background to the Study

Fuel is a valuable commodity, so designing and installing a Fuel Station Management System for fuel station managers has become necessary in recent times. This software package ones installed enables the industry to keep inventory of stock, fuelling and fuel usage. Once such an effective Fuel Station Management System (FSMS) is installed, efficient monitoring, control and dispense of fuel to vehicles are resolved through effective generated reports. A Fuel Station Management System (FSMS) is a technology which enables a manager to supervise and monitor fuel from the point of entry into the fuel station to the point of use. With so many tools and monitoring devices available on the market, a need to select the right one is critical. Fuel Station Management System with automatic underground tank gauges, electronic line leak detection system, monitoring software and an option to generate notifications with real-time status information or access to all data improves the efficient management of a fuel station.

It is therefore important for fuel stations to adopt and install effective management control systems with on-time accurate reporting systems. Accurate and efficient monitoring ensures the necessary input to the decision-making process. It also helps management to develop, implement, and evaluate a design for monitoring of performance objectives of the fuel stations. Globally effective and efficient management systems help managers to measure their strengths, weaknesses, opportunities and threats (SWOT) in the industry in which they operate. Again well organized and good management control systems guides management in organizations to deliver and take key decisions in their businesses. Effective management control enables organizations to adjust to

price changes, product branding and analyze suppliers. An efficient Management system by exception ensures that the right reports are generated and delivered to the right people in the organization in a variety of formats via email or SMS.

A management system is an organizational framework for managing and continuously improving an organizational process, policies and procedures. It encompasses information sharing, working with teams, benchmarking and working to the highest quality standards and organizational procedures. A management system according to Scheldt and Bachman (2010) helps an organization to achieve its goals and objectives through a couple of strategies via process optimization and management focus.

Schiedt and Bachman has indicated that the fuel station management system (FSMS) is required to capture the daily accounting inventories and creation of reports based on the data captured to serve as a baseline and guidance for transactional activities. These fuel management systems according to Prieto and Stadler (2008) "are used to monitor, control and maintain fuel consumption and stock in any type of industry that uses transport as a means of business". Fuel management systems are designed to efficiently measure, control and manage the use of fuel within the transportation and construction sectors of the economy. They are usually used for fleets of vehicles, railways and aircraft. So many methods and technologies are employed to monitor, control and track fuel dispensed, inventories and purchases. This information can always be stored in a computerized system so that reports can be printed or generated for management decision making.

1.1 Statement of the Problem

Information systems has expanded its role in all types and sizes of business enabling managers, engineers and manufacturers to adopt new and emerging technologies in their companies. The management of Total Petroleum Fuel Stations in terms of fuel supply, sales and stock taking has been a manual system in the sense that order of fuel products is done by the fuel station managers filling an order form from various fuel sites. The form is then sent by road to the Head office by the managers of the fuel stations or supervisors, no telephone call or email is used as correspondence.

Replenishing stocks at various fuel stations takes 48 hours. If there is no supply at the fuel stations after 48 hours, the station managers or supervisors follow up at the Head office. In Ghana, the current stocks measurement at Total Petroleum Ghana Ltd is done by using dip sticks and the meter reading from the fuel pump. Fuel tanks are measured with Dip Sticks to check the level of fuel quantity in the tanks. Meter readings of various fuel pumps are taken and subtracted from the fuel tank level to know the actual level of fuel left in the tanks. Reconciliation of the fuel management is done manually by checking the stock level and the amount of money received using the meter readings from the fuel pumps. For example, the products sold by

TOTAL Petroleum Limited are super, diesel, kerosene, super effimax and diesel effimax. Reconciliation is based on the principle of stock control system that is, measuring the amount of stock delivered into the storage or underground tanks and subtracting the amount sold, and measuring what is left in stock. Any variances that may arises may be due to evaporation, leaks, losses or theft of fuel. Daily sales are recorded in the sales book which can lead to inaccurate data recorded. The problem with the existing system includes lack of provisions of protected and secured system to records against natural disaster such as fires, flood, earth quake and a lack of

recovery system in the event of disaster. There is also delay in locating and retrieving records during audit and lack of security and access control to records to ensure integrity of records.

Currently, existing fuel management system that has been designed precludes a mechanism that helps managers to generate stocks, supply and sales reports of their fuel stations at various fuel sites. Also, the current existing system lacks the inclusion of technological properties that enables managers to analyse trends of products that sells faster in a particular fuel site and to track the stock level of products to know when to replenish stocks. In view of these challenges, there is a need for the development of an improved version of fuel management system that addresses these challenges.

It is against this background, and also considering the existing shortfalls in the current design of fuel management system, that a real-time fuel management system for monitoring and tracking products and sales at each fuel station needs to be developed to know the level of products left in order to replenish stocks quickly to avoid shortages at the fuel stations. With the developed fuel management system, the Head office and station managers can generate stock reports, supply reports and sales reports of each station without requesting it from the station managers. It can also help in auditing purposes and reconciliation of products received by fuel stations.

1.2 Aims and Objectives of the Study

The purpose of this study is to determine the challenges associated with the business operations of fuel stations in Ghana and to design and implement a monitoring system for fuel station operators using TOTAL Petroleum Ghana Limited as a case study.

Specific Objectives are:

- To investigate and determine challenges associated with the business operations of Total Petroleum fuel stations.
- To determine the accuracy and reliability of reports generated by the current management system.
- To develop an effective, efficient and user friendly fuel management system that could help TOTAL Petroleum Ghana Limited meet its objective and improve performance.

1.3 Research Questions

The main questions to guide this research are;

1. What are the challenges faced by Total Petroleum fuel stations in terms of service delivery and ordering of fuel?
2. Which management systems are in place to monitor and track sales and performance?
3. What can be done to make TOTAL Petroleum fuel stations work efficiently and effectively?
4. What systems can be used to analyze the performance of fuel stations?

1.4 Significance of the study

The principal advantages are that;

- It will enable fuel marketing companies in Ghana to monitor site operation in real-time.
- Production of timely and up to date reports for management decision making.
- Timely deliveries that avoid stock been run out.
- Expected to add to existing body of knowledge and help later researchers in similar studies.

Secondly, the benefits of a web-based application system are that accessibility to vital information will always be presented and viewable to all stakeholders, allowing all parties to generate reports and solve any issues that arises.

It ensures that data or information is can be accessed not only by the user, but by supporting staff, so that any problem that occurs are resolved quickly. Compatibility issues is not a problem with the fuel station management software as only a web browser will be needed to view data or information. The Software may be centrally updated to the advantage of all the users.

At the end of the day a good fuel management system will offer easy control and management of fuel stations. It would assist managers with timely information regarding the sales of fuel and stock delivery process.

The benefits that the company will get from this research study will help fuel stations to reduce cost and increase their profit margins, increase their market share and improved customer satisfaction, enhanced corporate image and achieving efficiency and reliability in business operation.

The adaptation of recommendations in this study will help fuel station transactions to be updated by the system in real-time, allowing reports to be generated and other critical analyses of the data to be efficient and reliable.

Finally, this study will contribute to extant literature on the design and implementation of information technology in order to enhance its effective use in organizations and among individuals.

1.5 Identification of Key Managerial Issues

Over the past decades, most fuel stations have crumbed and folded up, just as new ones are being resurrected and many more have gone through merger and acquisitions. These systems are very complex and multidimensional in nature which every manager must be abreast with. The system establishes expectations and requirements for business units and guides organizational leaders to manage and continuously improve performance; it is the basis for assuring standards and compliance within operating companies and business units across the whole enterprise.

Managers therefore have to integrate Operational Excellence into their daily operations.

These management systems should be able to focus on:

- Improving organizational and managerial performance
- Reducing the risk of accidents in the organization
- Assuring standards and compliance
- Preparing for potential emergencies and others

In Ghana organizational managers are faced with the problem of managing information systems, quality of output and adaptation of new technology. Again most managerial failures are attributed to misappropriation of funds, managerial incompetency and mismanagement. TOTAL Petroleum Ghana have failed to adopt and implement efficient and effective fuel management systems because of managerial decisions and directives which emanate from their parent companies in Europe, America, and etc. Many a time, decisions are centralized and prevent employee participation in management operations.

1.6 Scope of the Study

In order for the research to produce a realistic outcome, a developed questionnaire was used to elicit information from the station managers and supervisors of TOTAL Petroleum Ghana Ltd. It should be noted that these research focused on selected fuel stations in the Greater Accra region. These was because of availability, convenience and time constraint. There were some challenges regarding the generalisation of the findings as there was limited information about the study. Also individuals may overlook some of the questions that looked more personal.

- The TOTAL Petroleum station managers and supervisors were generally co-operative, yet some of them might not have answered certain questions that are sensitive.
- Physical hardware components involved was a problem.
- Getting books for the literature review was also a problem. The internet and other publications was the main source of information to build the literature review.

1.8 Organization of the Study

The organization of the study is in five chapters.

- **Chapter One:** Chapter one presents the Research Proposal, comprising of the Background and Introduction to the study, Objectives of the Study, the Problem Statement, Research Questions, Significance of the Study and The Scope and Limitations of the Study.
- **Chapter Two:** This presents a comprehensive review of relevant literature in an attempt to position the study in an appropriate theoretical framework. Thus it will discuss findings of related researches to this study and explain key words relevant to the study.

- **Chapter Three:** This chapter also presents the methodology to be employed for developing fuel station management system as well as the relevant analytical tools that will be employed for analysing the results gathered during the study. It will also delves into all the processes, procedures, philosophical approach adopted, the research design, identification of the population and the sampling techniques used.
- **Chapter Four:** This chapter presents the analysis of the research findings and the developed system using the UML tools and methods chosen for data analyses using Statistical Package for the Social Sciences (SPSS) version 21.0.
- **Chapter Five:** This chapter is the concluding chapter, which presents the analysis of the findings, summary, conclusion, recommendations and future work for the study.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews both theoretical and empirical literature relevant to the studies which include secondary data from journals, articles and reports. The first section looks at the Petroleum industry

and history of TOTAL Petroleum Ghana Limited. Areas of review include background to fuel station management systems, the Petroleum industry overview, the supply chain management framework, Fuel pumping system, Benefits of computerized accounting over manual accounting and challenges of TOTAL Petroleum Ghana Limited.

2.0 Fuel Stations Management Systems Overview

Business operations everywhere are engaged with new challenges like changes in customer satisfaction demand, effective and efficient management systems, technological innovations and advancement. The petroleum industry is no exception to all these current developments in the retail supply business. The challenges and threats facing the fuel stations in modern economy have an effect on the individual site performances. With the rising fuel cost and the benefits of fuel in relation to the profits of an organizational operations, it is very beneficial to understand and manage fuel very efficiently. It is also important to realize that there are so many factors influencing fuel consumption, and that creating awareness is important if real efficiencies are to be made. The task of monitoring and managing fuel use needs to be undertaken with a clear monitoring process in place.

Every fuel has its own management system needs, requirements and specifications. Synergon, an American fuel station has its management system controlled through the cash registers. The system is very suitable for controlling of other elements required for the operation of the fuel stations. The cash register transactions are processed by a back-end office computer, keeping accounting stock, taking the inventory of the stocks. The back-end office computer transfers or forward data to the company's central system.

Again in America, the CNG fuel Station has a management software which helps the owners to manage and keep records on all pending activities. The modules in their software according to management of CNG fuel station includes; managing of accounts, managing of sales and SMS Integration System. Standards guiding the fuel dispensing system is based on the ISO/IEC 14443 standard compliant.

2.1 The Petroleum Industry Overview

The petroleum industry is a very huge industry from different point of view (Masseron, 1990; Yergin, 1991). First, it comprises of significant amount of economical flows according to the world trade organization. The industry usually comprises of the upstream and downstream activities.

2.2 Overview of TOTAL Petroleum Ghana Limited

TOTAL Petroleum Ghana Limited (TPGL) has the maximum network coverage in Ghana with a total of not less than 210 service and filling stations across the eastern and southern parts of the country and also remained at the forefront of several innovations. TOTAL Petroleum Ghana Limited is a multinational energy company committed to leveraging innovations and initiative to provide a sustainable response to humankind's energy requirements. Total Petroleum is committed to conduct their business operations according to the world standards of professional behavior. With 50 years of Total's operations in Ghana, TOTAL is branding itself as number one in Ghana and a market leader amongst the Ghanaian public.

Total Petroleum Ghana Limited (TPGL's) is the first oil marketing company in Ghana to acquire the International Standards Organization (ISO) quality management standards certification (ISO 9001:2008).

2.3 The supply chain in the oil and gas industry

The supply chain processes of the petroleum industry are very complex as compared to other industries. The oil and gas industry is involve in a global supply chain platform that includes domestic and international transportation, ordering and inventory, control and visibility, material handling, import/export facilitation and information technology (Chima, 2007). This supply chain comprises two major segments. These are upstream and downstream supply chains. The table below shows an example of the petroleum industry that depicts the upstream and downstream processes was discussed by Shell. (Shell, 2011).

UPSTREAM	DOWNSTREAM
Exploration for oil and gas	Oil refining into fuel and lubricants
Oil fields Development	Petrochemicals production
Oil and gas production	Biofuels development
Bitumen Extracting	Trading
Liquefying gas by cooling (LNG)	Retails sales
Converting gas to liquid products (GTL)	Supply and distributions
Mining oil sand	Business-to-Business sales

Table 1.1: Upstream and Downstream Processes (Shell, 2011)

2.4 The supply chain management framework

Supply Chain Management (SCM) is a holistic integration of organizational units along a supply chain coordinating materials, information and financial flows in order to fulfill customer specifications and demands with the aim of improving competitiveness of the supply chain as a whole. (Stadtler, 2005). Mentzer et al, was also of the view that supply chain management is a strategic and systematic coordination of the traditional business functions and the strategies across these business functions with the purpose of improving the long-term performance of the individual companies and the supply chain as a whole. (Mentzer et al. 2001).

Huber (1990) was also of the view that effects of advanced information technologies on organisational design, intelligence and decision making processes drives the improvements in intelligence development and will be made possible by the availability of more accurate, reliable, comprehensive, timely and available organisational intelligence.

Roberts (2010) points to the changing capability, technology and expectations of retail supply chains and the extension of these demands on those involved in satisfying retail needs. At one level the requirements remain the same, products availability is fundamental but the ways of achieving this effectively and efficiently have been transformed.

2.5 Fuel Pumping System

There are primarily two methods by which fuel is distributed to the fuel dispensers within fuel station forecourts (APEA, 2005). The first method consists of remotely located submersible pumps installed within each fuel tank. i.e. example of pressure line layout (APEA, 2005). This operates on the basis of dedicated pressure switches incorporated into each fuel dispenser. When a fuel attendant operates the fuel handle there is a pressure drop in the distribution pipe-work which

causes the submersible pump to pressurize the system and hence allow fuel to be dispensed into the vehicle.

The second method consists of smaller suction pumps installed within each dispenser unit (APEA, 2005). When fuel is required, the integral pump in the dispenser literally sucks or pulls the fuel emanating from the remote fuel tanks and into the vehicle. In the first installation method (Pressure system) the pumps are submersed within underground fuel tanks while the second type of the system the pumps are located integral to the forecourt fuel dispensers which are often owned and maintained by the parent petrol company. (ESSO, 2008).

2.6 Transportation of Petroleum Products

Transportation of petroleum products varies from country to country. According to Kojima et al (2010), transporting crude oil to refineries in countries which has refining capacities for domestic or overseas to final destinations in all countries represent a significant amount of end-user prices, particularly in markets far from major refining centers. (Kojima, 2009).

2.7 Fuel Management Systems

Fuel management systems is a technology that maintains, monitor, measure and control fuel usage and stock in any type of industry that uses transportation as a means of business. Fuel management systems are designed to efficiently measure and manage the use of fuel within the transportation and construction industries. They deploy various methods and technologies to monitor and track fuel inventories, fuel purchases and fuel dispensed. This information can be then stored in computerized systems and reports generated with data or information for management decision making. Reports can then be generated by the fuel stations based on the total amount of fuel consumed and data can be directly retrieved.

According to a survey (EOM et al. 1998), Computer-based fuel management system are widely deployed in both profit making and non-profit organisations. Decisions are basically an integral part of management and it occurs in every level. (e.g., top management, middle management and lower management) and in every function (e.g. marketing, accounting, human resources and production) (Lucey, 2005). Today's organisation requires systems and tools to support faster and automated decisions, as well as ways to minimize uncertainty. With quicker access to needed information through MIS, fuel station managers, supervisors, system Admin, Head office management are able to make efficient and timely decisions regarding their investment, the products as it concerns the organisation.

According to Miles et al, 2000; Silverman et al., 2001, the benefits of deploying fuel management systems in web-enabled platforms have been widely recognized. A fuel management system is an interactive information system that provides information, models and data manipulation tools to help make decisions where no one knows exactly how the decision should be made. Benefits of the web-based fuel management system include better inventory control, reduced operation costs, global connectivity, high accessibility by management and managers of the fuel stations and interactivity. Fuel management systems are designed and implemented to aid organisational decisions as well as decision making by the individual.

2.8 Comparison between Manual and Automated System

Effective Fuel management practices is an essential part of any fuel marketing company. Management and stakeholders are concerned about making profit through the use systems and tools that will help them achieve their organizational objective. In an effort to achieve

organizational goals, fuel marketing companies have adopted computerized systems that help individuals in the organization to execute their responsibilities. These computerized systems present benefits such as quality of information, speed of access to information, information security and backup of organizational data. Unfortunately, the manual system does not present such opportunities. The subsequent section discusses the different between the manual and automated system based on the afore mention benefits.

- Quality of information

  The automated system presents the opportunity to store information electronically. Electronic information is essential because issues such as errors, redundant information, unreliable and inaccurate information are minimal. Unfortunately, such challenges are prevalent in the manual system where information are stored in files, cabinets, notebooks and paper. These traditional practices threaten the quality of information generated by the manual system.

- Speed of access to information

  In the automated system, data is processed much faster than the manual system. Data access and retrieval are done automatically in software programs at a click of a button, minimizing errors in and increasing efficiency. Once data is input into the system it can be retrieved by pressing a button in the automated system. These effective and efficient access, retrieval and processing of data in the automated system facilitates decision making in fuel marketing companies.

- Information Security and Backup

  Unauthorized access and manipulation of data continues to threaten the reliability of information present in the manual system. Unauthorized persons can easily access files and make changes, delete, or add new information because there are no security measures to restrict access by unauthorized persons. Also the manual system has no well-designed backup system in the event of fire outbreak. Fortunately, the automated system possesses technological properties and capabilities that addresses the afore-mentioned security challenges of the manual system. Security measures such as passwords, user authentication, user account privileges are some of the security measures that the automated system presents for the effective and efficient running of the organization.

CHAPTER THREE

RESEARCH METHODOLOGY AND ANALYSIS OF RESULTS

3.0 Introduction

Chapter three delves into all the processes, procedures, philosophical approach adopted, the research design, identification of the population and the sampling technique used. Methodology is very important in developing the system. The Design science methodology is the methodology that was adopted for this thesis because the purpose of this research is to investigate all those design components of fuel station management system which influence the overall productivity of the system and based upon these design components to propose a new improved framework for the fuel station enterprise systems in order to get better results as compared with the previous manual

frameworks. This section looks at the manual system and the relevance of the automated system which will be deployed. Choosing the right methodology will guide you to produce better quality software, in terms of documentation standard, acceptability to the user, maintainability and consistency of the software. Information was based on several literature sources and interactions with practitioners of the industry including managers of TOTAL Petroleum Company Ltd. The fuel station management system will be using agile development approach together with unified modelling language (UML). The chapter also examined the instrument used in collecting data.

3.1 Population

The population of the study was defined as Total Petroleum Fuel Stations. The survey was administered to a purposive expert sample consisting of Total Petroleum Station Managers. In all, 40 fuel stations were selected.

3.1.2 Sampling Technique

A non-probability sampling method was used for the study. Non-probability is a technique in which units of the sample are selected on the basis of personal judgment and convenience (Zikmund, 2000). Specifically, the purposive and convenient sampling techniques were employed. Purposive because the researcher studied only Total Petroleum Fuel stations of which these stations were conveniently sampled. According to Graziano and Raulin (2004) convenience sampling is the selection of a desirable group of people for a study. The reason behind the researcher selecting

this sampling technique has got to do with limited time span for the study completion, large sample size and cost consideration.

3.1.3 Measuring Instrument

A set of questionnaire will be used as a measuring instrument and an interview will be conducted for collation of information. This will allow the researcher to gather much information from both measures and to compare results to form better informed findings from data collected. Although the respondents are widely spread across Greater Accra region the researcher will personally deliver the questionnaires to the respondents. (See appendix C as interview guide).

3.1.4 Data Collection Techniques

The main source of data for the study was primary and secondary sources. The primary sources of data were obtained through the use of questionnaires and interview. The secondary sources were gathered from journals, internet and other publishing materials. Questionnaires consisting of both close-ended and open-ended questions were used. The closed-ended questions were used to obtain straight forward answers while the open-ended questions were intended to allow respondents to express their own opinion. The questionnaires were however piloted to identify their correctness and shortcomings.

3.1.5 Data Analysis

The data collected were analysed via the use of SPSS (Statistical Package for the Social Sciences) version 21.0.

3.1.6 Administrative Procedures

The respondent's premises (Office) was visited and enquiry made of the person in charge. After careful deliberations and discussion on the mission, the aims and objective of the research were outlined to management and the research questionnaires were administered.

3.1.7 Ethical Assurance

The biggest ethical issue envisaged to be encountered during the research had to do with the protection of confidentiality of all information disclosed. The research was conducted to the highest form of ethical standards, and respondents were assured of confidentiality in any information they provided. The confidentiality statement is also stated in the questionnaire (See Appendix A).

3.2 Manual System Description

With the manual system, supply of products is done by fuel stations filling an order form from various fuel sites. The form is then sent to the head office by transport, no telephone call or email is used as correspondence. Replenishing stocks at various fuel stations takes 48 hours. After 48 hours and there is no supply at the fuel station after 48 hours, the station managers or supervisors follow up at the head office. Measurement of stocks at the fuel stations is done by using dip sticks and the meter reading from the fuel pump. There is a daily tank dipping to check the level of the tank and the meter reading of the fuel pump to enable the station check the stock left and the variance. Daily sales are recorded in the sales record book which can lead to inaccurate data entry record.

3.3 Requirements Gathering Approach

The requirements gathering approach that will be adopted in the organizational management will be an agile development methodology. Agile method is a software development method that is:

- Communication-oriented and People-focused
- Flexible (Which means Ready to adapt to expected changes at any time)
- Speedy (It Encourages rapid and iterative development of the product in small releases)
- Lean (It Focuses on short timeframe, cost and an improved quality)
- Responsive (It Reacts appropriately to expected and unexpected changes)
- Learning (Focuses on product development improvement during and after product is made)

3.4 Automated System Description

With the automated system, supply of fuel products to various fuel stations is managed by the head office with the aid of the fuel station management system software that tracks products sold at each station without station managers filling and sending order forms. Fuel station attendants have a login page to key in amount of money and volume sold to each customer and the attendants only access the sales and volume page to see how much volume and amount generated by each attendant. They cannot access any other pages. Also these system is designed in such a way that anytime fuel attendants serves customers, the volume delivered and the amount sold is linked to a database at the back-end office which records all the total sales and volume sold daily. This solution deals with the issue of attendants going to enter sales and volume delivery at the back office.

This system will process the entire data keyed in by the User/Manager daily and will produce reports for the day and provides complete data for management as well. The system is secure, user-friendly as the User/Manager has to log in his/her page to perform any work. Users will be authenticated or identified by username and password. The automated system gives real-time information to management. Management will be able to make managerial decision in time. At a glance on their computer they can view how much has been sold at each station and the volume needed to be replenished. The automated system ensures more control and better accountability. This system allows you to view and analyse data of fuel stations from your computer to create accurate reports easily and efficiently. Manual error of recording in books is eliminated which ensures that real-time electronic reports can be generated.

3.4.1 Comparative Analysis of Manual and Automated System of Managing Fuel Stations

A recommended solution to achieve the objectives of TOTAL Petroleum Limited was to design and implement a fuel management system for tracking the performance of fuel stations which could be utilized at all management levels.

With the manual system, supply of fuel products is done by fuel stations managers filling an order forms from various fuel sites. The form is then sent to the head office by transport, no telephone call or email is used as correspondence. Manual ordering of fuel is very time consuming whilst with the automated system, supply of fuel products to various fuel stations is managed by the head office with the aid of the fuel station management system software that tracks sales, supply and stocks at each station without station managers filling and sending order forms. This system will process the entire data processing by users'/managers login into the system. The system will provide complete data for management as well and produce daily reports. There is an improved

process quality and real-time monitoring of fuel stations and a centralized monitoring of all business processes. Secondly, with the manual system, there are no back-ups of records in some of the fuel stations in the event of fire outbreak or natural disaster. Whilst the automated system has a graphical user interface (GUI) that provides functionality to display real-time and historical data. The fuel management system performs fuel inventory management which leads to stock accuracy and documentation of fuel sales. The automated system also optimizes stock replenishment and a detailed reporting system.

The benefits of having automated system are;

- Improving the speed of decision-makers with real time information
- Ability to access fuel management system by users over the internet.
- Creating a reporting system that produces reports based on user specified parameters.
- Centralized database that provides a single source of common information and faster retrieval.

The system was deployed at Haatso Total fuel station to test the feasibility regarding the use of the proposed fuel management system in fuel marketing companies.

3.4.2 Re-Order Level Formula

The reorder level formula is an inventory level at which an entity should issue a purchase order to replenish the amount of stock at hand. In other words, the reorder level is the point of threshold at which the fuel station orders more products to prevent shortages while avoiding overstock. This level is set at a threshold level in such a way that before the fuel ordered for is received into the

fuel stations, there is enough quantity to cover shortages. Reorder Level = (Lead Time in Days × Daily Average Usage + Safety Stock)

The lead time is the time it takes the supplier to provide the ordered units.

3.5 System Architecture

The system architecture defines the infrastructure common to the developed systems and the interfaces of components that will be included in the system. Designing of fuel station management system architecture is the most critical factor of overall enterprise systems. The fuel station management system architecture is based upon innovative web application service architecture. This system architecture provides access to users, manage data sources, connect them to the fuel manager application and allow users to access them in common formats.

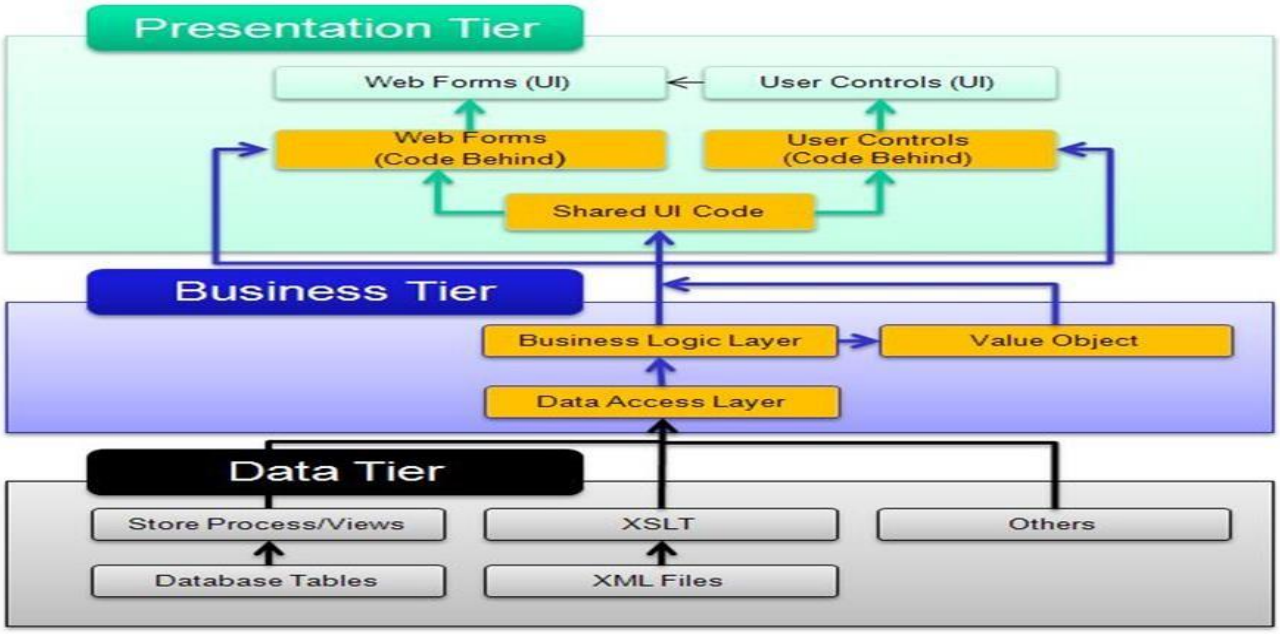


Figure 3.1: Three Tier Architecture Source: www.codeproject.com

3.5.1 Technical Review of the Developed System

The developed system is a web-based application to facilitate the management of TOTAL Petroleum fuel stations. The system includes capturing of records into digital format to store and retrieve records in a database. The fuel station management system is made up of web front end and a database back end. The database is used to store records of the fuel stations operations. These records can be accessed, viewed by users with the web front end. The programming language used in developing the fuel station management system is Microsoft ASP.Net together with SQL server 2012 used as a database.

The system displays the records from the database backend to the web front end user. The web application is to be installed on a web server made available on the local intranet and can be accessed by any client computer through authentication. This will facilitate the retrieval of records for business processes and also reduce the risk involve in disaster recovery as a result of reliance on paper-based records. The web interface takes the user request input, processes and analyses data from the database and displays the result in response to the request.

The technologies deployed in the development of the system include;

- A three tier architecture which comprises of the Presentation layer. This layer ensures that the user interacts with the system.
- Middle layer is where input codes are processed.
- Back end layer stores the data, which means an SQL server is used as the database.
- Programming Language: The programming language used for the development is

ASP.Net, which is a Microsoft Visual studio.

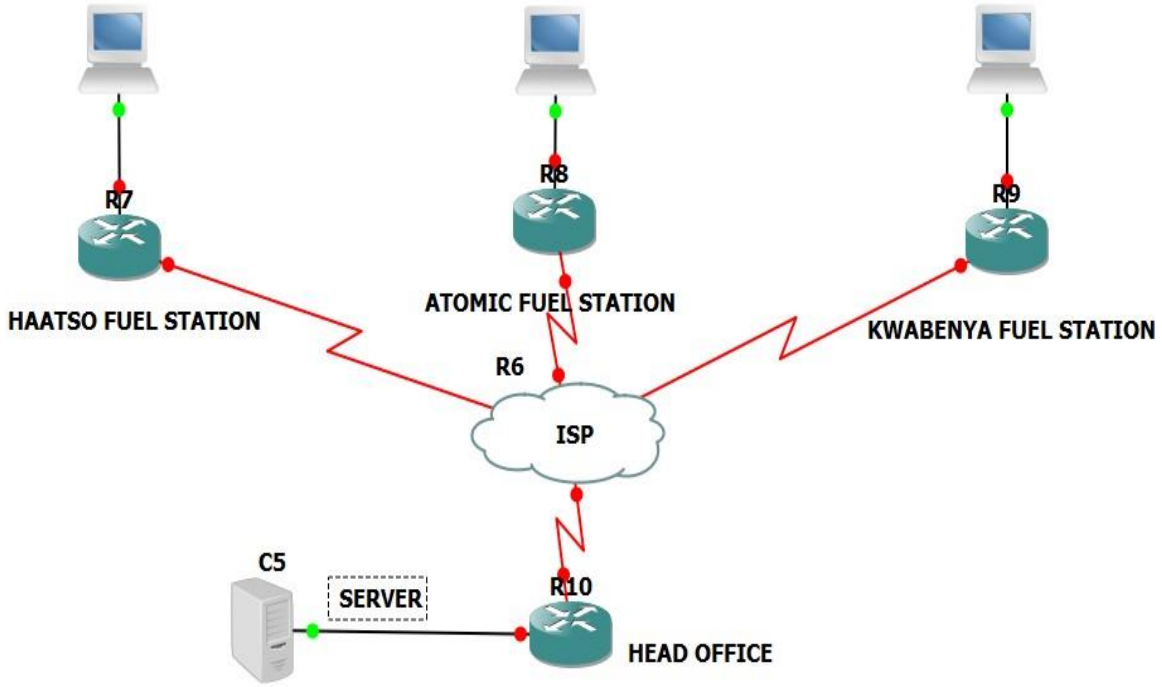


Figure 3.2: System Architecture of fuel station management system

3.6 Benefits of Automated System over the Manual system

The principal benefits of the automated system are that site operations can be monitored in realtime, stock figures of each fuel stations are always current and amount generated and volume consumed can be identified immediately. Another benefit is that the fuel station management system assists managers and supervisors of fuel stations with timely information regarding the dispensing of fuels and stock delivery process so that information is easily made available to all interested stakeholders ensuring that all parties have reports concerning the issue. Lastly, the automated fuel management system eliminates error-prone manual entry system, improve fuel tracking for accountability of fuel stations, eliminate misallocation and theft. Data is viewable not only by station managers and supervisors but the head office staff also can access data from each

station through a networking of all stations so that issues regarding the fuel are resolved quickly without delay. The manual system takes 48 hours for a request to be delivered and sometimes the request is delayed. With respect to the automated system, since the stations are inter-networked it takes a shorter time for a request to be delivered. The internet cost of the automated system is 100.00 Ghana cedis and the cost of transportation for the manual system is 500 Ghana cedis in terms of fuelling the car which is transportation cost. Finally, the automated system has the ability to track any transactions and it will give you complete data for reporting financial purposes, management review, analysis and decision-making.

3.6.1 Requirements Gathering Tools

The main source of data for the study was primary and secondary sources. The primary sources of data were obtained through the use of observations and data gathered from the literature review. The secondary sources were gathered from journals, internet and other publishing materials.

3.6.2 Modelling Techniques and Analysis

The following modelling techniques and analysis are useful in analysing and building information systems therefore, will be used for analysis and design of this research. These include; use-case diagrams, use-case descriptor, UML activity diagram, UML state diagram, UML class diagram and UML sequence diagram.

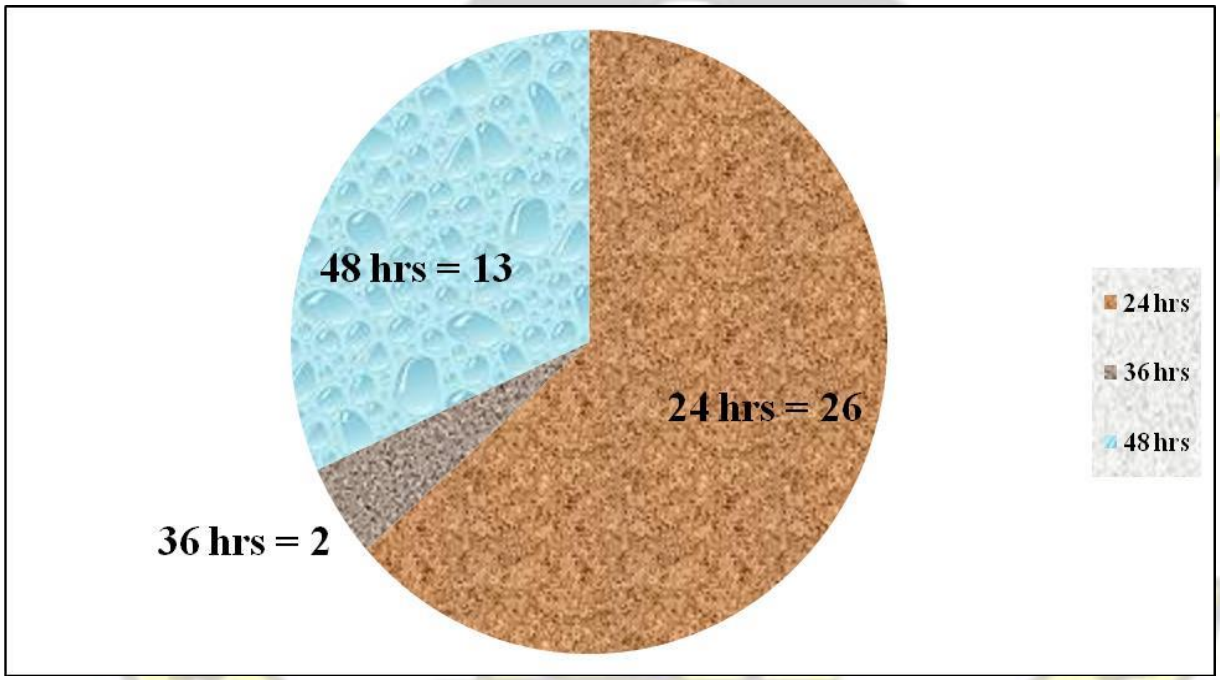
3.7 Analysis of results

The methodology was divided into two main sections thus Survey and Management system development.

Survey section

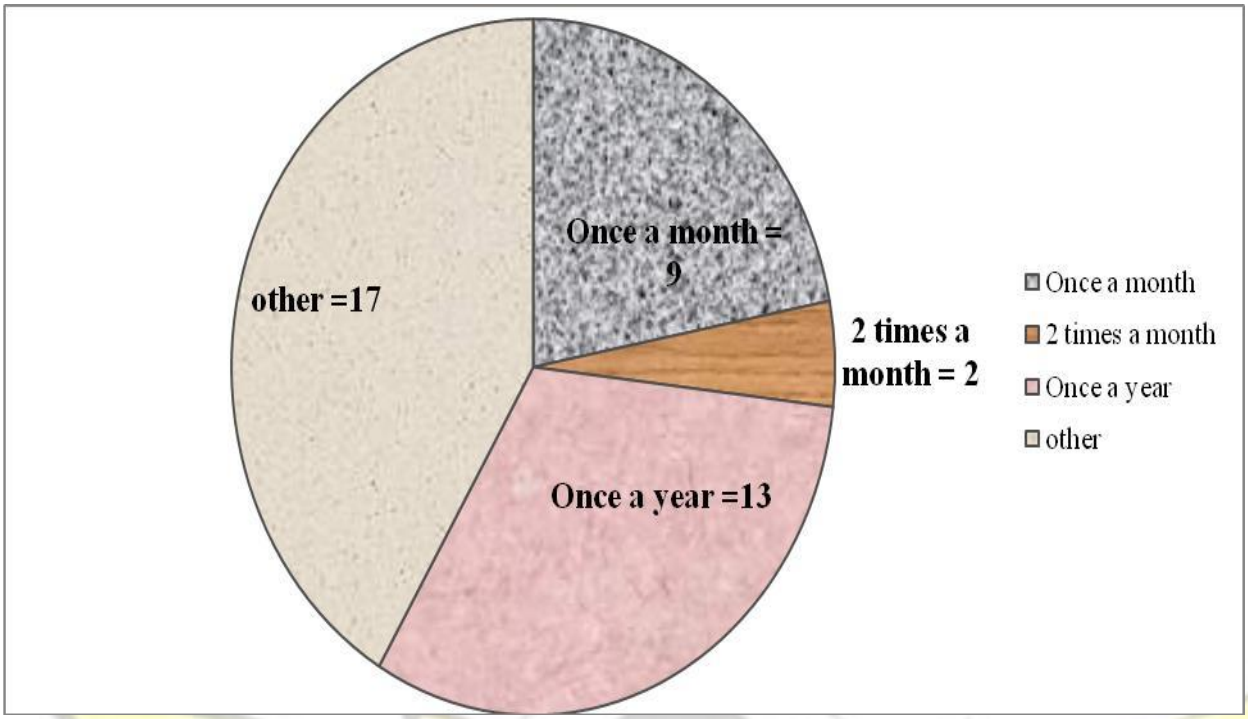
In order to determine the functional requirements needs for such system, the researcher surveyed station managers/supervisors working in various Total fuel stations in Accra and Tema. In all 50 questionnaires containing both open and close ended questions were distributed. However, out of the 50, 41 correctly filled questionnaires were retrieved indicating a response rate of 82 % and this formed the sample size for the study. The Statistical Package for Social Sciences (SPSS) version 21.0 was employed in analysing the data. Below are the summaries of results.

Figure 3.3: How long does it take for Total Petroleum Head Office to Replenish Stock?



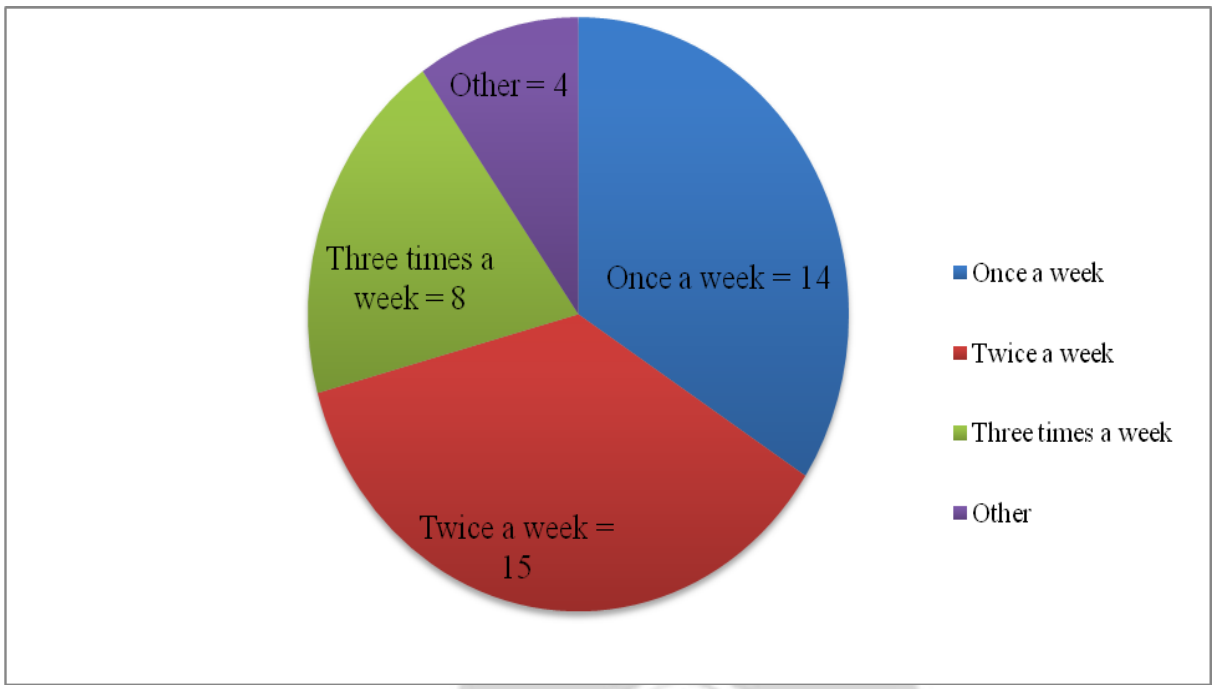
From the pie chart, it was observed that greater part of the respondents said it takes 24 hrs for management to replenish stock with 13 saying it takes 48 hours to replenish and 2 said it takes 36 hours. This therefore means that some fuel stations quickly get replenish than some other areas being as a result of slower manual management system.

Figure 3.4: How often does the fuel station get shortages?



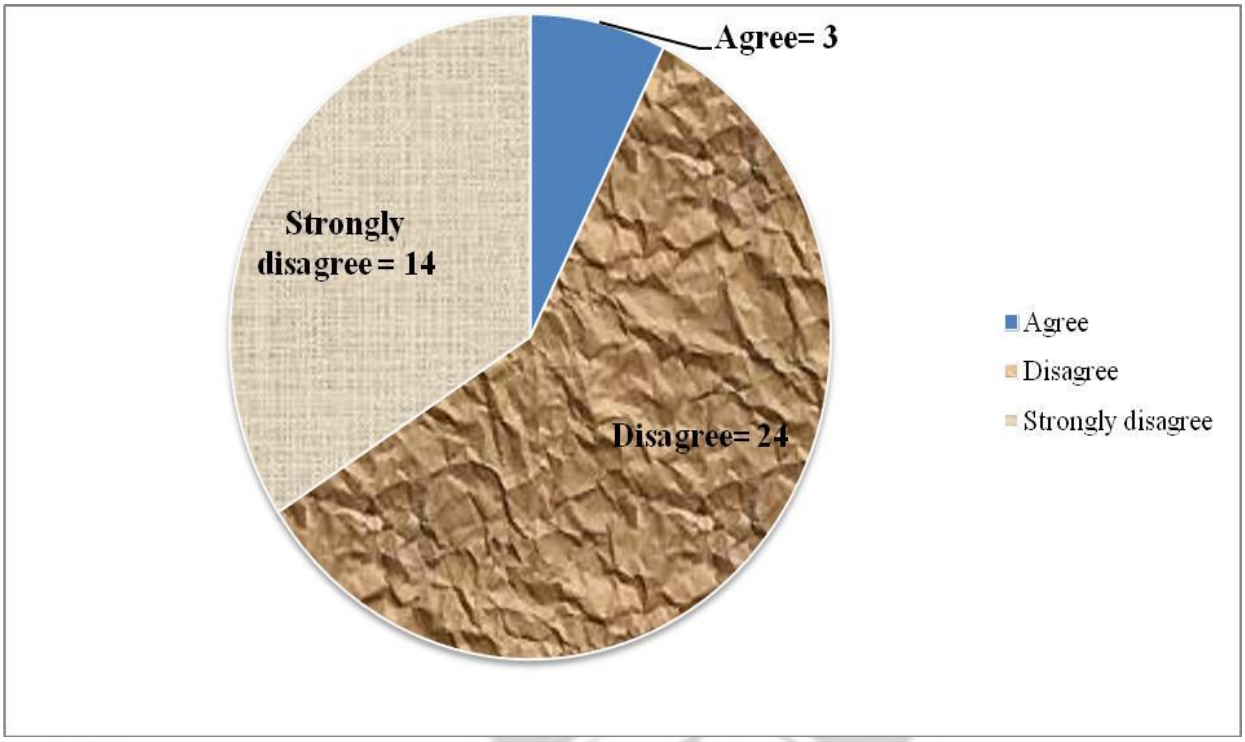
Greater number of the respondents responded that, they only experience shortage during general crisis. 13 respondent said, they experience it once a year, 9 said they experience shortage once a month and 2 said they experience shortage 2 times a month. Ideally we want a situation where shortage will be experience only during national fuel crisis. Once other fuel stations experience shortages within a month and a year therefore calls for a better management system is required.

Figure 3.5: How many times does the fuel station re-order for fuel?



From the pie chart, it was realized that 14 respondents from Total fuel station re-order fuel at least once within a week and this require cumbersome paper work. This cumbersome manual paper work can be stop when there is digital or software system that can track the fuel level in the tanks of the various fuel stations and quickly give instruction for them to be supplied with fuel.

Figure 3.6: Sales data has been lost before?



Every organization is most interested in keeping track and making sure that their information is properly saved. Due to this, the researcher expected that if Total Petroleum Station has a good management system, there should not be news on losing of any record. From the pie chart, it was observed 3 of the respondent indicated that their sales records or data has been lost before. This really shows an indication of danger and therefore the current management system will help stop this occurrence.

Table 3.1: Frequencies on some questions pertaining to problems faced by Total Petroleum Fuel station in their service delivery

		Frequency		
N	**Items**	**Yes**	**No**	**Not Sure**

1	Does the fuel station have back-ups for sales data and reports in case of disaster?	**29** (70.7%)	**12** (29.3%)	
2	The use of information systems can help overall business growth	**40** (97.6%)		**1**(2.4%)
3	The use of information systems will help in quick response to the fuel stations request	**41** (100%)		
4	Does the fuel station employ the use of computers to help in storing information and managing fuel sales?	**26** (63.4%)	**15** (36.6%)	
5	Are there any management systems in place for the head office to use to track sales and stocks?	**33** (80.5%)	**8** (19.5%)	
6	Sales data has been lost before	**3** (7.3%)	**38** (92.7%)	

EXAMINATION OF IMPROVED EFFICIENCY OF FUEL STATION

This was examined by asking workers at various Total filling sub-stations in Accra and Tema. Below is the table and pie charts displaying workers view on which specific system will improve efficiency.

Table 3.2: Efficiency level*System type Cross-tabulation

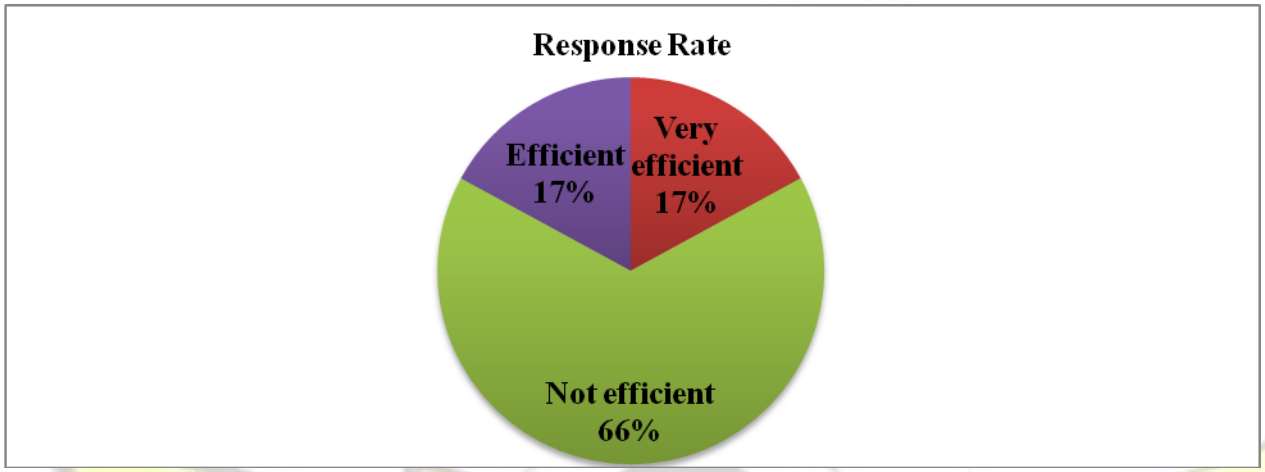
Efficiency level	**Type of System**		df	X^2	*P*
	Manual	Automated			
Very Efficient	7 (17%)	38 (93%)	2	7.30	.03*
Efficient	7 (17%)	3 (7%)			
Not Efficient	27 (66%)	-			

*p is significant @ .05 level of significance

From the table, the Pearson Chi-Square value is 7.30 with 2 degree of Freedom. The Significance is .03. There is a significant difference in terms of response (the significance level is less than

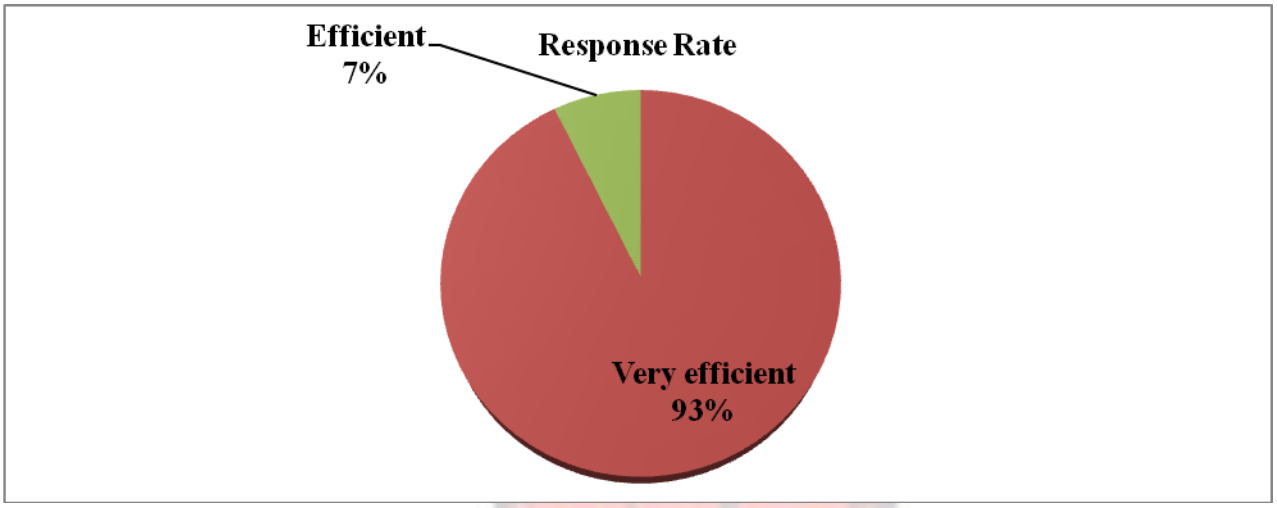
.05). Therefore, it can be said that the two variables (system type and efficiency level) are associated. This means that the choice of participants as management system being efficient or not depends on whether the system type is manual or automated.

Figure 3.7: MANUAL SYSTEM



From the pie chart in fig. 3.7, respondent or workers in the various Total filling stations situated in Accra and Tema metropolis largely disagree on the idea of manual system of management process leading to improve efficiency. Based on that 66 % of them indicated manual system as not efficient, 17 % indicated that it's efficient and 17 % also indicated that it's very efficient.

Figure 3.8: AUTOMATED SYSTEM



In fig. 3.8 above managers/supervisors working in the various Total fuel stations in the environs of Accra and Tema largely aired out that the use of automated system in managing the operations at the fuel station will lead to improved efficiency with 93% indicated very efficient and 7% efficient.

EXAMINATION OF TOTAL PETROLEUM FUEL STATION HAVING SOFTWARE TO TRACK BUSINESS OPERATION

Table 3.3: Chi-Square indicating the weight of responses given by respondent

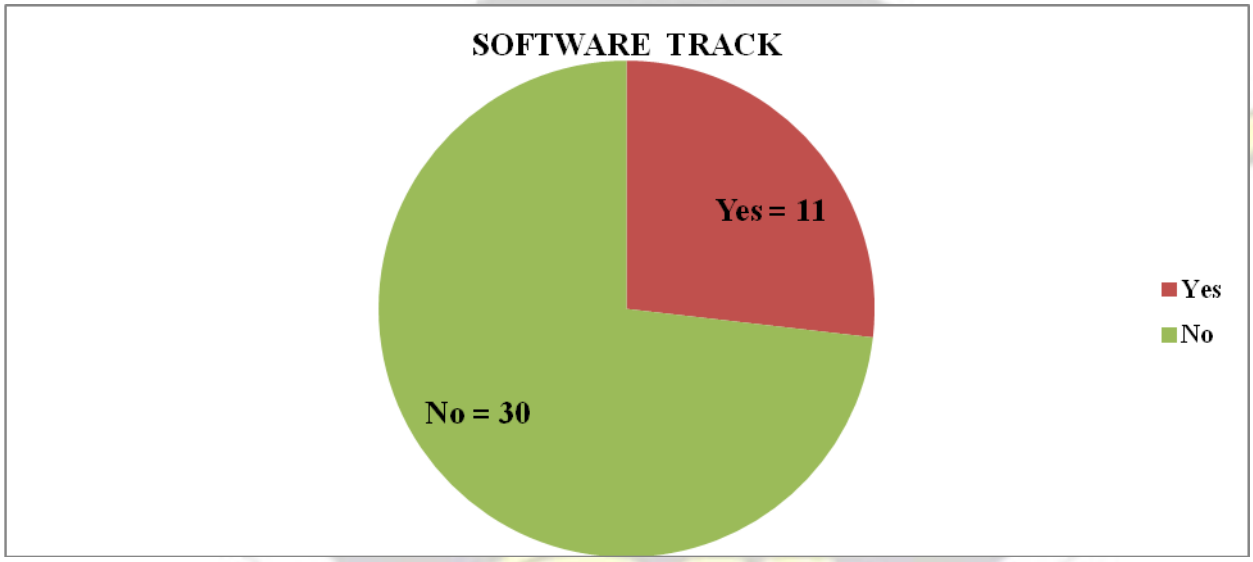
	Response				
Item	Yes	No	df	X^2	*P*
Software	11 (26.8)	30 (73.2%)	1	8.81	.00*

*p is significant @ .05 level of significance

From the table, 30 of the respondents indicated that there are no transaction software which captures transaction or sales of petroleum products approximating 73.2% and 11 with 26.8% indicating that they have. Looking at the chi-square value thus 8.81 with a significant value less than .05 indicates clearly that there is a greater weight on their responses and frequencies and therefore the need for immediate action to be taken.

Below is the graphical representation of response.

Figure 3.9: EXAMINATION OF TOTAL PETROLEUM FUEL STATION HAVING SOFTWARE TO TRACK BUSINESS OPERATION



Management system

From the open ended questions respondent said Total Petroleum Fuel Stations do have management system in place and provide them with certain management training programmes. Most of these training mentioned are, Attendant and customer training, Safety, promotional,

health, top service, tom-card, staff and retail network, electronic and quality van, product knowledge, fire, entrepreneur skills.

With these management training they reported, I realized that they did not mentioned any training of fuel management system that will track transactions and delivery of fuel to their station.

Uses of Fuel Management System and its importance

From the view of the respondents, they said management system will help them in good records keeping, serve as a back-up for their data or transaction in terms of emergency, help them in decisions support, information and data can hardly lost, bring efficiency, help in accessibility and tracking of records and data very easily by management, elimination of notebooks and receipts. In their view they also believe that fuel management system will help boost their effectiveness level and finally bring about organizational efficiency.

Challenges faced during business operations

Some of the challenges outlined by managers/supervisors are as follows:

- Lose of data
- Shortage of fuel due to late delivery, delay in orders and general crisis thus, national fuel shortage.
- Bad records keeping
- No back-ups in the event of experiencing fire outbreak

The way forward

After responding to the various questions, the final question put forth before them was, what in their own view do they think can be done to help remedy the situation. Below are some of the answers generated:

1. Upgrade of the manual system to an automated system
2. Supply of computers at various fuel stations.
3. Adequate back-up at head office
4. Quick delivery of fuel
5. There should be a fuel management system at the stations and head office **CHAPTER FOUR**

ANALYSIS AND IMPLEMENTATION OF DEVELOPED SYSTEM

4.0 Introduction

The main aim or goal of the study is to investigate into the operations of fuel marketing companies in Ghana using TOTAL Petroleum Ghana Limited as a case study.

Software development section

The software development section analyses the developed system to make it meaningful. The first step is improving the manual system of managing fuel stations, looking at the current situation, and analysing what is good and what is not. Based on this information, a choice can be made on how to proceed in order to improve the current situation. The final step is actually implementing these improvements in the developed system.

4.1 Justification of Using Agile Approach

Agile development approach and methods excel in fast-changing environments based on historical experiences. (Ambler, 2002). Claims of agile approach lie mainly in its ability to build high quality systems in a speedy and short time periods and ensure system flexibility to respond to changes with no descent into chaos (Boehm, 2002).

The principle of agile development is that design and testing is integrated throughout the lifecycle, enabling regular testing and inspection of the working product/service as it develops. This allows the owners to make adjustments if necessary and gives the product team early sight of any quality issues. Agile development principles improve active, 'user' involvement throughout the product and service development and a very cooperative collaborative approach. 'Agile methods are a popular alternative to the traditional systems development life cycle. Agile methods place considerable emphasis on flexible requirements and frequent interaction with users. This method skips detailed systems analysis and aim at delivering a new application in the shortest possible time. The major advantage of all agile methods is that they result in fast development of applications so that users can have them within weeks rather than months or years. Users do not have to wait long for system modifications, whether they are required because of programmer errors or because users have second thought about some features'.
(Allaboutagile, 2014).

4.2 Requirements Elicitation and Analysis

The requirement elicitation and analysis of the existing system was examined. It explains the techniques used in finding out the facts about the existing system, followed by the description of the existing system as it stands. Analysis of the existing system resulted in the requirement

specification of the new system. The requirement analysis was based on the questionnaire and interview responses of the fuel station managers/supervisors.

4.2.1 Functional Requirements

'A functional requirement defines a function of a system or its components. Functional requirements may be calculations, technical details, Processing and data manipulation and other specific functionality that defines what a system is supposed to accomplish'. (Allaboutagile, 2014). The system will make it easy to locate requirement for particular aspects. Functional requirements drive the overall system architecture of the application. Examples of the functional requirements specification are:

- User Registration

  The system shall let the admin or manager of the fuel station register a user who can then successfully log on to the system.

- Retrieval of Records

  When the user log on to the system it will enable the user to check records, enter sales and also generate reports.

- External Interface Requirements

  These comprises of a Software interface, Hardware interface, User interface and communication interface.

The functional requirement specifies the operations of the system which include:

- Functionality: The scope of functionality of the system.

- Performance: How the solution performs.

- Interoperability: How the parts of the solution interact with each other and the outside world.
- Scalability: How the solution is intended or designed to cope with increases in sale of data and usage
- Flexibility: How the solutions will adapt to different use cases.

4.2.2 Non-Functional Requirements

Non- functional requirements are standards that the system is required to meet. These non-functional requirements serve as a sort of quality check to the system. Non-functional requirements of this project involve

- Adaptation

  The system should be able to integrate with different systems without much modification and changes in systems.

- Security Control

  The system must meet all the security requirements of a quality system. The system must be available for use and must authenticate users. Finally, the system must ensure data integrity and confidentiality.

- Flexibility

  The system must be able to evolve to meet any organisational change that might occur.

- Usability

  The system must be easy and simple to understand and use by users.

- Performance

  The system must provide rapid response time. Response to request, Retrieval of records,

Display of records and presentation of records.

- Scalability

  The system must have the ability to expand to accommodate growth. Increase in user access, concurrency of retrieval by users and software quality features.

The Non-Functional requirement is one which helps define the boundaries of the solution which includes:

Reliability and Maintainability: Information systems that enables business operations to be reliable and maintained in an efficient manner.

Availability and Performance: Information systems equipments must be available to handle business information systems and also meet the performance needs of the organization. The software been used must solve organizational problems.

Usability and Adaptability: The software developed to meet the organizational needs must be usable by staff, clients, customers and employers must be adaptable to change when a new technology is introduced for the upmost benefit of the organization.

Business sustainability: Relating to how the requirement helps sustain the business side of the sector.

4.3 Use-Case Diagrams for the "as-is and "to-be"

The Use-Case is the foundational requirements for identifying and specifying the standards required to support exchange of data and reference development implementations and tools to ensure consistent and reliable adoption of the data exchange standards. These use cases address the requirements of a broad range of interests including customers, departments, Banks, their

significant and other stakeholders, providers, vendors, standards organizations. A use-case is a methodology used in system analysis to identify, clarify, and organize system requirements.

These Use-Cases describe:

- The operational context for the data exchange
- The stakeholders with an interest in the Use-Case
- The flow of information must be supported by the data exchange
- The types of data and their specifications required in the data exchange

The newly developed system offers two main functionalities to the end user. The first functionality allows managers and supervisors to monitor the volumes of fuel delivery and the revenue generated by the fuel stations. The second functionality also allows the corporate head office to track and monitor each service stations volume of fuel used, daily sales, amount generated by each fuel station and the volume of fuel needed to be replaced by the corporate office.

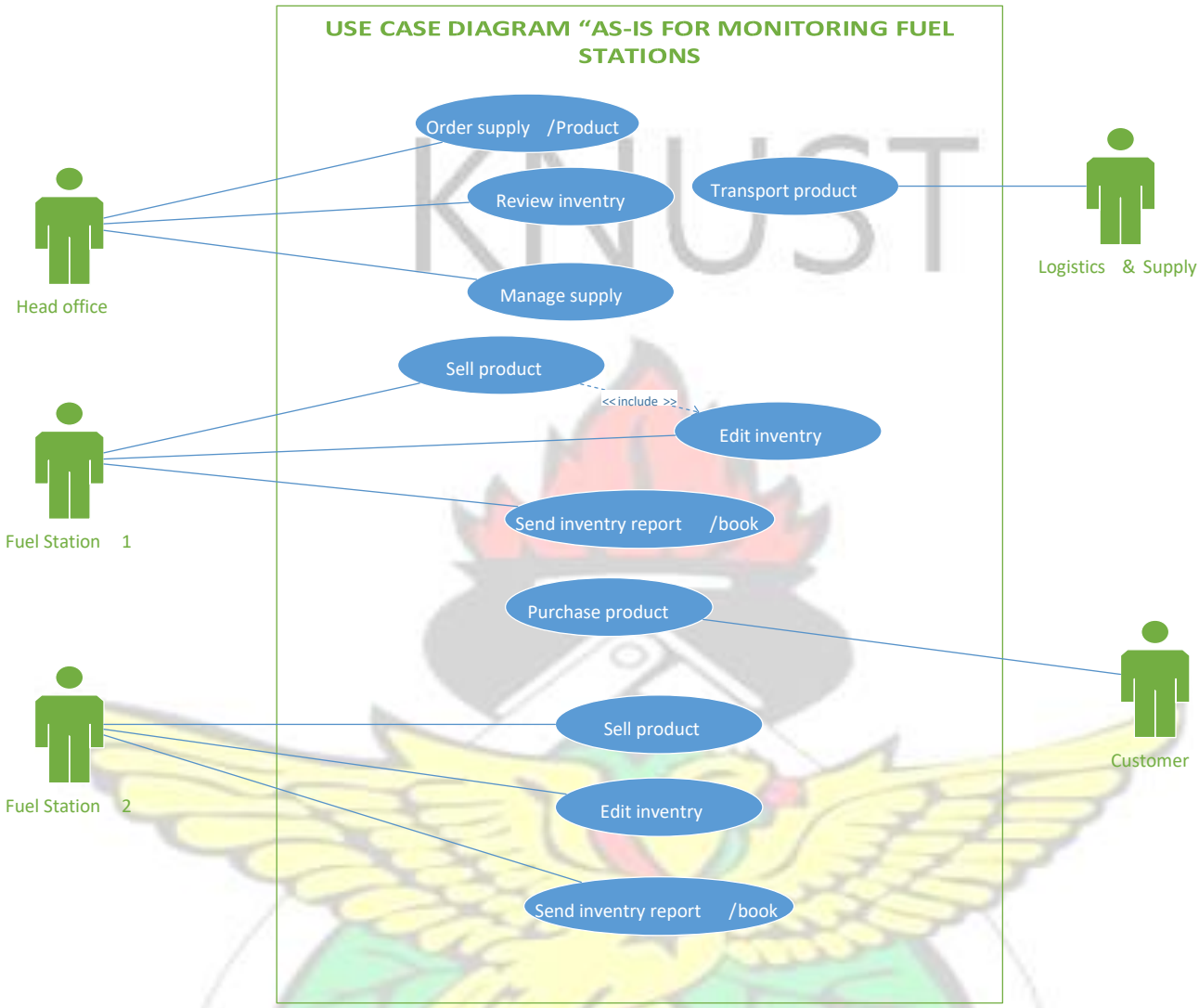


FIGURE 4.1: Use-Case Diagram "AS-IS" for Monitoring Fuel Stations

The "To-be" systems show the intended systems designed to improve upon the old systems for better quality of service in the organization. The "To-be" system for product certification aims to involve information systems to help in automating more of the manual processes to speed up the certification process system.

The “To-be” monitoring of fuel station management system has been designed to make the monitoring process faster, reliable, more transparent and convenient for both the fuel stations and the head office. The head office will be able to track product monitoring details.

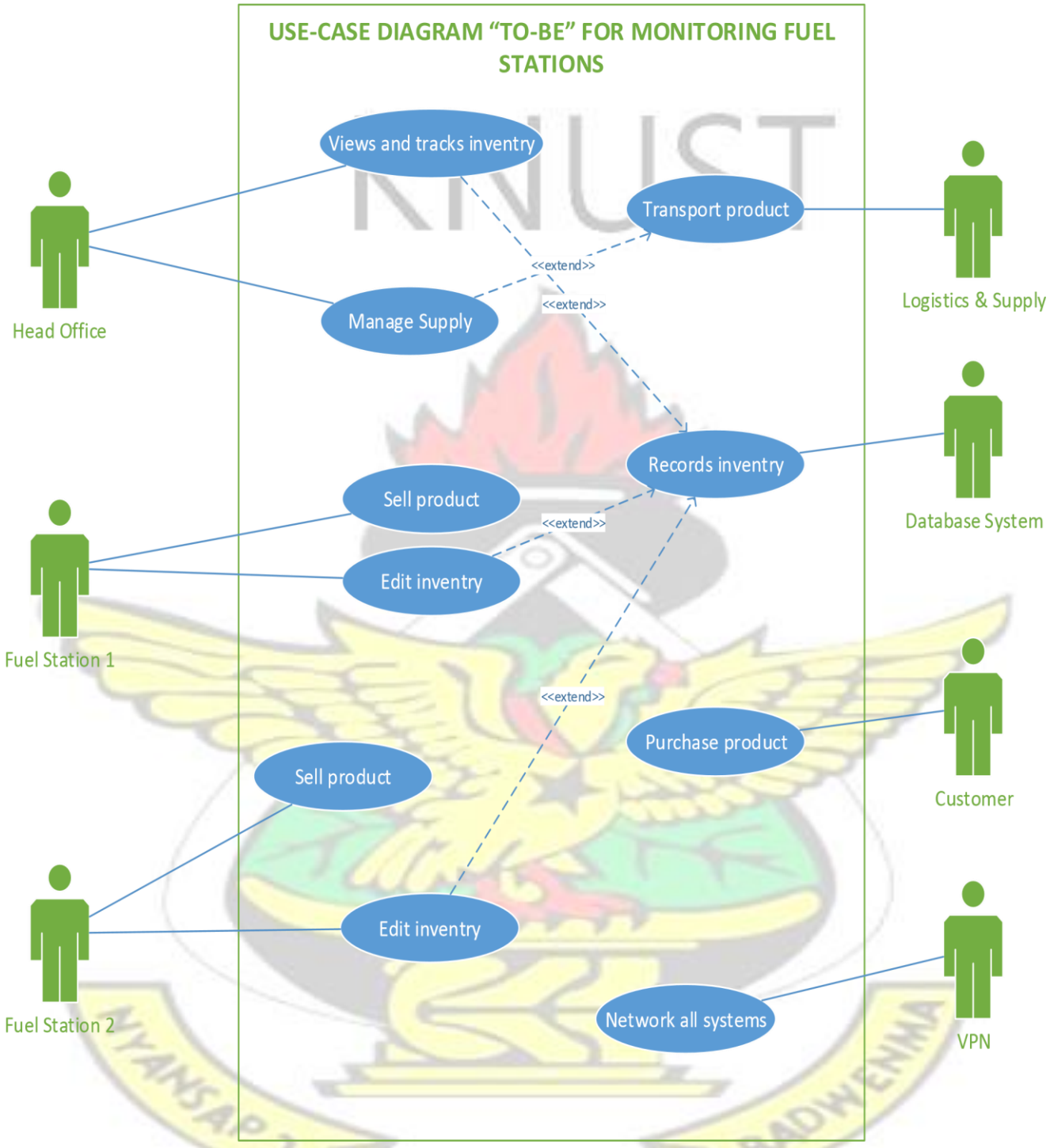


FIGURE 4.2: Use-Case Diagram "To-Be" for Monitoring Fuel Stations

4.4 Use-Case Descriptor

The Use-case descriptor is a chart used to describe activities in a particular use case scenario. It describes a brief description about actors, brief description, preconditions, trigger, flow of event, relationship, association etc.

Use-Case Name: View and Track	ID: UC001
Primary actor: Administrator and Server,	Use case Type: Essential
Stakeholders and interest: Administrator: Will view and track products of shortage at fuel stations. Administrator: Re-order products needed by fuel stations, view and track revenue generated and the current level of tanks at each fuel station. Head office: Generates reports from each station, monitor and supply amount of fuel needed by each station.	
Brief Description: This describes the process of view and track of products sold and the volume level of tanks.	
Precondition: The User has product details to the head office. Trigger: The User sees revenue generated, name of product and the current level of fuel tank.	
Relationship: Association, Extend Association: Consumers, Users	

Normal Flow of events: The Administrator sees product details A. User see revenue generated by the fuel stations User re-order products for fuel stations B. Head office generates reports from fuel stations Head office verifies and tracks the revenue generated and the level of tanks. Head office sends feedback to station managers/supervisors
Requirement met: Head office has successfully verified and track the processing of products
Risk: Low
Priority: High

TABLE 4.1: Use-Case Descriptor for view and track

Use-Case Name: Manage Supply	ID: UC002
Primary actor: Head office	Use case Type: Essential
Stakeholders and interest: Head Office: Will manage the supply of fuel needed by the fuel stations Head Office: Collaborate with the logistics team to supply products. Head office: Generates reports from each station, monitor and supply amount of fuel needed by each station.	
Brief Description: This describes the process of managing products to track products sold and the volume level of tanks.	
Precondition: The User has all the details of the fuel stations. Trigger: The User sees revenue generated, name of product and the current level of fuel tank.	
Relationship: Association, Extend Association: Consumers, Users	
Normal Flow of events: The head Office sends product details A. User sends products to the fuel stations User receives feedback from fuel station about the supply by adding stocks received.	

B. Head office generates reports from fuel stations Head office verifies and tracks the amount generated and the level of tanks. Head office sends feedback to station managers/supervisors C. When fuel is low the head office orders for more stock to replenish levels
Requirement met: Head office has successfully managed the fuel levels to keep supply running
Risk: Low
Priority: High

TABLE 4.2: Use-Case Descriptor for Manage supply

Use-Case Name: Sell Products	ID: UC003
Primary actor: Fuel Stations	Use case Type: Essential
Stakeholders and interest: Station Managers/Supervisors: Will input products sold and the volume level into the system Station Managers/Supervisors: Can access products sold, revenue generated and the current level of tank. Head office: Generates reports from each station, monitor and supply amount of fuel needed by each station.	

Brief Description: This describes the process of selling products and tracking products sold and the volume level of tanks.
Precondition: The User has product details at the fuel station. Trigger: The User can access revenue generated, name of product and the current level of fuel tank.
Relationship: Association, Extend Association: Consumers, Users
Normal Flow of events: The Manager/Supervisor can access product details A. Users access revenue generated at the branch. User access product details B. Head office generates reports from fuel stations Head office verifies and tracks the revenue generated and the level of tanks. Head office sends feedback to station managers/supervisors
Requirement met: Head office has successfully verified and track the processing of products
Risk: Low
Priority: High

TABLE 4.3: Use-Case Descriptor for sell products

Use-Case Name: Transport Product	ID: UC004
Primary actor: Logistics Team	Use case Type: Essential
Stakeholders and interest: Logistics Team: Will send products to various fuel stations upon instruction from head office. Station Managers/Supervisors: Receive products, and add fresh stock to the system. The current level of tank will increase. Head office: Generates reports from each station, monitor and supply amount of fuel needed by each station.	
Brief Description: This describes the process of monitoring products or to track products sold and the volume level of tanks.	
Precondition: The User has product details to the head office. Trigger: The User sends amount generated, name of product and the current level of fuel tank.	

Relationship: Association, Extend Association: Consumers, Users
Normal Flow of events: The Manager/Supervisor send product details A. User send amount generated to head office User send product details to Head office User send instant messages to Head office about status B. Head office generates reports from fuel stations Head office verifies and tracks the amount generated and the level of tanks. Head office sends feedback to station managers/supervisors
Requirement met: Head office has successfully verified and track the processing of products
Risk: Low
Priority: High

TABLE 4.4: Use-Case Descriptor for transport products

4.5 Activity Diagram

Activity diagram is a very important diagram in UML which describes dynamic aspects of the system. Activity diagram is basically a flow chart to represent the flow of events from one activity to another activity. The activity can be described as an operation of the system, so the control flow is drawn from one operation to another. This flow can be sequential, branched or concurrent. The activity can help to describe the flow of control of the target system, such as the exploring complex business rules and operations, describing the use-case also the business process. Activity diagrams are often used to depict a particular use case and may illustrate the different ways that an activity could happen and end (Kendall & Kendall, 2011)

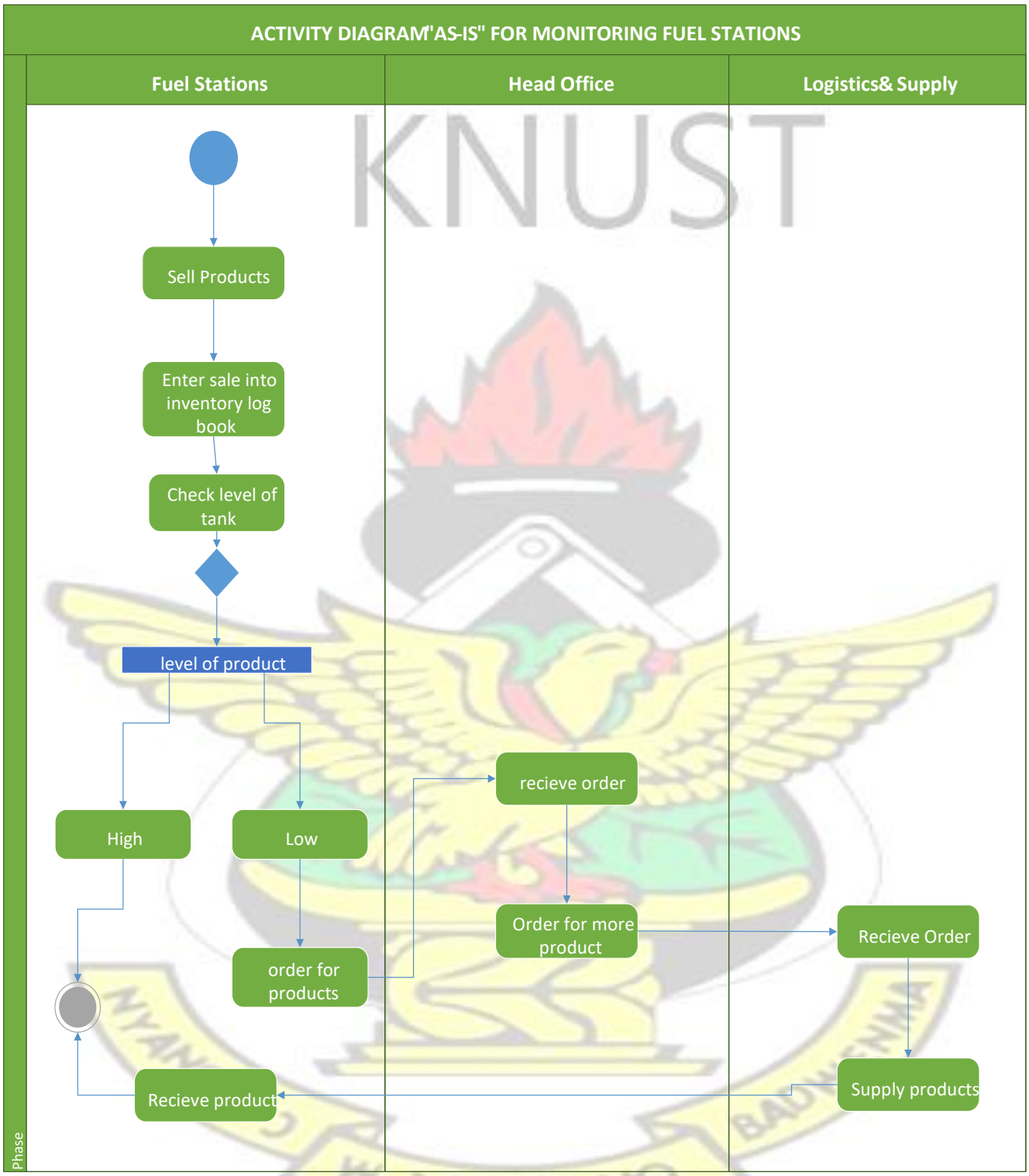

ACTIVITY DIAGRAM"AS-IS" FOR MONITORING FUEL STATIONS
Fuel Stations
Head Office
Logistics& Supply
Sell Products
Enter sale into inventory log book
Check level of tank
level of product
High
Low
order for products
recieve order
Order for more product
Recieve Order
Supply products
Recieve product
Phase

FIGURE 4.3: A UML Activity Diagram for "As- Is" for Monitoring Fuel Stations

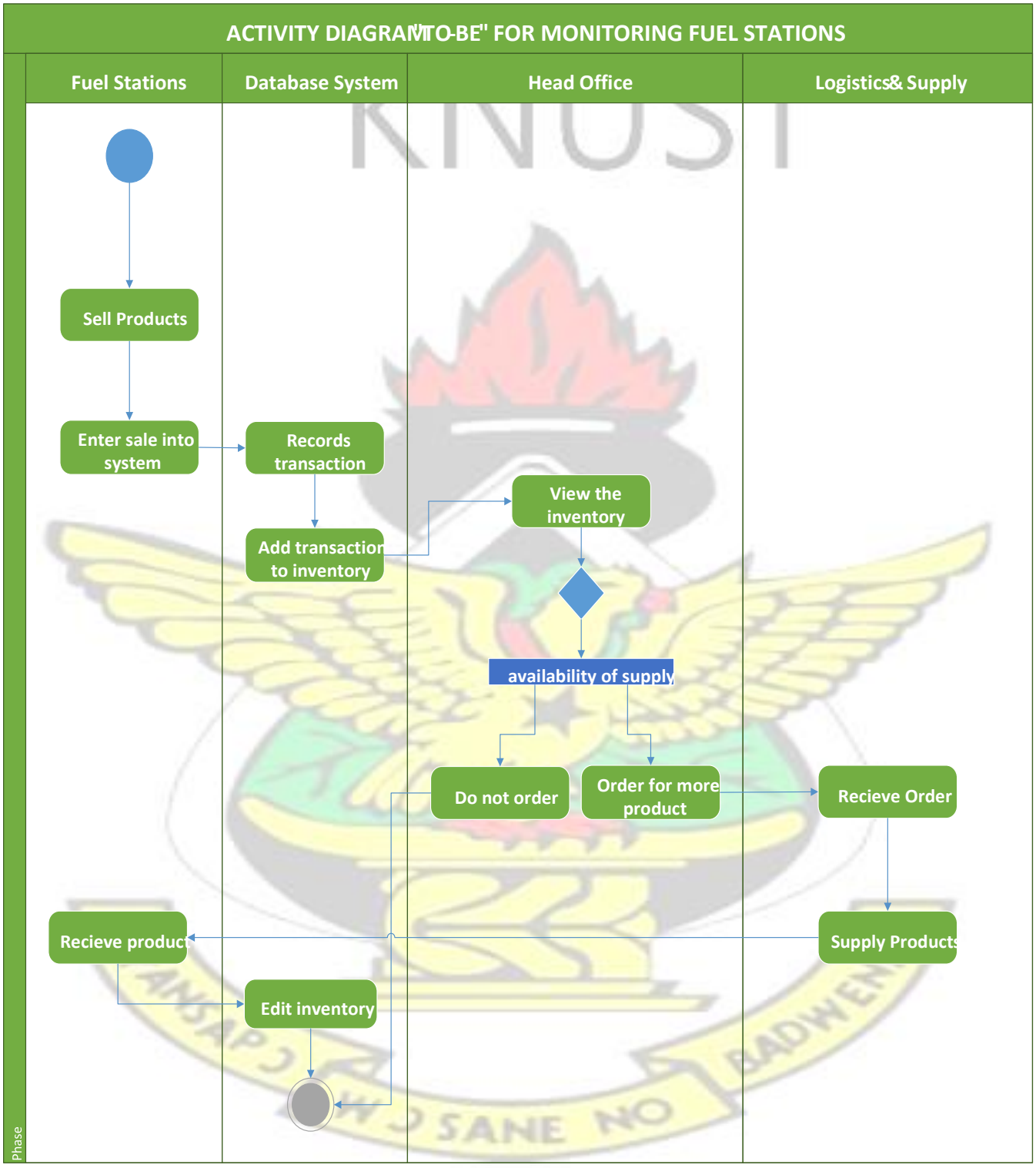


FIGURE 4.4: A UML Activity Diagram for "To- Be" for Monitoring Fuel Stations

4.6 UML Class Diagram

A Class diagram is a UML structure diagram which shows the overall structure of the designed system at the level of classes and interfaces, shows their features, constraints, relationships, associations, generalizations, dependencies etc. Class diagram provides an overview of the target system by describing the objects and classes inside the system and the relationships between them. Class diagram show the relationship between classes in a system. Class level is the level on which programming is done; class diagrams do not depict any particular activity or process but only portrays the static features of the system (Kendall & Kendall, 2011)

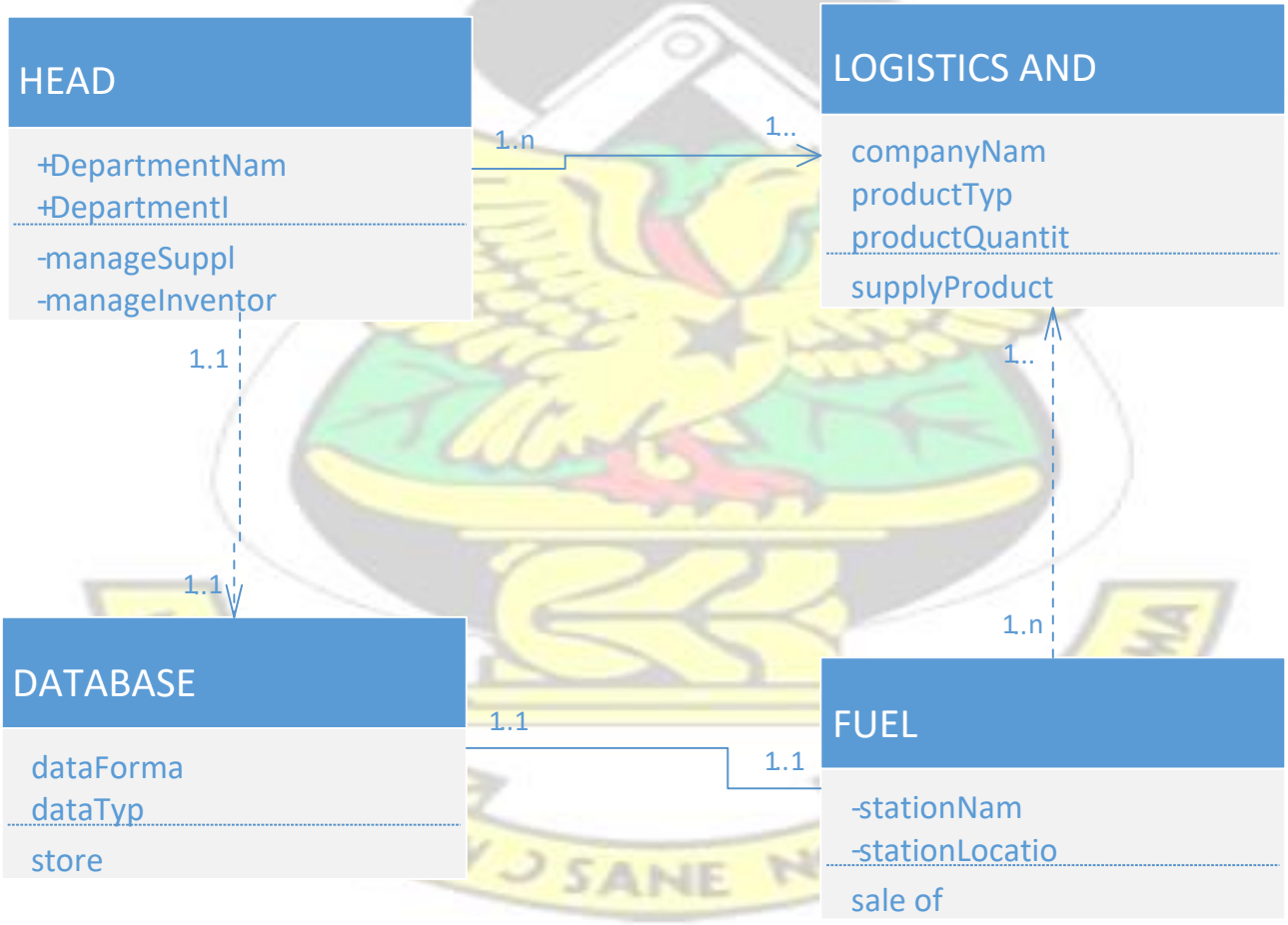


FIGURE 4.5: A UML Class Diagram

4.7 UML Sequence Diagram

The sequence diagram is the most common kind of interaction diagram, which focuses on the message interchange between a number of lifelines. Sequence diagram describes an interaction by focusing on the sequence of message that is exchanged, along with their corresponding occurrence specifications on the lifelines. UML sequence diagrams model the flow of logic within your system in a visual manner, enabling you both to document and validate your logic, and are commonly used for both analysis and design purposes. Sequence diagrams are the most popular UML artifact for dynamic modeling, which focuses on identifying the behavior within your system.

Most often sequence diagrams are used to depict activities in a use case. They are used to derive the relationships between objects in a system. Sequence diagrams are used to illustrate activities in use scenarios to make the activities follow in a more logical order for analysis. (Kendall & Kendall, 2011).

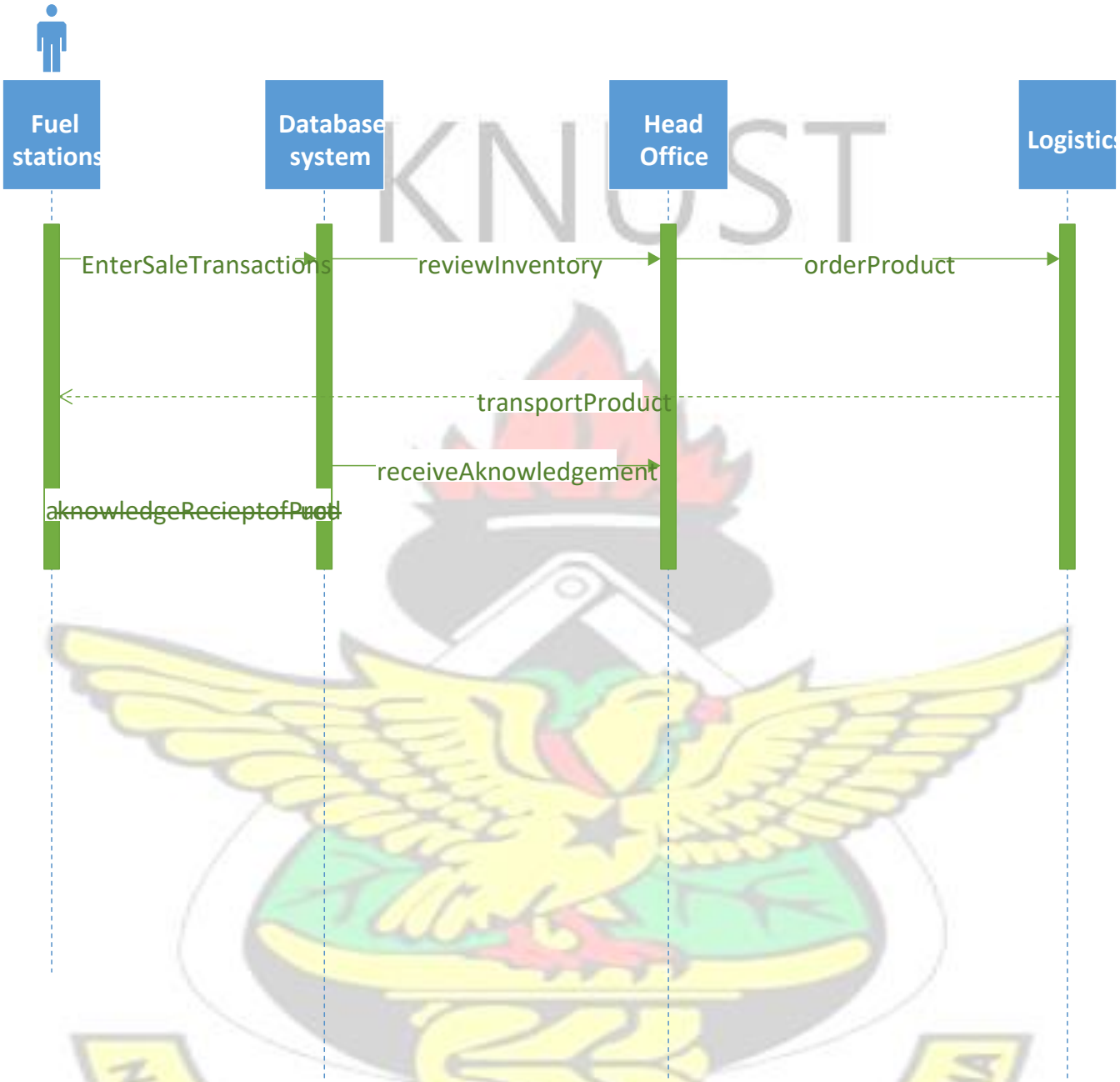


FIGURE 4.6: A UML Sequence Diagram

4.8 “To-Be” Design of suggested Improvement

The “To-Be” design has the components to create a complete integrated supply chain. It is expected that the total relevant cost can be minimized by creating an integral distribution supply chain. A “To-Be” design is created and has the potential of incorporating processes and product flows. The “To-Be” design is proven to solve the limitations of the manual processes of fuel management system. With the newly developed system you can manage and control your fuel stations from a central location which is the head office. Data from fuel stations can be managed and ensures that right reports are delivered to the right people. The fuel station management system software allows you to assess business performance quickly. The “To-Be” software developed allows you to monitor the status of the system remotely and ensures that any issues are detected proactively and that preventive action is taken.

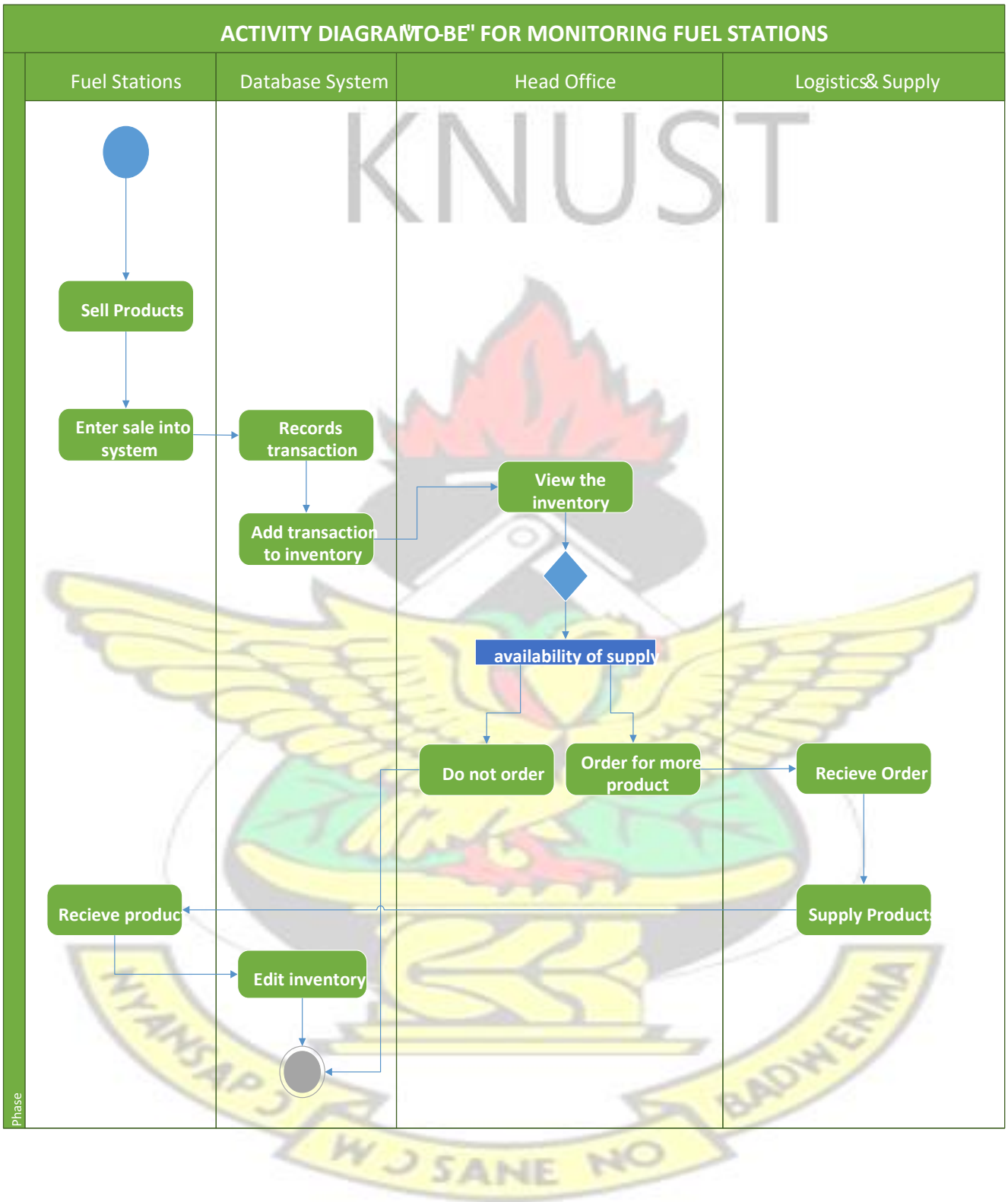


FIGURE 4.7: A UML Activity Diagram for "To- Be" for Monitoring Fuel Stations

4.9 Testing and Evaluation

The proposed system was implemented at the Haatso Total fuel station for testing and evaluation of fuel products. An installed fuel pump was linked to the back-end office computer which has the fuel management system application installed on it. The station received fuel product of 45000 liters of super and 40000 liters of diesel which was discharge into the underground tanks. The manager of the fuel station entered the details of fuel product received into the fuel station web application.

The fuel attendant started selling the fuel products to customers who came to buy fuel from the fuel station. The fuel attendant enters the amount to be purchased and the volume required by customers on the totalizer reading of the pump. Information entered into the totalizer reading of the pump is automatically updated into the database of the back-end office fuel management system application. As customers purchased the fuel products from the fuel station, the stock level kept reducing. In view of the fact that, the Haatso Total fuel station has a high patronage rate, the stock level was set at 20,000 liters for super and diesel. Each product was being monitored daily to see the stock level.

After four working days the web-application of the fuel management system at the back-end office indicated that the super product has reached its desktop level of 20000 liters, therefore there was a need to replenish stock of the super product. This occurred when the manager accessed the web-application to monitor the stock of fuel product. It was observed that super products sell faster at the Haatso branch of the Total fuel station.

The manager was impressed by the quality of information, the speed of access to information, back-up and security measures that the fuel management system presents to the fuel station.

There was no need for managers and supervisors to use dip-sticks to measure stock level of fuel products in the underground fuel tanks. Also the manager was able to generate sales reports, stock reports, supply reports, and to conduct a trend analysis of various product sales. At the station level the proposed fuel management system enables managers to track product sales and performance of the fuel station.

CHAPTER FIVE

SUMMARY, CONCLUSION, RECOMMENDATIONS AND FUTURE WORK

5.0 Introduction

Chapter five summarizes the whole research work and makes recommendation for future use of the developed fuel station management system and related studies. The creation of a fuel station management system for tracking products and inventory of fuel in Total fuel stations will help the organisation to enhance its performance. Moreover, a well implemented fuel station management system will provide the organization with the structure to activate continual improvement actions.

5.1 Summary

The architecture consists of a UML system design. The adoption of SQL server for data and services interfaces and Web service application which is ASP.Net framework for implementing the data services, allows the users to create and manage work flows and data analysis. This architecture has a potential use for managing fuel in rapid response systems.

The current monitoring and tracking models of Total Petroleum Ghana Limited fuel stations has been a manual system. Fuel tanks are measured with Dip sticks to check the level of fuel in the tanks. Theft and fraud sometimes takes place among fuel attendants leading to numerous complaints by station managers. Daily sales are recorded in sales books which can lead to inaccurate data recorded. Replenishing stocks at Total Petroleum fuel stations takes 48 hours.

Station managers fill an order forms to order for products. If there is no supply at the fuel stations after 48 hours, the station managers or supervisors follow up at the head office. The problem with

the existing system include lack of provisions of protected and secured system to fall on in case of natural disaster such as fires, flood and earth quake. Delay in locating and retrieving records during audit to ensure integrity of records. With the fuel station management system developed, the head office tracks and monitor products of all their fuel stations and replenishes them depending on how fast stock reaches its desk-top level at each fuel station site.

An overview of a fuel management system has been tested at Haatso Total Service Station and the results of the test run can be found in the appendix reports. The benefits of fuel station management system if adopted by Total Petroleum Ghana Limited ensures that sales reports, stock reports and supply reports can be generated quickly without demanding it from any fuel station. The quickness in generation of the reports is due to the fact that through the use of the fuel management system, data processing and analysis are faster and more accurate, hence Managers can instantly access different information which leads to easy and quick decision making. This is evidence during the test-run of the fuel management system at Haatso Total Service Station to generate reports needed for decision making. The fuel management system has the ability to perform sales entry, data processing, data security, reports such as sales report, supply report and stock report. All these functions of the system will enable Total Petroleum Ghana Limited to run its operations smoothly in a much more effective and efficient manner. The result from the research confirms that fuel management system performs several tasks at the fuel station which are satisfactory.

5.2 Conclusion

Using the fuel station management system by Total Petroleum Ghana Limited will enable its fuel stations run its financial operations right from sales, stock taking, replenishing stocks, supply reports and data processing to security of sales and stocks. The developed system will enhance Total Petroleum Ghana Limited confidence to track products of its service stations so as to get

value for money. It will also eliminate shortfall declaration of amount generated by station managers. Also, the system will offer a user friendly interaction, enabling Total Petroleum to achieve its objectives in managing fuel stations. It was found out during the test stage that using fuel station management system, sales reports, stock reports, stock level of the fuel in tanks, supply reports can be generated quickly. TOTAL Petroleum Ghana Limited can use the fuel station management system to analyse the fuel stations performance in terms of sales and in doing this, the company can always monitor the performance of its fuel stations. It was also observed that the fuel management system is quicker in generating reports due to the fact that reconciliation between the fuel stations and the head office can be done simply, faster and more accurate hence managers and the head office representative can access information from the fuel stations which will lead to easy and quicker decision making. The fuel management system developed can handle large volumes of data with ease. Training of staff at all levels of the organization is critical to fully utilizing the capabilities of the fuel station management system. In addition, because deploying such a system represents a new way of providing customer service, training TOTAL Petroleum fuel station staff in how best to use the developed system.

Finally, Total Petroleum Ghana Limited will have the advantage to monitor and manage site operations in real-time since the operation is supported by a web-based application so that stock figures are always viewable, current and fuel deliveries can be identified immediately. It is therefore viable to advice that Total Petroleum Ghana Limited actually adapt the use of fuel station management system.

5.3 Recommendations

The use of fuel station management system will solve the limitation problems in the manual processes of fuel station management system, therefore the need for Total Petroleum and the rest of the oil marketing companies to use this system is recommended. The system has the potential of meeting the needs and objectives of Total Petroleum Ghana Limited which will play a vital role in monitoring the strategic progress of all Total fuel stations through a feedback information system.

I strongly recommend that Total Petroleum Ghana Limited and the other oil marketing companies in the country should adopt the utilization of fuel station management system that provide enormous tasks and provide Total Ghana Limited with accurate, efficient and timely reports. However, the fuel management system developed will actually serve as an asset than a liability to Total Petroleum Ghana Limited business operations and it would therefore be of great necessity to recommend to Total Petroleum Ghana Limited the fuel station management system to implement this system and embrace the quality idea of establishing it so as to improve on its operations in terms of efficiency and effectiveness.

5.4 Future Work

In developed countries like Germany, United Kingdom and other European countries, they use Franklin Instrument systems for monitoring of fuel stations. An equally developed system like the fuel station management system has been developed, which is user friendly and web-based. More research should be carried out about fuel station management system to eliminate the manual system of managing fuel at TOTAL Petroleum Ghana Limited. Further research studies also needs to be conducted to establish and enhance automation in measuring stocks in tanks to eliminate the

manual system of measuring stocks using dip-sticks. Fuel management system will enhance complete fuel inventory reconciliation by providing automatic tank gauges to the fuel site underground tank to serve as a complete sensor detection tool.

Tank gauge measures can help you begin physical inventory of stocks underground using the gauge sensors which can appear on your personal computer without using dip-sticks to measure the volume of fuel underground. With the tank gauge installed in the underground tank, which is a hardware component, these will enable fuel reconciliation to be done with ease eliminating the manual process of measuring. The fuel reconciliation enables you to know what is coming in and what is being dispensed by combining dispensing data with the underground tank inventory data. Fuel tank gauges will improve fuel security, accountability and control for fuel sites and eliminate errors in the manual systems thereby improving accuracy, efficiency and productivity.

Above all, it will also improve fuel tracking and elimination of theft.

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APPENDIX A:

APPENDIX A

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI
INSTITUTE OF DISTANCE LEARNING

MSc. INFORMATION TECHNOLOGY

RESEARCH QUESTIONNAIRE FORM

RESEARCH TOPIC:

AN INVESTIGATION INTO THE OPERATIONS OF FUEL MARKETING COMPANIES

(A STUDY OF TOTAL PETROLEUM GHANA LIMITED) IN ACCRA, GHANA

This research is solely for academic purposes, in partial fulfillment for the award of Master of Science degree in Information Technology. Please be assured that the information provided would be treated as confidential.

Name of Fuel Station:…….

1.	How long does it take for the TOTAL Petroleum Head office to replenish stocks 24 hrs [ ] 36 hrs [ ] 48 hrs [ ] If other, please state……..

2.	How often does the fuel station get shortages Once a month [ ] 2 times a month [ ] once a year [ ] If other, please state……..
3.	An automated system will help the fuel station improves its efficiency Strongly Agree [ ] Agree [ ] Maybe [ ] Disagree [ ] Strongly Disagree [ ]

4.	The present manual system is efficient Strongly Agree [ ] Agree [ ] Maybe [ ] Disagree [ ] Strongly Disagree [ ]
5.	How many times does the fuel station re-order for fuel? Once a week [ ] twice a week [ ] three times a week [ ] If other, please state……..
6.	Sales data has been lost before Strongly Agree [ ] Agree [ ] Disagree [ ] Strongly Disagree [ ]
7.	Does the fuel station have back-ups for sales data and reports in case of disaster? Yes [ ] No [ ]

8.	The use of information systems can help overall business growth Strongly Agree [ ] Agree [ ] Maybe [ ] Disagree [ ] Strongly Disagree [ ]
9.	The use of information systems will help in quick response to the fuel stations request Strongly Agree [ ] Agree [ ] Maybe [ ] Disagree [ ] Strongly Disagree [ ]

10.	Information systems have had positive impact on fuel station business Strongly Agree [ ] Agree [ ] Maybe [ ] Disagree [ ] Strongly Disagree [ ]
11.	Does the fuel station employs the use of computers to help in storing information and managing fuel sales? Yes [ ] No [ ]
12.	Does the fuel station use any software to capture transaction or sales of petroleum products? Yes [ ] No [ ]

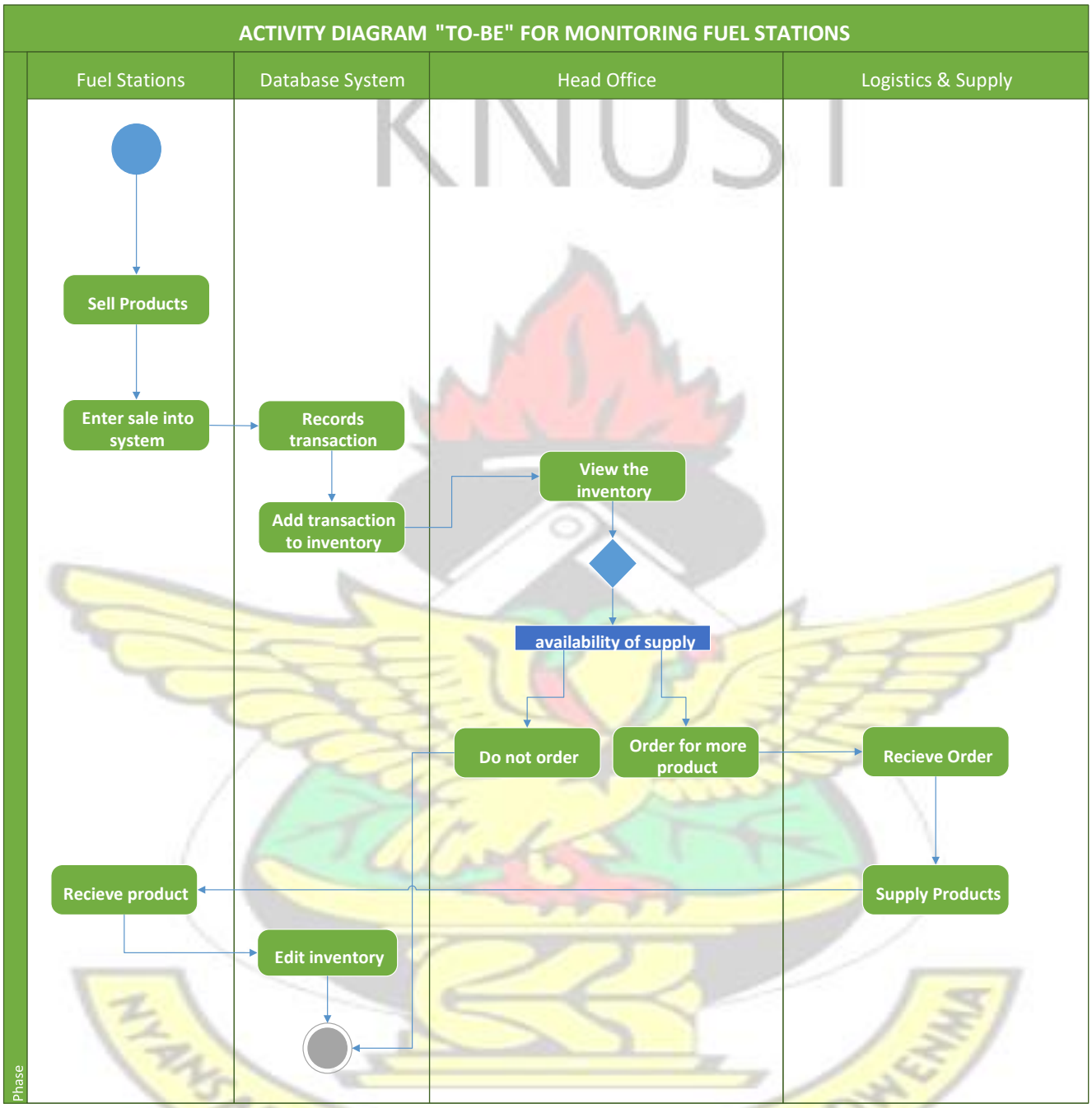
13.	Are there any management systems in place for the head office to use to track sales and stocks? Yes [ ] No [ ]
14.	Does the fuel station generate sales reports, stock reports and supply reports? Yes [ ] No [ ]

15.	Which of these areas of the organization does fuel management system beneficial to? Accessing records [ ] Speed to serving customers [ ] Records Keeping [ ] Accuracy [ ]
16.	Does the fuel station provide management system training to all employees? Yes [ ] No [ ] If yes, please specify the category of training …… ……
17.	How does the use of fuel management system support business processes, competitive strategies and business operation? …… …….. ……..
18	How does fuel management system helps in decision support and data retrieval application? …… …….. ……..
19	Does the use of fuel management system provide strong advancement in the field of information technology to achieve strategic objectives? …… …….. ……..

20.	What are the challenges of fuel management systems at your fuel station? …… …….. ……
21	What management system (s) in your on view should be implemented so as to address the problem and challenges in Q 20? …… …….. …… ……
22	If such management system in Q21 is implemented, can it bring efficiency in work delivery and be profitable to the fuel station? A. Yes { } B. No { } If Yes, explain how it can be done…….. …….. …….. …….. If No, please suggest new managerial system you think can increase efficiency, monitor operations and be profitable to the fuel station you work for. …….. …….. ……

APPENDIX B:

Activity Diagram of the developed system for tracking and monitoring of fuel stations



APPENDIX C:

INTERVIEW GUIDE USED TO ELICITE INFORMATION FROM SELECTED TOTAL

PETROLEUM FUEL STATIONS:

	QUESTIONS	REMARKS
1.	How does TOTAL Fuel stations order for products when the level of tank is low?	
2	How long does it take for the TOTAL Petroleum head office to replenish stock?	
3	How does the TOTAL Petroleum fuel stations record sales made by the fuel station.	
4	What instruments does the fuel station use to measure the level of fuel in tanks?	
5	What will Station Managers do if stocks has not been replenished	
6	How is reconciliation of fuel sold and stocks level done.	
7	How is the daily sales recorded or documented.	
8	How are records of sales protected in the case of disaster?	
9	What systems can the Head Office use to track sales of products and replenish stocks of TOTAL fuel stations?	

10.	What systems can the Head Office use to avoid shortages at fuel stations	
11.	How can the Head Office determine sales, stocks and supply of its fuel stations	

APPENDIX D:

Identification Requirements of the system

Since software is designed to operate only on certain platforms (a platform consists of hardware, computer programming language and operating system). Choosing the most appropriate platform is important. The following factors have to be taken into consideration in choosing the platform;

Hardware: Equipment cost and ease of upgrade

Operating system: Cost of licensing, years on the market, language, stability.

Access level: Different users need different levels of access to information. These access levels must be defined for each information resource and user profile.

Usability Requirements: The user's ability to navigate and exercise functions of the information system. If usability is taken into account, the software achieves faster acceptance among users.

General Requirements: Quality Management System has to be established, documented, implemented, maintained and continually improved in accordance with requirements of ISO 9001:2000

Documentation Requirements: Documented statements of quality policy and quality objectives. Three levels documentation is needed (Quality manual, regulations, work instructions). Documents and records have to be controlled.

Management Commitment: Management should be responsible and committed to the overall QMS.

Quality Policy: All employees should be aware of the declared quality policy of the organization. It should be appropriate to the purpose of the organization and include a long-term vision. It should include the commitment to comply with requirements and continually improve the QMS.

Planning: Detailed financial plan and exact calculation of development expenses. Establishing measurable quality objectives consistent with quality policy.

Human Resources: Human resources department/section should have divided personnel and educational activities. Map of organization's qualification structure, specification of work positions, personal development plans. Evaluation of employees through annual training plan.

Infrastructure: There should be an infrastructure development planning based on long-term strategic plans, making use of different investment studies and scenarios. Annual maintenance plan.

Management Review: Complex report on given period as input for management review. (Quarterly or Annual).

Assessment of implementation plan

The implementation of the newly developed system makes recommendations for use on this project. The developed system has not been implemented but an implementation plan and guidelines concerning the new system has been developed. The transformation in Total Petroleum Ghana Limited may be facilitated by advances in information systems. But information systems are not effective if it is not accompanied by an innovation in the human and organizational parts

simultaneously. The implementation of information system may be a key factor in improving the processes, as well as playing a vital role of co-ordinating the interdependent activities.

The developed system will speed up the operational activities of Total Petroleum Ghana Limited and the organization will find it convenient to have such a system in place which they can rely on.

APPENDIX E:

Implementation Plan

The implementation plan describes how the fuel station management system/application software will be installed, deployed and transitioned into an operational system. The plan contains an overview of the system or situation, a brief description of the major tasks involved in the implementation, and the overall resources needed to support the implementation system. (e.g.: hardware, software, facilities, materials and personnel). The management information system will simply manage its processes, people, users, consumers and other resources so that its products or services meet their objectives and customer requirements.

Implementation activities are needed to transform the newly developed fuel station management system software into an operational system for end users. Implementing the new system should include the following steps:

- Acquisition: acquire necessary hardware and software resources
- Software development: Develop necessary computer programs and make necessary modifications to software packages.
- Training: Educate and train management, staff, end users etc
- Testing: Test and make necessary corrections to programs, procedures and hardware.
- Documentation: Record detailed system specification
- Conversion: Convert present system to new and/ or improve system.

System Specifications

The software requirements for the fuel station management system are:

Equipment/Development Tools
Microsoft Visio is used to design the structure and analysis of the developed system. ASP.Net is the programming language used for script language
Operating system/Server
The current operating system used are Microsoft Windows 7 and Windows 8 for testing the system. The current browsers used in testing the developed system are; • Firefox • Internet Explorer • Google Chrome
Database System
SQL server 2012 is used as the database system

Software Requirements

Hardware Requirements

The list of hardware requirement for this research is listed below

Processor	1.4 Gz
Memory	1.0 Gz or above
Hard Disk Capacity	500GB or Larger
Modem or Ethernet Hub	Yes
Graphic /Display Card	Yes
Monitor	Yes
Printer	Yes
Input Devices	The common input devices include keyboards, switches etc
Output Devices	The output devices include Light Emitting Diodes (LED), Liquid Crystal Display (LCD), Printers etc Some devices that support both input and output devices, such as communication interfaces including Network Interface Cards (NIC), Modems and mobile phones.

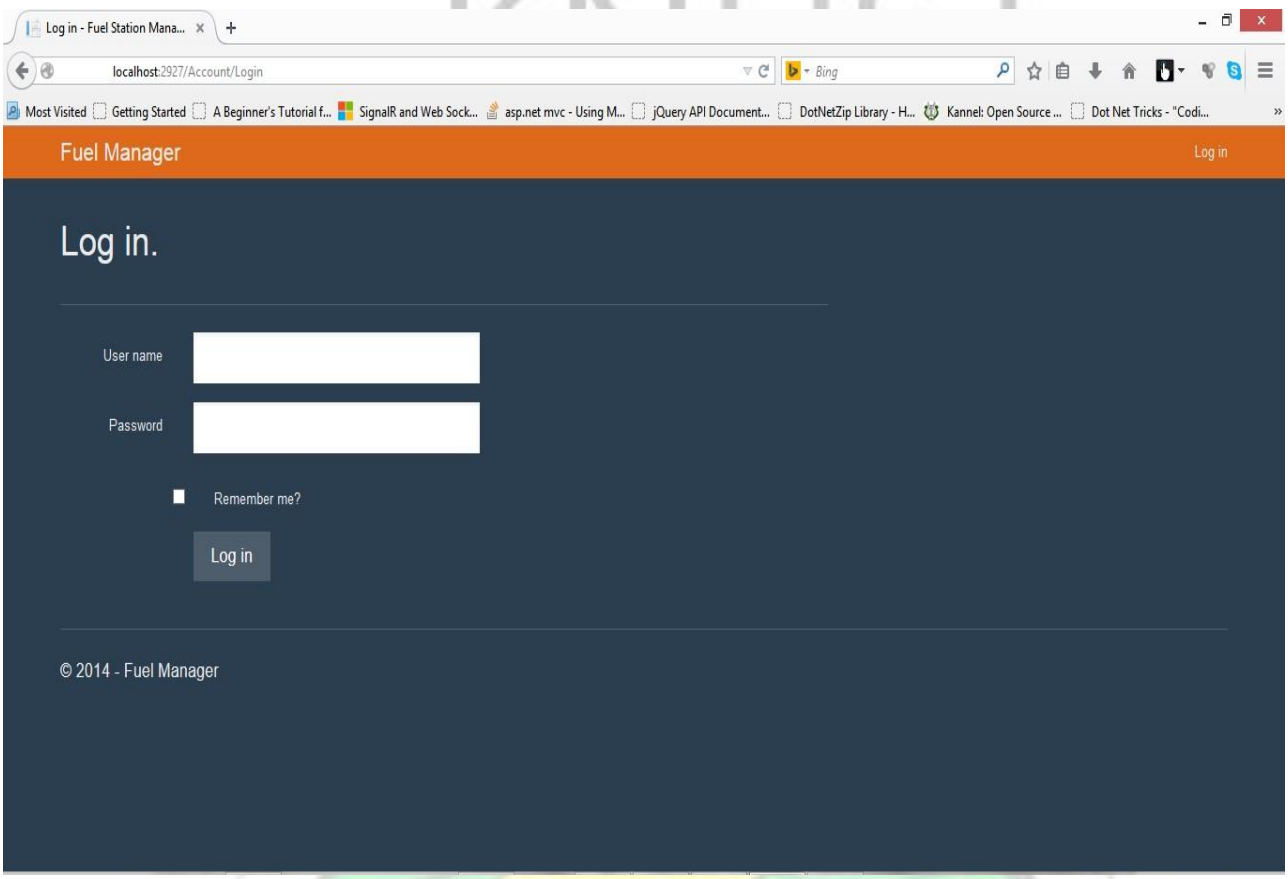
Hardware Requirements

Screen Shots of the Developed System

This system is a web-based application and is developed using Microsoft Visual Studio

(ASP.Net) platform that connects and runs on an SQL server database. **Log**

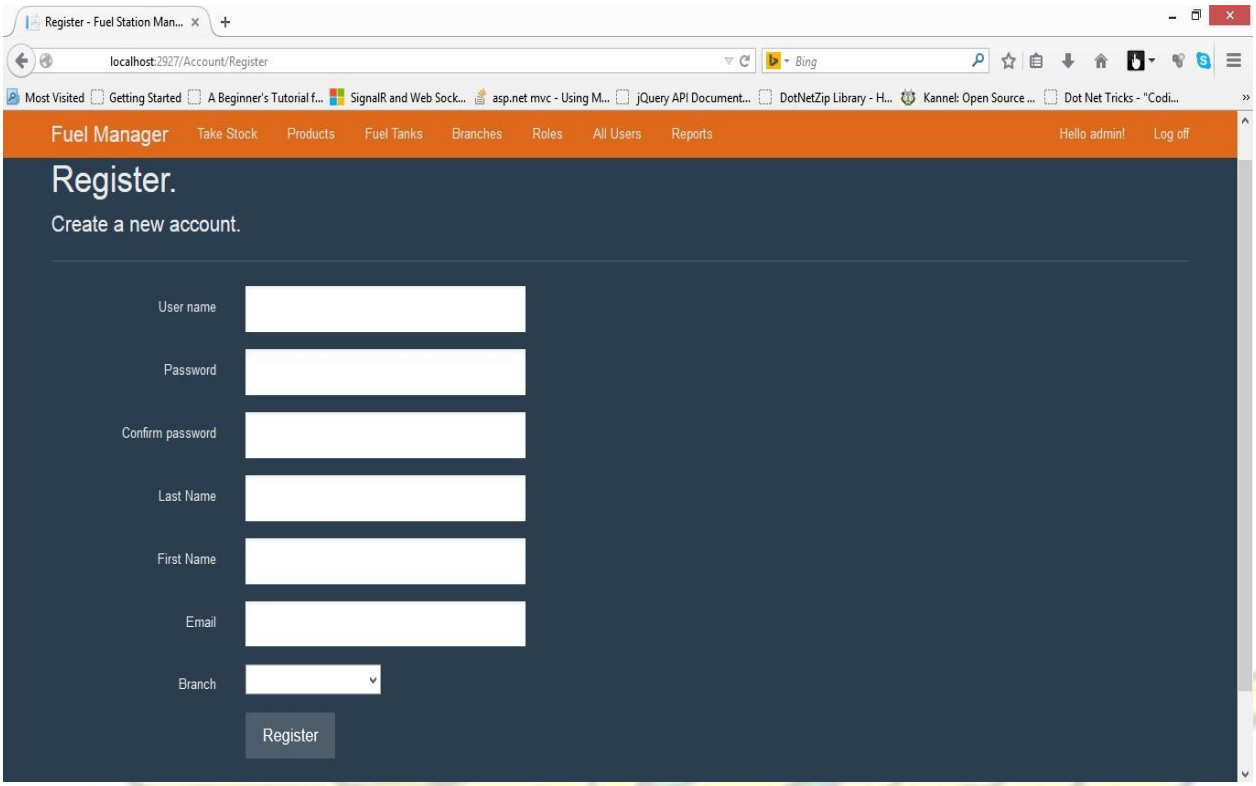
in Page for Users



Login Page for Fuel Manager

1. This is the page where users are allowed to log into the system and do their daily work.
2. The log in Page comprises of the username and a password of all the users.
3. This is the first page the administrator, managers, and user's sees when the person logs into the system. There is a log off link for the user.

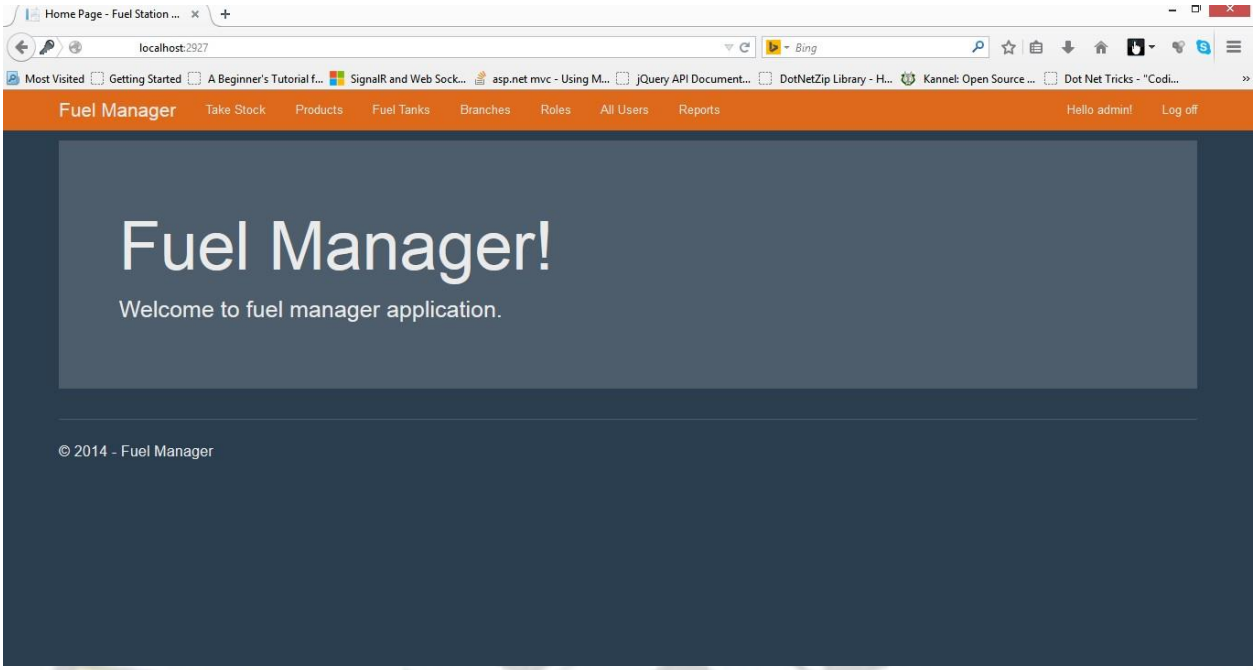
Page for creating Users



Registration Page for Fuel Manager

1. This is the page where users are created by the admin or manager of the fuel station.
2. After creating the user, you then assign the user a role which includes an admin, a manager and a sales person.
3. After creating the user, you then assign the user a branch.

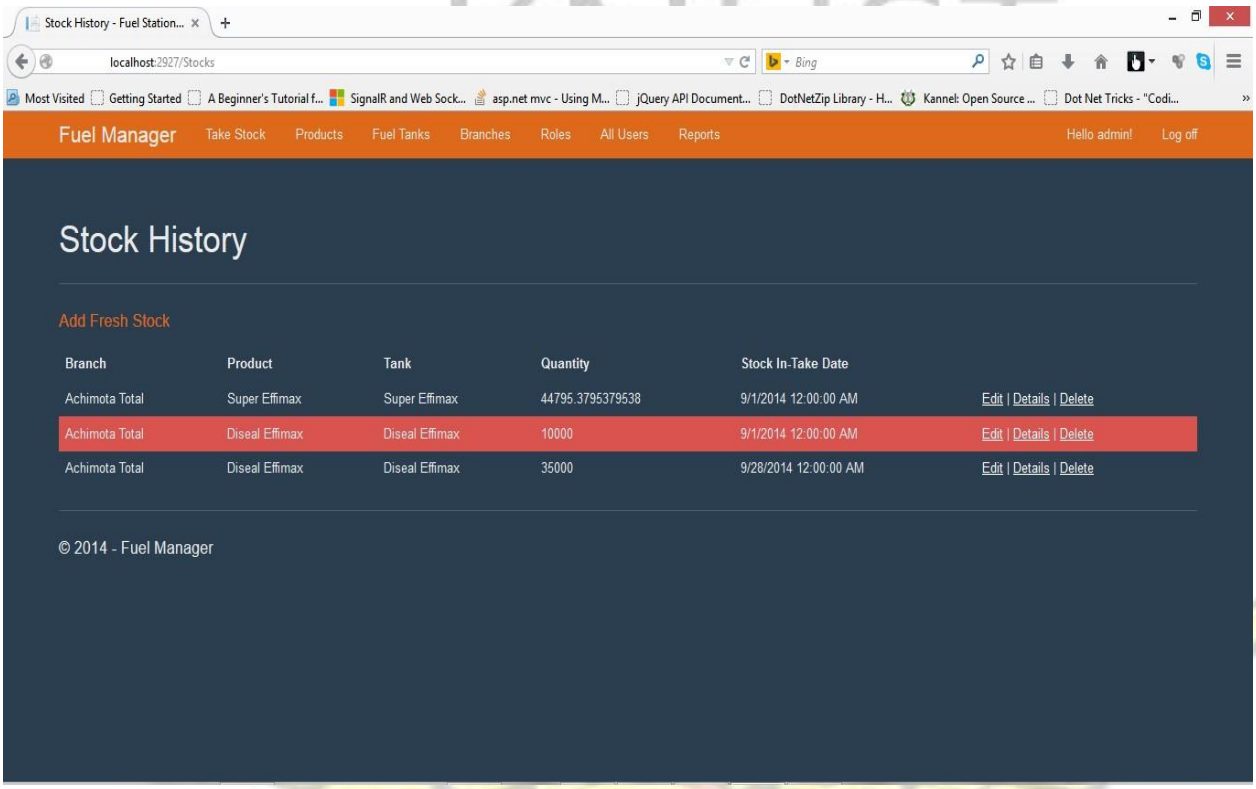
Log in Page for Administrators



System Administrator's Page for Fuel Manager

1. This is the page where the administrator logs on and sees the entire link pages of the developed system. The administrator sees the Take stock page, products, fuel tanks, Branches Roles for all users, all users of the system, and reports that can be generated by the administrator.
2. The administrator can view and check stocks of all the branches
3. The administrator can also access the products list and make changes of the price list of products when there is a price change.
4. The administrator can also check the fuel level tanks of all the branches and track the sales made by each branch. The fuel tank level will indicate red mark when the stock level reaches 15,000 litres.

5. The administrator can also generate various reports like stock level report, sales reports for weekly, monthly etc and supply reports for various fuel stations. **Stock History Menu**



System Administrator's Page to see all fuel stations

1. This is the page where the administrator clicks to check the stock level of all the branches of the stations. As soon as the stock level reaches 15,000 litres there is an indication of red mark, which shows on the product that has reach 15,000 litres, which will prompt the administrator to reorder for more product for the station.

Product List Page

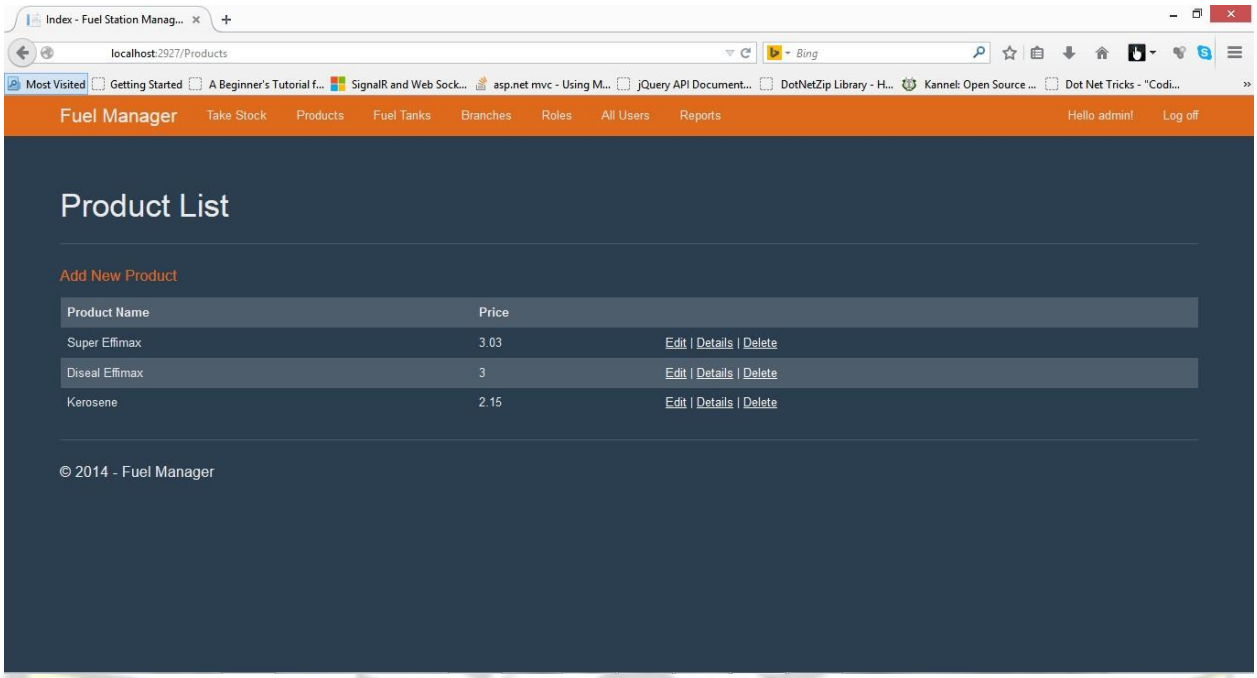
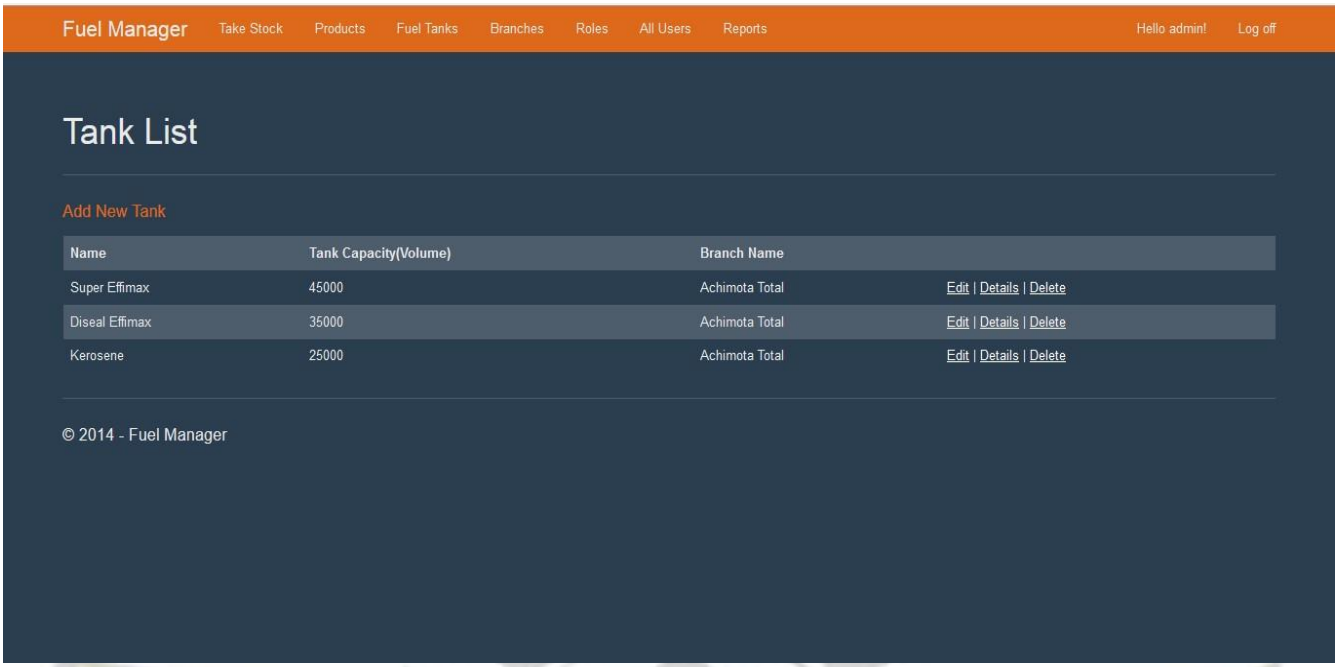


FIGURE 4.8.5: Product list page for Administrator/Manager to see all products and Price

1. This is the page where the administrator and managers can change the price list of the product when there is a price change.

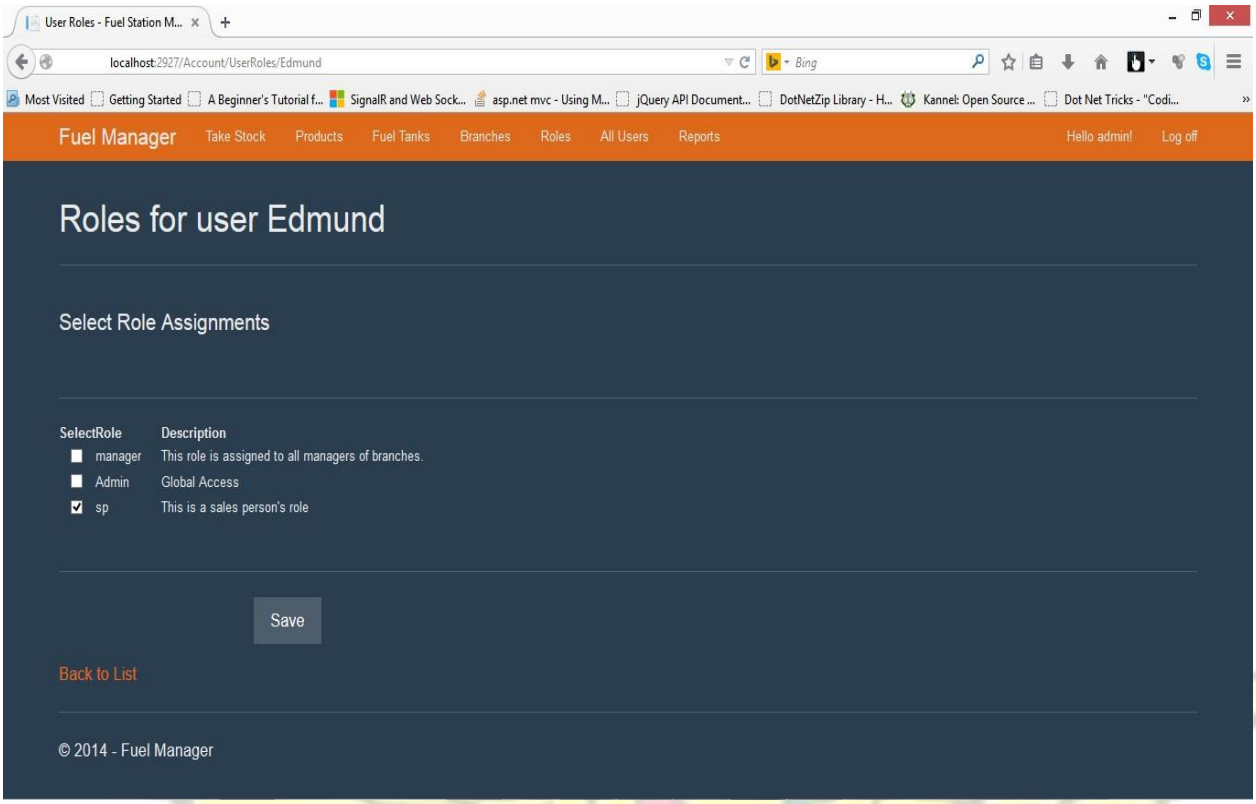
Tank List Page



Tank capacity for all products

1. This is the page where the administrator add fresh stocks to a new branch created. The administrator is the only person who can add fresh stocks and the managers also have a page to receive the stocks.

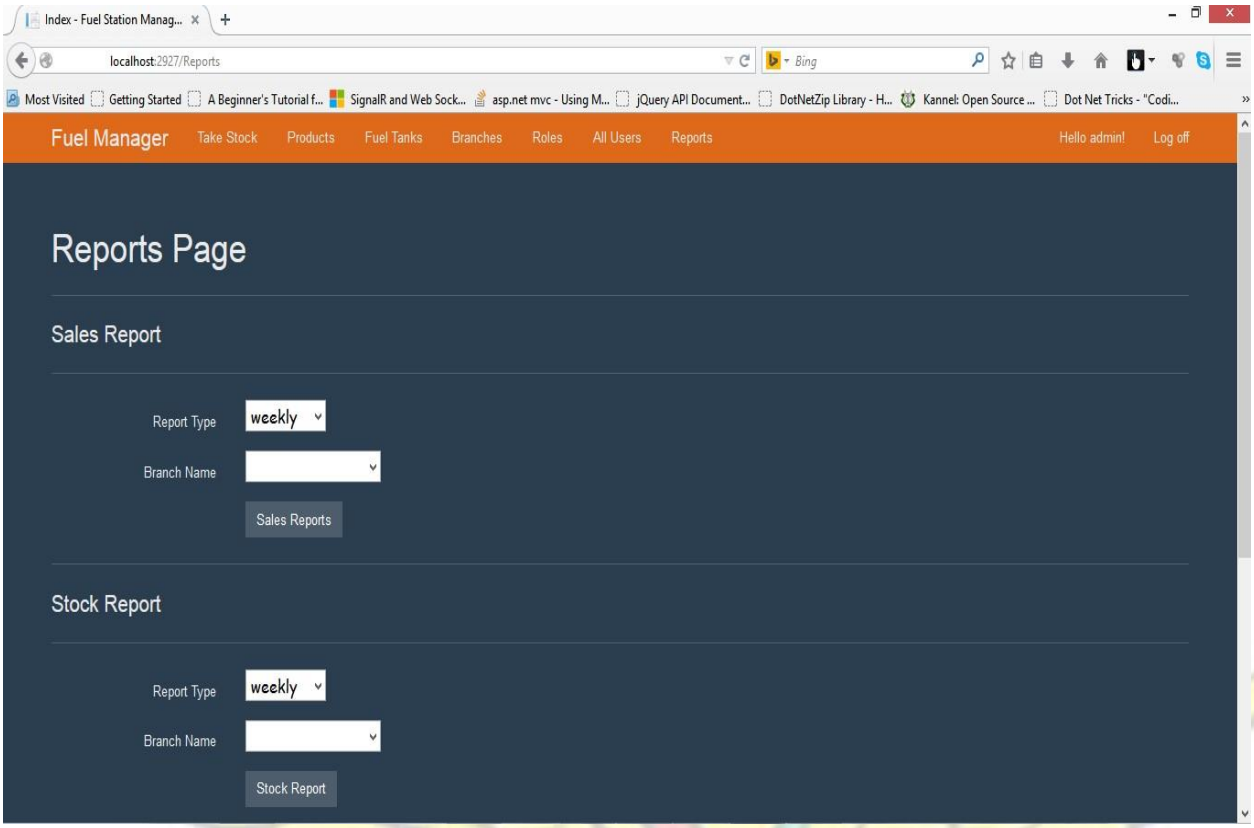
Roles for User Page



Administrator/Manager's page to assign roles

1. This is the page where the administrator or manager assigns a role for the user.
2. If the user created is a Sales person you then check the sales person box. If the user is a manager you then check the manager's check box. If the user created is an admin you then check the admin check box.

Reports Menu Page

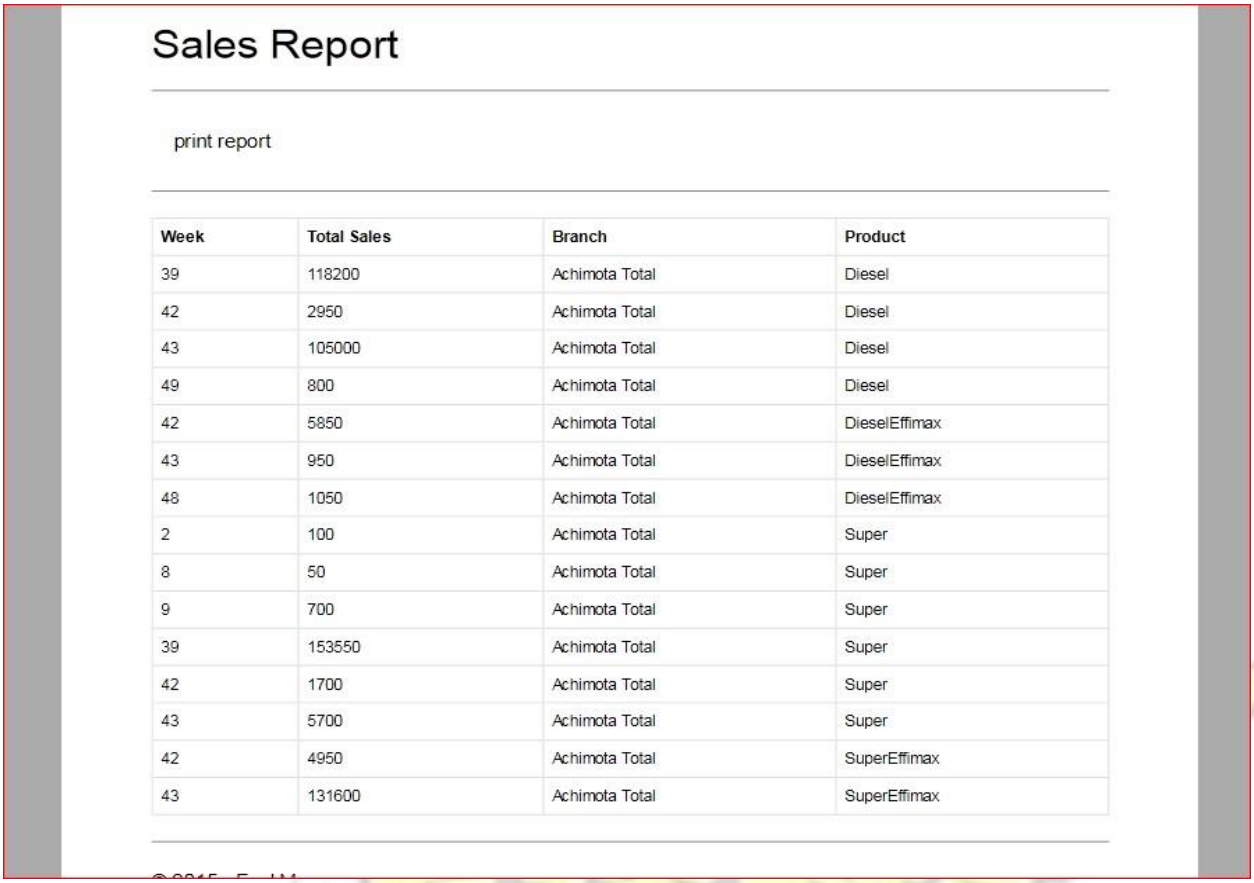


Reports page where various reports are printed

1. This is the menu page which allows the admin and the manager to print sales reports, stock reports and supply reports.
2. This menu page allows you to print daily reports, weekly reports and monthly reports of each fuel station
3. It is only accessible by the admin or fuel station managers. These reports can serve as a documentary proves in case of any audit purpose.

APPENDIX F:

REPORTS FROM FUEL STATION MANAGEMENT SYSTEM:

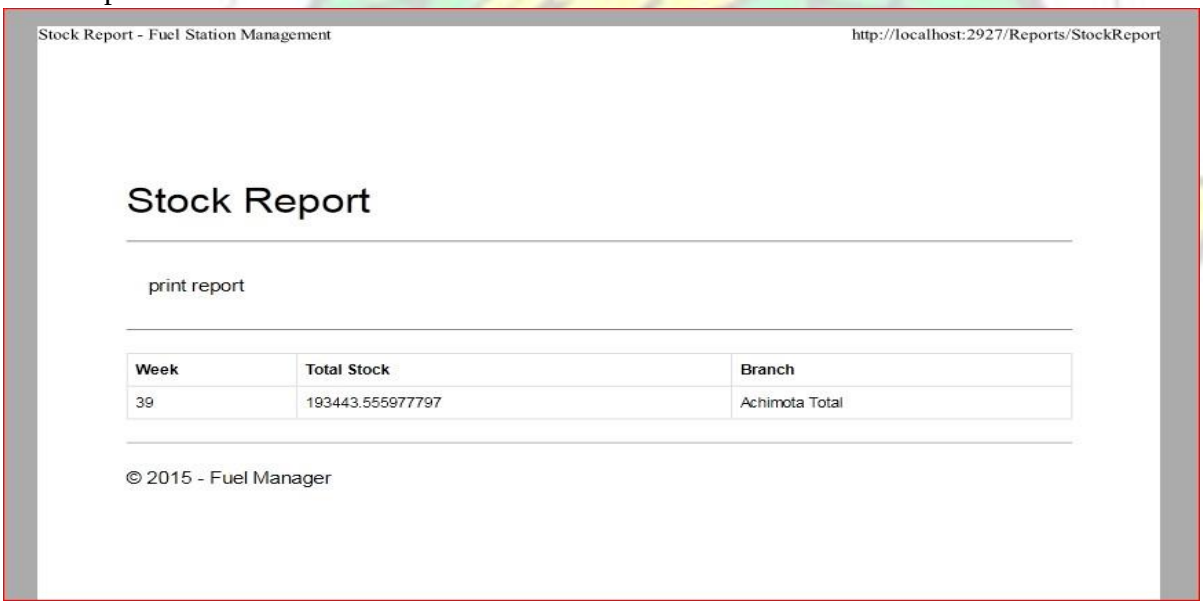


Sales Report

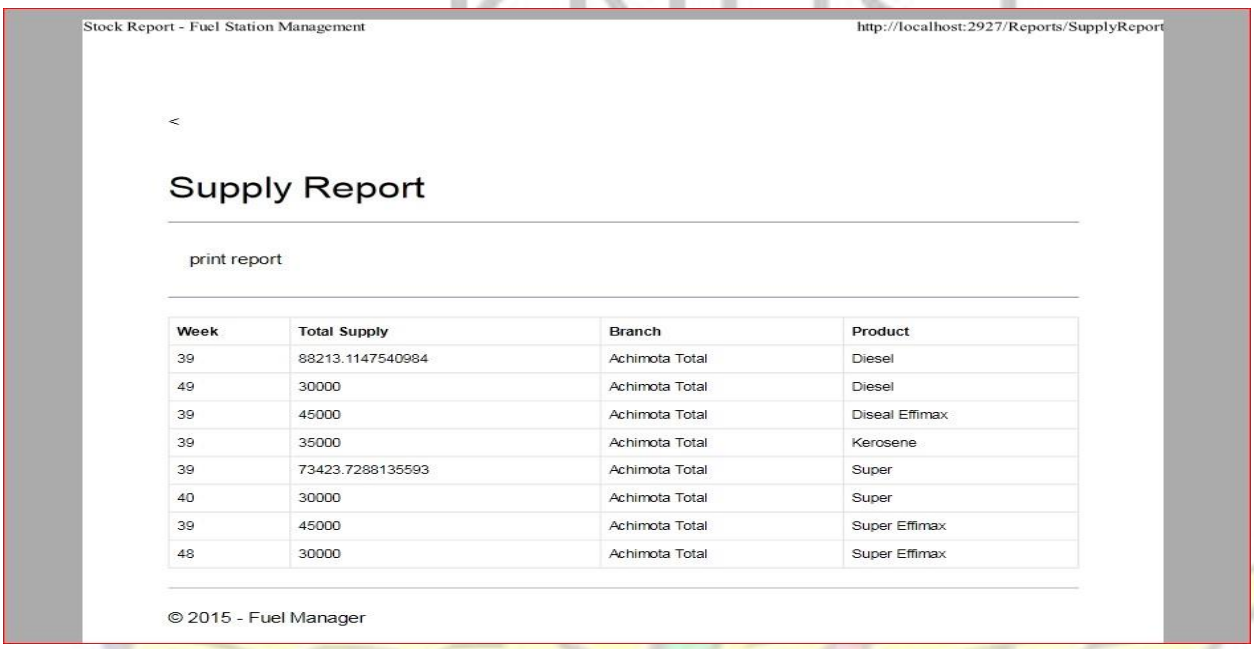
print report

Week	Total Sales	Branch	Product
39	118200	Achimota Total	Diesel
42	2950	Achimota Total	Diesel
43	105000	Achimota Total	Diesel
49	800	Achimota Total	Diesel
42	5850	Achimota Total	DieselEffimax
43	950	Achimota Total	DieselEffimax
48	1050	Achimota Total	DieselEffimax
2	100	Achimota Total	Super
8	50	Achimota Total	Super
9	700	Achimota Total	Super
39	153550	Achimota Total	Super
42	1700	Achimota Total	Super
43	5700	Achimota Total	Super
42	4950	Achimota Total	SuperEffimax
43	131600	Achimota Total	SuperEffimax

Sales Report of a branch – Achimota Total Service Station



Stock Report of a branch – Achimota Total Service Station



Stock Report - Fuel Station Management http://localhost:2927/Reports/SupplyReport

<

Supply Report

print report

Week	Total Supply	Branch	Product
39	88213.1147540984	Achimota Total	Diesel
49	30000	Achimota Total	Diesel
39	45000	Achimota Total	Diseal Effimax
39	35000	Achimota Total	Kerosene
39	73423.7288135593	Achimota Total	Super
40	30000	Achimota Total	Super
39	45000	Achimota Total	Super Effimax
48	30000	Achimota Total	Super Effimax

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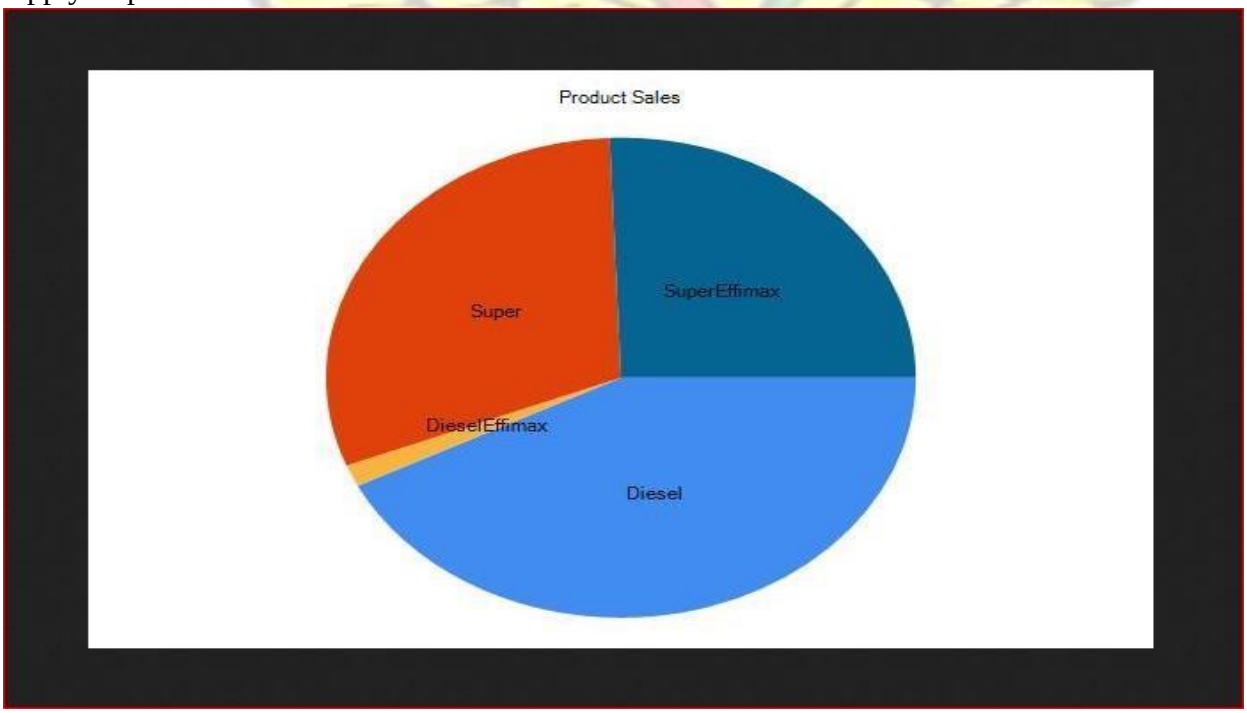
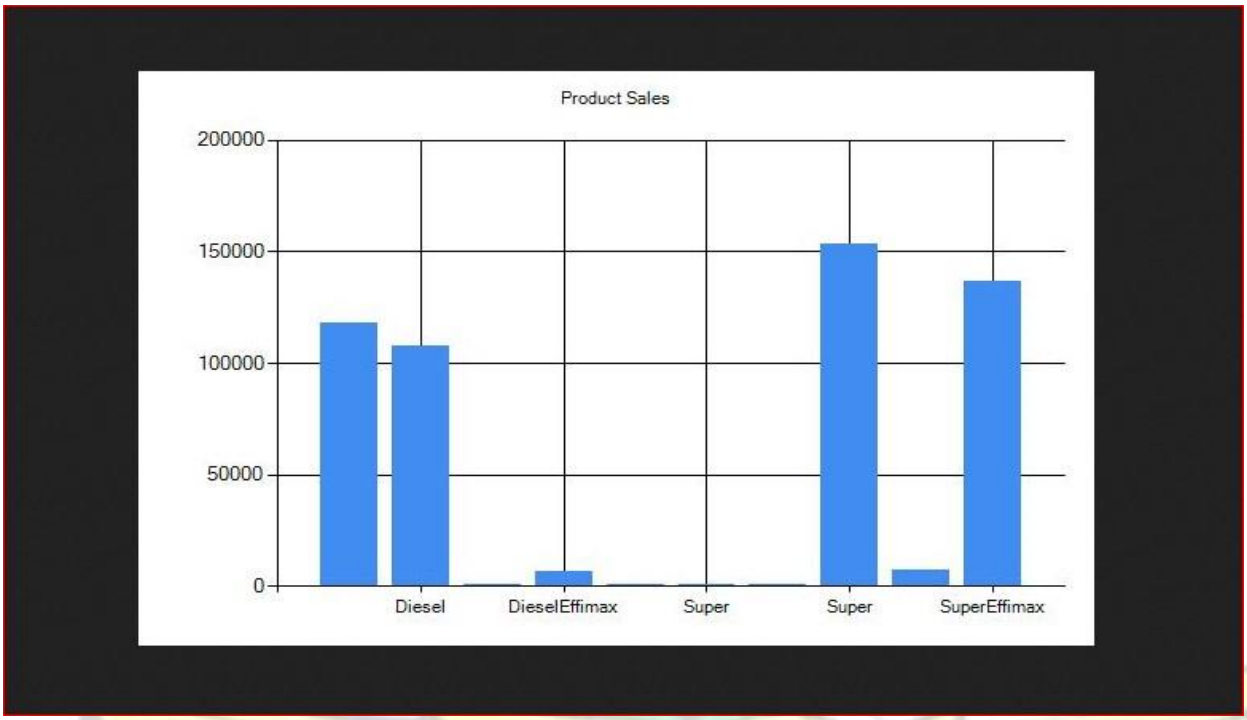
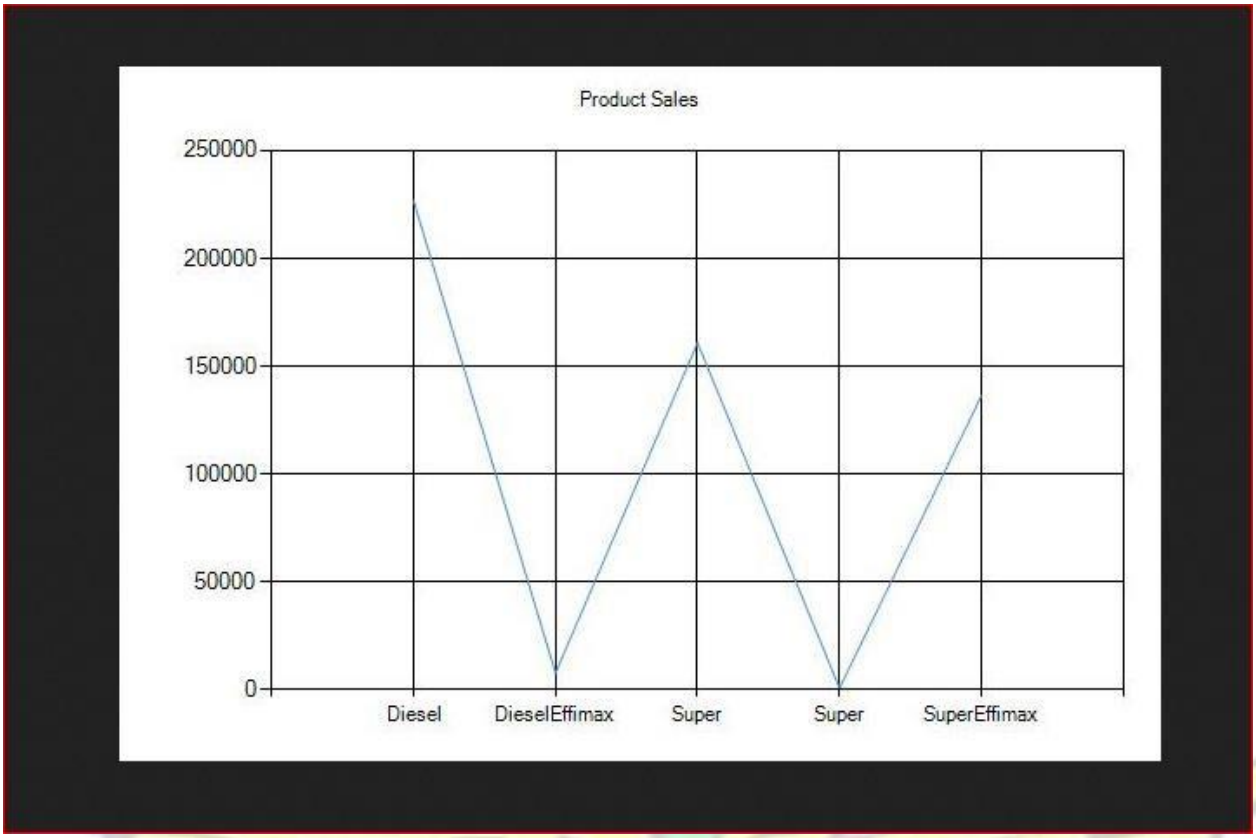
Supply Report of a branch – Achimota Total Service Station



Pie Chart of sales of products of a particular branch



Product sales of a particular branch to determine which particular product moves faster.



Trend Analysis of the sales of product chart

APPENDIX G:

USER MANAUL OF FUEL STATION MANAGEMENT SYSTEM

Features of the developed system

The new/proposed system has the following features;

- User Login and password authentication
- User registration
- Records of sales, stocks and supply
- Database management system
- Access control/authentication
- Record search and retrieval system

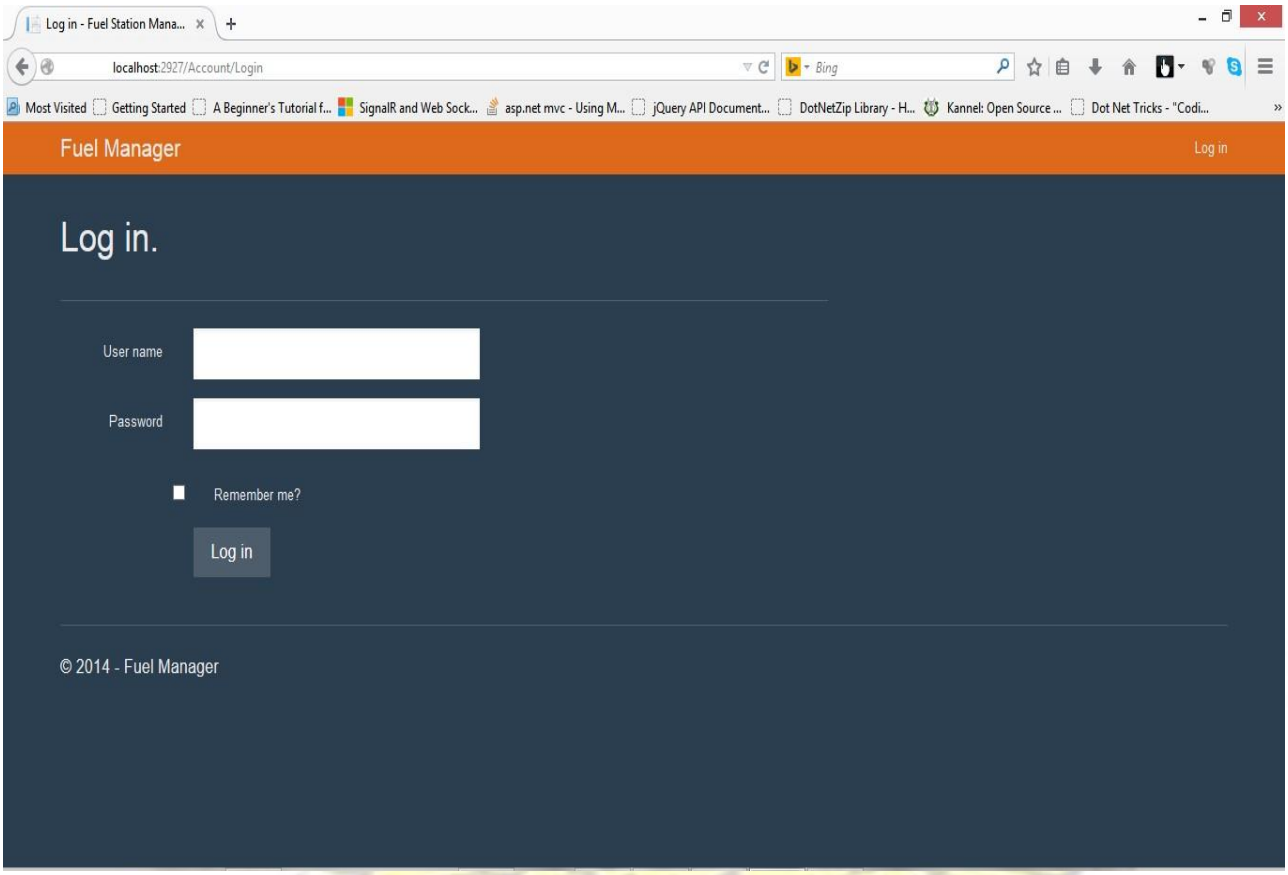
Web-based

The system enables remote access via the web to retrieve records from a web-based application via the internet.

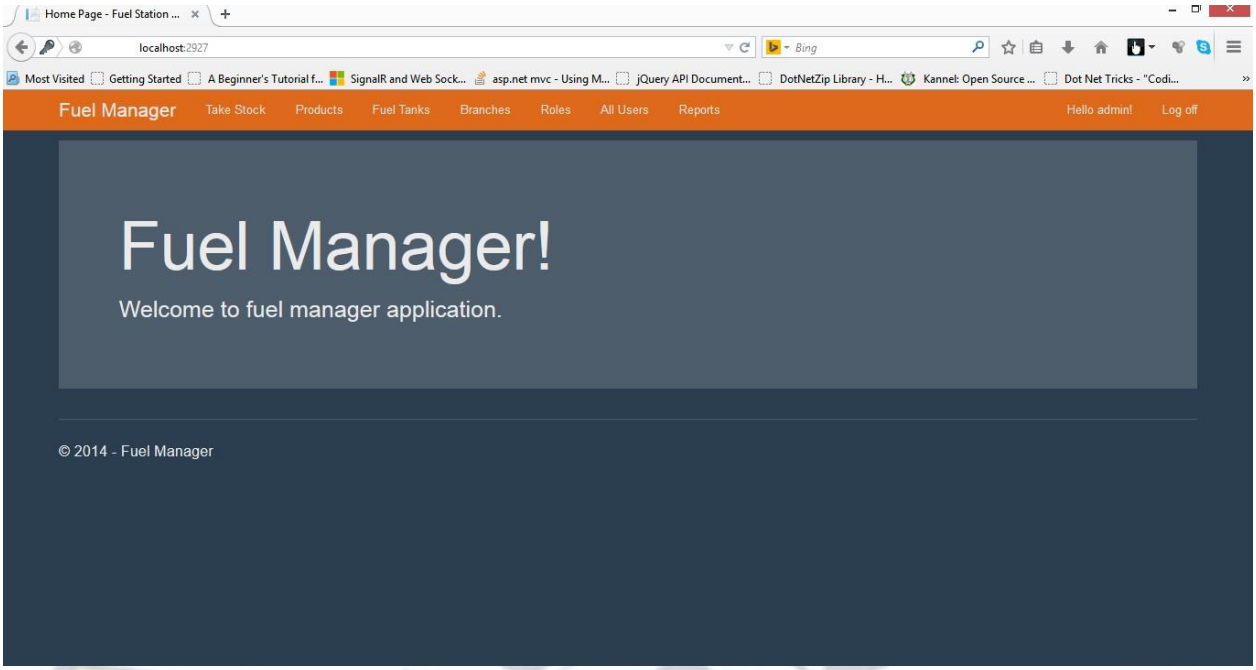
Log in Page for Administrators/Users

1. The Admin/User log in with a username and a password

2. The system authenticates the user and opens the assign pages that can be accessed.

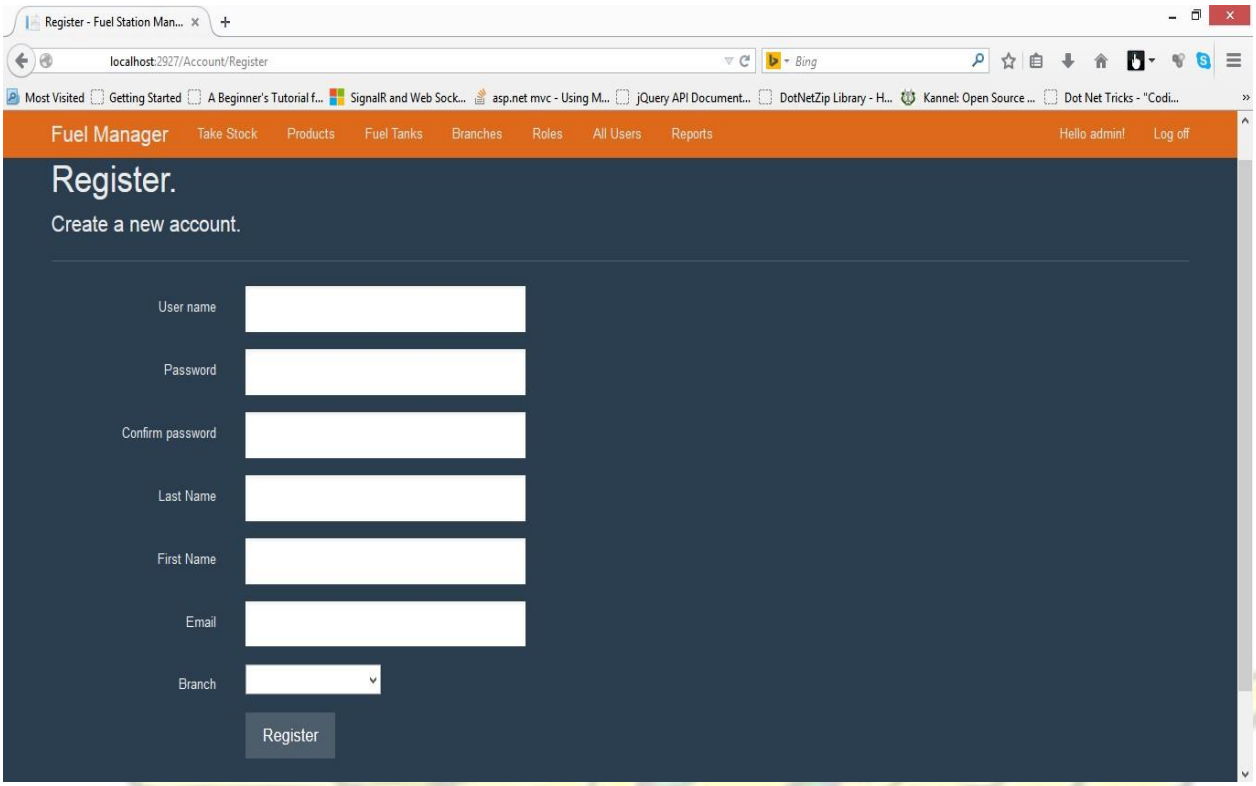


Log in Page for Administrators



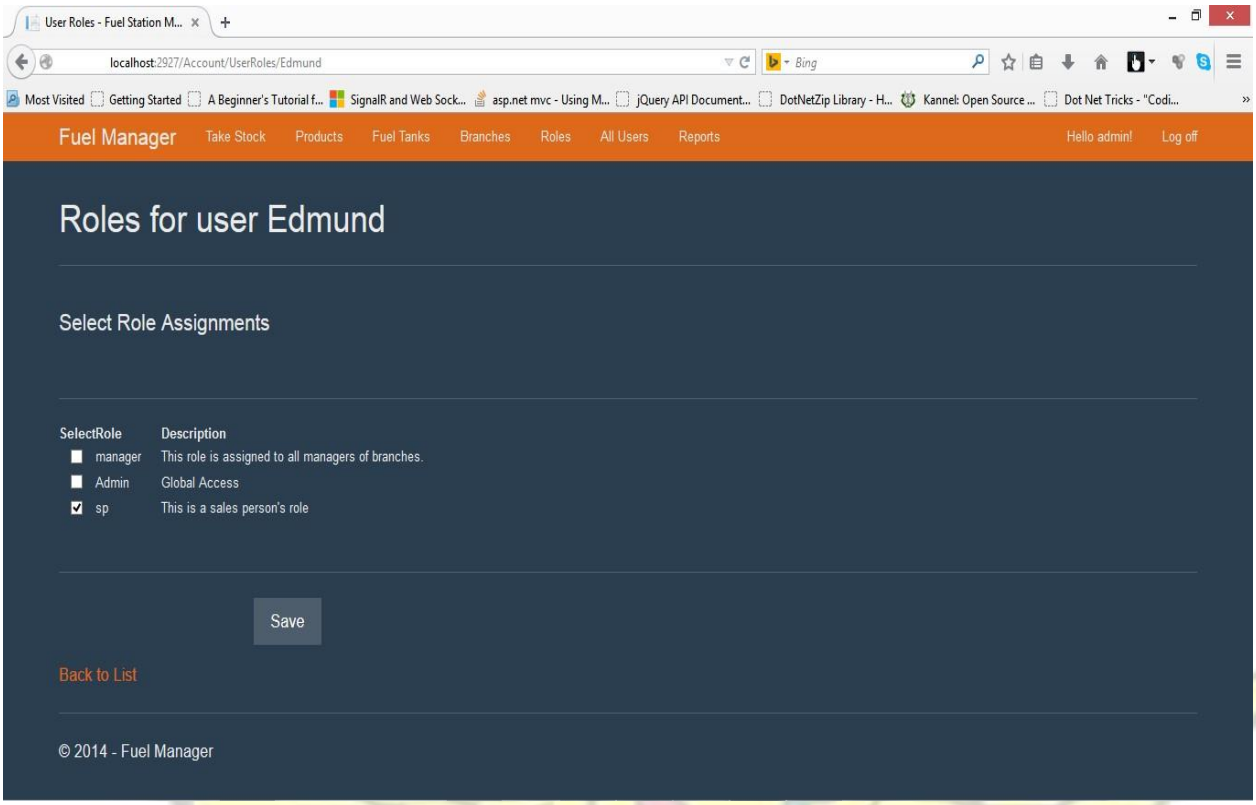
1. This is the page where the administrator logs on and sees the entire link pages of the developed system. The administrator sees the Take stock page, products, fuel tanks, Branches Roles for all users, all users of the system, and reports that can be generated by the administrator.
2. The administrator can view and check stocks of all the branches
3. The administrator can also access the products list and make changes of the price list of products when there is a price change.
4. The administrator can also check the fuel level tanks of all the branches and track the sales made by each branch. The fuel tank level will indicate red mark when the stock level reaches 15000 litres.
5. The administrator can also generate various reports like stock level report, sales reports for weekly, monthly etc and supply reports for various fuel stations.

Page for creating Users



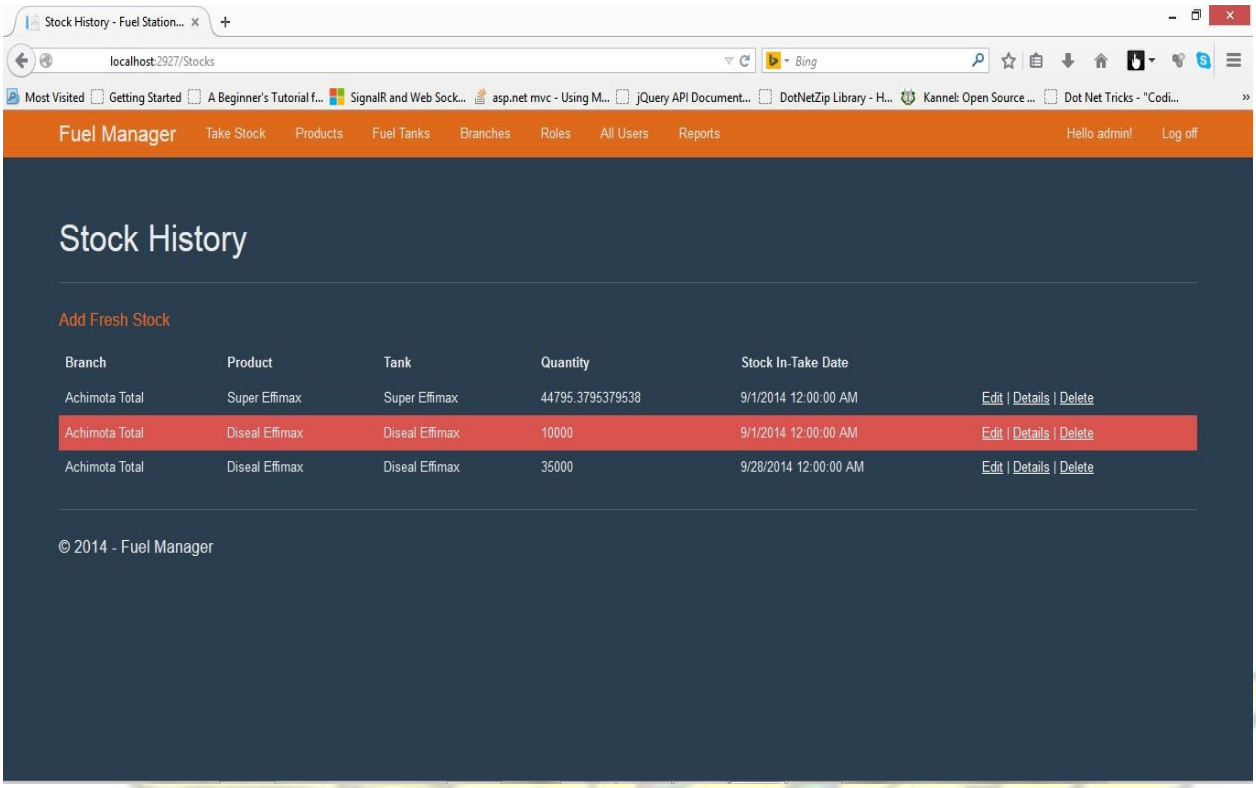
1. This is the page where users are created by the admin or manager of the fuel station.
2. After creating the user, you then assign the user a role which includes an admin, a manager and a sales person.
3. After creating the user, you then assign the user a branch.
4. The sales person has a page in which He or She only does sales.

Roles for User Page



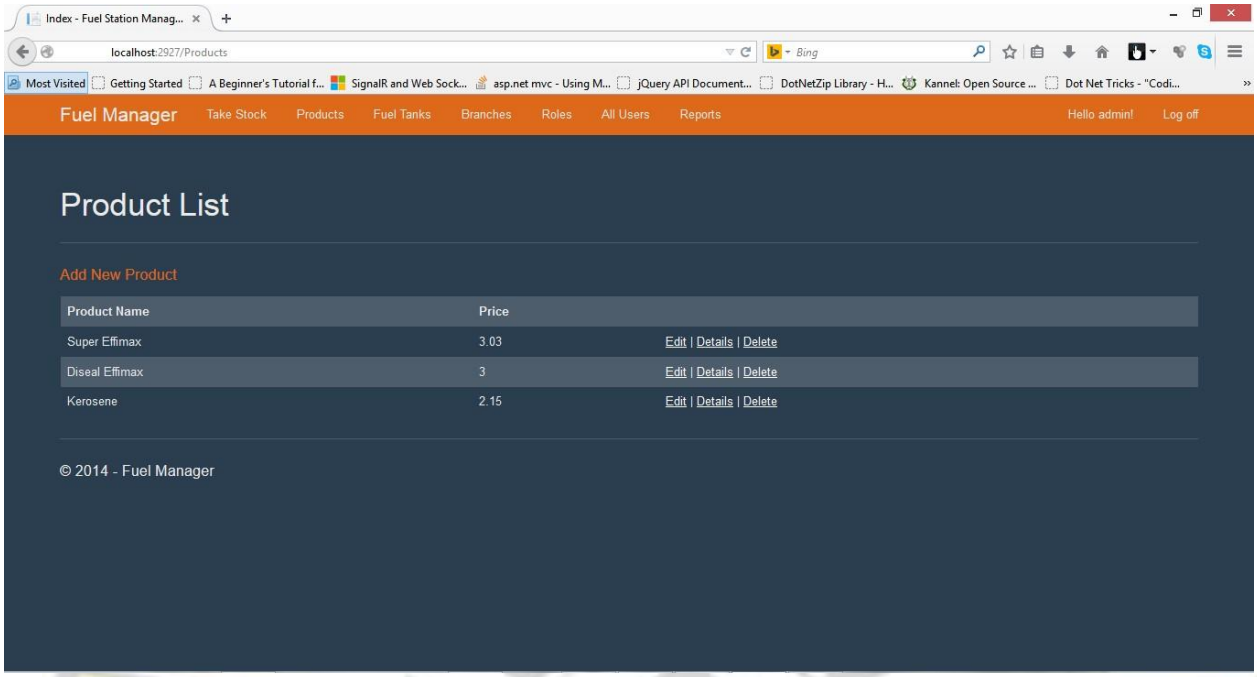
1. This is the page where the administrator or manager assigns a role for the user.
2. If the user created is a Sales person you then check the sales person box. If the user is a manager you then check the manager's check box. If the user created is an admin you then check the admin check box.

Stock History Menu



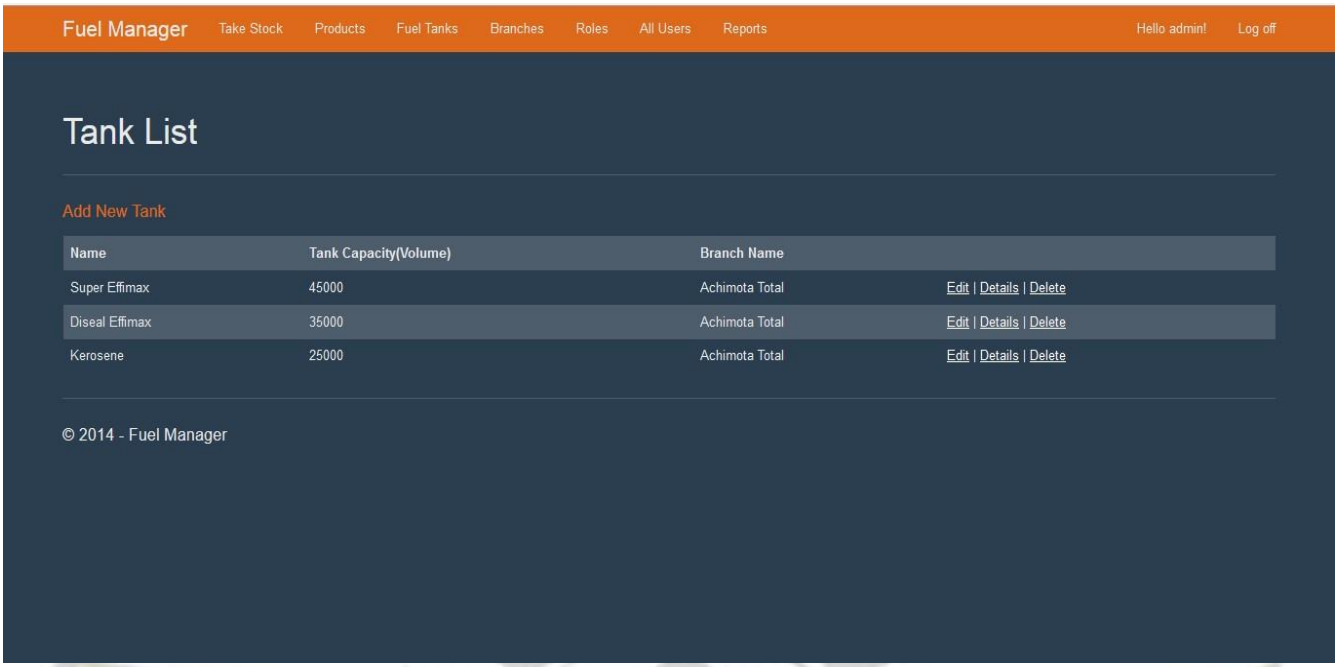
1. This is the page where the administrator clicks to check the stock level of all the branches of the stations. As soon as the stock level reaches 15,000 litres there is an indication of red mark, which shows on the product that has reach 15,000 litres, which will prompt the administrator to reorder for more product for the station.
2. The station managers of each branch can also check their stock level too. They can only access the stock level of their branch only. If the level of stock reaches 15,000 litres, an indication of red mark is shown on the product that will inform him to re-order from the head office.

Product List Page



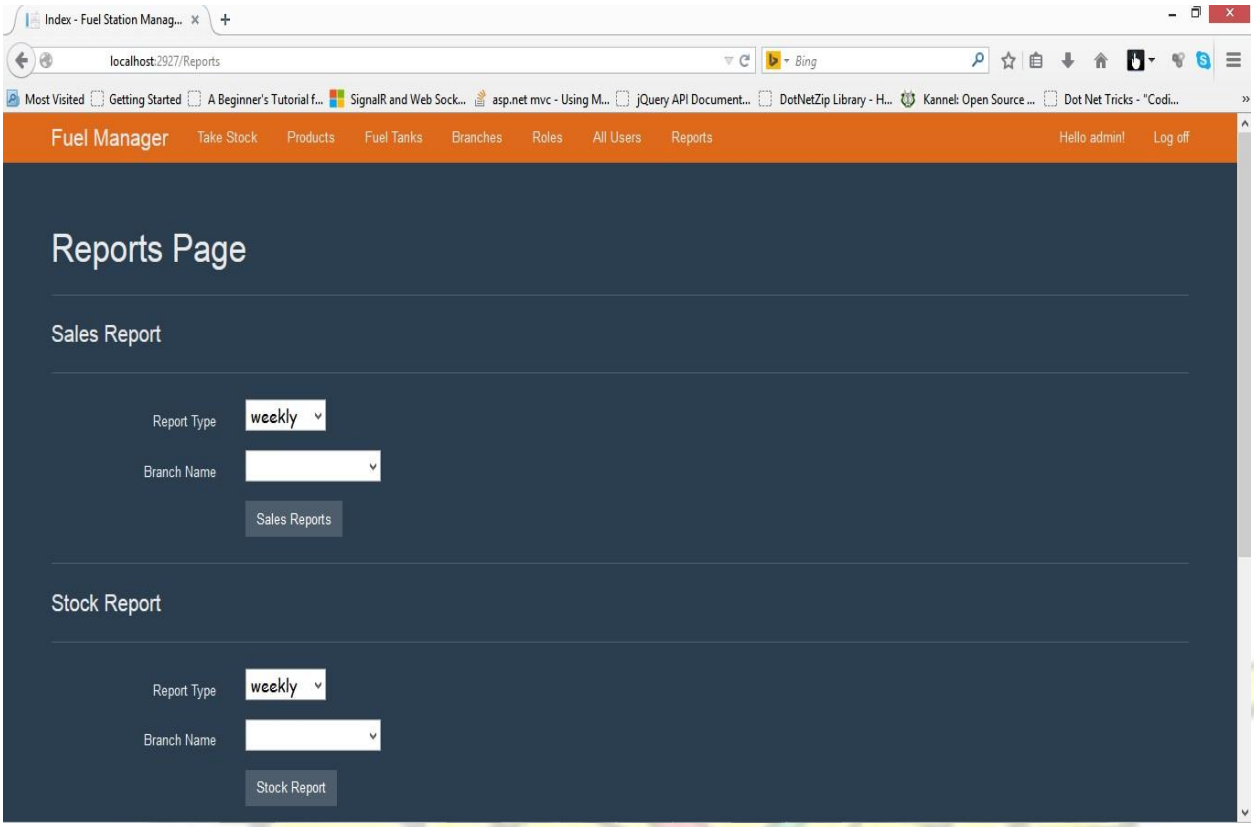
1. This is the page where the administrator and managers can change the price list of the product when there is a price change.

Tank List Page



1. This is the page where the administrator adds fresh stocks to a new branch created. The administrator is the only person who can add fresh stocks.
2. The managers also have a page to receive the stocks. For example the tank capacity of the fuel station 45000 litres.

Reports Menu Page



1. This is the menu page which allows the admin and the manager to print sales reports, stock reports and supply reports.
2. This menu page allows you to print daily reports, weekly reports and monthly reports of each fuel station
3. It is only accessible by the admin or fuel station managers. These reports can serve as a documentary proves in case of any audit purpose.