CAREER EPISODE 3 –
ENGINEERING TEST STATION FOR AVIONIC UNITS

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CAREER EPISODE 3

ENGINEERING TEST STATION FOR AVIONIC UNITS

CE 3. 1 INTRODUCTION

CE 3.1.1 PROJECT DURATION

The project started in June 1996 and was completed by Jan 2000. This project was basically carried out in order to provide ground clearance of aviation equipments like Navigator units, Digital Flight Control computer, and quadruple fly by wire communication devices.

CE 3.1.2 PROJECT LOCATION

The project was carried out in Light combat Aircraft (LCA) hanger and Aircraft Research and Design Center. The campus is located in Bangalore, Karnataka state, India.

CE 3.1.3 NAME OF INSTITUTE

Hindustan Aeronautics Ltd. is a central government undertaking under the Defense Research and Development Organization (DRDO). It is located in Bangalore city, Karnataka state, India

CE 3.1.4 MY ROLE

I joined on Contract and based on my performance I was inducted in role of Assistant Engineer for this project. I reported to Deputy Manager, who was also our guide for this project. I had to interact with a large group of Scientist both local and from overseas.

CE 3.2 BACKGROUND

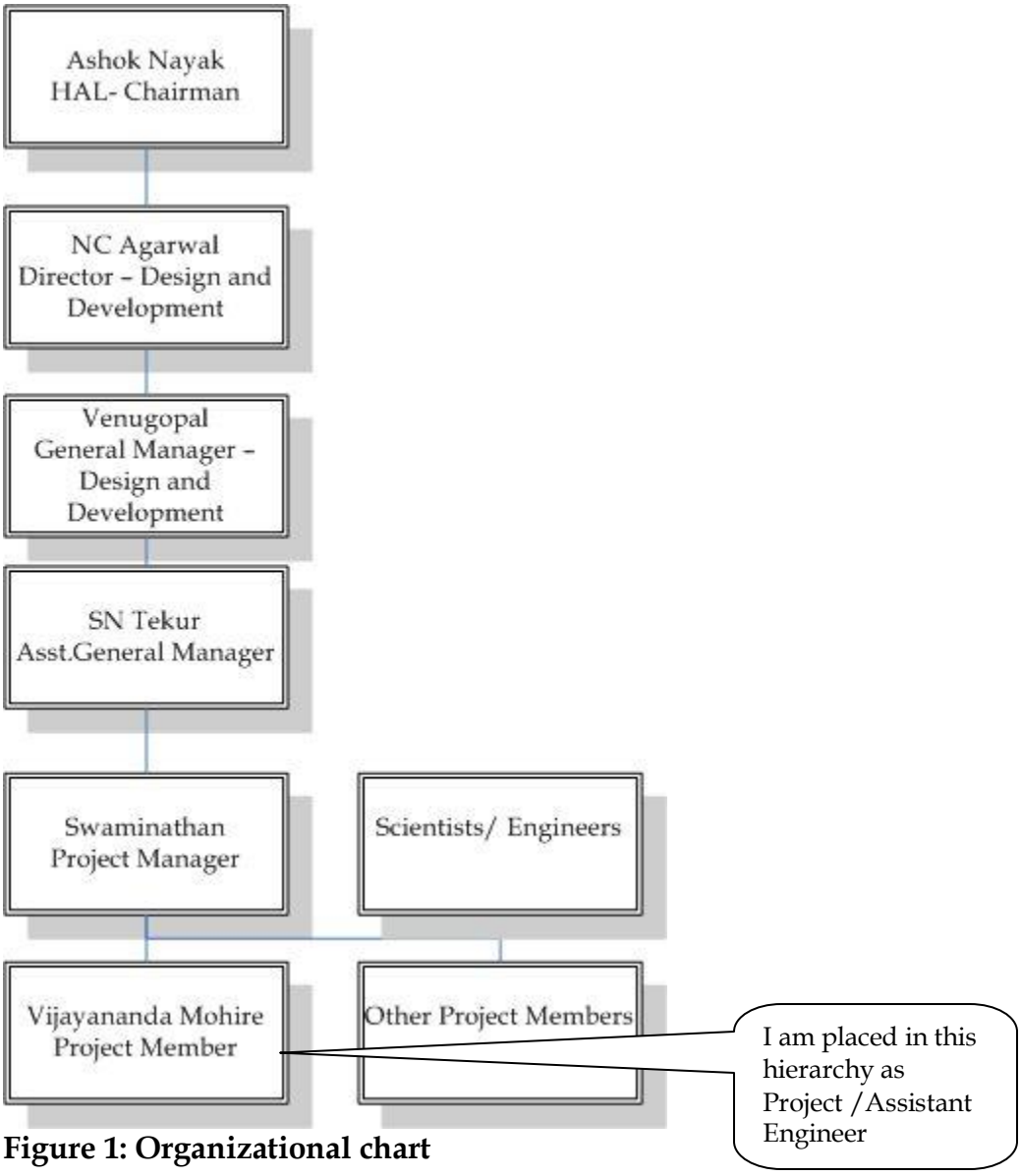

Figure 1: Organizational chart

CE 3.2.1 AIMS & OBJECTIVES OF THE PROJECT

- Study and Identify the existing systems and devices in hand
- Identify the gaps needed to execute the current test cases
- Design and develop missing electronic interfaces to the Flight control systems – hardware and software
- To develop suitable Low level programming meant for capture of instruction set from the Microprocessor

- ➔ To interfaces relevant external devices and toolkits for measuring digital avionic parameters like airspeed, vector velocity, angle of attack etc..
- ➔ To develop unit and integration test cases based on Defence standards
- ➔ To do testing on actual devices using real and simulated software and other COTS products

CE 3.2.2 METHODOLOGY

- ❖ Analysis of the existing testing platform – hardware and software
- ❖ Design new interfaces using electrical and electronic devices
- ❖ Interface with Electromechnical switches and actuators
- ❖ Design and develop Low level code using C and Ada to either simulate or extract data from the MIL-1553B bus.
- ❖ Mount the test devices in proper orientation – roll pitch and yaw
- ❖ Run the test cases under simulated conditions of varying flight parameters
- ❖ Confirm the behavior of the devices and tabulate the same
- ❖ Report the observations
- ❖ Provide clearance to the incoming devices that need to be on boarded to the actual aircraft.
- ❖ Repeat the procedures for different devices

CE 3.3 PERSONAL ENGINEERING ACTIVITIES

CE 3.3.1 ANALYSIS OF DFCC

I had to read operating manuals and attend session classes related to the DFCC and avionic industry standards.

I was able to identify and summarise the finding in short:
The DFCC is an Intel 80960 µC-based 32-bit quad redundant computer having a throughput of 2 MIPS (1750 digital avionics instructions per second equivalent). The cross-channel data links transfer data across the four channels at 2 MBPS. Over 512 parameters are exchanged for redundancy management. The I/O interface consists of 256 channels of 12-bit ADCs (analog to digital converter) and 32 channels of
12-bit DACs (digital to analog) with full scale accuracies of not less than 99.81 per cent and redundant high performance RS422 and MIL 1553B links to the rest of aircraft avionics and instrumentation. The DFCC has a fault detection capability of more than 95 per cent and has a proven reliability of 5235 hours MTBF.

CE 3.3.2 ANALYSIS OF ETS

I had to attend training sessions and get familiarize with the ETS. Also I had to identify the interface requirements and what all external and internal dependencies exist. In short I was able to summarize about the ETS.

This is a multi -processor-based realtime, automatic/manual test station used for the functional verification of FCS. Engineering test station (ETS) provides capability to simulate, stimulate, monitor and generate failure for all the inputs/outputs of the DFCC. The ETS is used for acceptance testing and real-time hardware/software integration of the DFCC, system integration, and testing of the LCA-FCS. It can replace some or all simulated sensors and actuators with real hardware. Also, the ETS interfaces with the mini-bird and iron-bird test facilities to monitor the DFCC performance during closed-loop testing, pilot-in-the-loop testing, interface calibration, end-to-end dynamic testing and FCS verification and validation.

Engineering test station

Mini-bird test stand

Figure 2: ETS and Mini Bird setup

The functional architecture I defined using Structured Analysis and Design Technique (SADT). I had to follow to follow Ward and Mellor DFD methodology. C and Ada languages were used as both design and code language. The software I developed and documentation broadly followed the MIL-STD-2167A standard. The software has been categorised as a computer software configurable item (CSCI) that executes on the hardware configurable item (HWCI). I had to work on the above defined principles and standards.

CE 3.3.3 DESIGN OF HARWARE AND SOFTWARE INTERFACES

- I designed and developed new circuit for proper power supply of the Navigator unit. I used the standard input and designed a mini board using electronic switches, rectifiers and power devices with power supply health indicators.
- I interfaced Data Device Corporation (DDC) chipset onto the external board using flat ribbon cables, RS232 serial communication cables.
- I developed low level code to capture and change the Timer settings in terms of nano seconds.
- I wrote interrupt sub routine for different interfaces
- I captured data from the RAM using suitable addressable memory, and made them persist onto archived files.
- I conducted the routine "Happy scenario" mode of operations, changed the external parameters and unit mounting positions and conducted several rounds of testing.
- I tabulated the readings and provided a copy to the reporting manager

One sample working scenario of the card was as Bus controller mode. I interfaced the required Pins of the chip and wrote code to run the card as Bus Controller and provide the controller settings to other terminals. Suitable data was coded in the data block and sent across to other terminals that would then take the commands and data.

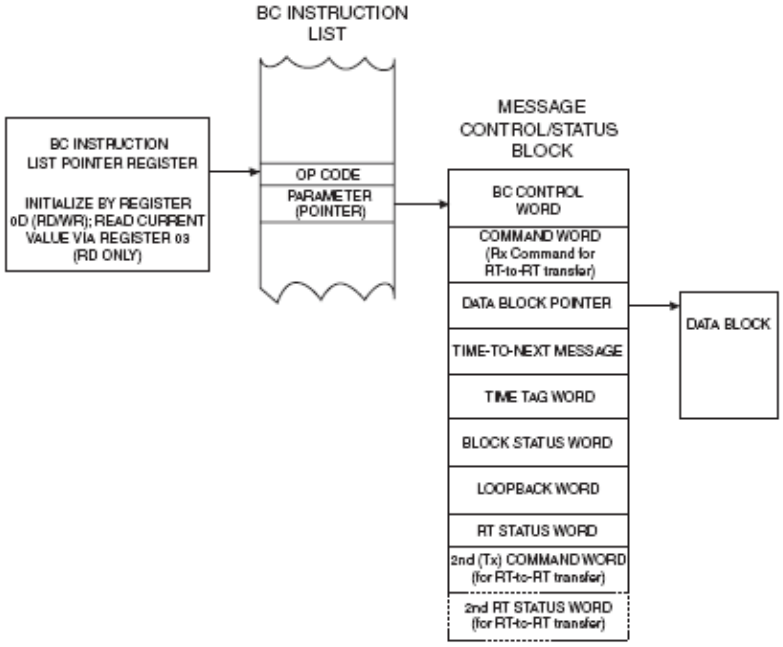

Figure 3: DDC chip in Bus controller mode

Below provides equipments used in one sample validation scenario

Sl.No	Equipment	Purpose
1	Connection Panel	This provides the equivalent functions of bus couplers, networks, terminators and cables required for test configurations.
2	1553 Bus Tester Oscilloscope, True RMS Voltmeter, Impedance Analyzer	Acts as external data monitoring devices
3	The 1553 Noise Generator	provides band-limited white Gaussian noise required for noise rejection testing of terminals designed to MIL-STD-1553

Table 1: Validation equipments

Sl. No	Parameter	Normal values	Recorded values
1	Vpp value [V]	18.0-27.0	18
2	Sync waveform - Tr value [nsec]	100-300	150
3	Data bit waveform - Tr value [nsec]	100-300	150

Table 2: Sample report

CE 3.3.4 MY TECHNIQUES AND STRATEGIES

- I adapted to the new environment that was quiet different from the academic world. This I did by observing carefully my seniors, their reporting orders, and their break times etc.
- I overcame few challenges like not making myself restricted to ideas and suggestions and at times I did advise changes in electrical wiring diagrams as it did not obey the laws of electricity.
- I had to start off without any help at times when I was on different shift and I did this by taking Knowledge transfer of staff on duty previous day.

- I used the official diary to record day to day works and that helped me recollect for any earlier issues that needed solution today.
- I got involved in a collaborative manner during Integration testing with other team members and had to trust on their efforts in delivering the results.
- I attended technical review meetings scheduled weekly to report and understand the progress of work. This needed me to be actively involved in the operations and provided me an opening to communicate effectively and seek help for any issues.
- I learnt a lot from senior scientist and overseas defense contractors who were working on the actual aircraft. I had to manage the language and accent they were speaking and had to respond properly.
- I learnt ways to reducing risks of failure due to human errors and report for any faulty operations immediately

CE 3.4 SUMMARY

My responsibility of design and implementation of the interfaces and testing of the avionic devices using ETS was completed successfully. This provided me the confidence to work on live projects and take on more responsibility of the same**.** I had good experience working of different engineering fields like Electrical, Mechanical and Instrumentation as relevant to Avionics.

Also this was a project I started off my career with the working knowledge in a Public sector and an opportunity to work hands on an aircraft.