VIETNAM AVIATION ACADEMY

Department of Telecommunication - Electronics Engineering Technology

LOCATED IN HO CHI MINH CITY

Graduate Internship Report:

"INTRODUCTION TO SIMULATOR MAINTENANCE PROCEDURE AND MPIC SYSTEM"

Written by

Nguyen Van Anh Tuan

Roll.No.1753020018

Under the guidance of

Msc.Vo Phi Son

June 18, 2021

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WORDS OF THANKS

Reality show that success is always associated with support of friends, teacher,... And i have special thanks to Mr.Vo Phi Son and my close friends for helping me completing this report.

I have tried my best to do this report. However, due to my lack of experience and knowledge, there are still some unexpected mistakes in the report. Please let me know your opinions and criticizes. Once again, thank you so much.

Auth.Nguyen Van Anh Tuan

REVIEW OF INSTRUCTOR

Tuesday, June 8th 2021

Instructor

REVIEW OF THE INTERNSHIP COMPANY

Tuesday, June 8th 2021

Internship Department

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Chapter 1

OVERVIEW ABOUT PROJECT

1.1 Reasons For Choosing The Topic

During the time of entering the internship unit, after being briefly introduced to the systems, components and equipment at BAA Training Vietnam, accompanied by the instructor's suggestion, I realized the importance of the system. The importance of applying flight simulators in pilot training.

But because the practice process is not too long to understand all the functions of the device. Since then, I have chosen the topic of learning about the maintenance process of the flight simulator and the components related to the flight simulator for this graduation internship.

1.2 The Target of Research

Through the implementation of this topic, I personally want to have more understanding about the maintenance process of a flight simulator, what is the MPIC system, and at the same time experience a working environment. Dynamic, open-minded, absorbing practical knowledge. Thereby cultivating yourself and adding other necessary skills in the working process.

1.3 Research Methods

The study uses the method of collecting secondary data from reputable books, websites and internal information of BAA Training Vietnam company. In addition, the primary data collection method was also used through observation and recording during the internship.

1.4 Research Scope

1.4.1 In Term of Time

From January 18th 2021 to March 18th 2021

1.4.2 In Term of Space

At BAA Training Vietnam company

Chapter 2

BAA TRAINING VIETNAM DESCRIPTION AND STRUCTURE

2.1 Registration and address

On February 2nd, 2018 BAA Training Vietnam was registered, assigned company number 0314876711.

Figure 2.1: BAA Training Vietnam logo

BAA Training Vietnam shall maintain a principle business office that is physically located at the address shown on the ATO certificate.
The principle business office may not be shared with, or used by, another person who holds an ATO certificate.

- **Address:** 99 Le Van Viet street, Tang Nhon Phu A ward, District 9, Ho Chi Minh city, postal address 71207
- **Hotline:** +84 28 389 739 39
- BAA Training Vietnam is CAAV approved ATO providing EASA standard aviation training solutions in Asia-Pacific region.

Figure 2.2: Headquarter of BAA Training Vietnam

2.2 Field Of Activities

BAA Training Vietnam's facilities and working environment shall be appropriate for the task to be performed and be acceptable to the Authority.

BAA Training Vietnam shall provide facilities, equipment, and material equal to the standards currently required for the issue of the certificate and rating that it holds.

BAA Training Vietnam have, or have access to, the necessary information, equipment, training devices and material to conduct the courses for which the organization is approved.

BAA Training Vietnam may not make a substantial change in facilities, equipment, or material that have been approved for a particular curriculum, unless that change is approved by the Authority in advance.

The BAA Training Vietnam shall have a technical library adequate for the level of training conducted.

BAA Training Vietnam is Approved Training Organization with the privilege to advertise and provide approved training courses as listed in the ATO certificate in a location that is normally accessible to the public and that is not obscured.

BAA Training Vietnam may provide training only if:

- The Training Organization is accredited for such activities (the permission is indicated in the attachment to ATO Certificate Training Course Approval);
- Has a relevant training program approved by CAAV;
- Has a sufficient number of ground and flight instructors (if necessary);
- Has necessary training material and equipment for the training course.

2.3 Premises

The ATO holder shall show that the classrooms and briefing facilities:

- Used for instructional purposes are heated, lighted, and ventilated to conform to local building, sanitation, and health codes;
- Are not routinely subject to significant distractions caused by flight operations and maintenance operations at the aerodrome;

- Audio and visual training equipment appropriate to the training conducted, including computer projected documents.

2.3.1 Building In

BAA Training Vietnam has 1 building located in district 9, Ho Chi Minh city. The building is framed, insulated and covered with lightweight metal sheets from the outside. These training premises occupy two floors and cover the area of approximately 200 m^2.

The first floor includes:

- 1 real size A320 flight simulators, their maintenance, spare part store and technical rooms;
- 1 Archive room;
- 4 Classrooms;
- 1 Pantry room;
- 1 Meeting room.

The second floor includes:

- 4 Office rooms;
- 5 Briefing room;
- 1 ATP training room;
- 5 Classrooms;
- 1 Lounge room.

The majority of rooms have windows. In addition to the natural light, all rooms have led/fluorescent lamps. All rooms are ventilated and equipped with air conditioners; supplied with 220V/50 Hz electricity and have the Internet connection. There are also backboards, projectors and aircraft cabin models (if necessary).

2.3.2 Training Equipment

2.3.2.1 Flight Simulation Training Devices

Flight simulation training devices shall be qualified according to requirements prescribed by the Authority.

The use of flight simulation training devices shall be approved by the Authority to ensure that they are appropriate to the task.

BAA Training Vietnam shall have available exclusively, for adequate periods of time and at a location approved by the Authority, adequate flight training equipment and courseware, including at least one flight simulation training device suitable for the approved curriculum.

BAA Training Vietnam shall show that each flight simulation training device used for training, testing, and checking will be or is specifically qualified and approved by the Authority for:

- Each manoeuvre and procedure for the make, model, and series of aircraft, set of aircraft, or aircraft type simulated, as applicable;

- Each curriculum or training course in which the flight simulation training device is used, if that curriculum or course is used to satisfy any requirements of these regulations.

BAA Training Vietnam shall ensure, prior to use, that the approval required by this section includes:

- The set of aircraft or type aircraft;
- If applicable, the particular variation within type for which the training, testing, or checking is being conducted;
- The particular manoeuvre, procedure, or crew memeber function to be performed.

The ATO holder shall ensure that each flight simulation training device used is:

- Maintenanced to ensure the reliability of the performances, functions, and all the other characteristics that were required for qualification;
- Modified to conform with any modification to the aircraft being simulated if the modifications results in changes to performance, function, or other characteristics required for qualification;
- Given a functional preflight check each day before being used;
- Provided with a discrepancy log in which the instructor or evaluator, at the end of each training session, enters each discrepancy.

2.3.3 Other Training Devices

In order to conduct the training, BAA Training Vietnam uses the other following training equipment:

- CAE 400XR Flight Training Device;
- Personal computers and tablet computers;
- Computer projector with remote control;
- Computers with headphones and microphones sets, software and sound recordings, radio contact for training and further self-development.

2.4 Approved Training Organization (ATO) Organizational Structure

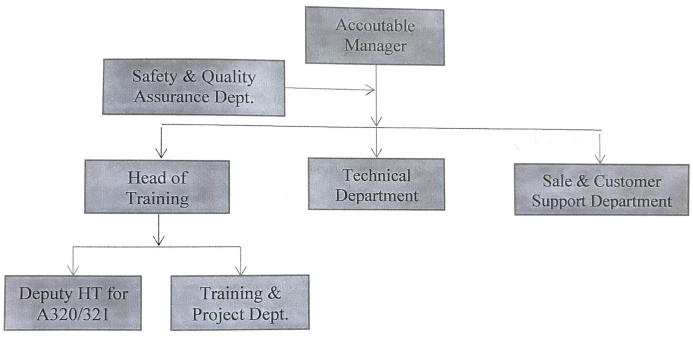

Figure 2.3: BAA Training Vietnam Organizational Structure

2.4.1 Managing Director

To be the legal representative of BAA Training Vietnam on the legal side, to sign the contract and to be the spokesperson for the company.

Responsible for managing all business activities to ensure that these activities comply with the provisions of Vietnamese law, the guidance of the Ministry of Transport, the Civil Aviation Administration of Vietnam as well as legal documents.

At the same time, he is responsible for running the company's activities, reviewing and recruiting personnel and appointing the positions of Heads of Training, Technical, Sales and Customer Care departments.

In addition, the CEO also performs other obligations and powers specified in the company's internal documents.

2.4.2 Quality Assurance Department

The main task is to ensure that the company's activities always comply with the quality regulations issued by BAA Training Vietnam internally and required by the Civil Aviation Authority of Vietnam.

Along with that, it is a tool to support the CEO in formulating policies and standards for aviation training, company operation or human resource quality.

2.4.3 Training Department

Develop training standards according to the requirements specified in the aviation safety regulations - Section 7 on Airline Officer Licenses.

Responsible for training, training students and supervising the company's training program to ensure service quality, detect hazards in the process of operation.

BAA Training Department includes:

- Head of training
- Flight instructor
- Ground instructor
- Training and service development department

2.4.4 Technical Department

Ensure that the training equipment at the company meets technical standards and is always in stable condition through regular inspection and evaluation activities. When detecting errors, they must notify the Executive Director for timely resolution. In addition, the technical department is also responsible for preparing equipment for students before the lesson begins.

2.4.5 Sales And Customer Care Department

Consulting and supporting students to learn information about the company's services. Answer questions and complaints of students during the learning process. Support students when needed and manage the company's social networking sites to reach and attract new students.

2.5 Performance results 2019 - 2020

Participating in the Vietnamese market since 2018 but BAA Training Vietnam officially went into operation in 2019 after completing the construction and assembling of equipment. Therefore, the operation time of the center up to now is less than 2 years. However, the operating results of BAA Training Vietnam still have a good signal.

In the past year 2020, BAA Training Vietnam was granted the UPRT training certificate - Upset Prevention and Recovery Training for the first A320 airplane in Vietnam for the purpose of improving the pilot's ability as well as the level of flight safety during flight performance.

Chapter 3

QUALITY MANAGEMENT

3.1 Simulator Maintenance

Reports-based database is primarily designed as a means to reporting simulator maintenance, organize quality logs and analyze performance measures that can be monitored against objectives. Such measures often referred to as Metrics, will be reviewed by the Certifying Authority as part of its oversight of the Quality System, at least, annual basis as well as an itegral part of the Quality Audit process.

3.1.1 Scheduled Maintenance

The maintenance procedures for the simulator will be in accordance with the manufacturer supplied maintenance documentation and local procedures. The routine maintenance requirement is grouped into the following categories.

- Hourly routine Maintenance
- Daily Routine Maintenance
- Weekly Routine Maintenance
- Bi-weeky Routine Maintenance
- Monthly Routine Maintenance
- Quarterly Routine Maintenance
- Six Monthly Routine Maintenance
- Annually Routine Maintenance
- Five-yearly Routine Maintenance

The numbers of categories applied for each FSTD (Flight Simulation Training Devices) depend on the official maintenance manual issued by FSTD manufacture.

Based on "Meantime Between Failure" MBF analysis, should a maintenance procedure require to be performed more frequently than the manufacturer recommends its category shall be changed accordingly.

Each Routine Maintenance tasks will be scheduled by the "Simulator Schedule Calendar" for each simulator. For specific Scheduled Maintenance actions are described in detail as follow:

- **Daily Routine Maintenance**
  - Computers and Peripherals: Inspect and test the motion system

  - Motion: Inspect and test the motion system
  - Smoke Generation: Check fluid level
  - Visual: Perform and image evalution

- **Weekly Routine Maintenance**
  - Smoke Generation: Drain fluid
  - Visual: Geometry, Full calibration, Night luminance

- **Monthly Routine Maintenance**
  - Air Conditioning and Equipment Cooling: Inspect the flexible hose between the air conditioner and flight compartment; Inspect the air conditioner intake filter; Inspect water drain, hoses and fittings
  - Crew Accessway: Inspect flight compartment access gate
  - Electrical: Perform UPS battery test; Electromagnetic Compatibility (EMC) maintenance check of electronic enclosure doors; Test the operation of the entrance emergency lighting
  - Motion: Clean the motion actuators and the outside of the motion control cabinet; Test the Emergency Power Off (EPO) circuit
  - Visual: Clean the air filters on IG PCs

- **Three-Month Routine Maintenance**
  - Air Conditioning and Equipment Cooling: Perform a functional check of the airflow and temperature monitoring system
  - Motion: Lubricate the upper and lower bearings; Test the interlock circuit; Test the drawbridge limit switches; Inspect the motion control cabinet and electrical cabling; Perform disk maintenance on the real time controller computer

- **Six-Month Routine Maintenance**
  - Crew Accessway: Test the safety interlock and STOP button
  - Electrical: Grounding inspection
  - Motion: Lubricate motion actuators
  - Visual: Golden Alignment

- **Annually Routine Maintenance**
  - Computer and Peripherals: Computer cleaning
  - Crew Accessway: Inspect the Interference Relay
  - Electrical: Test the battery of the entrance emergency light panel
  - Motion: Inspect and check-tighten the motion system bolts to specified torque; Motion system vibration isolator inspection; Inspect the platform structure welds; Check-tighten the bolts securing the fligh compartment tie-beams; Replace the air filters on the motion control cabinet; Clean the inside of the motion control cabinet
  - Safety: Test the motion and control loading (C/L) cutoff switches; Test the motion inhibit switches
  - Smoke Generation: Inspect and change filter in the filter/fan smoke extraction assembly

- **Five-Year Routine Maintenance**
  - Electrical: Replace the emergency lighting battery in the celing light controller

Monthly, Six-Monthly and Yearly Maintenance are formally scheduled as programmed maintenance slots.

The FSTD Technical Support engineer shall be responsible for ensuring that Maintenance Procedures are carried out at the recommended time interval and the correct procedure is adhered to.

Every scheduled maintenance form must be filled and signed by FSTD Technical Support engineer in proper manner when appropriate scheduled maintenance is done.

Scheduled maintenance Logs have column where is checkboxes YES/NO to indicate if planned action was performed. If action was not performed and indicated as "NO", then comment should be written and specific action number should be indicated.

The signed "Maintenance Scheduling Logs" must be put into "Maintenance Scheduling Logs" folder on a monthly basis.

If, as a result of any maintenance, remedial action is required a comment should be written at appropriated field of actual scheduled maintenance log and "Technical Defects Log" shall be raised, to reflect the work required/performed, stating any parts used. If necessary, maybe filled up or updated any other reprorts.

3.1.2 Unschedule Maintenance

3.1.2.1 Defect Reporting System

Each observed technical defect must be listed using **Form 27 "Notice to instructor"**

In this document provides the information for instructor about actual open defects on simulator, inaccuracies or anything else that could confuse instructor to use simulator in proper manner. There are not provided defects which have no effect on training. Notices to instructor should be updated in accordance with any resolved problem or in the case if a new problem is observed.

FSTD Technical Support engineer should ensure that notice to instructor is updated by actual situation.

Notice to instructor is placed for public access on the way to appropriate simulators to inform instructors about open defects. Duty engineer should explain notices in more details to instructor if required.

Form 27 should be filled using the following guidance:

1. **"Category"** - defect category;
2. **"SubCategory"** - defect subcategory;
3. **Description"** - notice text. It means description of raised problem and/or recommended actions how instructor should react to this problem

"Technical Defect Log" - reference to appropriate Technical Defect Log for more information if required.

3.1.2.2 Defect Rectification Process

Every raised technical defect is named like "Open defect" until it will be resolved. Each technical defect shall be assigned "Effect on Training" grade which means how much effect defect is providing for training session. Effect on training grade can be:

- **Level A** - The defect has a major impact on a training curriculum. The customer cannot perform the intended or planned training without bringing negative effect training to the crew and no workaround can be found. The defect may jeopardize safe operation or maintenance of the simulator.
- **Level B** - The defect has a major impact on one or more areas of the training curriculum. Training can be partially conducted in these areas but requires undesirable work-around procedures to be followed by the instructor/operator, or by the studen crew. The defect may have a significant impact on maintenance procedures such that regular procedures cannot be followed or executed properly.
- **Level C** - The defect has a minor impact on one or more areas of the training curriculum. Training task can be completed with or without work around but one aspect of the task is incomplete or inaccurate. Or the defect has a minor impact on maintenance of the simulator or is related to training aides (Training Aides: IOS MAP, Lesson Plan Editor, Brief-Debrief station, etc).
- **Level D** - Captured problems to be resolved relating to maintenance, documentation.

FSTD Technical Support engineer assigns Effect on training grade. He can discuss impact severity with FSTD Technical Support flight instructor if needed.

If an "Open" technical defect has no direct effect on the training, but is deemed still to be an issue then it shall be treated as an "Open" fault with the fault history being updated and its "Status" be reassigned accordingly.

If an "Open" technical defect has a direct effect on the training, which have no immediate solution, it shall be reassigned as an "Acceptable Deferred Defect" (ADD). Should the ADD be investigated and it deemed that no immediate solution is being sought or available, the fault history should be updated and its "Status" should be assigned as "Deferred".

Should an ADD be investigated and it deemed a solution is available, the fault history should be updated and its "Status" be reassigned accordingly.

ADD list should be provided for instructor before very training session in "Notice to Instructor" journal. F/O side slip ball indicator is stuck.

If effect grade is "Level A" then training sessions should be cancelled and moved to another time until defect will be fixed. If critical defect occurred then Accountable Manager and Safety and Quality Assurance Manager should be informed immediately by email. Typically, there should be written Technical Defect No. for reference and brief defect description.

As a result a technical defect is generated, it's "Category" assigned with defect feature. "Category" should represent general defect scope.

Defect "Sub Category" should be assigned with its sub feature if necessary. "Sub Category" represents defects scope under specified "Category".

The technical defect is to be investigated with the fault history being updated and its "Status" be reassigned accordingly. There are few "Status" positions used:

- **"Investigating"** - description of defect investigation progress;
- **"Deferred"** - defect status is "Acceptable Deferred Defect";
- **"Part Required"** - spare part required for repair progress but none is available. Spare part number (p/n) should be written;
- **"Part Ordered"** - required spare part is ordered and waiting for delivery. Order details or appropriate reference should be written;
- **"Part Received"** - ordered spare part received but there is no possibility to fit (simulator is in use, not enough manpower etc.);
- **"Other"** - any other action which can't be included under any of provided group;
- **"Resolved"** - defect is resolved;
- **"Expired"** - defect is no longer available

Each step in technical defect investigation progress should have written date, start time, finish time and duration. All these data will be used for quality metrics. There should be written engineer name for each step of defect investigation.
There is general sequence of engineer actions:

- Technical defect observed;
- Raise appropriate technical defect report

Investigate technical defect and accordingly fill up technical defect report until defect will be resolved. Change defect report status accordingly to actual defect investigation status.

3.2 Parts Management

3.2.1 Spare Parts Management

Spare parts are placed in the storage room.
FSTD Technical Support engineers can access spare parts at any time. The usage of spare parts must be traced using **Form 18 "Spare Part Log"**. The quantity of available spare parts must be updated at the appropriate **Spare Parts Log**.
Form 18 includes:

1. **"Component name"** - the name of spare part;
2. **"Part No."** - the part number of appropriate component;
3. **"Serial No."** - the serial number of appropriate component;
4. **"Qty."** - quantity of specific spare parts;
5. **"Status"** - there should be described current status of specific spare part: Available, On maintenance, Not available, Need to order etc.;
6. **"Location"** - brief description where to find that spare part;
7. **"Comment"** - additional information about spare part.

Simulator "Spare Parts Log" helps to manage usage of spare parts. "Spare Parts Logs" are put into "Spare Parts Logs" folder.

If the procedure of spare part exceeds the responsibility limits of FSTD Technical Support engineer, then Accountable Manager will be informed about required spare part in 24 hours to get confirmation about further actions.

3.2.2 Component Removal - Installation

Simulator maintenance manual procedures must be adhered to when work is being carried out on the simulator. Conductive plastic wrist strap and a suitable lead must be worn before handling any static sensitive devices.

Details of all work carried out, all components removed from or installed onto the simulator shall be recorded in the "Technical Defects Log". A summary of work carried out is to be enterd in the relevant "Technical Defects Log".

Additional information to identify the removed or installed component, the location where it is placed shall be filled in the **Error! Reference source not found**. All "Component Removal - Installation Logs" are put into "Component Removal - Installation Logs" folder on a monthly basis and sorted by date.

Error! Reference source not found contains:

1. **"Date/Time"** - time mark when job was done;
2. **"Defect No."** - the number of appropriate Technical Defect Log;
3. **"Destination Device Name"** - exact name, part and serial numbers (if available) of destination device where appropriate component was installed or it is dedicated to install to;
4. **"Component Name"** - the name of installed component;
5. **"Component Specification"** - manufacturer's specifications of installed or removed component;
6. Part No.;
7. serial No.;
8. other details (there can be written any other detail according to installed or removed component");
9. **"Action"** - there should be selected the kind of job: Removal or Installation;
10. **"Component Location"** - actual location of removed or installed component.

3.2.3 Repairable Components

All components, which have been repaired at an outstation, shall, upon receipt, be installed into the appropriate FSTD for functional and operational checks before warranty period expires. Only then shall these repaired components be credited back to stores. The progress for all repaired components is documented by **Form 17 "Repaired Component Log"**:

1. **"Date/Time"** - time mark when job was done;
2. **"Defect No."** - the number of appropriate Technical Defect Log;

3. **"Destination Device Name"** - exact name, part and serial numbers (if available) of destination device where appropriate component should be installed;
4. **"Component name"** - the name of repaired component;
5. **"Component specification"** - manufacturer's specifications of repaired component:
   - part No.;
   - serial No.;
   - other details (there can be written any other detail according to repaired component);
6. **"Company name"** - manufacture Company name of unserviceable component of name of potential repair company where to send unserviceable part;
7. **"Additional information about company"** - there should be written any additional information related to service/manufacture company;
8. **"Comment"** - any comments about unserviceable component.

"Repaired Components Logs" are put into "Repaired Components Logs" folder on a monthly basis.

3.2.4 Unserviceable Components

All serviceable components removed from simulator shoud have an Unserviceable Component label attached with all relavant information to identify the component and the particular technical defects log copy.

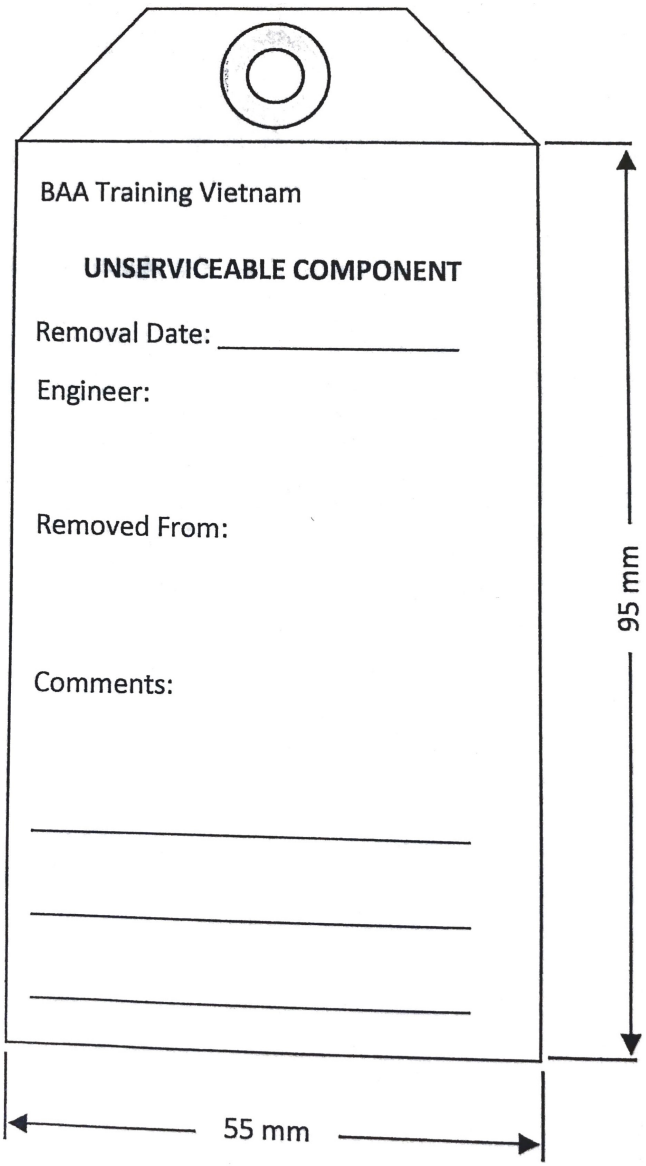

Figure 3.1: Unserviceable Component label

The Unserviceable Component label should be filled according to the following guidance:

- **"Removal Date:"** - the date when component was removed;
- **"Engineer:"** - engineer name and signature who did remove the component;
- **"Removed From:"** - the place where the component was removed from;
- **"Comments:"** - any additional information to make easier recognition of unserviceable part. It is recommended to write here the No. of appropriate Technical Defect Log.

Simulated aircraft components, for example Standby Altimeter, MCP Panel etc., shall be identified upon removal with a comment annotated "For Simulator Use Only".

All repairable unserviceable components dedicated to be sent to the simulator manufacturer, e.g. "Thales Training & Simulation" (TT&S), shall have the manufacturers "Return for Repair Authorization" (RRA) form attached and their warranty status determined.

3.2.5 Equipment Quality Check

After each training session simulator equipment condition should be checked for correct placing and any deterioration. Equipment Quality status and placement should be reported using **Form 20 "Equipment Quality Check"**.

If technical defects are observed during Equipment Quality Check actions, then technical defects must be documented and managed by following the procedure "Unscheduled Maintenance".

There are two checkbox options and adjacent comment field at each checklist item line.

- **"Yes"** - This should be checked if relevant equipment found placed in correct position and no defects are observed;
- **"No"** - This should be check if relevant equipment found not in dedicated position (e.g.Oxygen Mask is left on the floor). Actual place can be mentioned in adjacent comment field for further crew behavior analysis.

If adjacent comment field is to small to fit desired comment description, then continuous Note number shoud be indicated there and actual comment text should be written in general comment field below checklist table where notes numbering should be consistent as indicated along each checklist item.

Form usage explanation:

- **Items 1.1 and 2.1:** equipment was found in dedicated positions and no defects were observed;
- **Item 1.2:** equipment was found in dedicated position and no defects were observed, however worn **Hygiene Pads** were renewed;
- **Item 1.3:** equipment was found not in dedicated position. Adjacent comment field was too short to accommodate desired comment text. Complete comment text was referred as Note #1 and written in general comments field below checklist items table;
- **Item 2.2:** equipment was found not in dedicated position and defect was observed. This defect was managed according procedure "Unscheduled Maintenance" and related defect number was indicated in adjacent comments fields.

Chapter 4

INTRODUCTION ABOUT MPIC SYSTEM

4.1 Simulation Interface Concept

4.1.1 What is an interface module?

It is the module that allow the software to control and to monitor the cockpit hardware.

4.1.2 MPIC Interface System Overview Software Module

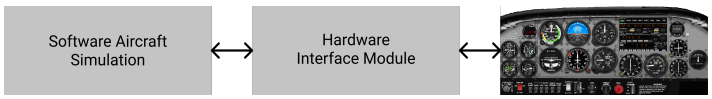

Figure 4.1: MPIC Interface System Overview Software Module

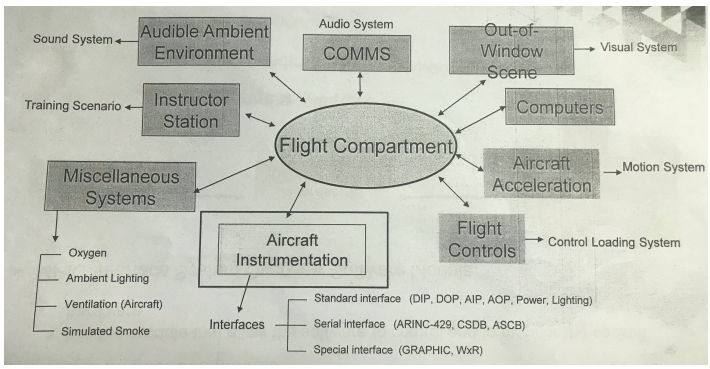

Figure 4.2: Simulator Support Systems

4.2 Interface System Architecture

4.2.1 Architecture Overview

To meet the A661 standard used by CAE, we must seperate the User Application (UA) from the Cockpit Display System (CDS). In other words, the appearance and contents of an object (Widget) on the display must be segregated from its functional behavior as this is managed by the UA. As a result, the system structure can be divided into two main modules, as shown in below figure, specifically the PC where the simulator sends all the data to be processed by the UA, and the CAE-MPIC where

the graphics rendering is performed.
To make things simple we choose to categorize the architecture into four modules:

- The UA
- The CDS
- The Window Manager UA
- The communication protocol ARINC 661/DUP

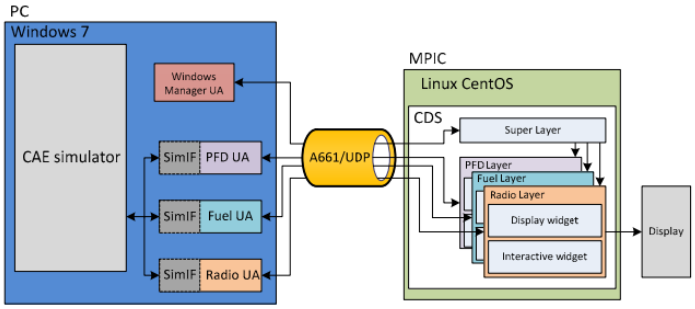

Figure 4.3: System Architecture

4.2.2 What Is ARINC 661?

ARINC 661 is a standard which aims to normalize the definition of a **C**ockpit **D**isplay **S**ystem (CDS), and the communication between the CDS and **U**ser **A**pplications (UA) which manage aircraft avionics functions. The GUI definition is completely defined in binary **D**efinition **F**iles (DF).
The CDS software is constituted of a kernel which is able to create the GUI hierarchy specified in the DF during initialization, thus not needing to be recompiled if the GUI definition changes.
The standard normalizes:

- the GUI definition of the CDS interface, in a binary file called DF (Definition File) defining the structure of the graphical interface tree. The GUI tree is instantiated at initialization time (called the Definition Phase in the standard) in the CDS, using the definition contained in the DF;
- the communication at runtime between the User Applications (UA) and the CDS. This communication protocol is typically used for UAs to send widgets modifications to the CDS, and return user events (such as buttons selection) from CDS to UA.

In order to be compliant with the standard, a CDS must have a kernel that can create the widgets tree during CDS initialization, using the Definition File, and communicate with UA in both ways using the runtime protocol.
ARINC 661 does not imply the use of a particular Data bus structure to perform the low-level communication between CDS and UA. For example, an ARINC 429 or Ethernet protocol such as ARINC 664 can be used, but it is not mandatory.

4.2.2.1 GUI Structure

- The **Cockpit Display System (CDS)** is the graphic Server which is responsible to show and manage the GUI;
- A **User Application (UA)** is one system application which communicates with the CDS. The CDS manage one ore more Definition Files for each User Application. At run-time, messages are exchanged between UAs and the CDS;
- A **Definition File (DF)** specifies the GUI definition associated with one User Application (note that a User Application may be associated by more than one DF). A Definition File contains the definition of one or more Layers;
- A Layer (also named User Application Layer Definition or **UALD**) is a GUI container for widgets;
- A widget is the basic building block of the GUI

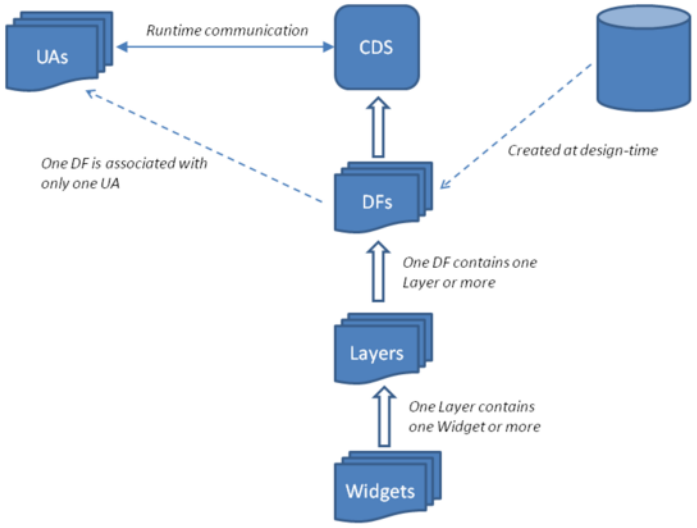

Figure 4.4: ARINC 661 structure

4.2.2.2 GUI Definition

Each DF binary file specifies the GUI definition for one User Application (UA) User interface. Several UA user interface trees can be combined to constitute the CDS display definition.

A DF is composed of two parts : an optional symbol definition, and a widgets definition. The widget library is similar to Widgets used in computing. There are Containers, Lists, ScrollPanes, Buttons, Menus, Labels, EditBoxes, etc...

Although the DF File is binary, the standard has also defined an associated XML definition, which is easier to manipulate in tools.

4.2.3 User Application

The UA contains the logic for each CDS. There are three generic CDSs are developed:

- Primary Flight Display (PFD)
- Fuel page

- Radio page

Each CDS is controlled by a UA. The main task for each UA is to update the widget's paremeters by sending precisely defined ARINC 661 messages to the CDS. The UA uses the simulator global variables such as speed, altitude, heading, etc., through a tailored simulator interface called SimIF, to build the message for the CDS. SimIF is a library that enables the UA to write and read simulator variables to and from the shared memory, which contains the global variables that the simulator needs to run its applications, including the PFD, fuel and radio variables.

4.2.4 Cockpit Display System

The CDS is made up of a number of Layers controlled by one UA. In A661, a Layer is the highest entity of the CDS as seen by the UA. From a CDS viewpoint, a Layer is a graphical entity related to the application within a window page. Layers are numbered and can be connected to a SuperLayer. Each Layer contains several widgets that are displayed as objects. The SuperLayer links all UA Layers for the flight deck together by a single CDS Layer. The SuperLayer also uses standard widgets, to define all of the groupings of functional UA Layers that are needed to draw each display and uses connectors to reference those functional UA Layers as shown in below figure.

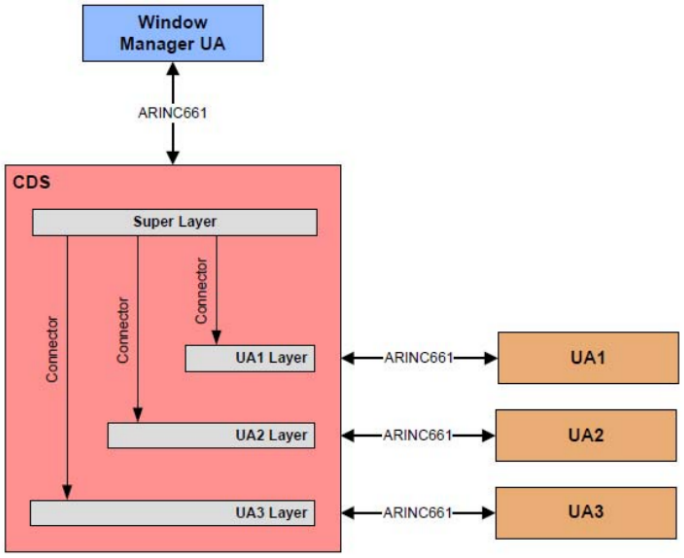

Figure 4.5: Super layer

This figure shows a Display Unit that has a set of windows, and each window is subdivided in a number of layers, which are owned by their respective UA.

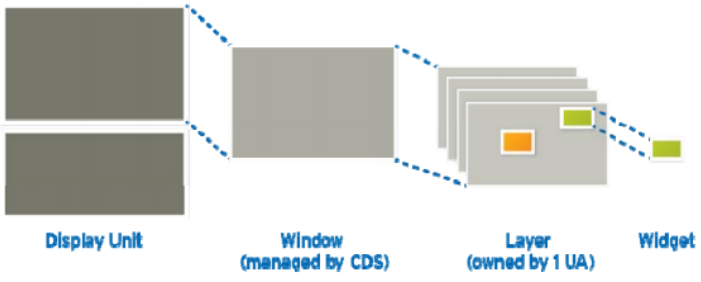

Figure 4.6: Window & Layer illustration

4.2.5 Window Manager

The Window Manager's primary task is to manage all the logical display of each CDS page as well as the page's selection interface, for the user to control **(CDS+UA)**.

4.3 Interface panels power and requirements

4.3.1 Simulation Interfacing Concepts

Figure shownws a typical power, lighting and interface signal requirements to drive an aircraft and simulated instruments/panels.

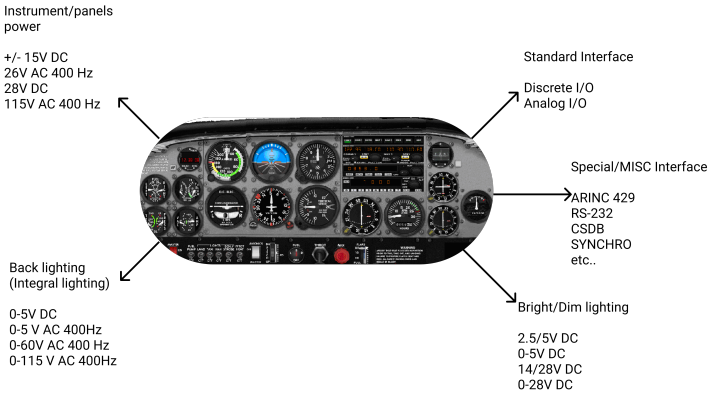

Figure 4.7: Aircraft panels power interface requirements

This figure is shown the Interface Systems Architecture.

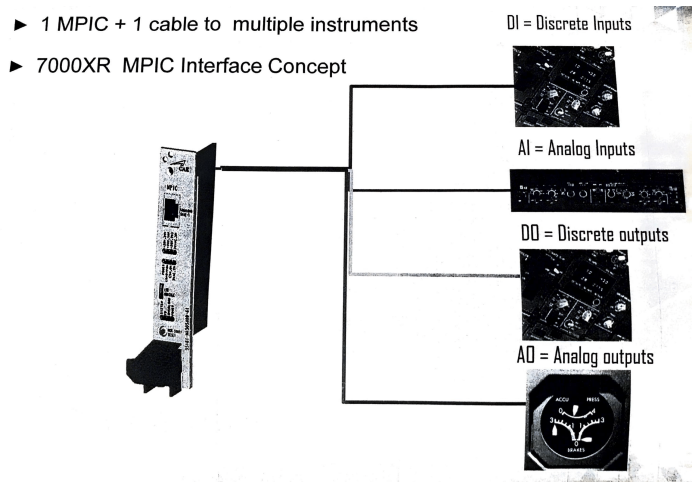

Figure 4.8: Interface systems architecture

Figure below here shows an actual typical aircraft wiring diagram for a lighting functionality.

- A switch (SW) turns the lamp on/off;
- A circuit breaker (CB) powers the bus;
- Lamp could be for reading, map utility light or annunciator light switch.

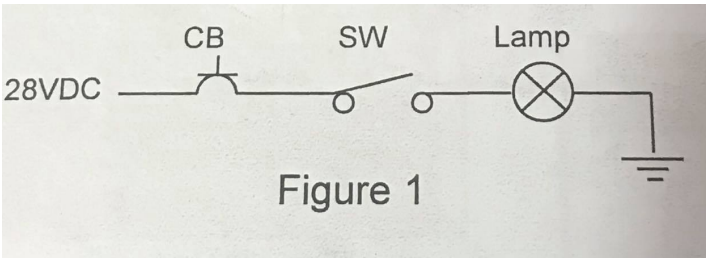

Figure 4.9: Wiring diagram for lighting functionality

And the typical interface simulation wiring includes:

- The DIP GND on the MPIC senses the status (on/off) of a switch (SW) or a circuit breaker (simulated CB);
- DOP 28V on the MPIC turns the lamp on/off;
- Additional DOP 28V and DOP GND create a fault (mal-function) condition;
- Software simulation manages all the above actions and also occasionally broadcasts aircraft condition to other simulation systems.

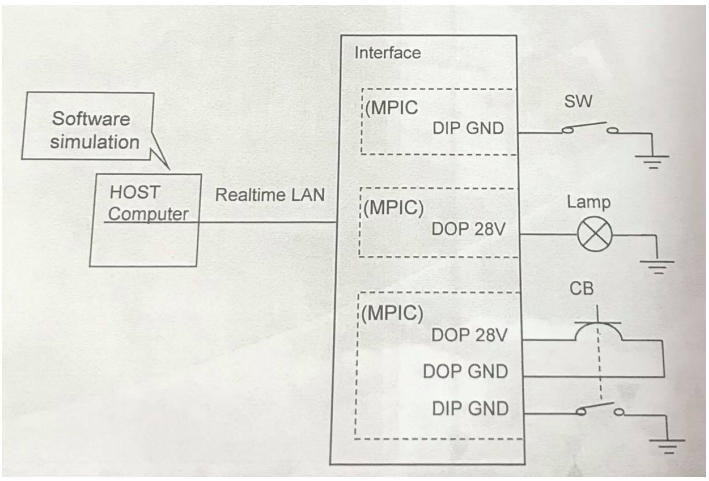

Figure 4.10: Interface simulation wiring

4.3.2 Major Components

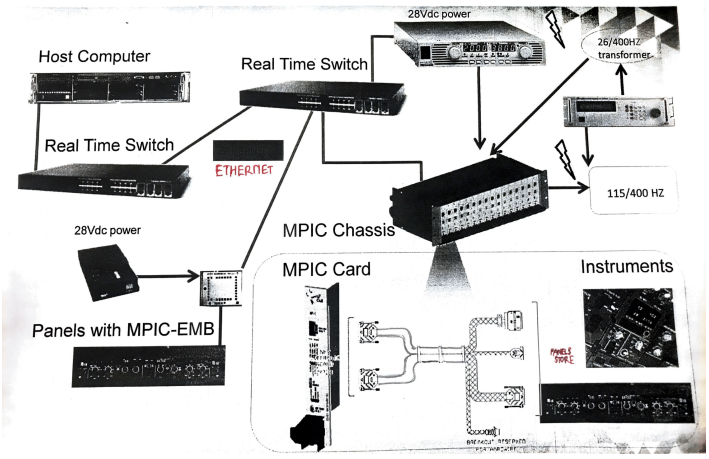

Figure 4.11: Interface systems architecture

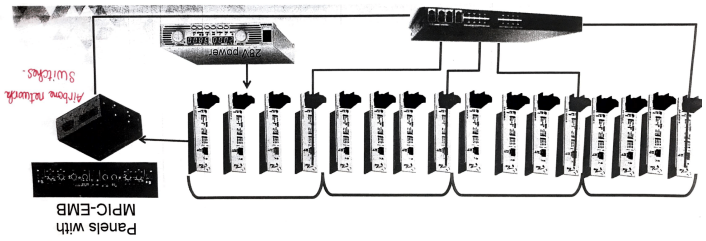

Figure 4.14: Module level network

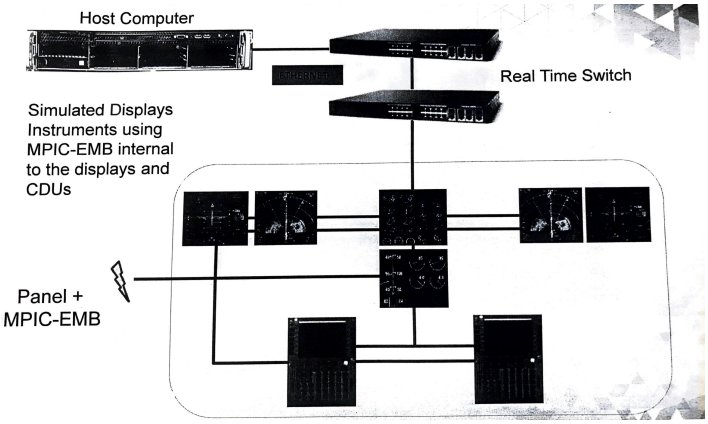

Figure 4.12: Simulated displays instruments

4.3.3 Network Architecture

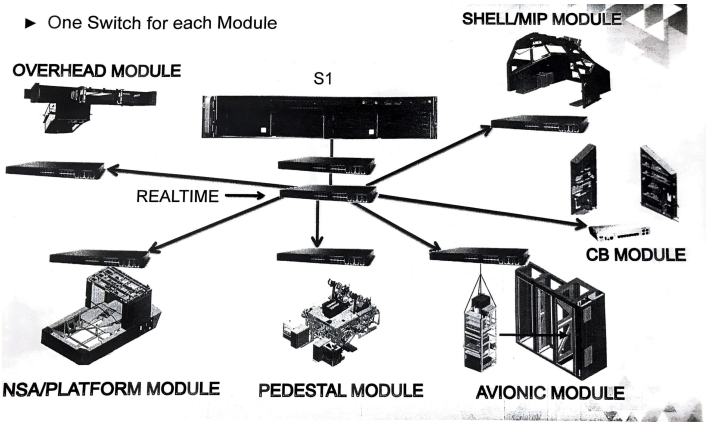

Figure 4.13: Network modules

4.3.3.1 Module Level

- MPIC chassis is composed of 16 MPIC slots, each divided in groups of 4;
- Each group of 4 uses the same Ethernet cable;
- Each MPIC-EMB has its own cable;
- An Ethernet cable part of a group of 4 can be plugged into any card in that specific group.

4.3.4 Communication Paths

Interface cards are connected to the Real time LAN.
Real time LAN is extended on the backplane.

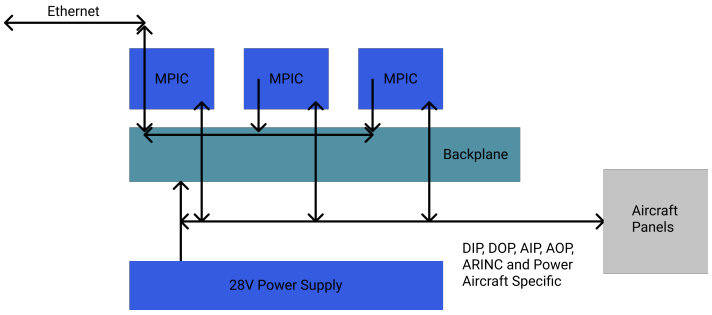

Figure 4.15: Backplane

4.3.5 Simulator Power Distribution

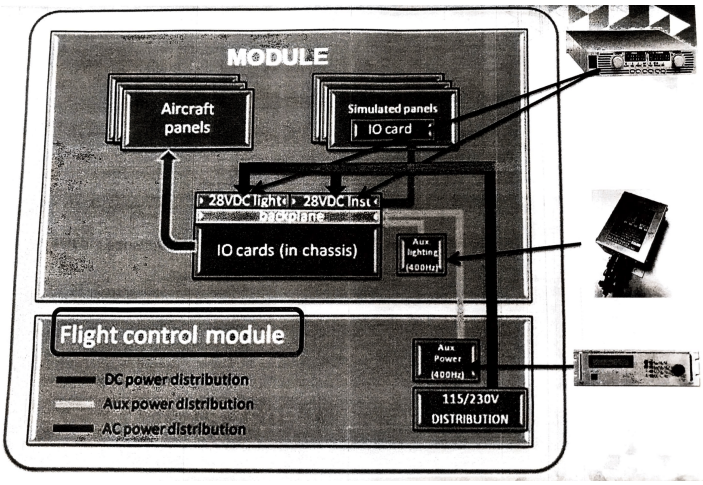

Figure 4.16: Flight control module

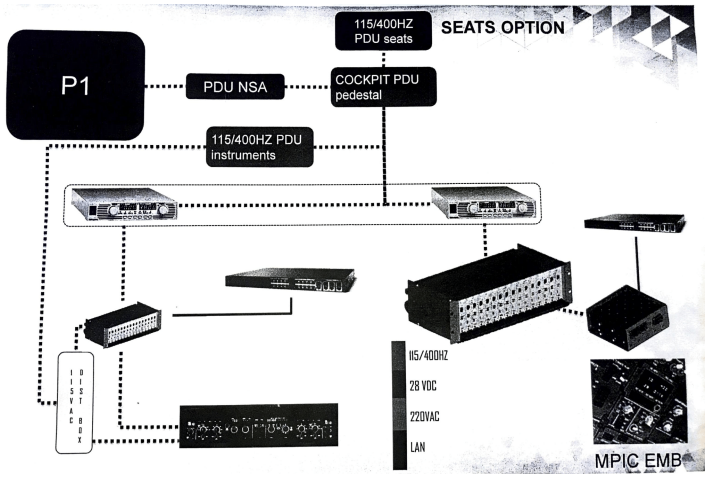

Figure 4.17: Seats option

4.4 Generic CDS Testing

Three generic CDSs have been initially created and tested on the CAE-MPIC. The development and tests conducted of those CDSs and their related UAs helped understand the specificities of ARINC 661. Furthermore, it allowed to observe some performance limitations and to determine the relevant benchmarking tests that must

be further conducted. The CDSs designed for the preliminary testing are very simple; the goal being the familiarization with the A661 standard.

4.4.1 PFD

The PFD is a non-interactive CDS. The widget positions are determined by the commands sent by the UA. The UA treats data received from the simulator. This new A661 PFD displays the same information as the simulator's PFD. This figure down here shows the PFD designed for the Benchmarking phase.

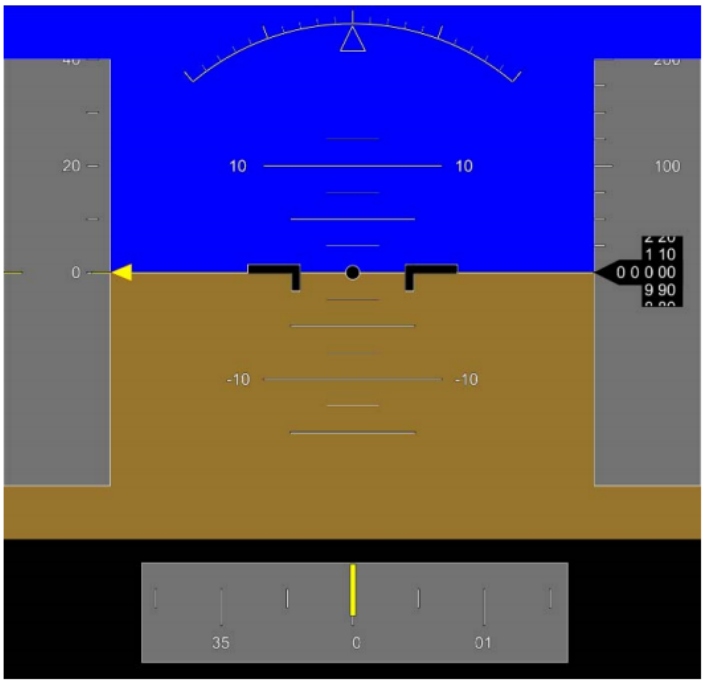

Figure 4.18: Primary Flight Display (PFD)

4.4.2 Fuel and Radio Page

Fuel and radio pages are interactive CDSs. Data is transmitted by the simulator to the UA that commands the appropriate W. The user has the ability to send commands to the simulator. The selection is done with interactive A661_TOGGLE_BUTTON widgets. Calculations, transmission to the simulator and display refresh are done by the UA.

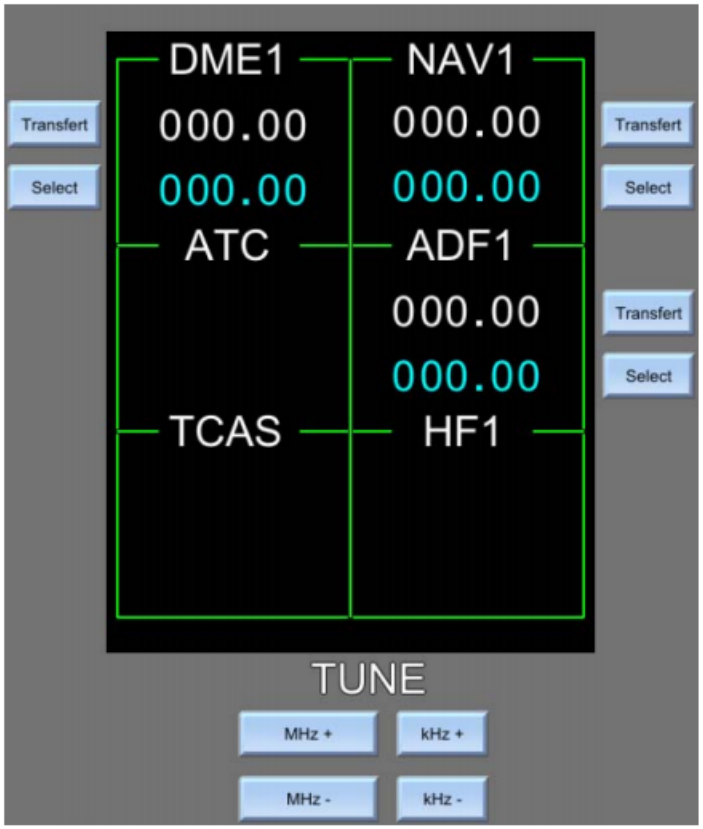

Figure 4.19: Radio page

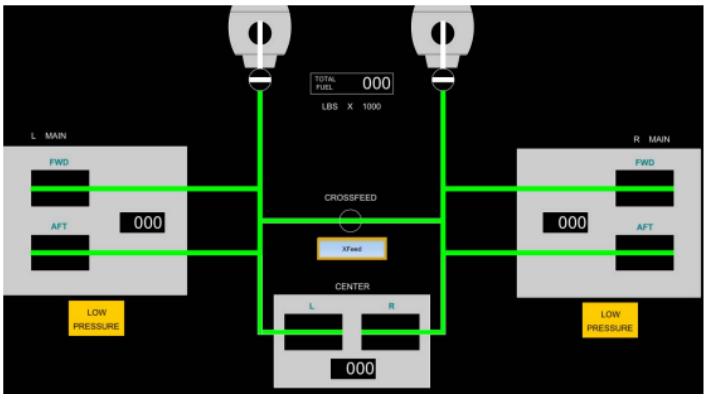

Figure 4.20: Fuel page

Chapter 5

CONCLUSION

5.1 Results

During my internship period at BAA Training Vietnam from January 18th 2021 to March 18th 2021, I have learned a lot from working evironment here.

Through the documents I have read as well as seen the maintenance process of the flight simulator, I personally see that the working process is not like what I had imagined. It will be quite simple because the equipment provided by the manufacturer to the company does not have too many technical documents as well as machine details inside, so the maintenance work of the maintenance staff here is Start the device, check all panels, as well as lights or buttons, if there is any damage or problem, the technician will review and replace the part, not repair it.

In addition to the knowledge about pilot training, under the dedicated guidance of the brothers and sisters in the company, I personally also learned more soft skills for the job such as:

- Communication skills when exchanging work with people in the company;
- Skills to read and filter documents on topics that you need to care about and research;
- Skills when working in a company with a large-scale and professional working model;
- Practice self-discipline and be careful when working;

5.2 Things That Have Not Been Done

Because of the short internship period, only 2 months, I did not understand all aspects of the training programs and did not have much access to the flight simulator at the company. The content shown in this report is the knowledge I have experienced in practice and only stops at the point of view of an intern who can only access everything through references that the technical department at the company provided.

In addition, at BAA Training Vietnam, contact with foreigners takes place regularly, so English is used frequently to communicate with superiors, colleagues and customers. This was a hindrance for me when I first started my internship, I have never worked in such an environment before so I had some difficulties in communication.

5.3 Lessons Learned

After completing my internship at BAA Training Vietnam, I realize that I have to study more. The knowledge at the school as a foundation helps me have an overview of the profession I am studying as well as gradually forming a career direction in the future. However, in order to develop myself in the most comprehensive way, I need to learn more, especially soft skills such as how to behave, communicate, connect with people in the company, how to receive information and handle them or work flexibly, etc. They help me work more efficiently, bring more productivity, no longer be surprised when receiving tasks and know how to collect information from many different sources to complete tasks into them. Also an advantage for my upcoming full-time job. However, not to stop learning, cultivating and upgrading from hard skills to soft skills every day is necessary to develop their abilities and knowledge.

THE REFERENCES

1. Operation Manual (Internal document from company)
2. Quality Management Manual (Internal document from company)
3. Grandjonc Thomas, Khattabi Yahya; 2016; "Benchmarking of the CAE-MPIC Interface Cards using ARINC 661 Standard"