FLIGHT PLAN MANAGEMENT SYSTEM

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ABSTRACT

The purpose of this research was to develop a computerised Flight Plan Management system for Thornhill Air Field to be utilised for their aviation operation. The objective was to align the aviation sector with information system technologies for efficiency and effective operation substituting the manual paper based system. The dynamic changes brought about by the ever changing inventions in technology have greatly impacted the operations of various organisations both positively and negatively. With the advancements in technology as observed especially in this 21st Century, it is poignant to note that faster, easier and more efficient ways have been introduced in the reception and generation of information. In this regard Air Traffic Control across the world aligned its co-business of coordinating the movement of air traffic landing, taxing and even passing through their designated airspace jurisdiction. Aviation industry is one of the riskiest sectors which require proper management of air traffic based on accurate and reliable information. International Civil Aviation Authority (ICAO) is the governing board for all aviation of the world defining the standard to be followed by aviation stakeholders. Flight plan is an integral document defined by ICAO which a pilot or flight dispatures fill-in with all details necessary for a flight schedule to be allotted to him/her. At Thornhill Air Field all the flight plans were in paper format by pilots or flight dispatures which in turn are submitted to the Air Traffic Controllers. The manual work from the filling part, the transportation, compilation and verification of the flight details and the responds to the flight plan giving the approval or rejection of the flight schedule is a tiresome task. Flight Plan Management System seek to overcome all hindrances to effectiveness and efficiency by providing a real time computerized system. In order to acquire much information pertaining the hypothetical problem identification, the researcher used various data finding methodologies which include interviews, questionnaires, site observations and even collected all relevant documents inclined to this study. The major finding which was common to all the operators among them the pilots, air traffic controllers, meteological officer and others, pointed out the problem of tiresome, labour intensive, costly, slow, ineffective among the many. The researcher concluded the facts gathered with a recommendation for the need of computerised system as a matter of agency. The software component is designed using PHP as the programming language and MySql as the database server. The pilots and the flight dispatures would in a position to enter the flight details on the computer which are then send via the web technologies to the air traffic controllers who then approves the flight schedule or reject online. This project will support the ZIMASSET cluster of computerizing the operations of various sectors of the economy through value addition and efficient delivery of services. This system provides an avenue for further development of such system as much resources are to be channeled to research and development in this sector of aviation. Future endeavors for the upgrading of the system require to link the system to other air traffic control centres and other relevant organisations in the aviation sector.

DECLARATION

I, **Tafadzwa Advance Mubaiwa,** hereby declare that I am the sole author of this dissertation. I authorize the **Midlands State University** to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature: ……. Date: ……..

APPROVAL

This dissertation, entitled **"FLIGHT PLAN MANAGEMENT SYSTEM"** by Tafadzwa Advance Mubaiwa meets the regulations governing the award of the degree of **BSc Honours Information Systems** of the **Midlands State University,** and is approved for its contribution to knowledge and literary presentation.

Supervisor's Signature: …….

Date: ……..

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DEDICATION

I dedicate this dissertation to my beloved precious wife, my daughter Amore and my unborn baby for they are greatest drive force behind my success story. The road of life have been very tough, with many ups and downs by my humble family have been my pillar of strength and always gave me the reason to fight on. You accepted the challenge and yielded all the pain, stress and pressures associated with this project but you never gave up. You are my heroes and this dissertation I dedicate it to you. Love you so much and may the dear Lord Jesus Christ bless you.

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LIST OF ACRONYMS

ATC ……...Air Traffic Control

ATC …….. ……Air Traffic Control Services

TAF…. …… ……..……Terminal Aerodrome Forecast

DFD ……...Data Flow Diagram

DVD-RW …….. ……Digital Video Disk-Re-writable

ER ……..Entity Relation

GUI ……Graphic User Interface

ICAO……International Civil Aviation Authority

TAF ……Thornhill Air Field

ID …….. ……Identification

IT …….....Information Technology

LAN ……..……..Local Area Network

MySQL …….....My Sequential Query Language

RAM ……..Random Access Memory

ROI ……Return On Investment

SMS ……..…..……....Short Message Service

UML ……..…….Unified Modelling language

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CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

The purpose of this research is to come up with an electronic flight plan management system which is a web based system which can be accessed despite geographical dispersion. Dennis, Wixom and Roth (2012) asserted that where there is no introduction there is definitively no conclusion nor results expected. The need for the improvement of organisational operations to enhance efficiency and effectiveness gave rise the invention of technology. After the invention of a computer, the need to employ it it various aspects of every industry resulted in many experiments and software development, Haider, *et al.* (2016). The information technology have become the greatest driving force for a productive environment in many industries including in the aviation sector. Air traffic control department at Thornhill Air Field is another sector which was lagging behind in the implementation of information, communication and technology in its operation. It is therefore the necessity of this development project to utilise information technology in its operation. This chapter is the introduction of the project development bringing into picture the information of the organization, Thornhill Air field focusing on the Air Traffic Control department. It also lay an introductory platform for the project, highlighting the organisational structure, the problem associated with the current system and outline the proposed objectives which the proposed system should meet in its operation and the tools and instruments being used in this project.

1.2 BACKGROUND OF THE STUDY

Development (2009) asserted background of the study as the backbone for any research as it brings into picture the drive force behind the need and expectations of the project. Background of the study brings the project into live as it points the reader on the path of expectation based on the existing situation, PMI (2013). It is therefore of necessity that this background of the study will explain in detail the reasons behind the need for the research project.

As technology is dynamically advancing every day, resistance to change is not an option. Information and communication technology is being employed in various sectors in Zimbabwe to enhance efficiency, effectiveness and productivity in line with ZIMASSET. Development in

technology have led to the utilization of information technology to become the backbone of military hardware advancement as well as training in a bid to fulfil its objectives effectively, (https://www.defensetech.org/). The research project called Flight Plan Management System seeks to harness technology for the improvement of flight management within the Air Force of Zimbabwe. Aircraft management can be hazardous if not well planned and managed based on real flight details.

Flight planning is an important aspect in the aviation sector which is key in the efficient management of the air traffic, (http://www.airtrafficmanagement.net/magazine/). A pilot or flight dispatcher must file a document with Civil Aviation Authority with the jurisdiction of that area before departure indicating the aircraft's desired route or flight path. The format for all internationally recognised flight plan are specified in the International Civil Aviation Authority Document 4444, see Appendix1. This document specifies the information contained in the flight plan which include departure and destination points, the approximate time taken in the flight, the other airports that can be used in case emergence such as bad weather, type of flight rules that the pilot will be using, the on board pilot's personal and operational details, number of passengers boarding and descriptive details about the aircraft itself. This information is important for identification and easy tracking of the aircraft. If the flight plan is received by the Civil Aviation Authority in this case Thornhill Air Field, it is sent to other concerned services especially those in the route highlighted in the flight plan.

Currently the system being employs a paper-based system to manage and coordinate the operations of taxing, departing and arriving aircraft. This old manual system is full of human errors such that if wrong information about a flight if communicated to the ATC, if it is used it can cause collision of aircraft which can be very disastrous. As the day-to-day running of air traffic controlling department is very vital and very risk task thus a well-defined and efficient flow of information from the pilots to the ATC personnel is of paramount importance, ATCA (2013). Any misinformation and miscalculations in the operations by the ATC personnel based on a wrong flight plan can caused a disaster which can lead to loss of many millions of dollars.

The paper-based flight plan management system currently being utilised have many limitations which have caused many hiccups in the operation flow of information. It is very pertinent to highlight that the study being undertaken in this research is very important as it can assist in the

efficient running of the aviation department at Thornhill Air field. It is against this background that this research project is done on the flight plan management system focusing on the Air Traffic Control department based at Thornhill Air field. To come up with this research the writer consulted journals, online websites and articles, publications, textbooks and other data gathering tools.

1.2.1 BACKGROUND OF THE ORGANISATION

Development (2009) asserted that background of an organisation entail the history, its core business vision, its mission and the hierarchical structure. Air Traffic Control in any aviation center is the backbone for its operations. The history of Air Traffic Control (ATC) at Thornhill started in 1939 when airfield was opened. Its purpose was to provide Air Traffic Service (ATS) to aircraft operating at Thornhill Air Field. Since its inception in 1939, the ATC Unit at Thornhill continues to offer ATS to flights operating at Thornhill airfield as well as to civil flights within the Thornhill controlled airspace. Air Traffic Controllers (ATCOs) based at Thornhill Air Field have also continued to carry out their duties during fly-pasts, Air Shows, Air Tatoos, Fire Power Demonstrations, Wings Parades, and Air Force Family Day displays and so forth.

1.2.2 ORGANIZATION STRUCTURE

Project Management Institute Inc (2000) defined organisational structure as the way strategically adopted by an organisation in arranging its lines of jurisdictional authority and communication entailing the allocation of operational and administrative roles and responsibilities to achieve organisational objectives. The primary purpose of Air Traffic Controlling globally is to ensure safe traffic of aircraft avoiding any disaster caused by inefficient and ineffectiveness in information flow between the pilots and the ATC personnel.

The Senior Air Traffic controller is the man responsible for all the operational and management of activities associated of air traffic controlling issues in the organisation. Below the senior Air Traffic Controller are various departments which ensure the smooth running of the tasks. These departments are the air traffic controllers, pilots, technicians, meteological department and rescue and fire cover department. The organisational hierarchical organogram is as shown below:

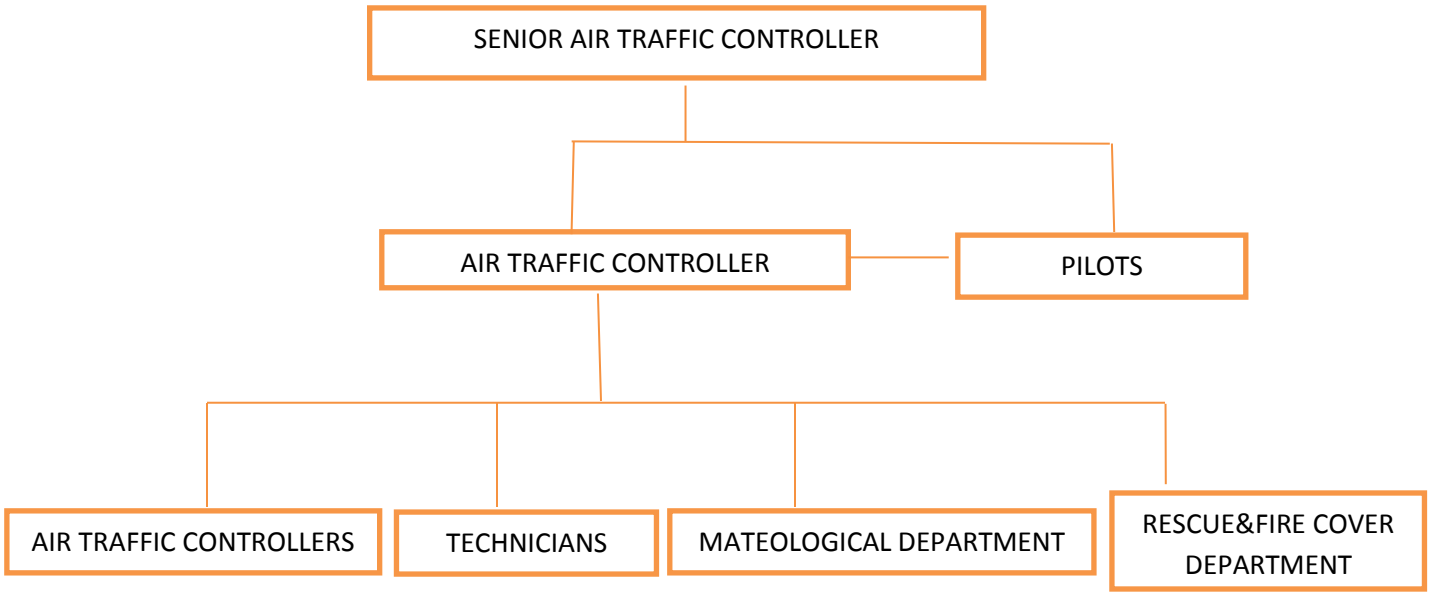


Figure 1.1 Thornhill Air Field Organisational structure

1.2.3 VISION

Williams (2008) defined vision as the guiding principle of an organisation as it seeks to fulfil its mission. The vision of Thornhill Air Field Air Traffic Control is "To provide avionic support to all flying aircraft with reliability, dependability and efficiency services."

1.2.4 MISSION STATEMENT

Mission statement are all obligations which an organisation is mandated in its overal operations, Williams (2008). The mission statement for Thornhill Air Field Air Traffic Control is "To provide air traffic control services for all aircraft within the designated area of surveillance and operation in the airspace of Zimbabwe."

1.3 RESEARCH PROBLEM

Research problem are all combined factors which have necessitated for the research project to be done, (https://www4.uwm.edu/cuts/ce790/problem.pdf). All combined challenges provides the pathway to follow in a bid to meet the objectives of the research. As air traffic controlling is very important in the aviation sector internationally, high standards must be maintained at all cost, Exforsys (2006). Information system flow must be prioritised in this regard emphasising its

efficiency and effectiveness for reliable operations in this department. The challenges associated in the current system are many and are interrelated mainly focusing on the information flow from the pilots to the ATC personnel and within the ATC department. Below are the challenges associated with the current system.

a. Pilots enter their flight details on a paper flight plan which is later transfer to the ATC Department to act on the information entered. This way of operation is less convenience as it is full of human error with a lot of paper work increasing storage costs, stationery expenses and effort to carry the flight plans from Operations Room to the ATC tower which is a distant apart.
b. Inefficient reporting of air information when it is needed as it is stored in the files and records piled in cabinets.
c. As the system is having data in many flight plans for many pilots at each point in time, if professional handling is not exercised, the flight plans can be misplaced before it can be used which can lead to havoc.
d. The system does not allow update of information as once the flight plan is filed the details can only be adjusted via the phone which can cause some inconveniences.

1.4 AIM

Williams (2008) defined aim as the focal point in which the research is basing in order to meet its objectives. The aim of this project is to have a system that will ease the challenges being faced by the ATC department. This research aims to design a Flight Plan Management System (FPMS) which is a dedicated computerised system that captures and process a variety of flight tasks based on the filed flight plan filed by a pilot or flight dispatcher with the local Civil/Military Aviation Authority. The whole process of filing, capturing and processing of the flight plan will be automated in a bid to ensure efficiency and effectiveness in service delivery.

1.5 OBJECTIVES OF THE RESEARCH

Naughton (2010) defines objectives as the goals that one seeks to achieve with a specific course of action focusing the purpose and the aim of the venture. In carrying out this research, the system will be designed aiming to achieve the main goals which target to create solutions to the highlighted challenges of the current system. This research will focus on the following objectives:

a. To allow a pilot to input flight information based on the ICAO standards.
b. To assist Air Traffic Controllers to keep track of aircraft arriving and departing from the terminal aerodrome assisting in safe aircraft controlling.
c. To allow retrieval of flight plan details from any pilot in the system for the purpose of updating or canceling.
d. To allow controllers to manage electronic flight data on the computer without Paper Strips, reducing the need for manual functions, creating new tools and reducing the ATCO's workload.
e. To enhance communication between the pilots and the ATC department through a computerised networked system.

1.6 METHODOLOGY AND INSTRUMENTS

Instruments and methods which Popoola (2011) defined it as all combined various data gathering methods from related sources. in order to attain enough information about the existing information and acquire the user requirements. The data-collection techniques will focus much from a wide range of sources of information to attain a clear and complete picture of the challenges which have led to the research problem. Questionnaires, interviews, observations among others will be used and are explained in detail in chapter 3. There a various instruments that can be employed and the below mentioned in the table will be ideal.

Table 1.1 Instruments

Dreamweaver CS6	It is a Rapid Application Development tool very ideal for a system requiring Graphical User-Interface. (http://qpdownload.com/macromedia-dreamweaver/). -support PHP and MySQL in system development. -provide many inbuilt interface and code templates.
MySQL Database	It is a database that is cheap and easily accessible as it is an open source database. It contains many security features and can be interlinked with other software such as PHP. (Carzaniga, 2016)
Wampserver	It is a very important server software which is employed in hosting the proposed system.(www.apachefriends.org/download.html) -support irrative testing on its host server. -open hence cheap to acquire.
PHP Middleware	Programming language for developing the software.(Carzaniga, 2016) -Easy to use Rapid Application Design (RAD) interface. - Support of legacy keywords necessary for system upgrading. - Option Strict aiding data integrity

1.7 JUSTIFICATION

John Wiley & sons (2010) asserted that justification is the rationale for something or one's course of action or the acceptable reason for one's actions. Air traffic control (ATC) is an integral part of the aviation sector worldwide which requires proper administration with a clear and well defined information flow from the pilots to the air traffic controllers and back. As the

heart is the engine for the body and without it the body will cease to function the ATC is the complimenting department for without it a great disaster will be the result. The primary role for ATC is to control the flow of air traffic, scheduling flights based on given information and communicating with the pilots and other centres. To do this the air traffic controllers utilise the information furnished to them by pilots and make continuous communication with pilots whilst flying. As this is a very vital job a very reliable system requires to be put in place which is able to capture, update and retrieve information in a systematic way. Though the use of paper in documentation can never be ruled out but the use of computerisation is the best way to capture and present the information in a way that is efficient and effective even in transmitting via network channels.

The Flight Plan Management System brings the following benefits:

a. To provide efficient and effective air traffic control services for the pilots on flight and taxing as they are required to have the correct and precise information about the air traffic based on the filed flight plans.
b. Provides a platform to trace the history of any air traffic that have earlier filed a flight plan in the future for the information to be used for security reasons
c. Assists controllers for flight scheduling.
d. The proposed system in this study is affordable as it does not require implementation of expensive software and hardware products.
e. The research will not just produce the desired results but many benefits are accrued throughout the whole research process.
f. Storage is inexpensive and does not take up much space.

1.9 CONCLUSION

Merriam (1831) asserted that conclusion is the logical and methodical reasoning after going through a certain subject. This chapter being the introductory phase of the research project highlighting the background of the research and the organisation. It has also exposed the challenges being faced by the existing system in the problem definition, the aim and objectives

are therefore derived resulting in a selection of the methodologies and instruments being used in the research and project development. This introductory stage lays a foundation to the next chapter which is the planning stage of a system which shall mainly focus on the feasibility of developing the proposed system.

CHAPTER TWO: PLANNING PHASE

2.1 Introduction

Laudon and Laudon (2001) asserted that developing a new proposed information system as a solution to a number of faced challenges requires planning from the top to the floor in the organisational hierarchy. This new venture can be characterized as an organisational transformation involving large number of stakeholders in the organisation, many resources and many professional individuals within and out of the organisation. Planning is an integral part of the system development which gives the convincing rationale of why the system is being developed and whether it survives the acid test.

In this chapter a great emphasis will be in the aspects which include:

a. To carry out an analytic assessment of the business value of the proposed system to the whole organisation.

b. To carry out a deep feasibility study on the development of the proposed system.

c. To deduce the overall profitability of the proposed project comparing costs with benefits accrued.

d. Identifying the system development tasks which require to be performed.

e. Selection of team and assignment of related tasks and the estimated time to complete tasks.

The applicability of the project development and business value associated with the system is critically looked into in this section in order to furnish the decision makers with the much needed information to make policies on an informed point of view.

2.2 Reasons for Building the System

Stellman and Greene (2006) asserted that for every action taken especially in an organisational transformation there must be a reason behind which support the chosen course of action. For an organisation to achieve its aims and objectives on a broader picture, the systems must be able to function efficiently and effectively. The current system being employed had many draw backs

highlighted in the introductory chapter which have triggered for this system development to be initiated. The system to be developed will help ease the challenges faced in the information flow which leaves much to be desired leading to many mishaps in the operation of flight controlling. There is no consistency in the existing system and as the air traffic will be increasing the dangers associated with mismanagement of air traffic will be increasing. An orderly and organized management of air traffic on and above the aerodrome will be enhanced through this new system. It is against this background that the building of the new system is initiated to solve the existing challenges. Enough information must be gathered in the feasibility study to support the notion brought about by the preliminary stage and the business value must be ascertained.

2.3 Business Value

Gould (2010)The planning process is an integral part of the system development as it exposes the reasons for an organisation's venture in the system enterprise considering its business value. The existence of an organisation is based on the objectives of which it upholds, and the operations supports its mandate. Development (2009) highlighted that if a system within the organisational setup fails to perform efficiently, it greatly impact the operations of that organisation which can lead to loss of valuable resources or credibility. ATC department have a risk operating environment in which a simple mistake can lead to a loss of millions of dollars. Thornhill Air Field being on the center of the country many air tasks passes through this point which can be very tiresome if the manual operation persist in the ATC. Taking over and handing over of air traffic and allocation of different altitude and other advisory roles can be very difficult if the flight plan are not properly managed.

The existing system was a high risk taking and work overload to the air traffic controllers as most of the operations were manual and paper based. For this new system to be accepted it should offer efficiency and effectiveness in operation and must be able to meet organisational aims and objectives. The alignment of information technology to the organisational aims and objectives should be taken into consideration in ascertaining the business value of the proposed system to the organisation. The business values associated with the proposed system can be considered as strategic or tactical benefits.

2.3.1 Tactical Benefits

Schroeder (2004) asserted that tactical benefits are all comparative advantages offered by a desired action which enhance operation capabilities. These can be considered to be strategic benefits that can assist ATC operations to continue functioning in the same level but with efficiency and lower costs. These include:

a. Faster and efficient air traffic controlling as much processing will be done by the computerised system. The decisions derived from the system will be very reliable resulting in reduction of accidences.

b. Automation of various procedures of the ATC. Everything that the ATC will Department will be doing will be automated enhancing better communication between the ATC personnel and the pilots and is achieved.

c. Online storage of the flight plans in a networked database assist in management of various inflight operations without limited by geographical positions. The system will be a web based such that the pilots will log in the flight plan at any position which can be viewed by the controllers automatically and stored in the centralized database.

d. Convenience to the pilots is enhanced as the system allows the retrieval of flight plans filed in the past and edit the details to suite their requirements for their flights. This reduce the time taken by each pilot in filing the flight plan and also reducing the expenses incurred in stationery.

2.3.2 Strategic Benefits

Schroeder (2004) defined strategic benefits are all positive achievements brought about by a system resulting in efficiency and effectiveness. These benefits enhance the operations of ATC to service many clients at the same time such that even passing aircraft which sometimes avoid passing over the aerodrome ATC tower due to its inconsistent service delivery. The benefits are enhanced by the following:

a. Utilisation of information communication technology in various sectors have greatly impacted the operations of many organisations. The efficiency and effectiveness aspect in operation result in achievement of the set goals at a faster rate. The same applies to ATC and the Thornhill Air Field as this system will increase rate of operation.

b. Employee value is taken into consideration as goals attainment should not be an issue to be looked into only but the convenience of the operators in performing their duties should also be considered. The computerization of the system will ease the work overload on the controllers as much processes are done by the system.

c. Efficiency and fastness in information flow as a driver to service delivery is promoted as the information can be transmitted at a faster rate than the traditional system.

2.4 Feasibility Study

(Giorgini, 2003) defined feasibility analysis as a critical consideration of various aspects in a chosen subject in which the facts gathered should give a way forward on police making of an organisation. This simplify all the circumstances associated in answering the question whether the organisation have what it takes for the system to be developed. Various considerations will be taken in the following subjects:

a. Technical feasibility which critically examine Human, Hardware and Software issues.

b. Economic feasibility which examine whether the organisation can afford to fund the system development and the economic benefits accrued against the expenses faced.

c. Operational feasibility which analyse the impact of the system to the operations considering the personnel concerned.

d. Social feasibility which examine the impact of the systems on the social wellbeing of the users and other people involved.

The overall assessment exercise of the above aspects will provide the stakeholders with the organisational position on its capability of undertaking the system development. A conclusion will be drawn at each stage paving way for the best course of action that should be taken by the decision makers.

2.4.1 Technical Feasibility

Caine (2009) considered technical feasibility as the evaluation exercise which consider the capability of the developers available in terms of expertise in various areas during the development process. Considerations also are taken on whether the organisation is able to procure the necessary resources required for system development and the operation of the system. This is very essential as it cause the development process to drag or to suffer a still birth. The specifications required must be met to avoid create a bigger problem instead of a solution to

the existing challenges. The analysis go on further to examine the level of the system users' ability to utilize the system. As the proposed system must enhance efficiency and effectiveness, the users must not face too much difficulty in operating the system. Computer literacy being the first evaluation on the users as the proposed system will be purely computerised. Overally the technical feasibility will cover the question whether the organisation have the technological expertise and the resources required.

2.4.1.1 Hardware Requirements

Hardware are all tangible platform which a software run on for it to operate, (https://docs.mulesoft.com/mule-user-guide/v/3.8/hardware-and-software-requirements). The ATC department has computers which have been used for other administrative duties but require to be upgraded to facilitate speed and efficiency. The hardware and their specifications to be utilized are as follows:

Table 2.1 Hardware Requirements

HARDWARE	DESCRIPTION	NUMBER REQUIRED	AVAILABLE
Computers	Desktop Coi4	5	3
Tenda Router	Tenda 2 Gb	2	1
Switch	8 Port	2	2
Patch Panel	12 Port	1	1
Printers	HP Deskjet 4:1	3	2
Connecting Cables	Rj45 Connectors	20	0
Server	1 series IBM	1	1
UPS	220 (Power Backup)	5	5

It is recommended that all the shortfalls of the required hardware for this project to be a success. The stakeholders must be conscientised on the need to have these requirements for them to fund this project.

2.4.1.2 Software Requirements

Software requirements is the intangible aspect of a system which include programs, utilities and applications, (https://www.computerhope.com/jargon/s/software.htm). Analyzing the challenges being faced by the Air Traffic Controllers and the pilots for perfect information flow and collaboration, various software was wisely selected to achieve the best. As there are various software packages which comes with different capabilities, analysis of whether they will serve the purpose which they are intended to be used is also an important point to be noted. Below are the software packages chosen in development and delivery of intended services:

Table 2.2: Software Requirements

Item	Description	Number Required
Setup disk	TP Link Setup Wizard & User Guide	1
Dreamweaver 8	Installation disk	1
WAMP server	Installation disk	1
Eset End-Point Security	Antivirus disk	1
Microsoft Office Package	Installation disk	1
Operating System	Windows 8 installation disk	1

Table 2.2 Software Requirements

From feasibility carried out on the hardware and software requirements, it can be conclude that the organisation is capable to undertake the development process of the proposed system.

2.4.1.3 Availability of Technical Expertise

Technical expertise is a very vital aspect for any development process despite which field it is in. Matson (2009) asserted that without the technocrats and the expects in that corresponding field, the development process is bound to face a still birth or to be abandoned before its accomplishment. Support (2002) described technical expertise as the ability to withhold the knowledge, skills and past experiences in a specified field of specialty. In this particular context the ability to transform and translate the given objectives of the proposed system through manipulating the hardware and software packages on disposal. The ATC department was using computers in other administrative issues, giving a concrete evidence that the personnel are computer literate such that little user training on operation and mantainence and manipulation of various features on the system and a supply of the user manual will be done.

In terms of the availability of the development team, there is a very capable programmer who is well vesed in various development tools and applications and also have carried out other complex projects. Among the team there is an expert with the knowledge of avionics and the operations of the ATC department as well as the information flow within the Thornhill Air Field. This person will make sure that the right product with right features will be produced. There is also among the team gurus in the setting up of the hardware components. There will minimum hiring of other experts during the development phase and also the mantainence will be carried out internally. From this gathered information there is nothing established obstacle except for the unseen future events.

From this technical feasibility study, it can be overall concluded that they high possibility that if the project development is commenced it be finished as far as the technical facts are concerned.

2.4.2 Economic Feasibility

Giorgini (2003) asserted that economic feasibility is concerned with the financial aspects associated with the development of the system and the capability retain all invested resources. Besides having the capability to sponsor the project, it is also pertinent to highlight that the system must be able to have economic benefits in its life time. If the profits accrued by the system outweigh the development costs together with the maintenance cost of the system, the development process would be very feasible.

2.4.2.1 Costs

Support (2002) defined cost in software development as all combined expenditure accrued in software development. This Flight Plan Management System is a long term investment which requires much resources for the best to be produced. Various costs which include designing the system, development requirements, operation and its mantainence needs to be covered. All these require a financial support which the Thornhill Air Field must shoulder in its responsibility budget. In this feasibility study the costs will be divided into development and operational costs.

2.4.2.1.1 Development Costs

Development costs can be defined as all the costs that are associated in the development process including acquisition of all requirements and services employed, (Support 2002). These are very important to be considered as they entail whether the project will be successful. The costs can change with time depending on the period when they will have be incurred. The whole proposed costs schedule is highlighted below:

Table 2.3 Development Cost

ITEM	DESCRIPTION	COST
P4 COMPUTERS	3	1200
PRINTER	1	75
TENDA ROUTER	1	120
Patch Pane	1	45
CABLES (CONNECTING)	20	80
SWITCH	2	90
Setup Wizard Installation Software	1	20
AVAST (ANTIVIRUS)	1	350
OPERATING SYSTEM (WINDOWS 8)	1	60
MICROSOFT (PACKAGE)	1	150
Windows7 Operating System	1	60
Cost of a Personnel	10	950
Cost of Training	10	550
TOTAL COST OF DEVELOPMENT		**3850**

Table 2.3 Development costs

2.4.2.1.2 Operational Costs

Operational costs can be defined as all the costs and expenses associated in the day to day running of the system, (Schroeder, 2004). Every system accrue operational costs and most of them are unavoidable. The costs associated in the operational life of the system are grouped as follows:

a. **Maintenance:** the components that comprise the system are hardware and software which requires regular checks ensuring that it continues to operate at the required standard best

for service delivery. The Cost will be very minimum since the personnel who will be maintaining the system will be from within.

b. **Upgrades:** Upgrading the system will be very necessary especially as technology is advancing, the system also requires to commensurate with the existing standards. As user requirements change frequently, the system also needs to be upgraded in that regard for it to continue serving its clients. When the costs of mantainence and upgrading becomes much, another option will be to develop another system.

2.4.2.2 Benefits

Caine (2009) described a benefit as an advantage that can be quantified or measured on quality based on the outcome achieved on a taken course of action. The benefits can also be measured in terms of whether the objectives have been met or not basing on the satisfaction of the user requirements. The benefits can be grouped as either tangible or intangible depending on whether they can be touched or not.

2.4.2.2.1 Tangible benefits

The anticipated tangible benefits can be accrued and measured monetarily by adding the total estimated returns. The anticipated benefits of the proposed system upon its employment are as highlighted below:

Table 2.4 Tangible benefits

BENEFITS	2017 USD ($)	2018 USD ($)
Savings in operational costs	500	400
Labour	1 000	900
Reduced stationary expenses	600	500
Handling	1 000	900
Reduced time of enquiring	1 200	1000
Total Tangible benefits	**4 300**	**3 700**

2.4.2.2.2 Intangible benefits

Caine (2009) defined intangible benefits as the advantages that are associated by the utilization of the proposed system that cannot be quantified and measured monetarily. This means that it is impossible to set a value in terms of money but these significant fruits can be enjoyed by the users and the organisation as a whole. These intangible benefits are follows:

a. The system aid Air Traffic Controllers to perform their duties effectively as the information flow channel would have been enhanced. The pilots would be able to send the flight plans in time and the controllers can manage and schedule the aircrafts taxing and landing on the aerodrome with reliable information.

b. The hassles and labour to facilitate the movement of the flight plans from the operations office to the Air Traffic Control Tower are reduced as flight plans will be sent from the office to the Tower.

c. Collaboration and liaison between the controllers and pilots is enhanced

d. The staff morale is improved as the workload is reduced as much is now been done by the system.

e. The proposed system has back-up system for all the data for all operations such that it is guaranteed that the data stored is safe.

2.4.3 COST BENEFIT ANALYSIS

Lucey (2002) highlighted that cost benefit analysis is comparing the costs accrued during development process and operating the system with the benefits which are accrued. This is a very important phase as it gives the administrative information for decision making in carrying out capital budgeting. If the costs exceed the benefits that will be accrued, the system will be a liability to the organisation and it won't be very wise and economical to take on the project. There are various methods that will be used to ascertain the profitability of undertaking this investment.

Table 2.5: Cost-Benefit Analysis Ratio

Narration	**ESTIMATED COST USD ($)**
TOTAL COSTS	
Developmental and Operational costs	3 850
Total Costs	**3 850**
TOTAL Benefits	
Tangible	**4 300**
Total Benefits	**4 300**
NET BENEFITS (*TOTAL BENEFITS – TOTAL COSTS*)	**450**

From the table above it can be noted that the costs associated with the system are lower than the benefits accrued by utilizing the system. It can be concluded that it if very feasible to undertaken the development of the proposed system.

2.4.4 Return on Investment Analysis (ROI)

Return on investment can be defined as the calculations monetary of the benefits accrued subtract the total expenditure and the total is expressed as a percentage, (https://strategiccfo.com/return-investment-roi/). This analysis method is usually utilized by investors in a bid to establish the percentage of deviation of the value of investment over a given period for example a year, (Laudon and Laudon, 2001). The annual ROI can be calculated as below:

$$ROI = \frac{(Total\ Benefits - Total\ Costs)}{Total\ Costs} * 100\ \%$$

$$= \frac{(4300 - 3850)}{3850} * 100\ \%$$

$$= \underline{\mathbf{11.69\ \%}}$$

According to ROI calculations above, it is advised that the proposed system is an asset and its development is very viable and economically feasible. There will be a positive 11.69% appreciation of the investment every year.

2.3.4 Social Feasibility

Giorgini (2003) asserted that social feasibility study is concern with how the proposed system will impact the social set up of the users and other associated people. Laudon and Laudon, (2001) highlighted that the social impact of any information system must be established at all cost and negative effects be minimized. It is very important to take consideration also the social relations aspects of employees after the new system is implemented in the organisation.

These are the benefits accrued after the implementation of the system:

a. The paper work in the administrative duties is reduced by sixty per cent improving working conditions for employees and employee self-esteem as the work overload is reduced thus motivating them.

b. It gives improved in relationship among all members along the hierarchical chain of command as there is quick response to issues raised which require immediate feedback.

The conclusion reached by the analyst is that the proposed system will enhance the operation of the members hence it is very necessary to continue with the development.

2.3.5 Operational feasibility

Support (2002) described operational feasibility as the determination of whether the system proposed to solve the prevailing challenges will be able to yield the expected results during its utilisation in the already existing frameworks. The proposed system implementation will be critically investigated whether it will fit well within the existing structures at the same time delivering the required operations. It also looks into whether the management of the organisation will be supporting the introduction of the system as a solution to the problems. It is a vital step to make as the commitment of the management will ensure successful development and subsequent implementation as it is the source for resources. The employs also have an effluence on the acceptance and efficient utilisation of the system as their attitude can determine its operation. Committee (2011) asserted that operational feasibility will also analyse compatibility of the proposed system to the already available hardware as well as software packages already in use by the organisation. To do justice to this aspect, the feasibility will be carried out under the following headings:

i. Computer literacy skills of the users.

Without hesitation or assumption the intended users of the system are very much computer literate. Being a technical field and an area whereby the members must have technology on their fingertips, the members first undergo a computer appreciation course with ICDL. The members also are encouraged to further advance with enhancing their computer skills and some even hold various certificates in ICT fields. However, training on the operation of the proposed system will be done to ensure that all will not have problems in operating it. User manuals will be given to the users as a reference document whenever they meet challenges.

ii. Compatibility of the system with the existing infrastructure and IS.

Currently the organisation have computers with Windows 7 Operating System which is the same as the one being used for the proposed system development. After carrying out the technical feasibility, the results produced gave the conclusion that the existing hardware and software are very much compatible with the proposed system being developed. A detailed research was carried out in all areas and they are high confidence that no challenges will be met during either the system changeover or even implementation and operation.

iii. User friendliness of the system.

Efficiency and effectiveness have been the main theme in the crafting of the objectives in a bid to produce not just a result oriented system but user friendly of the system. The carefulness was done by the developers in a bid to enhance the operation of the system without creating further problems related to system unfriendliness. The proposed system will contain features which will make the system appetizing to operate, fastness in loading, having all the necessary operations and producing the desired reports. The interface of the system will allow an efficient user interaction with the system and a room is available to adjust various features to suite the users.

iv. Management support of the system

The success of the system is determined mainly on the commitment of the management as they are the policy makers and source of resources. It is also very hard to determine the commitment of the management as they have many questions especially if it is a new thing in the organisation. Being a security force, aspects related to security of information on the aerial operations and cyber wars with enemies especially with case studies from developed countries whereby other systems are hacked is also cause of concern. After being educated on various security strategies and mechanisms that can be employed to ensure protection of the system from unauthorised access or even malicious damaged, the management supported the initiative. Management also realised that much expenses will be reduced and much time was to be served, the support was overwhelming.

v. Users' Attitude.

The users are the ones who will be operating the system are also to be considered in this operational feasibility study. The users of the system will be interacting with the system every day and belongs to them. If the users develop a negative attitude on the proposed system it will

be very hard to convince them. Their worries will be the negative effects which are associated with the introduction of information systems. Some of them include retrenchments meaning that their jobs will be at risk, continuous productivity monitoring and many other disadvantages of information systems to the employers. With this proposed system, efficiency and effectiveness on user operations are much emphasised rather than scaling down the manpower. The system is designed for the users to carry out their daily tasks in a way that reducing their work over load but being able to carry out their relevant tasks. The intended users are in support of the system and are looking forward for the invent of the system.

In conclusion, after carrying out the operational feasibility study, the results show that there is high confidence that the system will be able to achieve what it is designed for.

2.4 Risk Analysis and Management

Gorrod (2003) defined risk management as the application of various investigatory techniques upon a defined proposed course of action and the definition of proposed mechanisms to be applied in the event of meeting the unexpected. Risk analysis refers to all the combined efforts taken in a bid to predict what can be expected during the system development and even the implementation in order to avoid or tackle them without diverting the intended route. If the risks are not preplanned, the organisation may loss a considerable amount of resources resulting in the proposed system to be abandoned or chewing much resources for its survival. Umist (2000) emphasized that risk analysis approach is very essential for any software project development and must be priorities during the course of all the phases. In order to carry out the risk analysis for this proposed system the following aspects will be taken into consideration:

a. Project Risks

Fontaine (2016) highlighted that project planning is the integral aspect which is critical in every aspect of a software development and the risks associated can affect the entire objectives of the project. For every phase they is a defined time frame allocated to it and any risks that may cause a slight delay in any phase can be hazardous as they can result in accrual of expenses. Umist (2000) also asserted that project risks assessment is very vital as it result in planning of budgets, schedule, manpower in both system development and operation and requirements potential problems and how each affect the overall software project development.

b. Technical risks

Neill, Thakur and Duus (2007) defined technical risks as the unforeseen circumstances that affect the technical aspects associated with hardware compatibility to a software. Stoneburner, Goguen and Feringa (2002) asserted that if the potential challenges or threats are encountered, it will make the implementation of the proposed system to be very hard or even very impossible. Considerations can be made on the specification ambiguity, technical uncertainty and change in technical environment.

c. Economic Risks

Biffl et al. (2010) described economic risks as all aspects which negatively affect the system development and the economic benefits associated with the system. Informatik (2000) also highlighted that if the system development face a scarce in resources resulting in either producing a product which cannot satisfy the objectives. If the economic risks are over looked, the overall project development is affected.

d. Operational Risks

Committee (2011) defined operational risks as the total unexpected loss due to insufficient or failure of processes, people and systems within the structures or caused by events from the external. After the implementation of the proposed system the challenges which may be faced can be related with the attitude of the users upon the system. The end-users may anticipate that the proposed system may be very difficult to learn and even prefer using the old system rather than the changeover. Risk (2006) emphasized that in case the users develop a negative attitude on a system much confidence must be instilled in the users for it to survive all operational challenges otherwise the project will suffer stillbirth. The users will be involved in the operation, troubleshooting in case of malfunction and shutting down so operational risks must be dealt with at all cost.

The table below will look into various risks aspects, their impacts to the project and the preventive measures if the project development encounter such situations.

Table 2.6: Risk Analysis

Ref	Risk Details	Probability of Occurrence	Risk Impact	Preventive/Contingence
1	Insufficient resources required	6%	Incompatibility challenges with hardware and software resulting in failure to meet user requirements.	Proper planning with all hardware and software specifications. Stakeholders must be advised for them to allocate sufficient resources to the project.
2	Shortage of skilled members in project management, implementation and operation.	5%	Skilled members required may retire from the organisation due to expire of contracts or braindrain.	-Worker development in all skills required must be emphasized. -Extend contracts for all relevant skilled members and creating conducive environment which retain skilled members.
4	Failure to satisfy stakeholder requirements	10%	-the developers fail to design a system which satisfy the given objectives and fail to meet user requirements	-Develop a quality monitor framework throughout all the phases of project development. -Create a check list and a log system to ensure all issues are looked into.
6	Unavailability of critical resources needed	5%	-if the critical path processes in the project development are not supplied with	-First identify critical path processes and set aside all the critical resources before the commencement of the project development.

			enough resources can cause an overall delay resulting in not meeting set dates.	

2.5 Work Plan

Lindee and Lloyd (2013) defined a work plan as an organisation's blueprint with a clearly laid out activities and timeframe in organizing a project. It is a framework that project developers refer to with the project manager making sure that the team maintain the set dates. Each and every phase or activity is given the maximum duration with defined start and end dates. The breakdown of all work to be carried out and its timeframe is highlighted in the table below:

Table 2.7: Detailed project plan.

Job	Begin	Completion	Time
Proposal for the project	08 Jan 17	05 Feb 17	4 week
Progress Initial Construction Sketch			
Produce Development Suggestion			
Proposal is Accepted			
Project Feasibility			
Implement Risk Analysis and Feasibility	05 Feb 17	19 March 17	6 weeks
Identification of Development Responsibilities			
Develop Test Plan and Schedule			
Review, Approve and Produce report for Project			
Project Analysis			
Gathering of Information			
Model building of the proposed system			

and the current system			
Evaluation of Model			
Review, Approve and produce report for Project review.	19 March 17	16 April 17	6 week
Designing of project			
Designing of Structural design, Databank, Crossing point			
measures for design experiment	16 April 17	04 May 17	8 week
Review, Approve and produce report for Project review			
Coding and Development			
Coding and development, database and query construction, Interface construction, Code development, Review	07 May 17	02 July 17	8 week
Testing and Implementation			
Technical testing, user acceptance testing, implementation	02 July 17	06 Aug 17	6 week
Review and maintenance, submission of final report	06 Aug 17	20 Aug 17	2 week

2.5.1 Gantt Chart

Stellman and Greene (2006) defined Gantt charts as software project development planning tool that shows the activities involved and their corresponding time frames. It was developed by Henry Gantt in a bid to show the start and end dates of the tasks involved in the project until its completion. Below is the Gantt chart of the proposed system development with the corresponding information above:

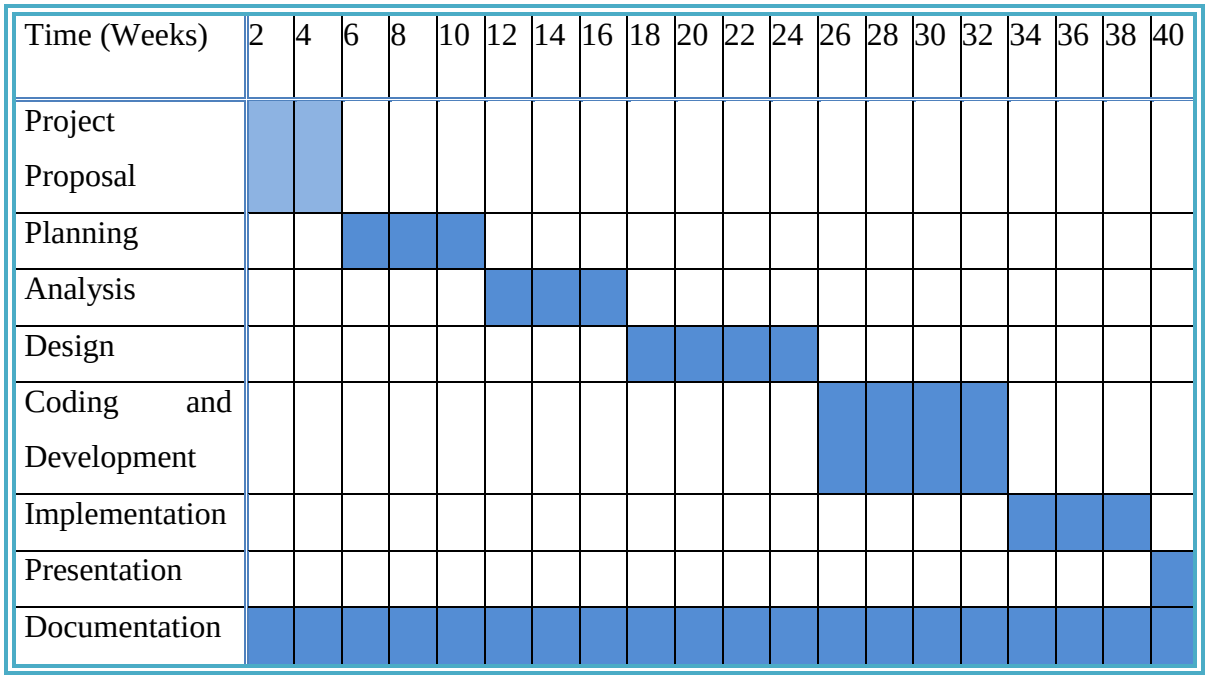


Figure 2.1 Gantt chart

2.6 Conclusion

Development (2009) asserted that project development without planning is a very good recipe for disaster. It is however emphasized by Stellman and Greene (2006) likening poor or no planning as a nation wedging a war without a defense force. Many authors have nailed this point in a bid to make planning the corner stone for project development. This chapter critically investigated many aspects in a bid to determine whether it is viable for the project to be developed. The business values of the proposed system are analyzed highlighting the total expenses associated with the system comparing them with the benefits to be accrued. Feasibility study was done exhausting all the areas of interest which include social, economic, technical and operation. The proposed system passed the test and it was therefore concluded that it was feasible for the project to be developed. For every intended move there are some uncertainty to

be expected in the form of risks and these were not left out in this chapter and preventive measures where determined. All the tasks to be done during the project development were determined and anticipated time frame was set. Gantt Chart was used to clearly represent the detailed working plan and can always be referred to during the project development. This chapter brought into picture the position of the organisation in respect of the proposed system and the next chapter to follow is the analysis stage which scrutinize the current system.

CHAPTER THREE: ANALYSIS PHASE

3.1 Introduction

The analysis stage of system development is a very important stage that critically look on the existing system. Stellman and Greene (2006) asserted that analysis study consider the inputs, processes and the outputs activities of the current system scrutinising all components. A critical anaylsis of the Air Traffic Control Department is done together with associated departments. Development (2009) highlighted that system analysis in a pragmatic way is important for the development team must to be well versed with the problematic system in order to develop an appropriate solution to the challenges being faced. In this chapter possible options are critically analysed and compared for the best course of action to be selected. Various data gathering techniques will be used to make sure correct and reliable data is gathered.

3.2 INFORMATION GATHERING METHODOLOGIES

Dennis, Wixom and Roth (2012) highlighted that information gathering is the back bone for every successful project, characterized as the pathway to an unknown ambition. Once information which is reliable and correct is gathered a well-defined and possible course of action can be taken. As the saying is knowledge is power, the success of the project development depends much on the data gathering methodologies. Urquhart (2015) defined data gathering methodologies as the techniques that are employed in the collection of information from various sources to achieve a purpose. These sources of data in this case target the users of the system which are the traffic controllers, pilots, clerks and system administrators and other concerned personnel. The data gathering methodologies chosen by the researcher are questionnaires, interviews and observations. A closer look to the documents involved such as operational manuals, flight plan files and ICAO documents.

3.2.1 Interviews

Stellman and Greene (2006) defined interviews as a method of collecting data from an individual by posing a number of related questions on a specific topic. The respondent is allowed to answer the questions thereby giving out the required information. This a direct conversation which is one on one as the researcher seeks to acquire all the information related information on how the system works, having a clear insight on the challenges being faced by the users. In this data gathering exercise, the researcher will conduct an interview to the senior controller officer, air

traffic controllers, pilots, clerks and technicians. This method like any other technique its advantages and disadvantages.

a. Advantages of interviews

i. This method provided the researcher with an instant feedback and all gray areas are made clear.

ii. First hand data is gathered from the actual users who face the challenges whilst operating.

iii. The researcher was able take his time in this exercise in order to gather as much information as possible.

iv. Other not considered challenges and issues were highlighted adding flesh to the framework which was drafted in problem definition.

b. Disadvantages of Interviews

i. The exercise was not limited in terms of time there by consuming a lot of time.

ii. Much resources where set aside in this exercise making the data gathering expensive. Travelling costs were incurred in order to meet interviewees.

iii. There is a probability for the interviewees to withhold vital information which may make the researcher have a clear insight of the system. This is as a result of fear of being victimized and unclear of the consequences of giving out the information.

3.2.2 Questionnaires

Lietz (2008) defined questionnaires as a list of prepared survey questions on a particular context in a bid of gathering information. This is very vital as it can be used to gather information for a wide spectrum. Much information was gathered and the bulk of the information gathered shows that the users was facing too much work load thereby reducing their moral. Too much errors were incurred as a result of fatigue due to long tiresome hours of concentration. The questionnaires provided information that the whole system users were not happy about the operations of the current system, slowness in information flow being the main challenge. Therefore, the development of the computerised Flight Plan Management System is a necessity which must be considered as a first priority. This methodology has its own merits and demerits as highlighted below:

a. Merits of questionnaires as a methodology

i. The questionnaires provide much needed privacy such that a person is able to give out information because of the anonymity character.

ii. It is a cost cutting measure as travelling cost and time factor is minimised and some of the questionnaires can be sent through emails.

iii. The people being given questionnaires are given enough time to analyse the questions and give out a prepared answer which can be of help in system development.

b. Demerits of questionnaires as a methodology

i. Most of the questions where designed in a closed ended such that the resondence were not able to give out their own opinions.

ii. The problems with people who were given the questionnaires were not cooperating as some delayed handing back the questionnaires and some did not return with them.

iii. Some respondents were not able to interpret the framed questions making the research exercise obsolete.

3.2.3 Observations

Baker and Baker (2017) asserted that observation as a data gathering technique can be carried out by going physically on sight and analyse the system. There are some aspects in the system which is hard to explain or put it in words. According to Urquhart (2015) the users may find it very difficult to explain it to someone who have little knowledge of the system as a whole. The researcher took time going around following the information flow from the inputs which was the operations room where the flight plans were submitted, analyzing how they will be processed and transported to the Air Traffic Control tower and the actual management of the aircraft based on the filed information. The researcher noted that they were indeed a real problem which is was hard to overlook. There was too much resources that were utilised in this process from stationery to transport to take the flight plans every time a pilot files it to the operations room. An incident happened whilst the researcher was in the operations room when one pilot had written wrong aircraft type but remembered it when the flight plan had already been transported to the tower. The unfortunate part was that the phones at the tower were down and there only way to give out the information was to amend the wrong flight plan with the correct one and transport it again to the Air Traffic Control Tower. This observation technique was an eye opener and made the researcher to have a clear picture of the system as a whole. Besides being a good methodology it have its merit and demerits as highlighted below.

a. Merits of using Observation as a methodology

i. This technique was very effective in clearing all the gray areas which the researcher had assisted him to make independent conclusions.

ii. Accurate and reliable information was gathered through this exercise.

iii. The operations of every individual was observed and all the processes were noted giving enough time for each.

b. Demerits of observation as a methodology

i. The information about the exercise had leaked in other sections such that they altered the way they operate resulting it biased information.

ii. People tend to hide the way they operate when they notice that they are being critically being observed. As a cantonment area, unknown persons are not accepted in some areas due to security reasons.

iii. The exercise is practical and requires time and right mental attitude for it to be a success.

3.3 Analysis of the current system

Emphasis of the analysis of the problematic existing system was put across strongly by (Dennis, Wixom and Roth, 2012) when he asserted that without investigating the shortfalls of the current system there are high chances that the same challenges are bound to be faced in the new system. The current system has being existence since the invent of air traffic controlling at the base. The system is purely paper based and relies much on the manual operation at each and every stage of the information flow. Flight safety being the main cause of concern, effective aircraft controlling both on ground and in the airspace is based on the accuracy of the information provided. Human errors are common and the consequences can be unbearable if action to upgrade the current system is delayed or overlooked.

3.3.1 Description of the current system

The process of flight plan filing is initiated by the concerned pilot or the assigned flight dispatcher. As the system is paper based the flight plan is filed with all the personal details of the pilot, the aircraft description, departure and defined destination including the purpose of the flight. The time of departure is also noted as it is important for managing aircraft taxing, taking off and landing. In case of emergence whilst in transit the pilot is able to divert the root and land at an optional landing zone which he would have noted on the flight plan. After all the details

have being filed, the flight plan is handed over to the operations room staff who can relay it to the Air Traffic Control Tower where it is received by the Air Traffic control Tower assistance. The information is checked and then filed and handed over to the Senior Air Traffic controller. The Controller on duty then prepare the paper strips related to that particular flight plan. The flight paper strips are grouped according to the timings of departure except in exceptional points whereby the aircraft's departure time is not to be published. When the time for departure comes, an official radio communication is initiated by the pilot seeking clearance from the ATC which then advise based on the information at hand. When the runway is clear and there is no landing aircraft, the ATC gives clearance to the pilot who then tax and finally take off. The landing aircraft as well communicates with the ATC seeking clearance and if the run way have no aircraft it is then allowed to land. Aircraft coming from other areas towards the ATC, the ATC were they would have taken off or along the route should advise the Thornhill ATC on the estimated time of arrival. Once that information on the flight plan is communicated to the receiving ATC, aircraft management will be done efficiently. If the information about the taxing and landing aircraft is not relayed well, a disaster can result in loss of many millions of dollars and experienced personnel. This current system was having much loop hopes and much information was not lost during the flow.

3.4.1 Context diagram of the existing system

Burge (2009) asserted that Context Diagram is a very important tool in functional modelling as it precisely denotes the systems' boundary and defines all the external and internal flow of data as entities interact with the system. It is a true representation of the whole integrated system together with all its associated entities which interact with it. The context diagram below highlight the different inputs, processes and outputs associated in the current system

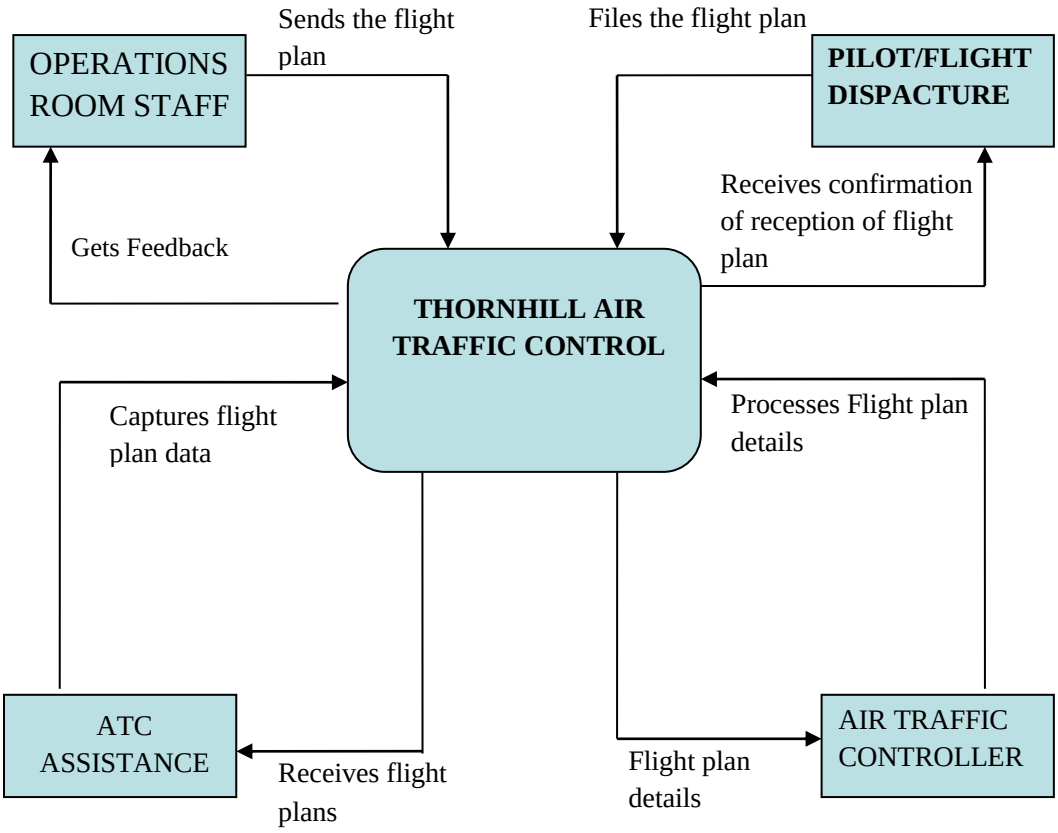
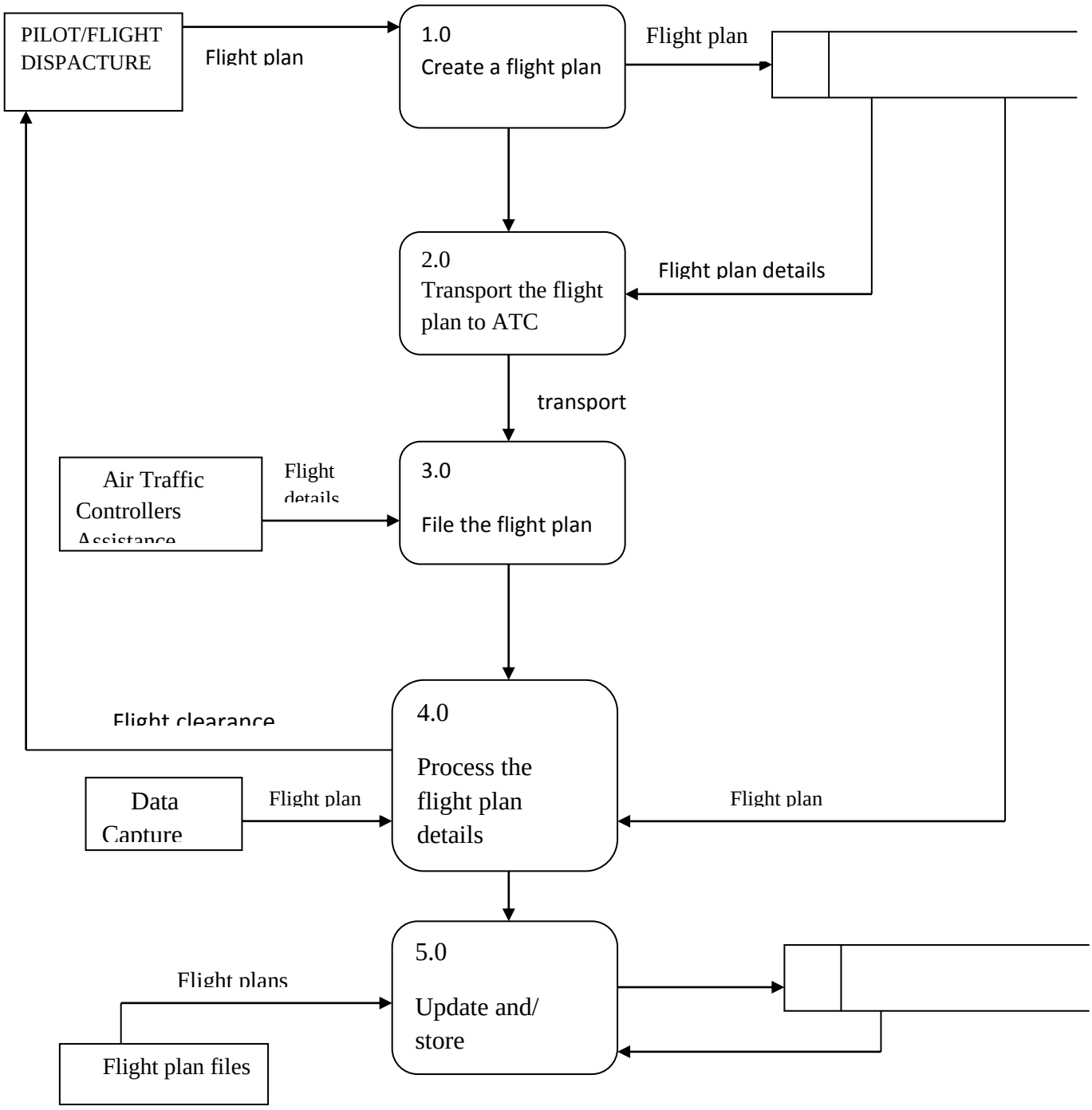


Figure 3.1 Context Diagram of the existing system

3.4.2 Data Flow Diagram of the Existing System

Burstein (1986) described a data flow diagram as how data is processed from the time it enters the system and when it come out as outputs. Burge (2009) also defined data flow diagram as a vital software development component that helps developers to picture the whole system as functional processes joined together by pipes which facilitate flow of data. Much of the information gathered in the data gathering exercise gave the researcher a clear insight on the information flow within the system and how various entities interact in the process. Below is a data flow diagram of the existing system:



Data flow diagram symbols

File/storage Entities Processes Data flows

Figure 3.2 Data Flow Diagram of the existing system

3.4.2 Weaknesses of the current system

a. The current system does not provide timely information contained in the flight plans for efficient management of traffic flow.

b. As the system is having data in many flight plans for many pilots at each point in time, if professional handling is not exercised, the flight plans can be misplaced before it can be used which can lead to havoc.

c. The system does not allow update of information as once the flight plan is filed the details can only be adjusted via the phone which can cause some inconveniences.

d. The current system was mainly paper based chewing much money on stationery and its storage in cabinets.

e. The system cannot be accessed online for convenience as the interested members will file in flight plans despite their location.

3.5 Evaluation of alternatives

After a critical analysis on the current system, the researcher was highly convinced that a new system to replace the existing one was to be developed. With all the challenges outlined and the user requirements gathered together with the proposed objectives, it is however pertinent to note that a wise selection of the method of coming out with the solution must be done. The available solution to the problem are outsourcing a system which meet the user requirements, improvements to be made on the existing system or having an in-house system development. A detailed comparison to the noted methods is carried out as highlighted below.

3.5.1 Outsourcing

Williams (2008) defined outsourcing as the acquisition of an already developed system based on the user requirements and objectives. The developers will be hired from outside the organisation and can only be delivered once it satisfies the users and all other stakeholders. Stellman and Greene (2006) asserted that outsourcing a software can be described as seeking professional solutions from an outsider who is better that you. This also brings the issue that some companies are already in that industry as their primary business and can produce a better product that an organisation not fully into it. On the other hand, an insider is in a position to know the challenges and the organisational information hence is in a position to even predict the challenges before they come hence is able to produce a more customized product. Below is a highlight of the merits and demerits of outsourcing.

a. Merits

i. Outsourcing as a solution is very possible if reputable developers are approached.

ii. It reduces the stress and time for organisational members

b. Demerits

i. Risk of purchasing a wrong system with security loopholes.

ii. It poses challenges for other developers to upgrade the system or make changes to fit other changing requirements as document for development process will not be handed over to the organisation. The original programmers and designers are the ones who will be able to make changes.

iii. There is high risk for user resistance to accept the system as they are not incorporated in the development process.

3.5.2 Improvements

Making improvements to the current system entails modifying the existing system to meet user requirements but not abandoning it completely. Making adjustments in order to solve the problems is only achievable if the challenges are not of operational nature, (Project Management Institute Inc, 2000). As this system has failed to deliver the service in an efficient way, much will never be achieved through improving the system but a new system will offer new ways of operating. The merits and demerits of this methodology is highlighted below.

a. Merits

i. Minimum costs are incurred as the users are well conversant with the system processes thus there is no training involved.

b. Demerits

i. The challenges faced by the users in the current system are bound to be inherent in the improved system.

ii. From the analysis done of the current system, an improvement will not solve the challenges but van create more problems thus a total change will help.

3.5.3 In-house development

Haider et al. (2016) described an in-house development entails that the members within the organisation will be gathering the user requirements and design a system that will best solve the highlighted challenges. Many aspects will be looked into during the development process for the best solution to be produced. PMI (2013) asserted that the selected team of developers will be

balanced with all departments concerned well represented covering all the users of the system. Various tools such as programming languages and development techniques will be selected with much considerations made with critical analysis. The proposed system for it satisfy the requirements for every user, requirements are researched from the users. Below are the noted merits and demerits of the system.

a. Merits

i. As the users will be consulted at every stage of the development process, there will be little resistance to the system as they have the sense of owning it.

ii. Many challenges which were not noted in the analysis process are further scrutinized and the system produced will solve all problems.

iii. Advanced costs for further development are minimised as the system will be customized to fit the users.

b. Demerits

i. An in-house development chews much resources in terms of time and money which can be avoided by acquiring an already finished product.

ii. The in-house developers may not be having enough professional knowledge in system development which can pose a challenge in meeting all the laid down objectives.

3.5.4 Selecting alternatives

After carrying out a critical analysis, in-house development had merits which outweighed all other options presented. It is noted without doubt that in-house development is able to produce a customized product that is able to meet all department requirements. Much facts were considered as much the members selected in developing the system proved to be having perfect knowledge of the organisation and development tools.

3.6 Requirements Analysis

Glinz (2007) asserted that requirements analysis stage carries out scrutiny of all the necessary requirements from the gathered information from the users. For a perfect system to be designed the functional requirements must be noted by carrying out a deep investigation on the existing system. All the components intended to be present on the proposed system must be established well before the actual design process commences.

3.6.1 Functional requirements

Larman (2005) asserted that functional requirements give a description of all the services which can be offered by the proposed system. The functional requirements should consist of the inputs, processes and outputs they by perform according to an expected level as described below.

a. Inputs

Inputs to the system are the following: Security level, Graphic User Interface (GUI), Details of Users, Information of Flight Plan, information of aircraft and meteological information.

b. Processes

Processes include the following: Processing Flight schedule based on flight plans and processing meteological data

c. Outputs

Outputs for the system are: flight schedules, Terminal Aerodrome Weather Focus (TAF) and Aircraft capabilities.

Case diagrams beneath will help to illustrate the system's functional requirements. Their use will help to outline who (actor) does what (associations with the system) and the reason (objective). So the case diagram is a complete picture of the system in terms of all the various system functionalities and the different users that will use it.

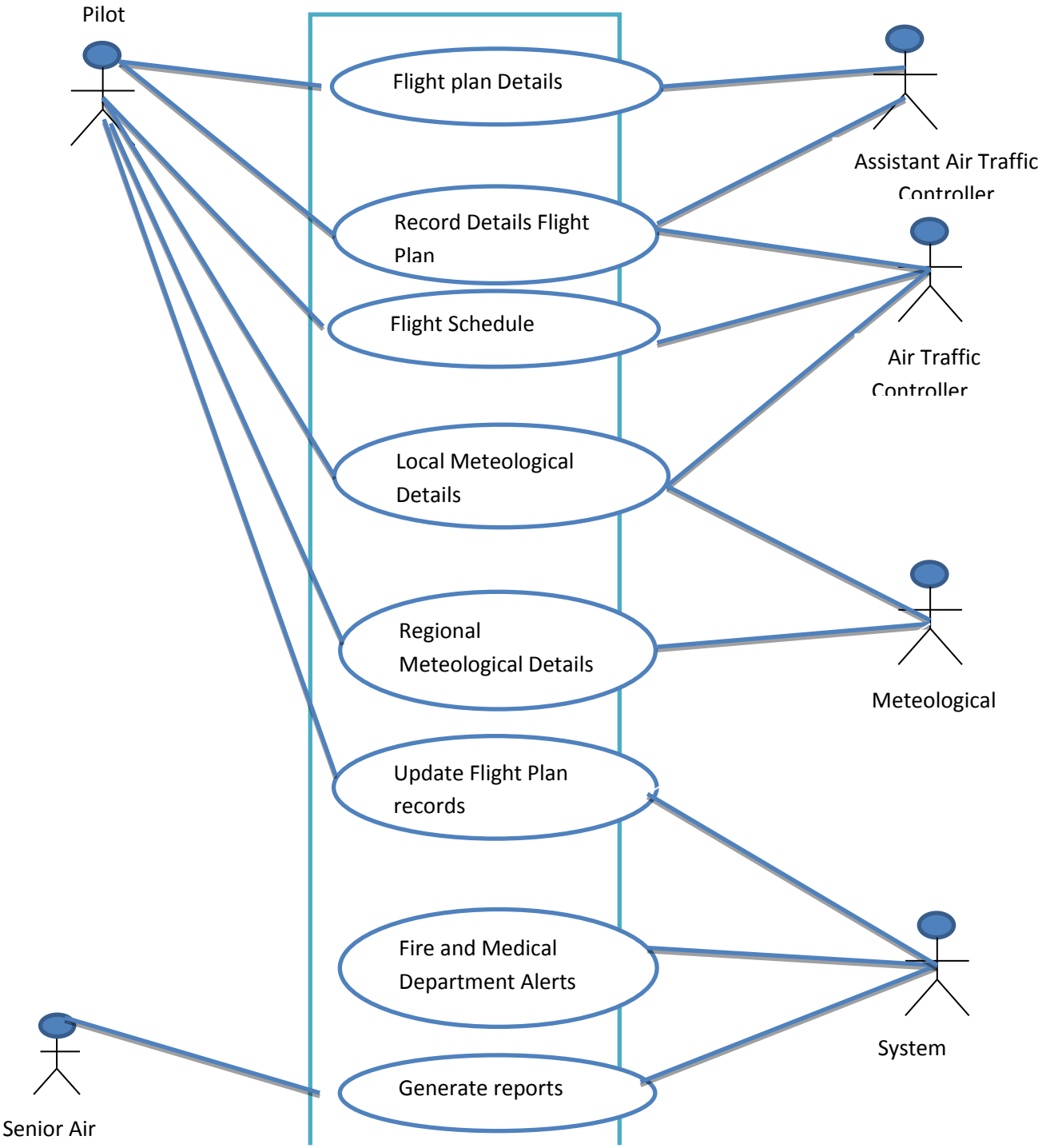


Figure 3:3 Use Case Diagram

Key

	ACTOR
	COMMUNICATION BETWEEN ACTOR AND CASE
	DESCRIBES

3.6 NON – FUNCTIONAL REQUIREMENTS

Malan and Bredemeyer (2001) defined the non-function requirements in software development, as the features which a software system must have but does not define what the system will do. These non-functional requirements include issues inclined with performance, interface requirements and other quality features. Glinz (2007) asserted that the non-functional requirements are very hard to be tested that is the reason they are subjectively evaluated. The proposed system will have the following non-functional features listed below:

1. User interface and human factors

a. The system's complexity is simplified for it to be easy and understandable to operate.

b. The system's user interface must be easy to comprehend and self-explanatory.

c. System must be easy to correct errors and recoverable.

2. Error handling

Error handling entail the communication done by the system in detection anticipated errors, (Malan and Bredemeyer, 2001). The error handling features which the system possess include:

a. Data entry

b. Data analysis

3. System interfacing

a. The system must show the user at execution.

b. The status of the assets should be updated instantaneously.

4. Quality issues

a. Besides the proposed system producing correctness but should provide acceptable runtime performance which should aid in efficient and effectiveness to operate.

b. System must offer competitive advantage.

5. Security issues

a. Proposed system must have sign in password.

b. System must have varied access levels depending with user requirements.

3.7 CONCLUSION

With all areas covered in a bid to analysis the system, the next stage is the design phase. The Analysis phase have managed to prove that indeed the current system had challenges and a better solution must be designed. Various alternatives have been highlighted with in-house development of the proposed system being the chosen alternatives. All the information gathered

in the analysis phase will help the developer to craft a system to address the challenges being faced and meet all the user requirements. The next chapter will cover the design stage of the proposed system.

CHAPTER FOUR: DESIGN PHASE

4.1 Introduction

A critical examination of the old system has been carryout in the previous chapter, and an appreciation of how the system and its components operates is comprehended. In order to tackle the existing challenges and meeting the highlighted objectives various alternatives have been evaluated to come out with the most appropriate course of action. Dennis, Wixom and Roth (2012) asserted that the design phase mainly emphasize in making the invisible theoretical objectives into workable and visible components which can active the overall goals of the system. Many questions will be answered as the stakeholders will be waiting in anticipation of the information system solution to the prevailing challenges. The Design Phase documentation will bring into picture how the system will be developed, configured into compatible infrastructure and deployed to stakeholders. In summary this phase is going to cover the under mentioned topical issues:

a. System design –this mainly focus on aspects which bring out how the proposed system will operate emphasizing how it intent to solve the challenges and making it a superior system to the old system. Context and Data Flow Diagrams of the system being developed are drawn on this section.

b. Architectural design – this entails the collection various hardware and software related components in a bid to establish a framework of the proposed system.

c. Physically design – tackles how data and software procedures are to be structured internally as they interact with the hardware.

d. Database design – address the collection of processes and procedures which facilitate the development of a detailed and comprehensive data model of the system.

e. Interface design - involves the actual design of the systems' interface which the users will use in interacting with the system. The graphical user interface in the form of menu design, input and output design and display form.

f. Pseudo code – which highlight how the program code in pseudo will be as the developer focus in developing a working system

4.2 System Design

Saltzer and Kaashoek (2009) defined system design as the development of the components of the system which brings out how the system operate. In order to develop an efficient information solution to the existing problems being faced, the design of the proposed system will put maximum emphasis on the undermentioned aspects:

a. Efficiency- as a main feature the system is not only aimed at fulfilling its primary role but to combine the satisfaction of user requirements in an efficient and effective way. This must prove why they was need for a new system.

b. Functionalities- the system will be developed based on the objectives of the users, various functionalities to satisfy the user requirements must be included and the ability for alterations and modifications to meet ever changing user needs.

c. User friendliness- the proposed system must emphasize maximum usability and user experience with minimum down time and easy to learn.

d. Security- as the operations of the system will be of high security priority, the data associated with this system must be of high privacy and confidentiality. Security mechanisms such as usernames and passwords must be put in place to safe guard the data from unauthorized access.

e. Performance- as much is invested in this system, the stakeholder of the system expects a positive result as the proposed system will be performing according to the set standards and procedures.

With all the information gathered, the developer is expected to tackle all the weakness of the current system and produce a clear picture of what is expected as an information solution. The system will substitute the existing paper based system as the pilots and the flight dispatures fill enter the flight details electronically on the computer in their offices. Once the details are filed, the ait traffic controllers, a notification is sent to them and the details are validated which can be accepted or denied. The acceptance or denial is based on the fact that two aircraft cannot takeoff at the same time or the departure time may be the arrival time for another aircraft. Once the result of the request is sent back to the pilot or flight dispatures. A search engine is also relevant for the system as it helps the members to track the history of a past flight schedule. Once the flight is scheduled, the pilot can then verify the weather for the route on the system which is fed by the meteological officer. All weather aspects are important as they affect the flight of the

aircraft. The proposed system is not going to offer completely new functionality but to computerise the whole process making it effective and efficient as depicted by the context and activity diagram below.

4.2.1 Activity Diagram

Waldo (2006) defined activity diagram as a diagram that depict the dynamic processes of the system as the system move from one activity to another. It clearly represents the operation of the system from the start point to the end point showing the requests and the flow of the information.

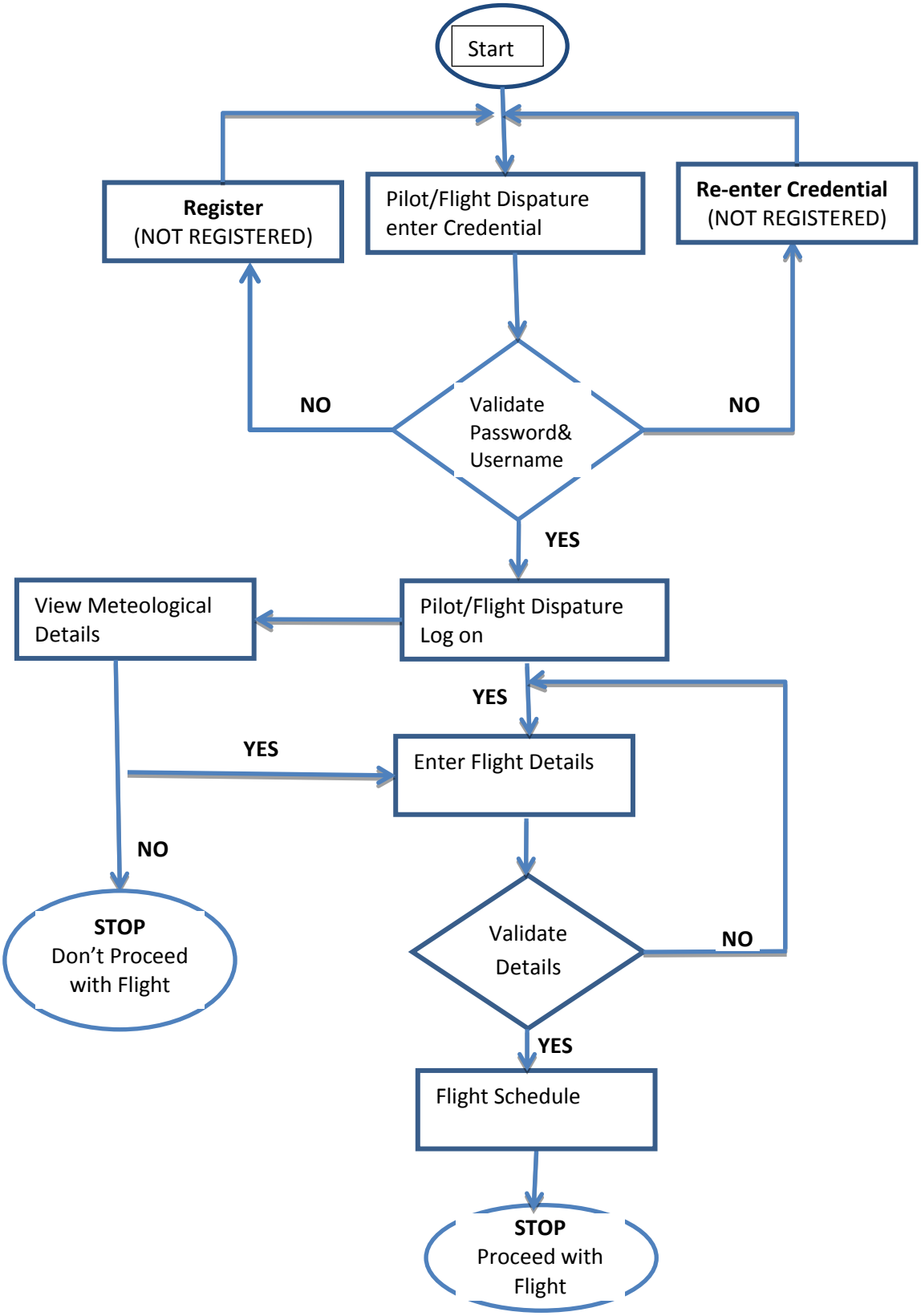


Figure 4.1: Activity Diagram (Pilot or Flight Dispature)

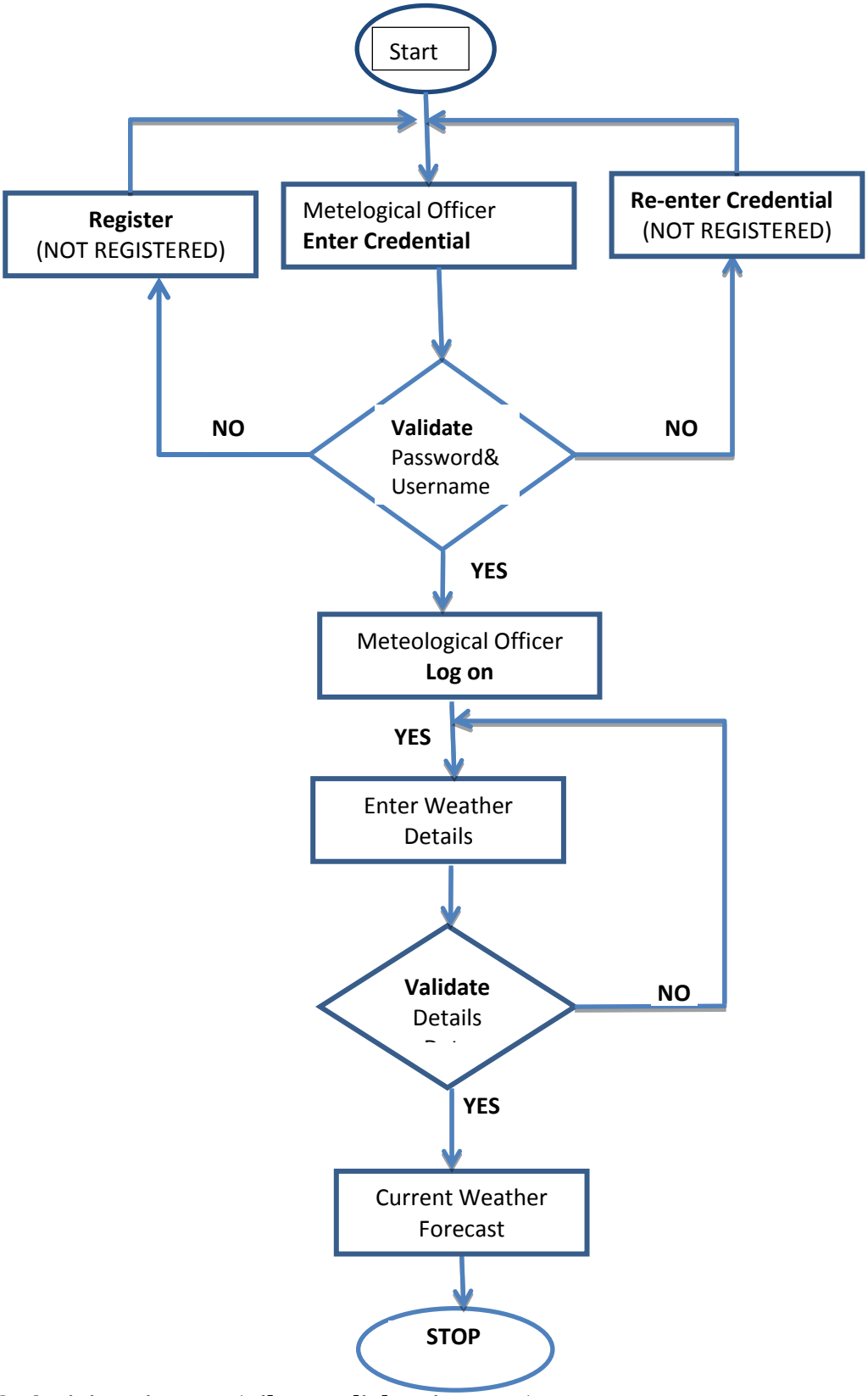


Figure 4.2: Activity Diagram (Pilot or Flight Dispature)

4.2.2 Context Diagram

Gould (2016) stated that context diagram shows the area of activity under investigation and it uses only one process symbol representing the system's components and other external entities interacting with it and the data flows as a result of system interactions. It shows the boundary for the entire system illustrating the data flow within the system with inputs entering and outputting coming out of the system. Context diagram is easy to comprehend especially for the non-technical stakeholders to understand and have an appreciation of the overall concept of the whole system. An emphasize is made of the nature of the information flowing in and from the proposed system as it interacts with other external entities.

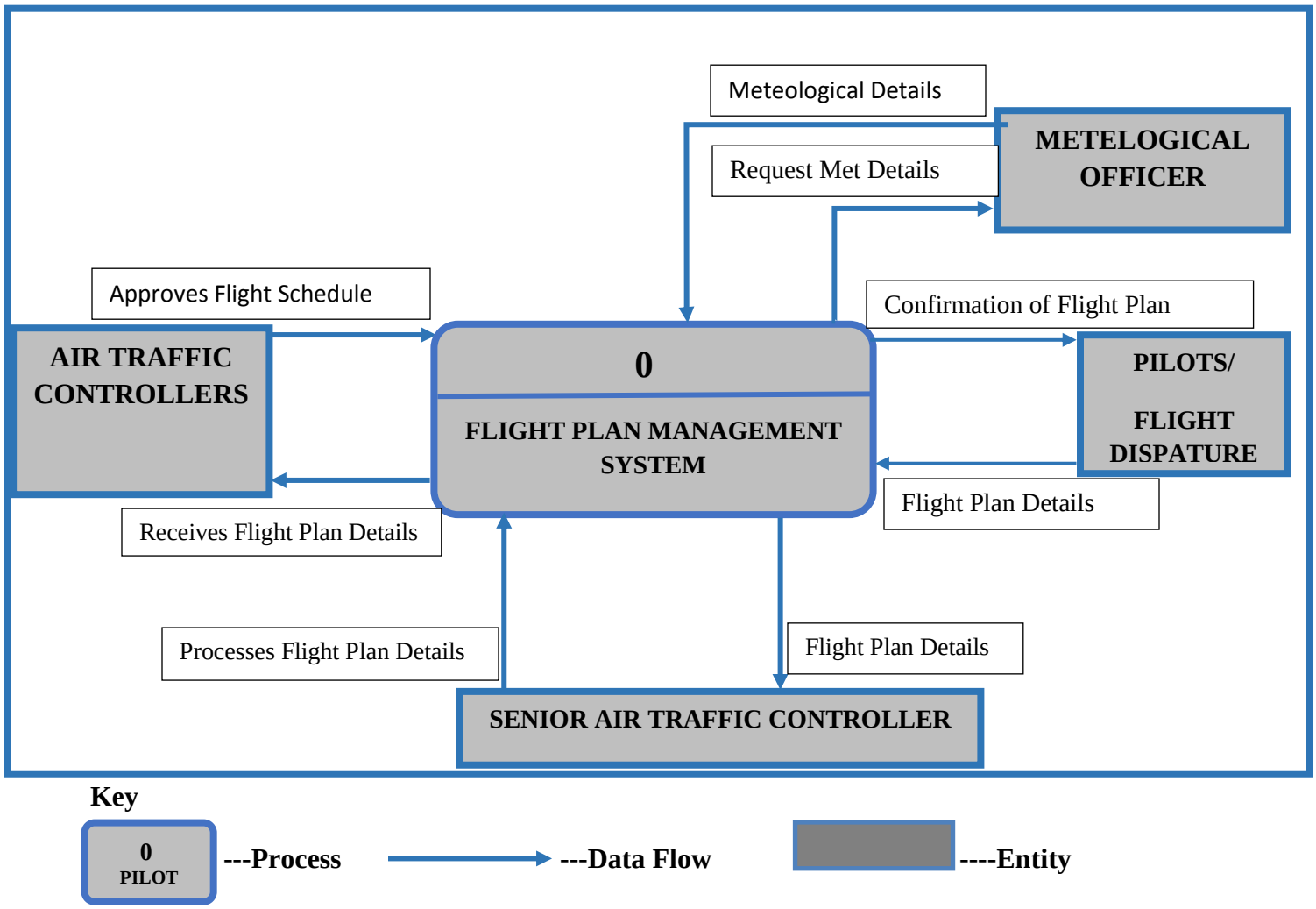


Figure 4.3 Context diagram for the new system

4.2.2 Data flow diagram for the new system

Waldo (2006) defined a data flow diagram (DFD) as a diagrammatic clearly shows the inflow and outflow of data as an system interact with other entities linked to it. DFD shows a clear picture of the system as an analysis tool for the technical and non-technical people to understand. All the processes, data stores, system's entities and other external entities linked together by flow arrows resulting to the physical design.

The diagram shows the DFD for the new system

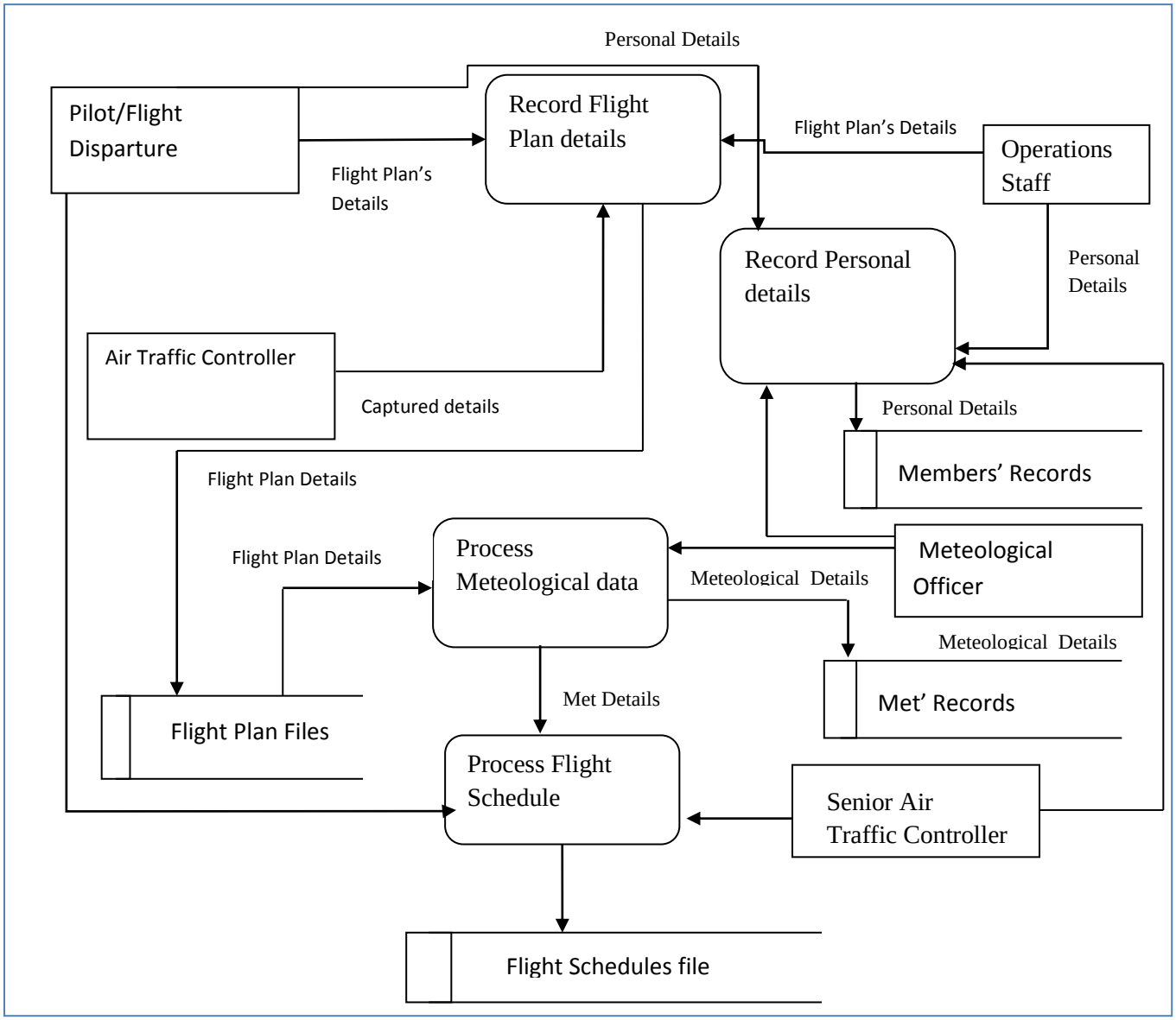


Figure 4.2 Data flow diagram

4.3 Architectural Design

Harsu (2003) defined architecture design as the technical representation of the physical components of the system omitting all other components not interacting with it. All the hardware, software components and associated people are highlighted in this architectural design showing how they interact. The developers proposed that all the users will get connected to the networked system through the network. Carzaniga (2016) asserted that computer networks are built by amalgamating various components which include general-purpose programmable hardware, software, networking cables, routers and switches. For all the requirements of the system to be completely networked, Foundation and Equity (2011) identified the following groups to be available in any network setup:

a. An application programmer who is responsible for designing the application and is concerned with the type of messages sent and that the messages are delivered in the intended formats and without distortion and in the time expected.

b. A network operator is responsible for listing specialized requirements on the network system which is easy to manage and simple to administer in that the faults can be quickly identified and new clients can be easily added.

c. A network designer is responsible for identifying the network resources with the properties which offer competitive advantage and are concerned with the performance of the overall system and the efficiency to the users.

Table 4.1 Hardware requirements

HARDWARE	DESCRIPTION	NUMBER REQUIRED
Hp Computer	Pentium 4	3
Tenda Router	Tenda 150 Mbps	1
Switch	8 ports	2
Patch panel	12 ports	1
Printer	HP Deskjet 1050 with scan	1
Connecting cables	RJ45 connectors	10
CD ROM drive	For Hp computers	3
Server	1 Series IBM	1
UPS	220V (Power Backup)	1

4.4 Physical design of the system

Carzaniga (2016) defined physical design as the technical and physical aspects of a system covering how the hardware will be setup. As all the computers and other hardware components will be laid out to provide the services required, a well-planned setup is required. Information sharing will be much enhanced by the interconnectivity of the various concerned entities in their respective offices whereby their computers will be configured to the systems settings. The web which is an internet application which links computers dispersed geographically will be utilized. Foundation and Equity (2011) emphasized that the web provides the interface on a network which have enhanced the utilization of the internet in a way that was never imagined. Every users have accessibility to the system depending on the allocated access rights. The administrator have the highest access rights whereby he is able to access all the information of the system as part of his/her administrative duties. As part of the data security and for backup services, all the information is backed up regularly on external storage devices like external hard drives and also on the cloud. Part of the system's components are as follows:

a. Client

Comer (2014) defined a client in computer networking as a user defined point on the interconnected system which a user can interact with the system as he acquire specialized

services in a bid to meet the set objectives. The client offers a customized interface for the user to access the features which aid in the utilization of the system.

b. Server

Comer (2014) defined a server as a hosting platform which is utilized to lounge the system and is able to accommodate many databases for the system operation.

c. Computers

Computers will offer the users with much interaction with the system as it can provide the platform for the system application and process the requirements of the users.

d. Networking cables

Carzaniga (2016) provide the much needed linking connections between all the computers, server units, switches and printers in the local area network setup.

e. Printers.

Printers are vital as the system will generate reports which can be used and also filed for future reference.

Client/Server computing will be utised for the system as the computer platforms will be linked to the server during operation of the system. Below is the proposed architectural design with the above listed components in the setup:

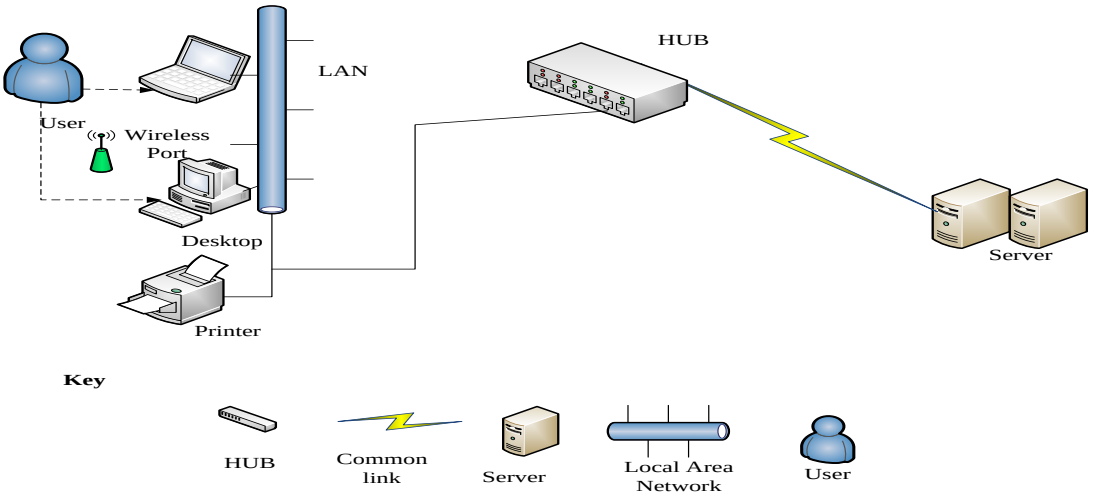


Figure 4.3: Physical design of the proposed system

The proposed system will be structured in the form of a dynamic Web application. Heights and Boyce (1990) identified the three specialised software which can assist in making a web structured system and these include the SQL server, specialized programming language, and the Web server. The structure is as illustrated below:

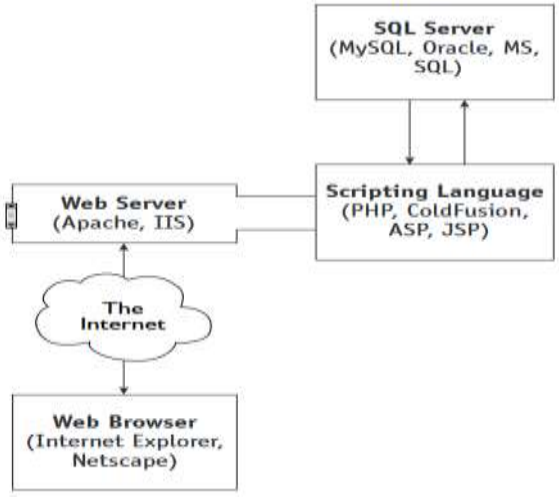


Figure 4.4 Tools in the Web development process

4.5 Database Design

Robertazzi (2011) defined database design as the processes and procedures which bring about the development of comprehensive data model to support a system. As database is one of the important components of the system which dictate the overall outcome of the system, special care must be taken in its development. Heights and Boyce (1990) highlighted that the data in the database must be stored in such a structure which should not change as it can affect the outputs expected. The following aspects in the table must be taken into consideration:

Table 4.2 Database Design Issues

Database Property	Aspects of concern
Storage media	▪ The type and the amount of data to be stored? ▪ How that database is to be accessed?
Database change over time	▪ Is the database attributes going to change or more will be added?
Security	▪ The accessibility of the information and when? ▪ Who must manipulate the database and the data?
Database Architecture	▪ Distributed or centralized?

With much consideration taken, MySQL v5.0 was selected to be the database to support the system. STROE (2011) described MySQL server as a popular and very reliable relational database management system which was implemented by many organisations across the world. Many popular companies such as Google, Nokia, Wikipedia and many other organisations utilize MySQL because of many database functionalities advantages which goes with it. With much advantages over other database and other aspects considered the developer concluded that it was the best database to use. These advantages include the following:

a. No licensing costs attached to it as it is an open source software.
b. The product is readily available making development progress positive.
c. Provides exception database functionalities over other competing database systems.
d. MySQL is a very simple to learn database system and quick to be configured.
e. It can run on more than twenty operating systems and can be easily integrated with various programming languages.
f. Regular updates of the database patches by the community as it is an open source software.
g. MySQL offers much security as the accessibility through passwords is enhanced through encryption.

According to Denton and Peace (2003) a specialized database design should be carried out in two stages which are Logical Database Design and Physical Database Design. LDD mainly concentrate on what is supposed to be stored whilst on the other hand physical database design focuses mainly on how to store what is to be stored.

4.5.1 Physical Database Design

Denton and Peace (2003) emphasized that physical database design is concerned with ensuring that the database system reaches the expected performance. Bachman (2003) defined physical database design as the translation of the logical data model into a set of SQL statements of the database. It mainly emphasized the ANSI SPARC Architecture which focus the arrangement of the data to be stored in the database. Below is the ANSI SPARC structure of the database.

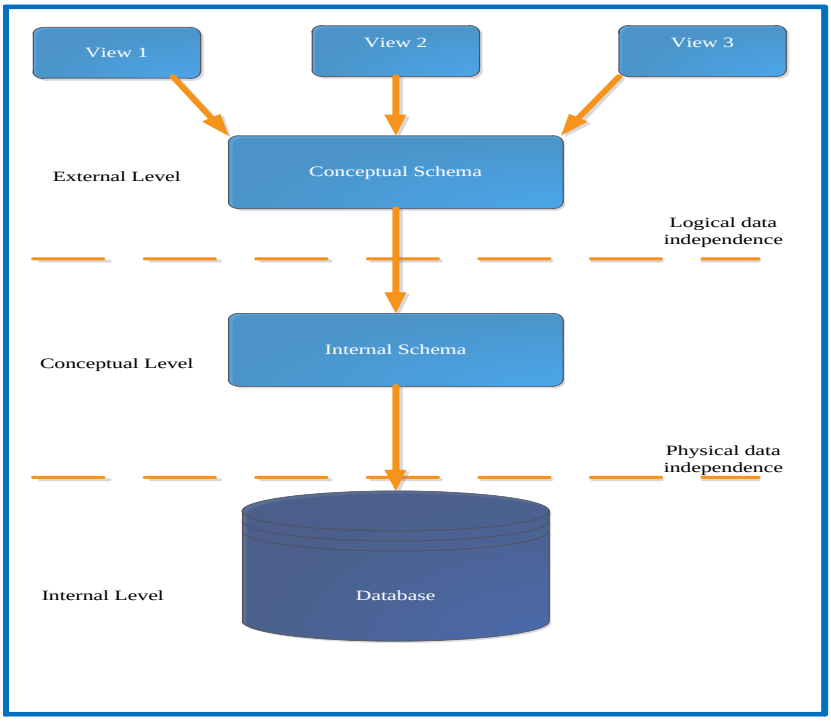


Figure 4.5 ANSI SPARC Architecture

The levels highlighted above are very important in this structure and (Fischer *et al.*, no date) defined the levels as the following:

a. Internal Level

Focus on how the machine views the data and how it is encoded, stored and accessed. This is the lowest abstract representation of the actual data of the system. A human cannot comprehend the

structure but the database management system accesses it for the human to instruct organized information for operations.

b. Conceptual Level

This is the next level in the structure as it defines the kind of data to be stored and the relationship existing between it and it can be referred to as the logical level. The database administrator and application developers operate on this level defining what kind of data to store.

c. View Level

This level also referred to as the external level which define the part of the database which the users are more concerned with. The users access the database through a user defined interface which aid for easy manipulation.

4.5.4 Logical Design

Borgida, Casanova and Laender (2010) defined the logical design as a process of arranging and establishing the data into relationships known as entities and attributes. The main aim of logical design is to develop defined structures of the database which clearly reflect the core objectives of the information requirements of the organisation. The structure will represent the abstract of entities and their relationships with primary and foreign keys stated. The attributes of the established entities will describe the characteristics of each entity.

The logical design of the proposed system is as indicated below:

4.5.5 Data dictionary

With all the entities and attributes being well laid out to reflect the organisation informational structures, it is pertinent to further describe the details of the data. (STROE, 2011) defined a data dictionary as the detailed definition of all the data objects in an informational system which is important for the system development. Programmers refer to it in a bid to establish the restriction to put in place in critically determining what data the user to input.

The data dictionary will be summarized in tables as below:

a. Login table

This is the platform used by the targeted users to login using the credentials and all the details are stored as follows:

Table 4.3 Login table Design

Field name	Type	Description
ID	Integer	Field that uniquely identifies a member
Force_number	integer	Unique identification used to login
Password	Text, integer	Secret key of the user used to log in

b. Members' registration form

Table 4.4 Members' registration design

Field Name	Type	Description
Force No	integer(10), Not Null	Organizational identification number
Name	Text(19), Not Null	Name of the member
Surname	Text(19), Not Null	Surname of the member
National ID	Varcha(19), Not Null	Member's national identity number
Rank	Text(10), Not Null	The current rank of the member
Trade	Text(25), Not Null	Trade for the member
Qualification	Text(25), Not Null	The highest qualification held by the member
Squadron	Varcha(25), Not Null	Squadron which the member belongs
Cell /Phone	Int (13), Not Null	Member's reachable phone for communication
Email	Varcha(13), Not Null	Member's email for further communication
Username	Text(25), Not Null	Username for each member for login
Password	Varchar(12),Not Null	Secret input for the user

4.6 PROGRAM DESIGN

Saltzer and Kaashoek (2009) defined program design is the diagrammatic representation of the operation of the system stating how modules and entities interact with each other. The structures are easy to follow up just like pseudo code such that even non programming expects will understand the whole system.

4.6.1 Package Diagram

According to Foundation and Equity (2011), package diagram is defined as a structural diagram that represents the dependencies of modules in a bid to meet the system requirements. Complexity is removed in the design in a bid to make all the people understand the system. The diagram is shown below:

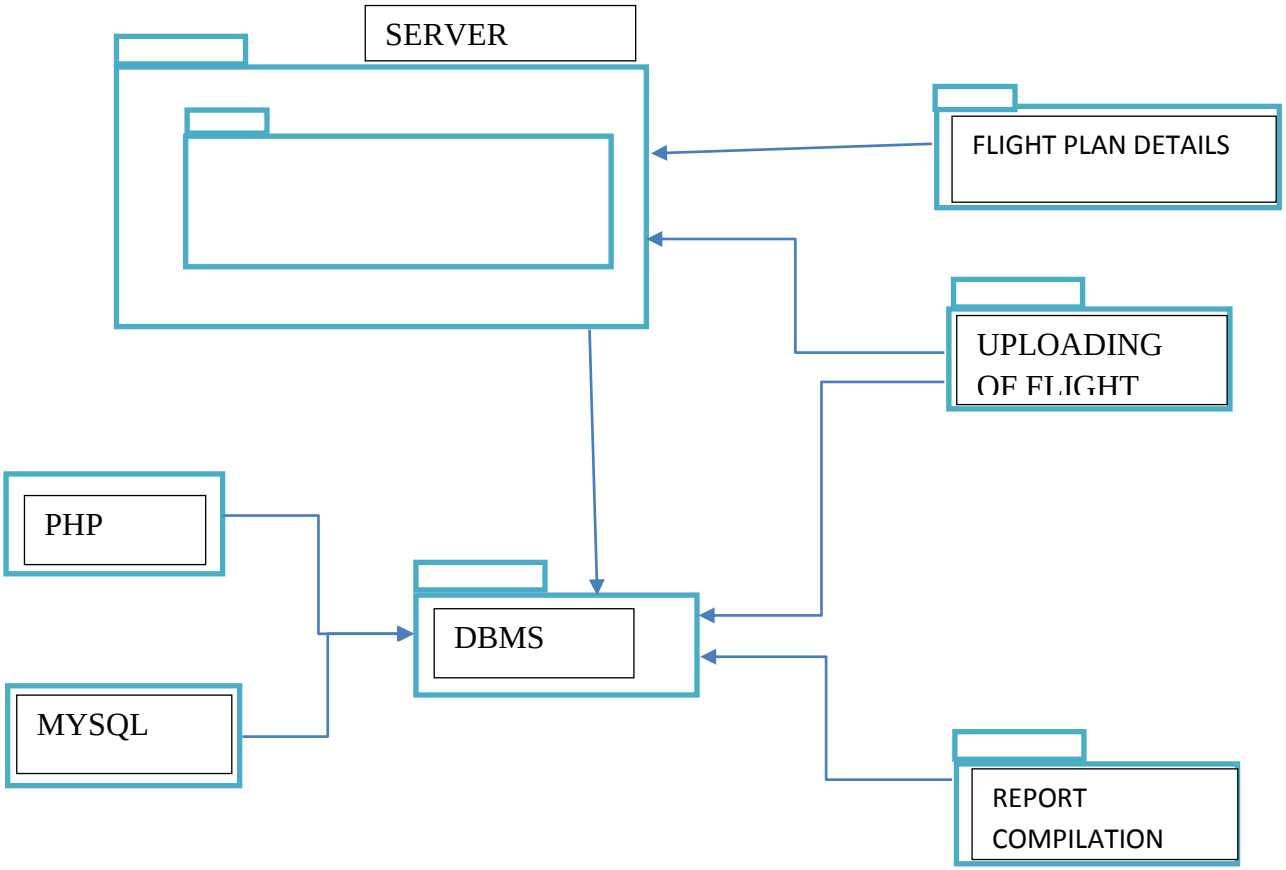


Figure 4.6 Package Diagram

4.6.2 Class Diagram

Robertazzi (2011) highlighted that Class diagrams as extensively utilised in describing the various modules or entities in a system and how they are related to each other. The interactions of each entity to the respective or corresponding entity which is in relation with it is essential to ascertain the flow of information.

The class diagram shown below is for the Flight Plan Management system:

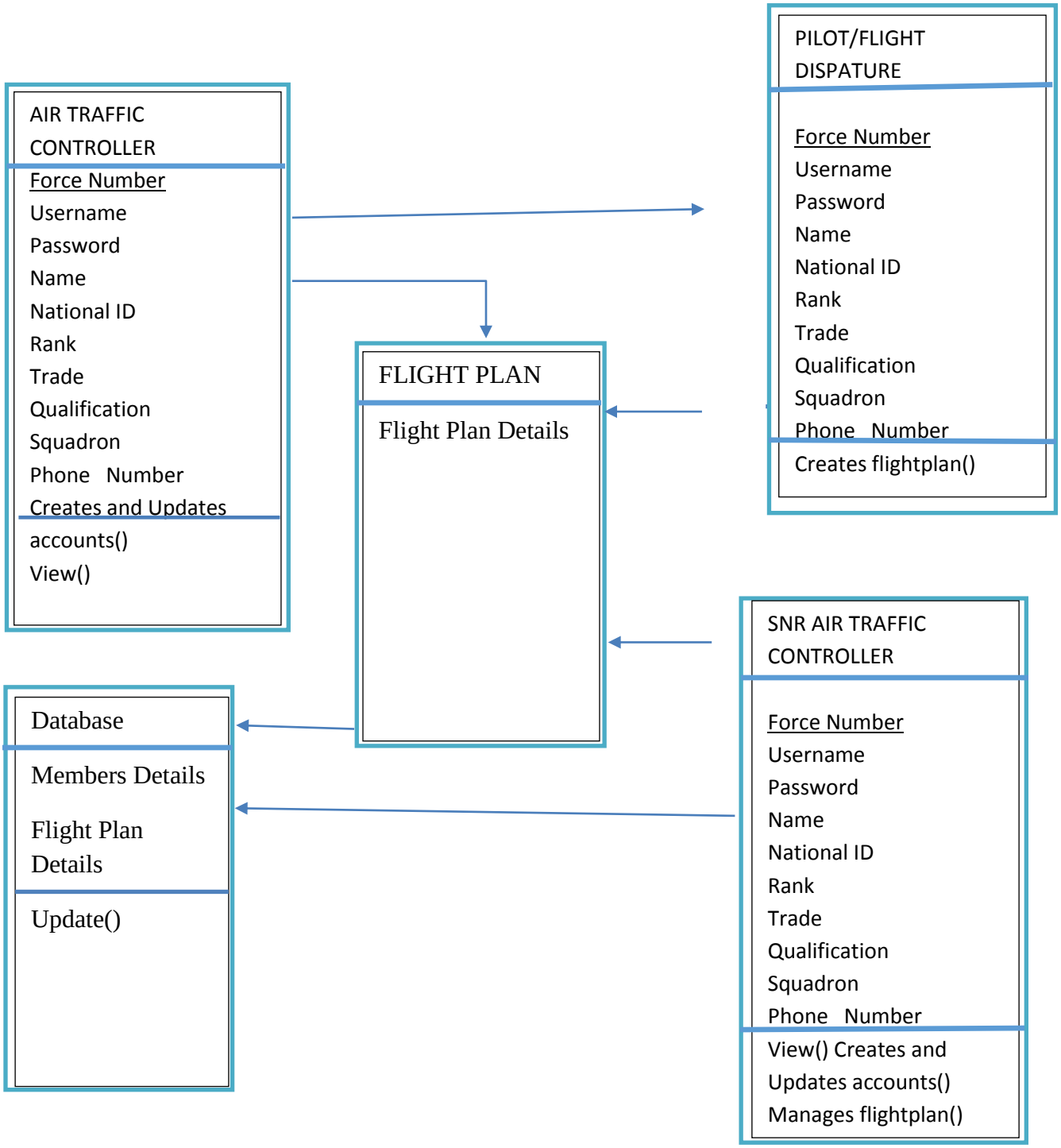


Figure 4.7 Class Diagram

4.6.3 Sequence Diagram

Matson and Brien (2011) stated that sequence diagram depict how modules of a system interact with each other emphasising on the messages they send to each other. The scenario of how each object behave after a function is initiated to complete the functionality. The structure of the diagram is such that it is read from left to right and in descending from one object and class

passing to the next. The diagram below shows the sequence diagram of the flight plan management system:

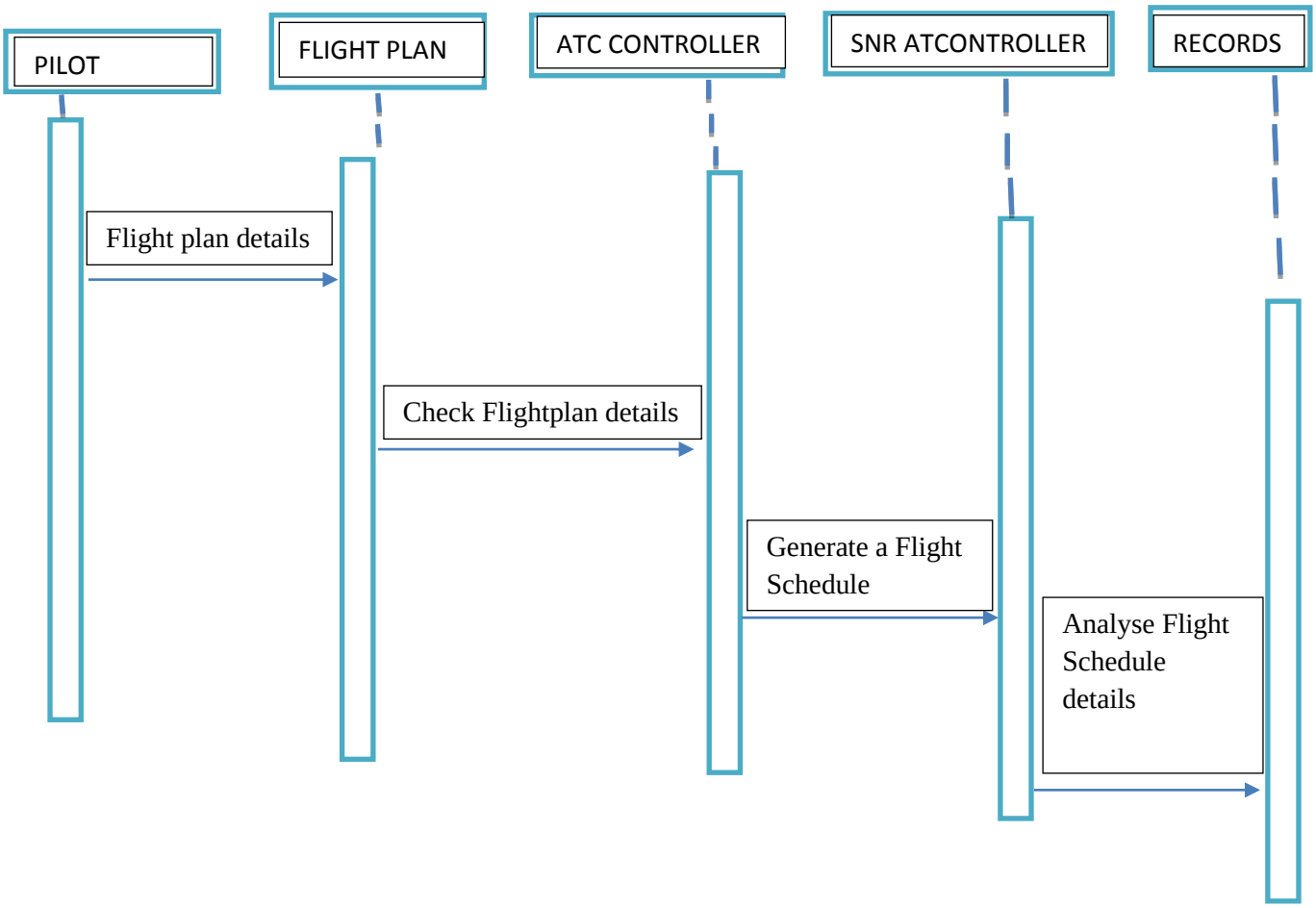


Figure 4.8 Sequence Diagram

4.7 INTERFACE DESIGN

Lauesen (2005) defined interface as a communication view or the platform for interaction of the users and the system. The interface is the point in between the database and the users which is made easy by the utilization of a graphical user interface. The interface is very specific to the user and aid the navigation through the window, menus and other additional features. For the user to know what to input and what to extract from the system, a leading way is very vital especially in login and generation and interpretation of reports. Hence interface design, Etheridge (2009) is the development of a specified graphical user platform ideal for a specific user. Below are the essential interfaces for the users:

a. Home pages

The system will be designed in such a way that each user has a specific home page which is customized for a specific requirement. The home page is designed as a fall back where he can start after login in and after finishing specific operations. (Lauesen, 2005) defined a home page in interface design as a platform referred to as working space for an individual where he can navigate utilizing menus provided. Below is a type of a customized homepage for a pilot or flight disparture:

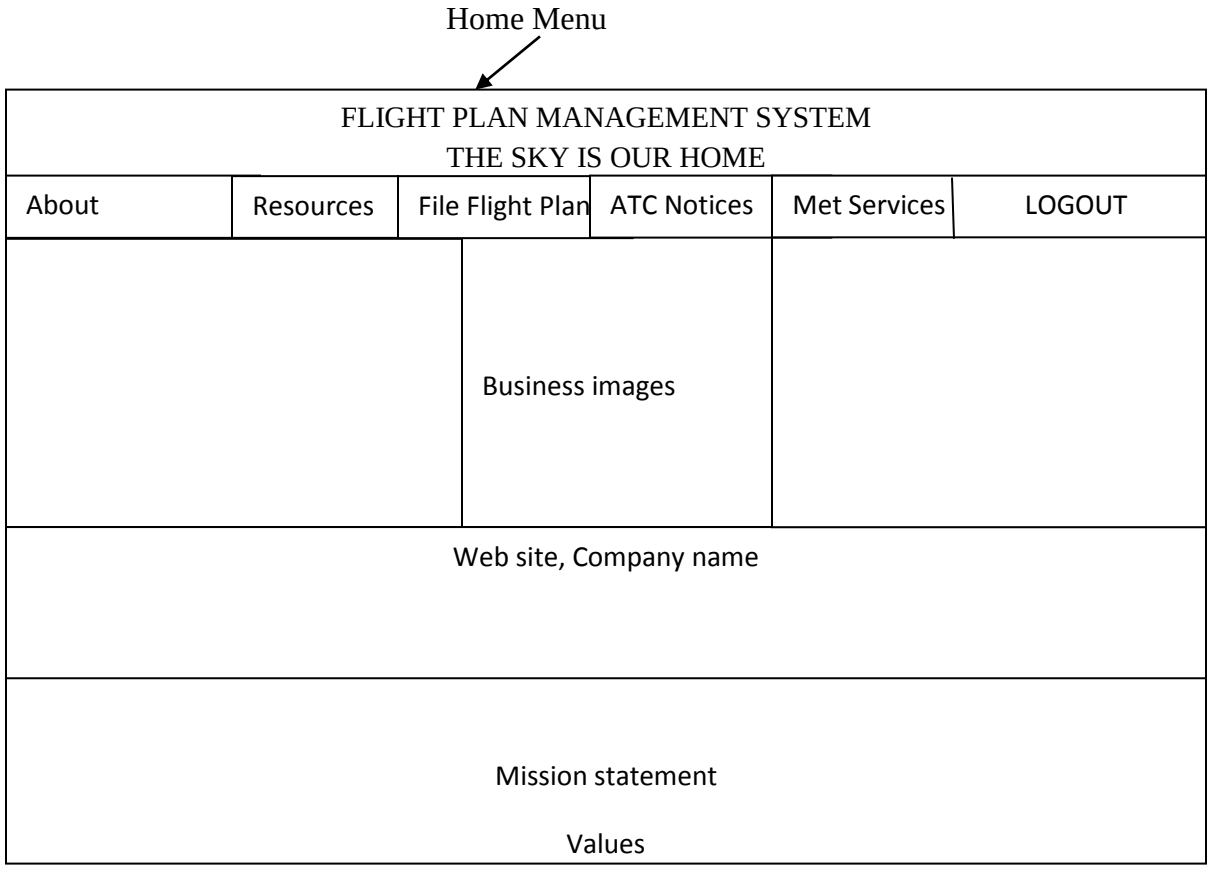


Figure 4.12 Pilot or Flight Disparture Home page

b. Input interface design

Thimbleby *et al. (*2003) defined the input interface as a user defined platform which the user is able to enter the required data into the system. The data must be validated to enhance data integrity and screen unwanted data components. For easy manipulation all the input boxes are well labeled avoiding confusion in entering the data. The input forms are as follows:

i. **Login Interface**

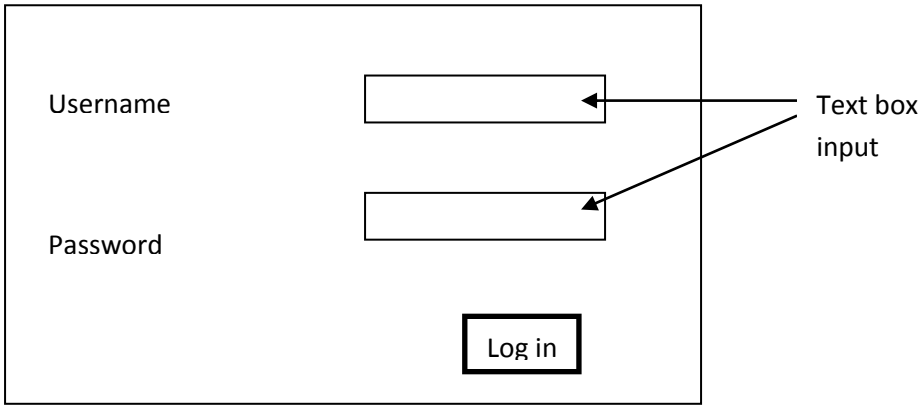


Figure 4.9 Login Interface

The graphical user interface indicated above display how the members/users' login form will look like which prompts the user to input the force number and the password. The already registered users will input the credentials and enter the LOGIN button and the system will open to the next interface depending with the type of the member and access level.

ii. Registration Platform

Registration form is another important input form which is supposed to be input first for every member to have the credentials of the force number and password. All new users who are supposed to utilize the system input all the required details which are then kept by the system. The graphical user interface of this registration form is as displayed below:

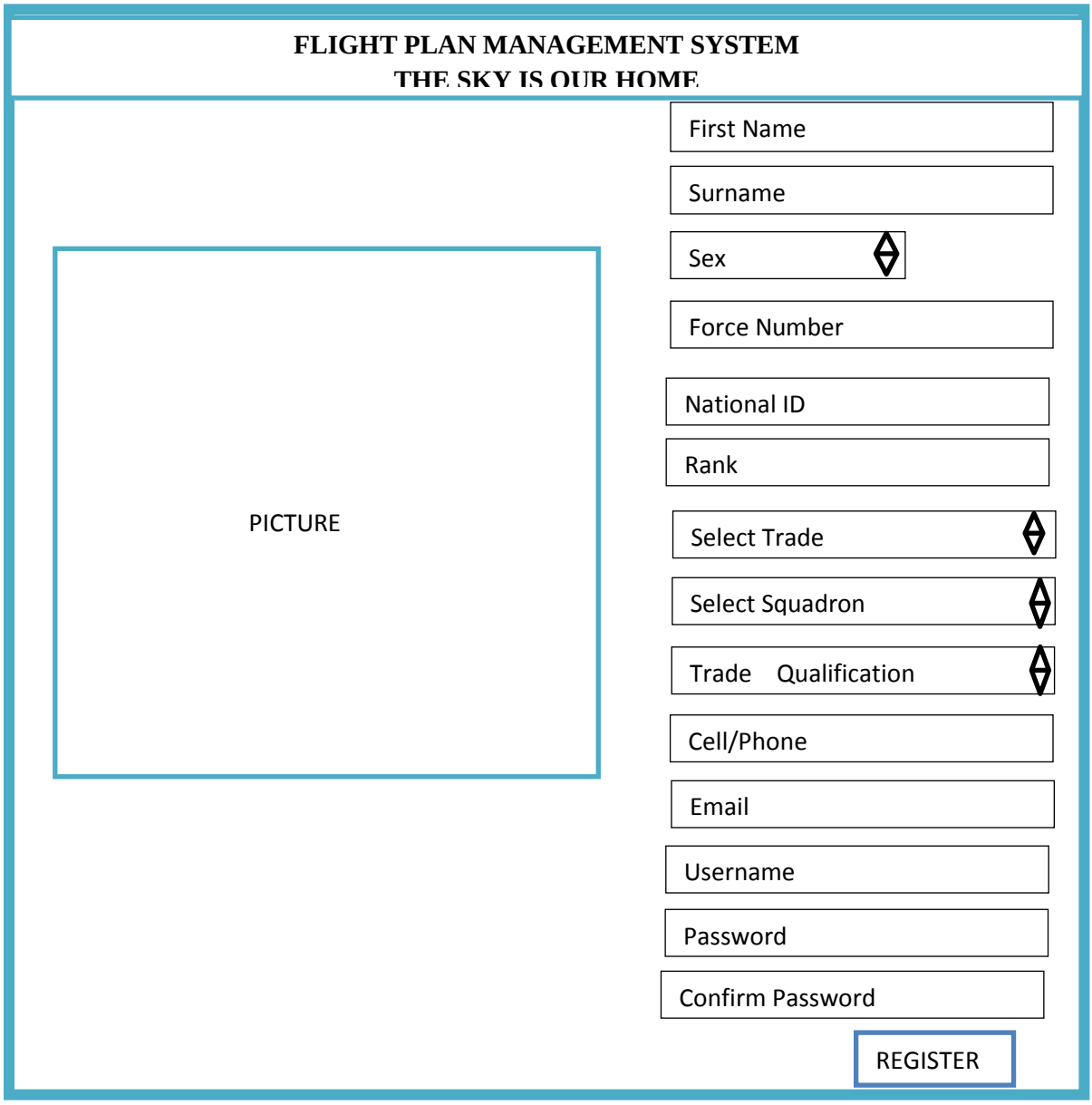


Figure 4.10 Members' Registration Interface

iii. Flight Plan Filing Platform

The pilots and flight departures utilize this platform in filing their flight plans for their scheduled flights. The platform will be labeled for the members to input correct data which will be taken into consideration by the Air Traffic Controllers. The Flight Plat is internationally recognized and is extracted from ICAO document and all the information is vital for traffic scheduling. Below is the information to be filed by the pilot or flight disparture:

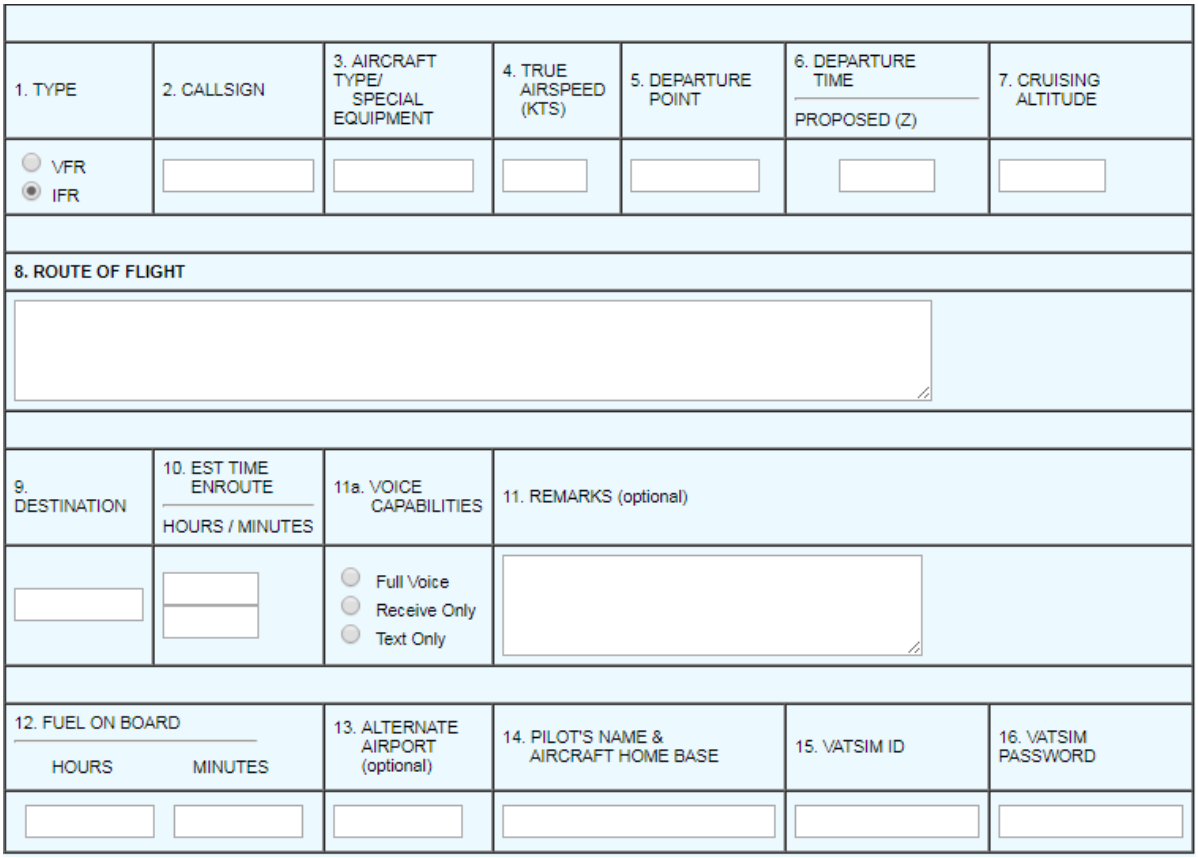


Figure 4.11 Filing Flight Plan Interface

c. Output design

The users of the system require to use the information derived from the system as a result o0f the raw data being input by various users which is then integrated to produce mean full information. (Etheridge, 2009) highlighted that output design entails the development of various output reports by the system depending on what the user will be requiring. The efficiency of the system is based on the types of the reports produced by the system as it is vital for decision marking. It gives a historical background of the system in terms of the operation of the system as a whole. Output design also takes into consideration the generation of reports in the form of on screen reports or printing the outputs.

4.8 Pseudo code design

Thimbleby *et al.* (2003) described that pseudo code is the layman way of defining the how the actual programming of the system will look like. This helps the untechnical people to understand the outward look of the actual system. It forms the systems framework and the developers will be guided with this code.

a. Login

Fill in your credentials

If they are valid then

home page with various operations will pop up

Else

Re-enter the credentials

Else

Register

End if

b. Registration Process

Fill in all the required details

Check validity

If invalid details

Through Error Message or highlight the error

Else

Report Registration Successful

c. Creating a Flight Plan

Fill in all the details for the Flight Plan

Check for validity

If invalid details

Throw Error Message or highlight the error

Else

Report Flight plan uploaded

d. Searching for a record

Enter the clue for search for example pilot name

Validate the search clue

If the clue is invalid

Through a report for the error

Else

Display all the hits for the search

End

For the sample code see Appendix E.

4.9 Security design

Security at all levels are of paramount importance which must be taken into consideration and necessary mechanisms must be put in place. Security design as defined by Stroe (2011) as all combined efforts and mechanisms set up in a bid to counter all anticipated risks associated with a proposed course of action or a planned project. As it is an investment and an information solution to the existing problems, much security must be emphasised at all levels in terms of software security, physical security and database security as highlighted below:

a. Software Security

Matson and Brien (2010) asserted that software security entail all mechanisms set in place to protect the software and network from unauthorised users hence authentication, authorisation and accountability mechanisms must be put in place. Being a security organisation whereby security is primary concern, the authorisation usage of the system will be highly monitored with passwords and usernames being used and force numbers as unique identifiers. There will be access levels put in place with different privileges for each user for example the administrator has all privileges to add or delete user whilst a user like a pilot can only access all information associated to his own domain. Firewalls and antiviruses and antispyware will be combined to safeguard the system from external cyber intruders.

b. Physical Security

Matson and Brien (2010) highlighted that physical security entail all physical ways setup around all system infrastructure in a bid to prevent unauthorised intruders from having a physical interaction with it. The server which the administrator will be in charge of it together with other people doing their duties will only be authorised to it. The server room will be set up with burglar bars and screen doors and locked. All rooms with the computers accessible to authorised users will be protected and authorised people will only be allow to enter and security guards will authorise entry. Fire extinguishers are put in place in all rooms with system infrastructure to be used in case the fire break out.

c. Database Security

The database of the system is the backbone of the whole operating system and operational information, once it is tempered with disaster will be the result, Foundation and Equity, 2011). Maximum protection must be emphasised hence database administrator will assume the authority over it together with other assigned members. Usernames and passwords will be used for users to gain access to the database and only users will operate based on his privileges which can be evoked at any time.

4.10 CONCLUSION

This is an important stage of the system development as it brings all the gathered details into a workable design. All necessary components have been setup ready for implementation which is the next stage. The interactions of relevant entities of the system have been clearly represented and the flow of data diagrammatically shown. The proposed system is ready to be implemented in the next phase.

CHAPTER FIVE: IMPLEMENTATION PHASE

5.1 Introduction

A theoretical hypothesis can only become valid only if it is practically implemented. Ammann and Offutt (2008) defined implementation in software development as the combined efforts employed on a designed information system solution assessing whether it solves the challenges in the environment which it is designed for. Expectations of the users must be met with standard performance of the system as highlighted that implementation is an important stage in software development as it proves practically beyond doubt the ability of the information system to meet the user's objectives and requirements. The functional and non-functional requirements on the system must be tested on implementation to make sure the users are able to perform their tasks efficiently and effectively. If there are challenges noted on the system, adjustments on the system modules and code are effected or a revision of the objectives can be opted. Sneller, L. (2014) asserted that implementation and testing work hand-in-glove as the process seeks to verify whether the specification of the system can be implemented practically and the actual implementation go along with the specifications. The irrative process of testing gives a clear picture that no stone is left unturned as the developer seeks to iron out all challenges on the system and customise it to the users' satisfaction. This chapter will explore in detail various areas which include coding, various types of testing, verification and validation, installation, system conversion, training and maintenance.

5.2 Coding

Varajão, J. (2015) defined coding as the ability to express human understandable intelligence into a language understood by the computer and executable into an information system. Coding ensures that the invisible and can be visualised and operated on the computer. Unlike coding which is directed for the computer comprehension, pseudo code is directed to other humans who does not understand the jargon of programming. In his research (Etheridge, 2009) defined pseudo code as a layman understandable language which the software developers especially programmers use for the non-experts in programming languages the basics of the code. For a proposed information system to meet user requirements there must be enough information and instructions on how the system must behave upon receiving commands from the user. The user

does not visualise these instructions but only interact with the interface ass he/she perform their tasks. PHP was favoured by the developer as it offers vast advantages. The hard coding of the web interface and instructions are done on a Dreamweaver software development tool. MySQL database will be utilised to support the databases employed by the system. Below is the pseudo code for the system:

e. Login

Fill in your credentials

If they are valid then

home page with various operations will pop up

Else

Re-enter the credentials

Else

Register

End if

f. Registration Process

Fill in all the required details

Check validity

If invalid details

Through Error Message or highlight the error

Else

Report Registration Successful

g. Creating a Flight Plan

Fill in all the details for the Flight Plan

Check for validity

If invalid details

Throw Error Message or highlight the error

Else

Report Flight plan uploaded

h. Searching for a record

Enter the clue for search for example pilot name

Validate the search clue

If the clue is invalid

Through a report for the error

Else

Display all the hits for the search

End

For the sample code see Appendix E.

5.3 Testing

For any proposed system to be acceptable it must be tested on its genuinely, expected operational standard, specifications and user requirements Fontaine (2016) defined testing as the process of practical assessment on the system on all levels conform with the expected specifications and functional requirements. The various types of testing utilised are as indicated on the diagram below:

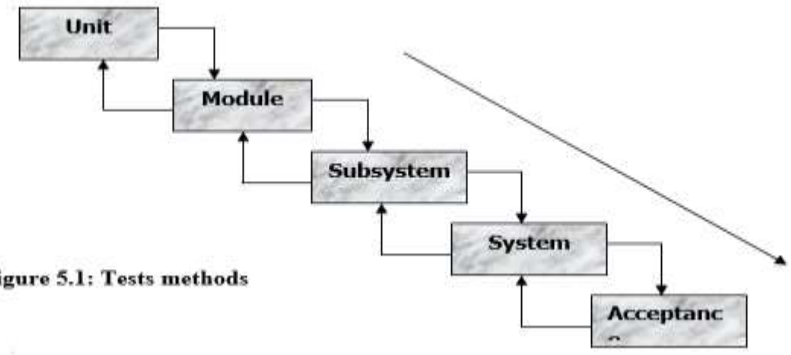


Figure 5.1: Tests methods

Testing allows various functionality of a complete designed system as all modules are integrated together and evaluation is done. The following testing types are carried out to evaluate the system:

a. Black box testing (Functional testing)

Ammann and Offutt (2008) stated that black box testing entails evaluation of all external functionality of the software system utilising the aid of requirements documented and is done by the users. The technical knowhow of the programming and architectural design is not of importance and is carried out after integration have been done. This test is aimed at determining the errors on the system associated with missing features or functionality which the developer have not taken into consideration.

b. White Box testing

PMI. (2013), asserted that white box testing is a way to test the internal structure of the system based on the functionality comparing all the inputs with the desired report or outputs. All issues for example security aspects are critically tested and loop holes corrected. This test was done and all errors corrected on the real system.

5.3.1 Unit testing

Oscherone (2013), defined that as a technique to verify whether the various modules of the system are functioning as anticipated. The system must be in a position to display the correct data at the right module. This also focus on various query functions which involve manipulation of the data stored in the database for example members' details or flight plan details. Database must be interfaced such that the user must be in a position to enter the correct data at each module. If the attributes are accepted by system into the database shows that the modules have no errors. The unit testing was done and all syntax and semantic errors have been picked and corrected.

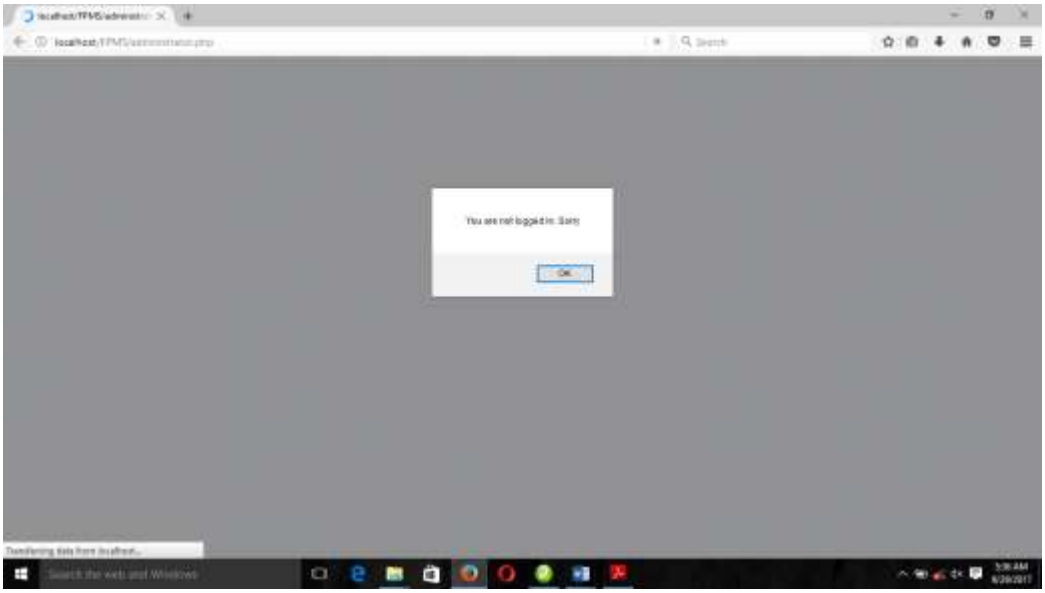


Figure 5.2 Not Logged in

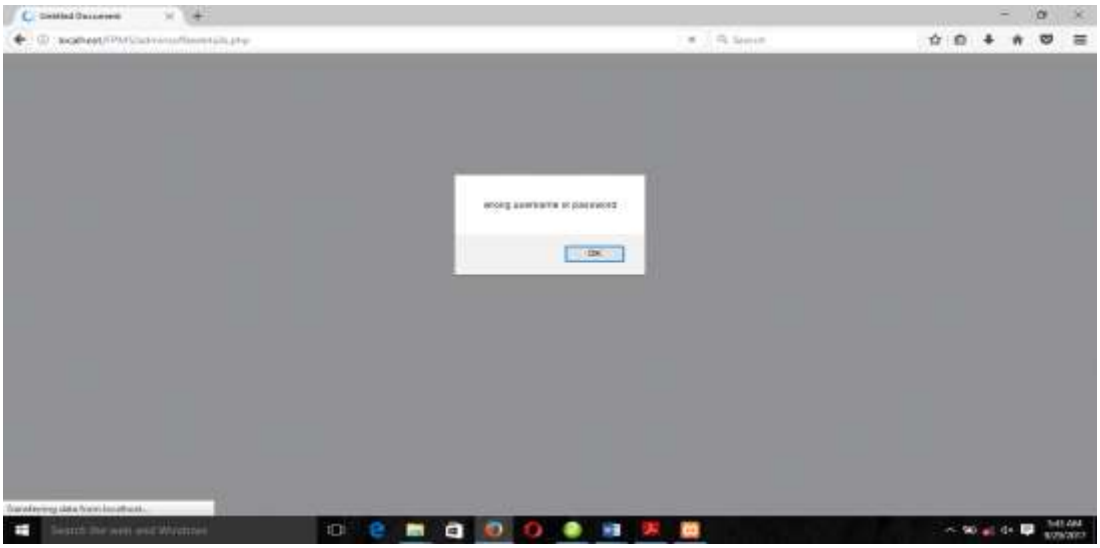


Figure 5.3 Login failed on the user's side

5.3.2 Integration testing

Ammann and Offutt (2008), asserted that Integration testing is performed in order to evaluate whether the interface to link various modules are interacting well. It emphasise on correct and proper communication of modules that compose the subsystem. The boundaries of each operational module are set and the interfaces connected to the module are tested for integration. The developers of the system are the one who was responsible for conducting this test till the results were satisfactory.

5.3.3 System testing

System testing implies evaluating the system as a whole with all functionality tested as indicated by Burge (2009). For effective and operation results the system is given to many users for trial which each individual is to write a report and give a feedback on the condition of the system. All errors encountered by the user are noted and reported for them to be corrected. A sample user for every level of operation for example a pilot, Assistant air traffic controller and Senior air traffic controller and each user report the status of the related modules and if the user fail to satisfy all anticipated requirements, a revisit of the system modules will be done.

5.3.4 Acceptance testing

Burge (2009) asserted that acceptance testing is the final trial of the system which is deemed to be the determination factor the success of the software operation. The end-users of the final system are the ones that matter as all the user requirements are crafted from them. The system can only be accepted as a working system only if it is free from errors and satisfy user needs and expectations. The acceptance test is conducted in two ways which include:

a. Beta testing:

This entail testing the system inputting actual data that is used by the users as emphasized Project Management Institute Inc. (2000). The iterative process is done where by the identified errors are corrected and the system is tested again and the system is rectified. The process of testing is done until system is free from all defects and ready to be utilised as a working system.

b. Alpha testing:

This technique is carried out by handing over the developed system to the users and other interested parties for them to have an appreciation of the system, Burge (2009). All errors which would been identified are reported to the developers which in turn correct all the defects on the system.

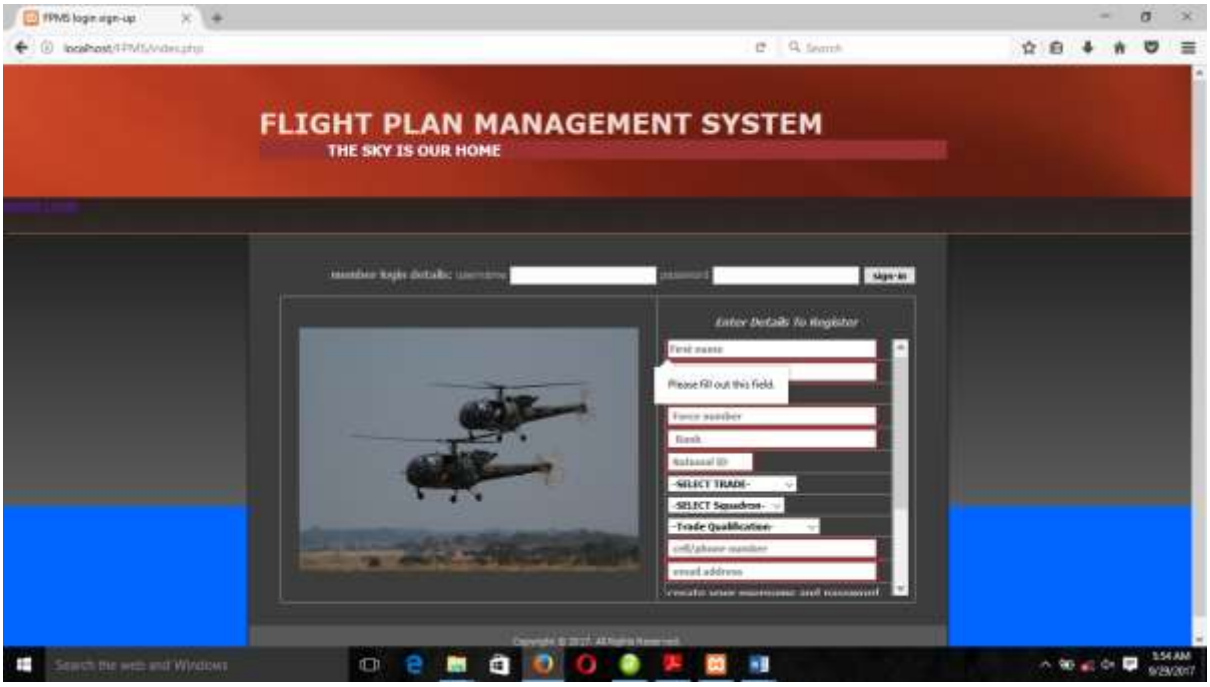


Figure 5.4 Validation on member registration.

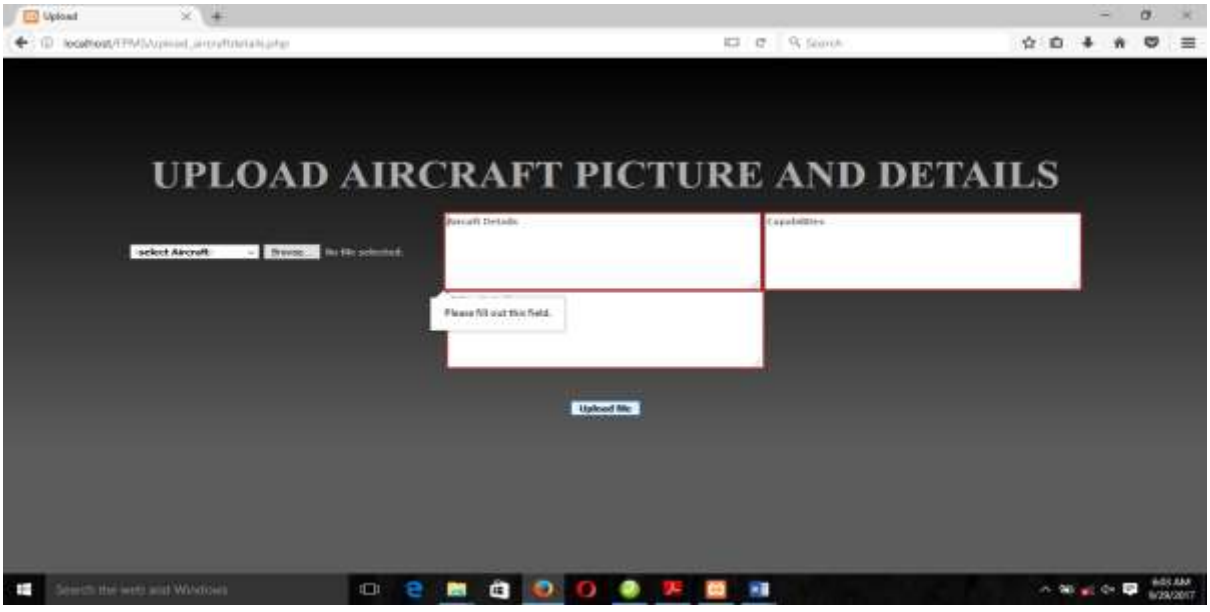


Figure 5.5 Validation of aircraft details upload

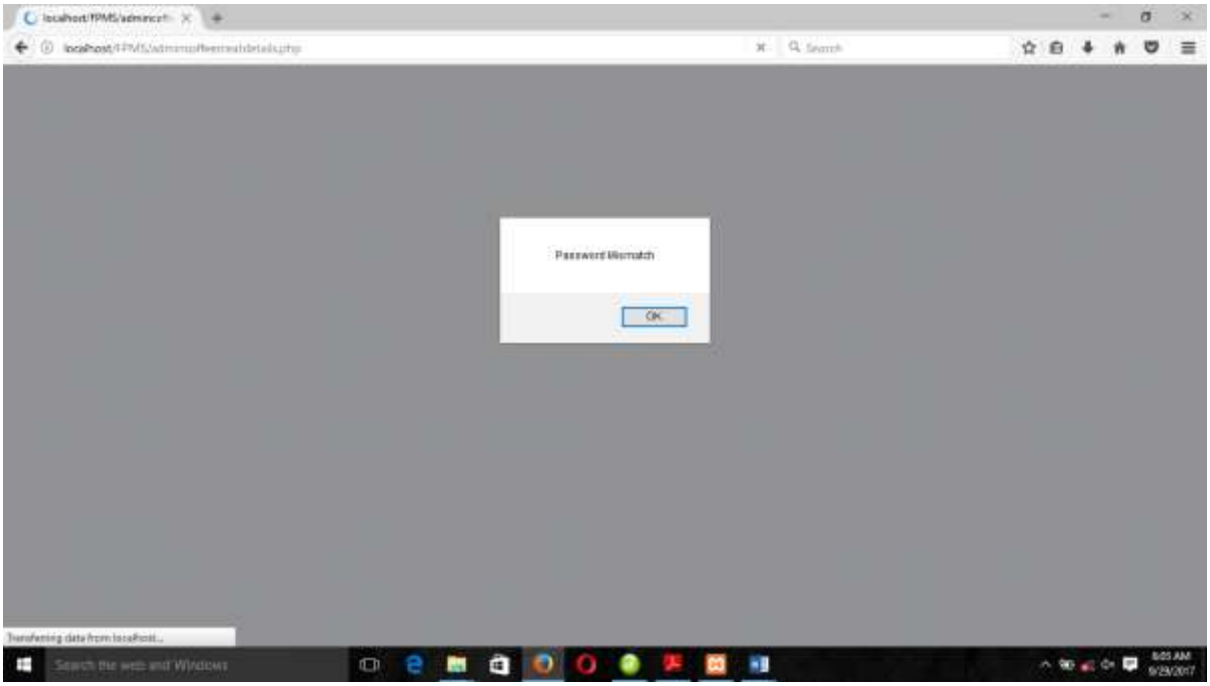


Figure 5.6 Login failed on the user's side

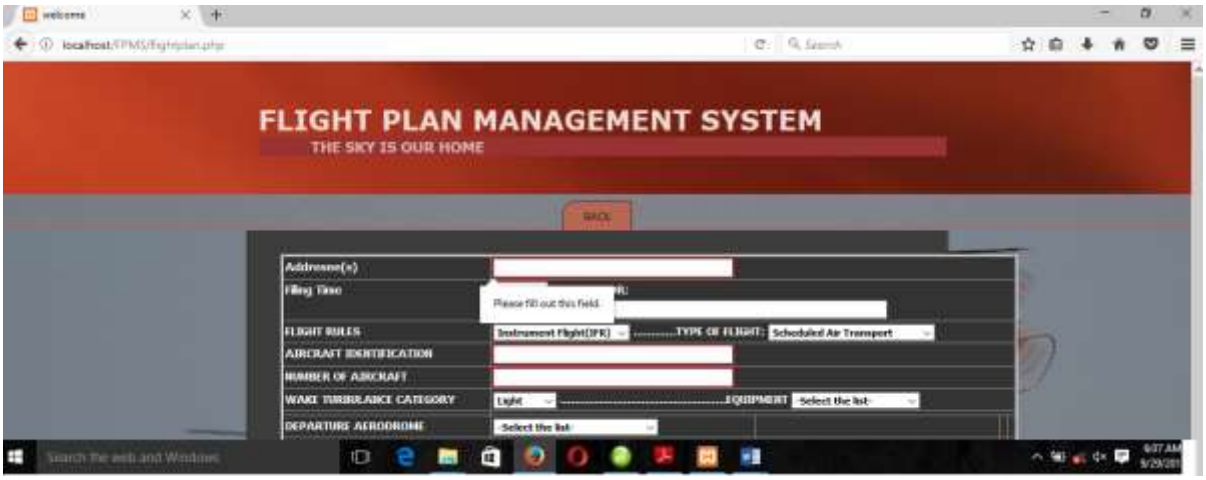


Figure 5.7 Validation of flight plan

5.4 Installation

For the system to be operational it has to be installed on the hardware platform which is supposed to operate on. Installation is defined by Limaye (2009) as the setting up of the software system on a hardware platform for operation. After the Flight Plan Management system is programmed it is then installed on the platforms which they will be used on using a flash stick

and an external storage like the DVDs or external HD will be used as backup. Training for the users will commence as soon the system is installed.

Table 5.8: Installation plan

Procedure	Start date (approx)	End date (approx)
Arrange system by components	October 31	November 10, 2017
Data collection	November 2	November 3
Connections setting up	November 3	November 3
Hardware installation	November 4	November 5
Software installation	November 5	November 5
System installation	November 6	November 6

All dates given are approximations and they are subject to change any moment, as per the institution activities. It is just a schedule of the installation plan, which shows the processes and the dates on which those processes are expected to start and end. The system is going to be installed by the developer.

5.4.1 System changeover

System change is dynamic process which require enough information about the existing environment, impact of the changes to be effected and the perfect way of carrying out the process. PMI (2013) described system changeover s gradual or quick replacement of an existing system with new system that offers better benefits than the one already operating. An emphasise was given by Aquinas (2008), that changeover must not affect the operation of the system totally as fallback plan must be initiated in case the new system become incompatible not as expected. Below are some of the methods that can be employed for the system changeover and the most appropriate methods must be used.

a. Direct Conversion (Preferred conversion type)

Aquinas (2008), highlighted that direct change is a once for all replacement of the existing system with a new system. It is a completely overhaul process as the new system takes over the operation of all the activities which were done by the old system. The new system will start fully operational only if the users are well acquainted with the new system for it to offer the required

operational capabilities. There are various advantages of this system though there are also the demerits as indicted in the table below:

Table 5.1: Advantages and disadvantages of Direct Conversion

Advantage	Disadvantage
-duplication of duties are minimised -costs are minimized as the resources are for one operational system	-art most care must be emphasized for one mistake will ruin everything. -Difficult to revert back to the old system if the new system fails -Intensive training necessary

b. Pilot Operation.

The pilot operation changeover is a process of selecting a targeted department and implement the new system whilst other departments re still using the old system, Aquinas (2008). After the new system proves to be efficient and effective, the other departments will then switch to the new system. This happens when they are so must risk of losing important information and failure of the new system to uphold the standards of the old system.

Table 5.2: Pilot Conversion method

Advantage	Disadvantage
Ability to rectify errors of the system if they are encountered on the pilot unit	Incompatibility of the manual system and the computerized system will result in problems.

c. Parallel Operation

PMI (2013) defined parallel changeover entail a simultaneous process of implementing the new system whilst the old system is in operation. The two systems are to run together at the same time for a defined period of time of which the old system will be done with if it proves to be better than the old system. If the system be installed fails to deliver as desired requirements, it is possible to abandon the project and use the old system. The same data that is used for operation

is fed to the two system concurrently and the outputs are compared with other analysis components being checked as well. The advantages and disadvantages of this method are shown in table below:

Table 5.3: Parallel changeover method

Advantage	Disadvantage
- reduces the risk of system failure. -old system can act as a reference system and also back up past operations	-duplication of tasks and costs -tiresome as both systems require the same data. -processing delay

d. Phased Operation

Phased changeover is gradual implementation of a new system stage by stage until the system is new, works in different phases or stages, PMI (2013). All the users of the system are able to have a feel of the attributes of the new system in some parts of their operational areas before the whole system is changed. The advantages and disadvantages of this methoid is indicated in the table below:

Table 5.4 Phased changeover method

Advantage	Disadvantage
- encountered errors are corrected at that phase be implemented - costs are minimised as there is no duplication of tasks	-difficult to implement is the modules are very large and cannot be separated.

Parallel changeover method was recommended by the developer due to its advantages. Being a critical system which failure is cannot be imagined, the two systems are opted to run simultaneously until the new system proves to be able to handle the tasks. It was also chosen to allow other members to learn the system gradually until they are well acquainted with it.

5.4.2 User training

Training is an important component of the system implementation which involves introducing the system to its owners, Sneller (2014). Training and induction of the new system will be carried out in groups broken down into pilots and flight dispatures, meteological officers and the air traffic controllers. A training program is designed in such a way that all the members will be educated with a hands on strategy for them not to know the theory but the practical aspects.

Table 5.5: Training Plan

Type of Users	Start date (approx)	End date (approx)
Pilots and Flight Dispatures	November 10	November 13, 2017
Meteological Officers	November 14	November 17
Air Traffic Controllers	November 18	November 21
System Admins	November 22	November 27
Technicians	November 28	November 30

5.5 Maintenance

Mantel, etal (2011) defined maintenance as the continuous assessment of the system in an investigatory manner in a bid to maintain or improve the efficiency of the system operations. The proposed information solution to the ATC Department must be evaluated for it to be a solution in its life time. The working environment is continuously changing with more challenges imaging as more objectives require to be fulfilled, improvements are essential. Implementation of the system hence should accommodate changes and improvements as it is an ongoing process in the system life cycle. Maintenance process is not only centered on improvements of the system but to ensure that the system's breakdowns are rectified. The types of maintenances to be associated with this system include the following:

a. Corrective Maintenance

Dennis, Wixom & Roth (2012) defined corrective maintenance as all procedures and processes involved in rectifying a breakdown system which include troubleshooting to establish the problem, repairing or restoring to its normal state. Routine checks must be well defined in the maintenance policy of the system and faulty modules must be established in time and corrected.

In this regard, a failure of the Flight Plan Management System can cause a disaster if it is not rectified as quickly as possible. An example if the pilots or flight dispatures fails to upload their flight plans, the ATC Departments will be having false information thus it cannot schedule the flights hence the operation procedures will be affected. A person well conversant with maintenance procedures must be available all the time and the users be trained in issues of troubleshooting and rectification of problems.

b. Preventive Maintenance

Mantel, etal (2011) defined preventive maintenance as the evaluation and continuous assessment of the system to determine its condition at any given point in time. The investigatory examination is carried out regularly and ensure that problems are predetermined before there happened. This method help to identify the problems before they affect the system hence protecting the system.

c. Adaptive Maintenance

As technology is evolving every day, the user requirements and objectives towards the system need to be satisfied and adjustments must be done. Adaptive maintenance was defined by Mantel, etal (2011) as the adjustments necessary on the system in order to meet the changes in the operating environment. This entail the customising of the features of the system to meet the prevailing requirements of the system users.

5.6 Recommendations for future/further development

As the user wants and requirements are ever changing with the change also in the operational procedures, there have to be a lookout plan to improve the system. The system being developed customarily based on user requirements, it is however recommended that the system be implemented. The manuals are recommended to be placed on all operational platforms for reference in case the user encounter a challenge or errors in operating. If the challenge goes out of hand especially is to do with the system, a well-documented problem report is to be send to the system maintainers. Since the system was developed internally, the organisation must provide enough resources for continuous research and development for the system to continue being competitive and proving the services in an efficient and effective way.

5.7 Conclusion

This stage of system implementation concludes the final phase of the system development. After this stage, everything is well set and the system is ready to be employed as an operational information system. All the users have been trained for the system are now have the knowledge of the system in operating and maintenance. The system was tested at various levels and all errors were identified and rectified until it now in a perfect state. Maintenance of the system was emphasised in the life time of the system for it to continue operating in a perfect state. As part of the system development cycle, research and development must continue on the system to improve with adding more features on it.

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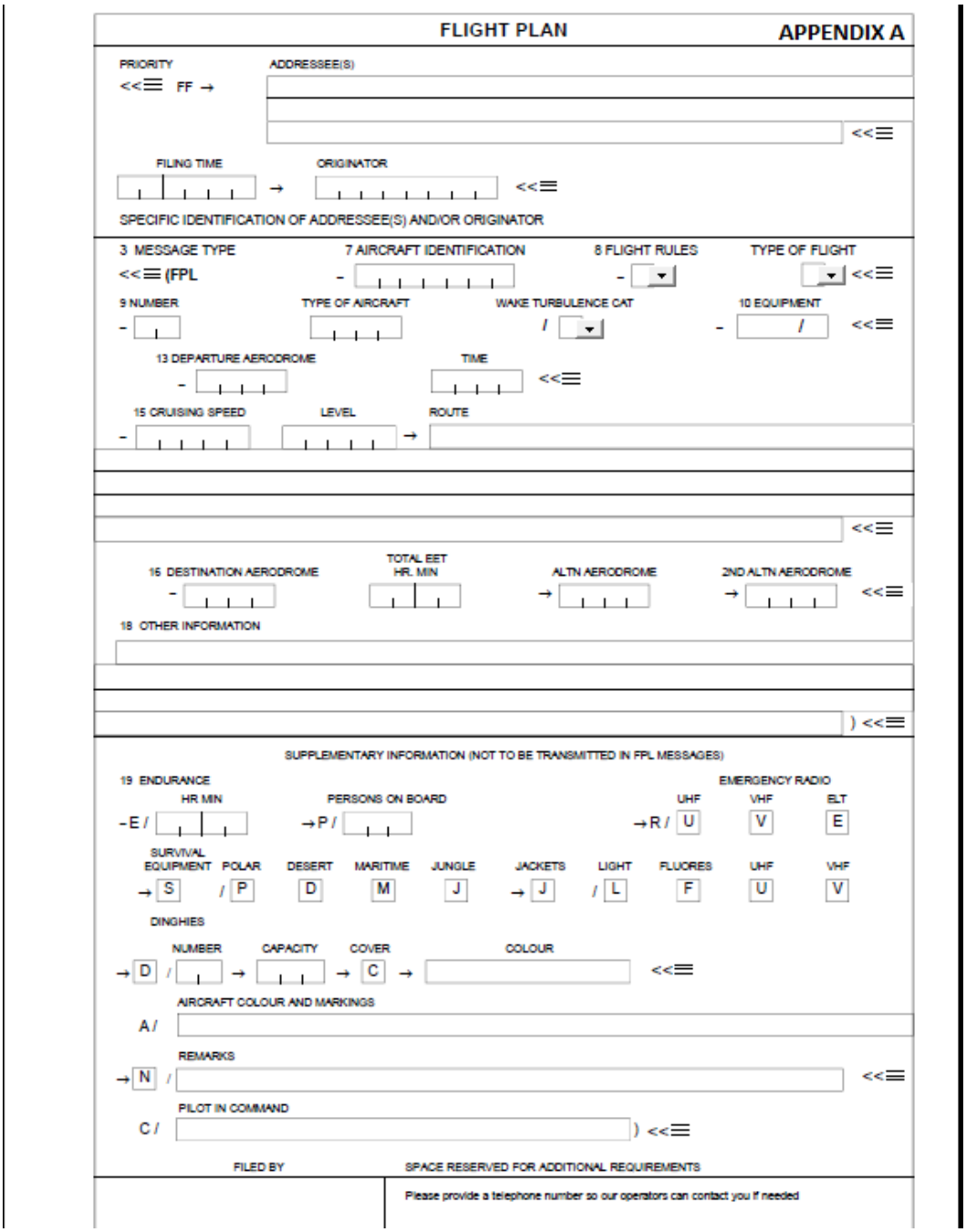
Appendix B: Flight Plan Samples

Flight plan is an internationally recognized document in the aviation standardized and designed by International Civil Aviation Authority. It is a document that is filed by a pilot or other person in a bid to notify air traffic control centres on the intended movement starting all the information as per requirement of this document as shown in the sample below:



Appendix 1 figure: Sample Flight Plan

Appendix B: Questionnaires samples

In order to gathered information on the operation of the current flight plan management, the researcher drafted the questionnaires and distributed them to the pilots, flight dispatures, operations staff, air traffic controllers and other interested stakeholders at Thornhill Air Field.

The Questionnaire for Thornhill Air Field Members:

Introduction

I, Tafadzwa Advance Mubaiwa (R14458N) am a student of Information Systems at the Midlands State University (MSU). As part of my final year research dissertation, on Flight Plan Management System, I hereby ask your assistance by responding to the following questions in this questionnaire. Your responds will be treated with art most confidentiality and will assist me in gathering all information for my academic research project.

I appreciate your support and thank you in advance.

Instructions

a) Please complete or fill in details for spaces provided or tick in the boxes.

b) For confidentiality do not sign in your name or any recognizable mark on the questionnaire.

1. may you please indicate you trade

Pilot ☐ Air Traffic Controller ☐ Flight Dispature ☐ Technician ☐

2. How long have you been in this trade?

0-5 years 5-10 years 10yrs or more

3. May you indicate your mode of operation Flight Plan Management

a) Manual ☐ b) Computerized ☐ c) Not sure ☐

4. Rate the efficiency and effectiveness of the mode of operation.

a) Below 30 % ☐ b) between 31 and 50 ☐ c) Between 50 and 75% ☐ d) Above 75% ☐

5. How do you compile needed reports and detailed documents?

……
……
……
……

6. Approximately how long does it take to prepare and file a flight plan? (Pilots and Flight dispatures only)

7. Are you computer literate?

a) Yes ☐ b) No ☐ c)Not sure ☐

8. Do you support for the system to be computerised?

a) Yes ☐ b) No ☐ c)Not sure ☐

9. Any other information

……
……
……
……

Thank you very much for your support!

Appendix C: Sample Interview Questions

In order to gather detailed information about the system and its challenges, the researcher conducted interviews and mainly centered on the operation of the system. The people who were engaged for the interviews were the pilots, air traffic controllers and meteological officer.

a. How much do you understand the flow of information in the flight plan management in this organization?

b. Which entities are involved in the whole system from the inputs to the output?

c. How do you communicate the information from the system to relevant stakeholders?

d. How do you store the documents and other related material?

e. What is the purpose of the above mentioned documents?

f. Are you happy with the operation of the system? If not what are the challenges?

g. Do you recommend the system to be computerized?

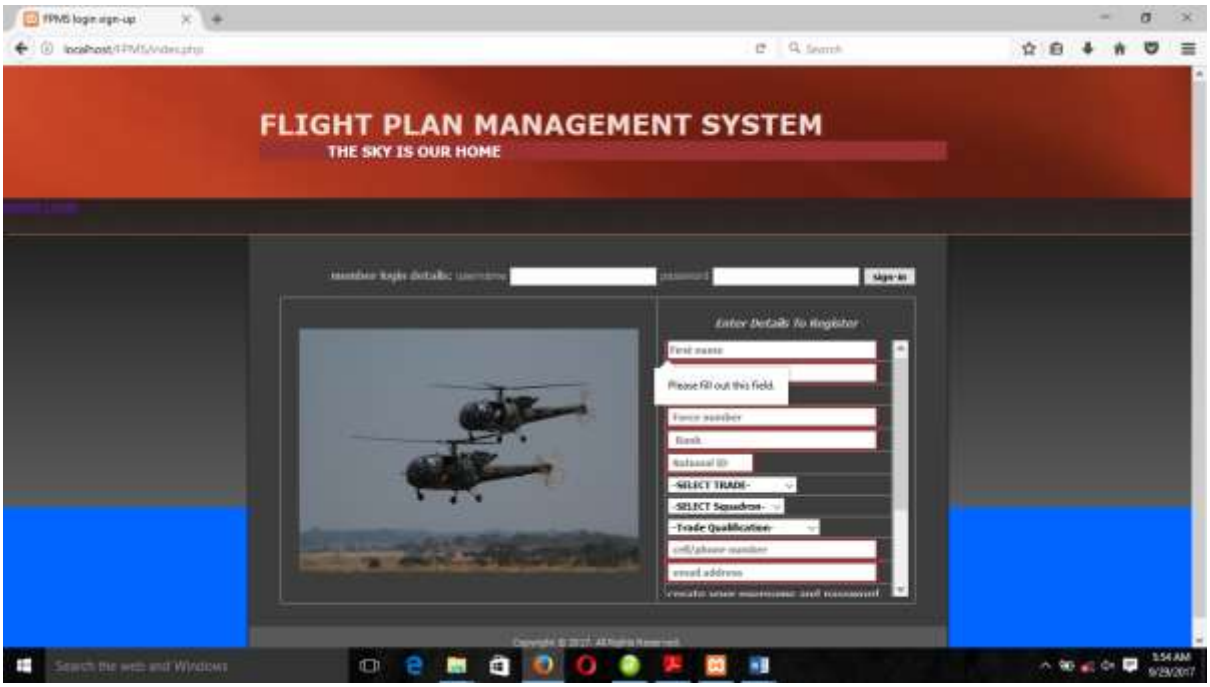
Appendix D: Sample Manual for the Flight Plan Management System.

Appendix A: User manual

The user manual is the document that gives all the information relating to the use of the system and in this case this user manual will focus on both the users of the system and the administrators of the system. This manual will assist the users to understand how the system will function and how to operate as they maneuver through their designated areas of operation. If a user faces any problem after system training and induction they can refer to this manual. Follow the instructions at each stage!

Member Registration

Before a member acquire a username and password which he/she uses as the security credentials to access the system, registration is the first thing to do. The user enters all required details for all the fields and click a button REGISTER and a script message will notify the user for a successful registering and welcome him/she to the system. The registering interface is as shown below:

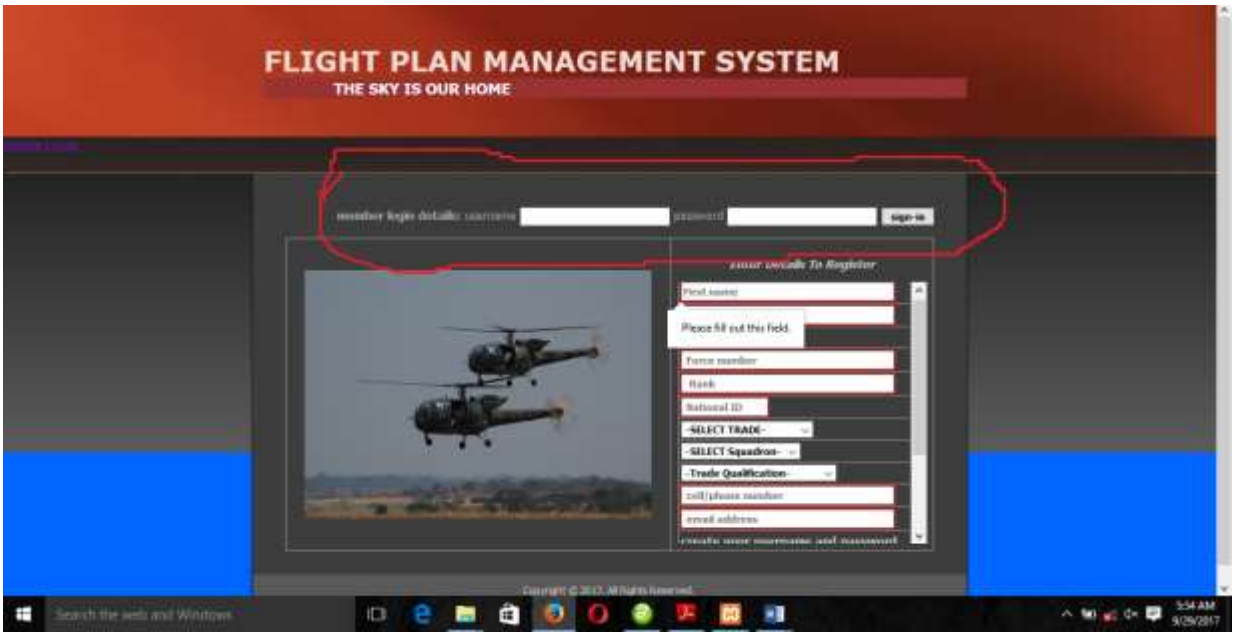


Appendix 1 figure: Registration Interface for the user

Login

The system request the user enter the credentials that is the username and password on an interface as shown in **Appendix 2 Figure** and a **LOGIN** Button will grant the user access to the

system if they are valid. After a successful login, the system will welcome the user as shown in **Appendix 3 Figure** and it refers to their respective main menu where the member can carry out the operation as he/she intend as shown **Appendix 4 Figure**. Invalid credentials for the user produces a script message that shows that **WRONG USERNAME AND PASSWORD** as shown in **Appendix 5 Figure.**



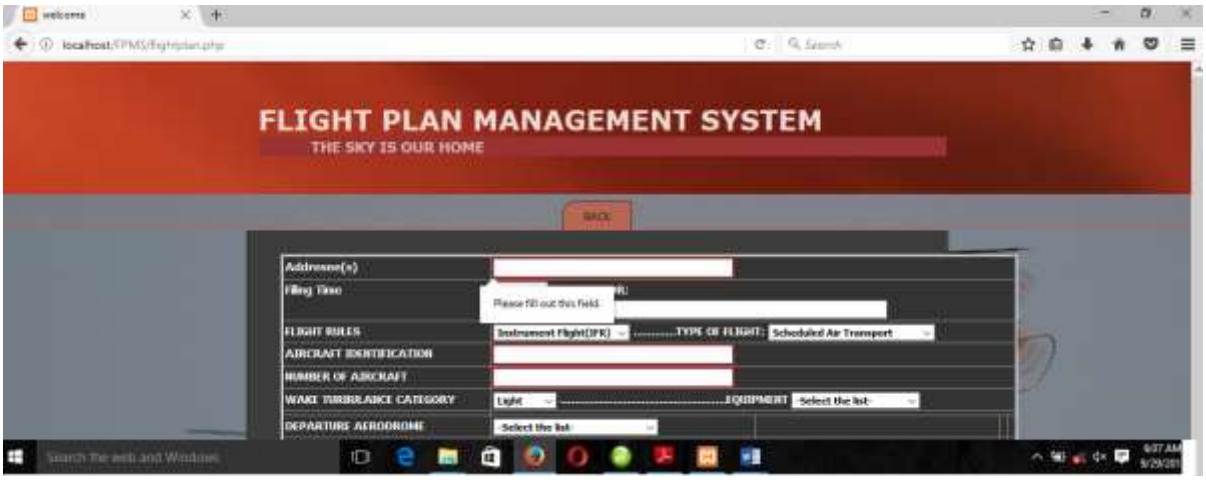
Appendix 2 figure: Login for the member

Appendix 3 figure: Admin Main Menu

Appendix 4 figure: Pilot/Flight Dispature Main Menu

To File a Flight Plan

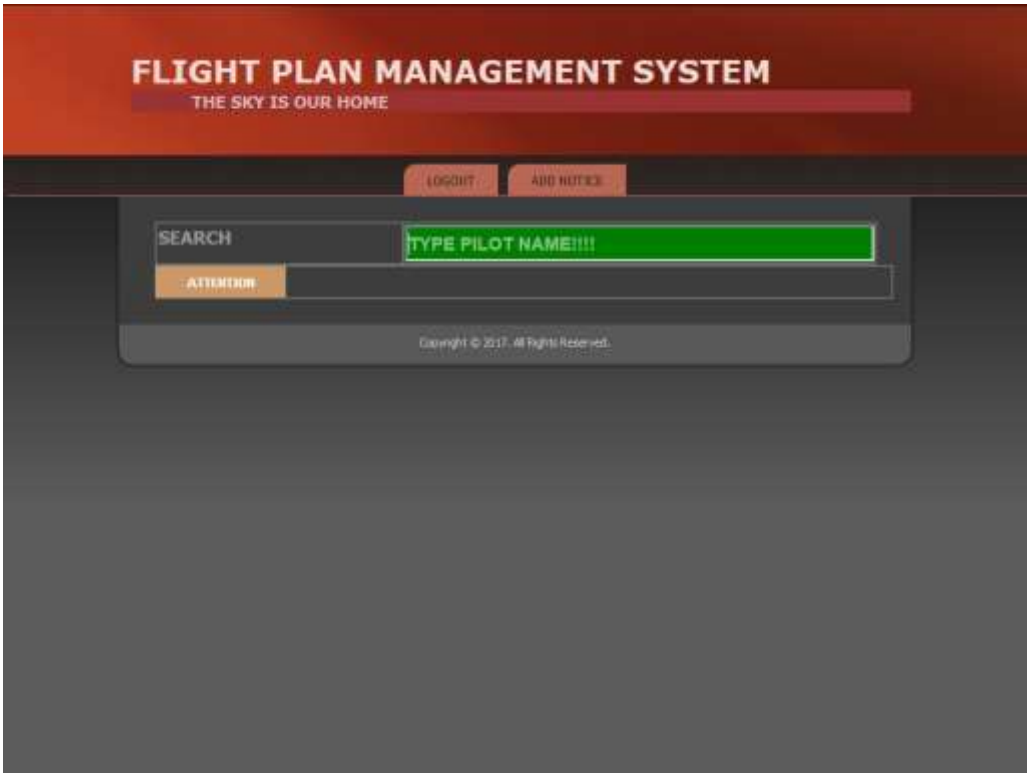
For a pilot or flight dispature to file a flight plan, an interface as that shown in **Appendix 5 Figure** will be shown and a button UPLOAD will commit the details and a flight plan is filed.



Appendix 5 Figure: Flight Plan

Search a flight plan

To search for a flight plan in a system a search engine will allow a search with the name of the pilot or username to appear with many flight plans hits



Appendix 6 Figure: Search for Flight Plan

Appendix E: Code Snippet

Below is the PHP Code for the Flight Plan Management System for the main modules:

Login for Members Code

```
<?php

session_start();

include "Connections/CONN.php";

$rs= mysql_query("SELECT * FROM member WHERE username='$_POST[username]' and password='$_POST[password]'");

if($row=mysql_fetch_array($rs))

        {

$username=$row["username"];

$_SESSION['username']=$username;

$_SESSION['logged'] = true ;

//$_SESSION['level']=$row["level"];

?>

<script language="javascript">

window.location="membermenu.php";

</script>

<?php

        }

        else

        {

        echo "<script language='javascript'> alert('wrong username or password'); window.location='index.php'; </script>";

        }

?>
```

Registration Code

```
<?php
```

```
if(isset($_POST['REGISTER']))
{
include("functions.php");
$forcenumber=$_POST['forcenumber'];
$fname=$_POST['fname'];
$lname=$_POST['lname'];
$rank=$_POST['rank'];
$nationalid=$_POST['nationalid'];
$trade=$_POST['trade'];
$qualification=$_POST['qualification'];
$squadron=$_POST['squadron'];
$sex=$_POST['sex'];
$phone=$_POST['phone'];
$email=$_POST['email'];
$username=$_POST['username'];
$password=$_POST['password'];
$pass2=$_POST['pass2'];
//$stat=0;
if(isset($_POST['REGISTER']))
{
//if(!$forcenumber|!$fname|!$lname|!$rank|!$nationalid|!$trade|!$qualification|!$squadron|!$sex|
!$phone|!$email!$username|!$password|!$pass2)
//{
//message("Enter all details please");
//}
if(!preg_match("^[0-9]{2}\-[0-9]{6,7}\-[A-Za-z]{1}\-[0-9]{2}^", $nationalid))
{
```

```
message("Please enter valid characters for ID number,in the correct format e.g,63-1234567-H-80.");

}

if(!is_numeric($phone)){

message("Cell number should be numeric");

  }

  if(strlen($cell)<6|strlen($cell)>15){

message("Invalid cell number");

  }

  if(!eregi("^[_a-z0-9-]+(\.[_a-z0-9-]+)*@[a-z0-9-]+(\.[a-z0-9-]+)*(\.[a-z]{2,3})$", $email)){

message("Invalid e-mail address");

  }

$addfile = "INSERT INTO member(forcenumber,fname,
lname,rank,nationalid,trade,qualification,squadron,sex,phone,email,username,password ) ".

          "VALUES (
$forcenumber','$fname','$lname','$rank','$nationalid','$trade','$qualification','$squadron',$sex',$phone','$email','$username','$password')";

mysql_query($addfile) or die(mysql_error());

message("Thank you ".$fname."__".$lname." for being our member. " );

 }

  }

?>
```

Filling Flight Plan Code

```
<?php
if(isset($_POST['Submit']))
{
include("functions.php");
$addresses=$_POST['addresses'];
$fillingtime=date('H:i:s',$tim);
$originator=$_POST['originator'];
$flightrules=$_POST['flightrules'];
$aircraftid=$_POST['aircraftid'];
$numberofaircraft=$_POST['numberofaircraft'];
$waketurbulencecategory=$_POST['waketurbulancecategory'];
$departureaerodrome=$_POST['departureaerodrome'];
$destination=$_POST['destination'];
$altdestination=$_POST['altdestination'];
$altdestination1=$_POST['altdestination1'];
$departuretime=date('H:i:s',$tim);
$estimatedarrivaltime=date('H:i:s',$tim);
$estenroutetime=date('H:i:s',$tim);
$endurance=date('H:i:s',$tim);
$numberofpass=$_POST['numberofpass'];
$emergenceradio=$_POST['emergenceradio'];
$voicecapabilities=$_POST['voicecapabilities'];
$aircraftcolourmarkings=$_POST['aircraftcolourmarkings'];
$pilotincommand=$_POST['pilotincommand'];
$callsign=$_POST['callsign'];
//$stat=0;
```

```
if(isset($_POST['Submit']))

{

if(!$addresses|!$fillingtime|!$originator|!$flightrules|!$aircraftid|!$numberofaircraft|!$waketurbulencecategory|!$departureaerodrome|!$destination|!$altdestination|!$altdestination1|!$departuretime|!$estimatedarrivaltime|!$estenroutetime|!$endurance|!$numberofpass|!$emergenceradio|!$voicecapabilities|!$aircraftcolourmarkings|!$pilotincommand|!$callsign)

{

message("Enter all details please");

}

if(!preg_match("^[A-Za-z]{3}\-[0-9]{4}^", $originator))

{

message("PLEASE ENTER VALID CHARACTERS FOR ICAO ORIGINATORS' ID,in the correct format e.g,TAF-8000.");

}

if(!preg_match("^[0-9]{4}\-[A-Za-z]{3}^", $aircraftid))

{

message("PLEASE ENTER VALID CHARACTERS FOR ICAO AIRCRAFT ID,in the correct format e.g,323-B77.");

}

if(!preg_match("^[A-Za-z]{3}^", $departureaerodrome))

{

message("PLEASE ENTER VALID CHARACTERS FOR ICAO AERODROME,in the correct format e.g,FVL.");

}

if(!preg_match("^[A-Za-z]{3}^", $destination))

{

message("PLEASE ENTER VALID CHARACTERS FOR ICAO AERODROME,in the correct format e.g,FVL.");

}

if(!preg_match("^[A-Za-z]{3}^", $altdestination))
```

```
{

message("PLEASE ENTER VALID CHARACTERS FOR ICAO AERODROME,in the correct format e.g,FVL.");

}

if(!preg_match("^[A-Za-z]{3}^", $altdestination1))

{

message("PLEASE ENTER VALID CHARACTERS FOR ICAO AERODROME,in the correct format e.g,FVL.");

}

if(!is_numeric($numberofaircraft)){

message("Number of aircraft in numeric");

  }

if(!is_numeric($numberofpass)){

message("Number of Passengers in numeric");

  }

  if(strlen($cell)<6|strlen($cell)>15){

message("Invalid cell number");

  }

  if(!eregi("^[_a-z0-9-]+(\.[_a-z0-9-]+)*@[a-z0-9-]+(\.[a-z0-9-]+)*(\.[a-z]{2,3})$", $email)){

message("Invalid e-mail address");

  }

$addfile = "INSERT INTO flightplan(addressees, fillingtime, originator, flightrules, typeofflight, numberofaircraft, waketurbulancecategory, departureaerodrome, destination, altdestination, departuretime, estimatedarrivaltime, estenroutetime,altdestination1, endurance, numberofpass, emergenceradio, voicecapabilities, aircraftcolourmarkings, pilotincommand, callsign)" .

      "VALUES (`$addressees`, `$fillingtime`, `$originator`, `$flightrules`, `$typeofflight`, `$numberofaircraft`, `$waketurbulancecategory`, `$departureaerodrome`, `$destination`, `$altdestination`, `$departuretime`, `$estimatedarrivaltime`, `$estenroutetime`, `$altdestination1`, `$endurance`, `$numberofpass`, `$emergenceradio`, `$voicecapabilities`, `$aircraftcolourmarkings`, `$pilotincommand`, `$callsign`)";

mysql_query($addfile) or die(mysql_error());
```

```
message("Flight Plan Filed " );
 }
  }
?>
```

Database Connection Code

```
<?php
# FileName="Connection_php_mysql.htm"
# Type="MYSQL"
# HTTP="true"
$hostname_CONN = "localhost";
$database_CONN = "fpms";
$username_CONN = "root";
$password_CONN = "";
$CONN = mysql_pconnect($hostname_CONN, $username_CONN, $password_CONN) or
trigger_error(mysql_error(),E_USER_ERROR);
?>
```

View Flight Plan Code

```
<?php
        $query=mysql_query("select * from flightplan");
        while($fetch=mysql_fetch_array($query)){
        ?><tr>
    <td><?php echo $fetch['adressees']; ?></td>
    <td><?php echo $fetch['fillingtime']; ?></td>
         <td><?php echo $fetch['originator']; ?></td>
         <td><?php echo $fetch['flightrules']; ?></td>
         <td><?php echo $fetch['typeofflight']; ?></td>
        <td><?php echo $fetch['numberofaircaft']; ?></td>
        <td><?php echo $fetch['waketurbulaancecategory']; ?></td>
        <td><?php echo $fetch['departureaerodrome']; ?></td>
        <td><?php echo $fetch['destination']; ?></td>
        <td><?php echo $fetch['altdestination']; ?></td>
        <td><?php echo $fetch['altdestination2']; ?></td>
    <td><?php echo $fetch['route']; ?></td>
     <td><?php echo $fetch['departuretime']; ?></td>
      <td><?php echo $fetch['estimatedarrivaltime']; ?></td>
       <td><?php echo $fetch['estenroutetime']; ?></td>
        <td><?php echo $fetch['endurance']; ?></td>
       <td><?php echo $fetch['numberofpass']; ?></td>
        <td><?php echo $fetch['emergenceradio']; ?></td>
         <td><?php echo $fetch['voicecapabilities']; ?></td>
          <td><?php echo $fetch['aircraftcolourmarkings']; ?></td>
        <td><?php echo $fetch['pilotincommand']; ?></td>
   <td><?php echo $fetch['callsign']; ?></td>
```