

# Factory Acceptance Test of Static Flight Simulator Boeing 737 NG : Acquisition by Universiti Kuala Lumpur MIAT

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**Abstract-** Universiti Kuala Lumpur Malaysian Institute of Aviation Technology (UniKL MIAT) had acquired a static flight simulator of type Boeing 737 NG. Before the arrival of the simulator, a Factory Acceptance Test (FAT) was actuated in order to confirm the simulator would arrive according to the specifications and also within the correct conditions. FAT was also actuated to gauge the functionality of the components of the simulator and to confirm that it would be delivered according to the timeline. This paper delineated the FAT procedures that was implemented and the corresponding results of the FAT.

**Index Terms-** Boeing 737 NG, Flight Simulator, Factory Acceptance Test

## I. INTRODUCTION

There are myriad number of aircraft that are extensively used by airlines to transport passengers and cargoes. The Boeing 737 NG had been a popular choice by airlines to fulfill their objectives and the twin engine aircraft had shown to be efficient and economical. Hayward stated that Boeing's aircrafts were successful due to their fine design and their capabilities to meet various demands [1].

Pilots usually are trained in Flight Simulators before they proceed to handle actual aircraft. The simulators offer comprehensive training to pilots and could simulate numerous events and scenarios which test the pilots abilities and responses. One type of simulator is called the Static Flight Simulator which is a full fledged simulator minus the physical movement. This type of simulator is also certified by authorities like FAA and EASA.

Universiti Kuala Lumpur Malaysian Institute of Aviation Technology (UniKL MIAT) had purchased a Static Flight Simulator of type Boeing 737 NG where it would be used by it's students. Allerton indicated that simulators allows individuals to fix and find faults of components of the aircrafts without having to actuate costly procedures upon real aircrafts [2]. This itself is a benefit to aviation institutions like UniKL MIAT.

Simulations offer individuals the avenue to perform tasks repetitively till proficiency is achieved. According to Harridon, simulations or continuous training had shown to be effective in obtaining the desired results [3]. Harridon gave an example of

Aviation Search & Rescue where success depended upon well trained personnel. Thus the acquisition of the Static Flight Simulator is welcomed and desirable.

Before the arrival of the Static Flight Simulator to UniKL MIAT, a Factory Acceptance Test (FAT) was performed. The FAT had allowed UniKL MIAT to gauge and confirm the fidelity and conformance of the simulator pertaining to the given specifications. According to Kopcek, FAT is actuated in order to eradicate most of the undesirable traits such as faults or wayward entities [4]. FAT ensures the products that are received by the clients are within the tolerable range as agreed by the clients and sellers.

For the assessment and evaluation that were carried out pertaining to FAT, our team consisted of professionals with extensive experiences from the Aviation Industry. The team consisted of Test Pilot, Licensed Aircraft Engineer (Boeing 737), Licensed Aircraft Engineer (Boeing 737 NG), Licensed Aircraft Engineers (with ratings), Aviation Academicians, and others. This breadth provided the team with different perspectives with different approaches of evaluation which surmounted to a comprehensive evaluation process.

Due to the Covid-19 pandemic, the FAT was actuated online where the Original Equipment Manufacturer (OEM) had provided a live telecast of the demonstration of the Static Flight Simulator Boeing 737 NG. The simulator which was located in Poland had gone through scrutinization as outlined by our customized FAT methodology and the scrutinization was dealt by the assessment team of UniKL MIAT via Microsoft Teams (members of the assessment team were located throughout Malaysia).

## II. LITERATURE REVIEW

The Boeing 737 NG had been a popular choice by airlines throughout the world and the company that produced it had seen a surge of profits due to it's variants of Boeing 737, ranging from classical to NG [5].

To cater for training of flight crews, engineers, and technicians, flight simulators were built and produced. These simulators are vital in order to effectively produce personnel that are familiar with the working surroundings and able to act swiftly

in any situations. Boril mentioned that the usage of flight simulator would enhance flight safety as crews are trained in the simulator to anticipate any incoming dangers [6]. Boril further stated that the simulator could also be used to study pilot's limitations during flight.

Zheng pointed out that flight simulator gives opportunities to the pilots and engineers to test newly installed systems in real time and prepare them for the utilization of these newly installed systems in real life aircraft [7]. This approach reduces cost as not an ounce of fuel is burned during the testing or training of the newly installed system.

There were numerous flight incidents and accidents that occurred that had taken lives. These incidents and occurrences could be deterred if the pilots or engineers were aware of the situations before it happened. The situations could be simulated in the flight simulator in order to create awareness to the pilots and engineers and prepare and prep them early to counter the situation. Harridon had analyzed flight accidents of Helicopter Guimbal Cabri G2 and had stipulated that early and meticulous preparation for pilots is essential to prevent flight accidents [8].

As mentioned before, we had actuated FAT in order to gain the Static Simulator in accordance to the agreed specifications. FAT according to Vaisanen is a process of testing the

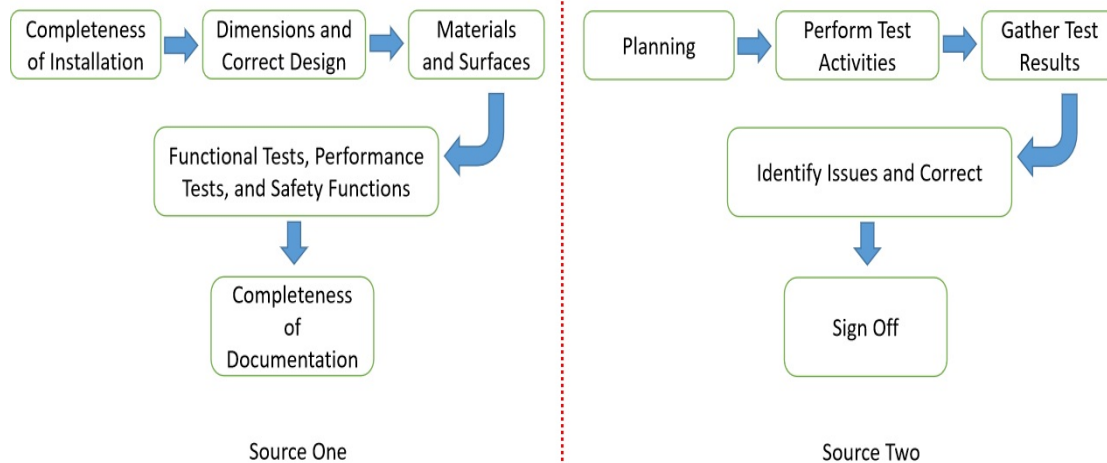
components of the product in order to gauge it's functionality before the product is shipped to the customer [9]. This is a logical approach by customer to ensure the capital spent is well worth.

Patel had performed FAT upon instrumentation that was acquired and Patel stated that FAT was performed in order to gauge the functionality of the instrumentation and also to measure the healthiness of the instrumentation as well [10].

FAT is constantly applied throughout wide variety of fields. In Aviation Search and Rescue, FAT was applied to equipment that were purchased in order to ensure they perform well during Aviation Search and Rescue. This was outlined by Harridon where he stated that management of Aviation Search and Rescue, which includes integrity of equipment, is vital in ensuring the success of Aviation Search and Rescue missions [11].

### III. METHODOLOGY

Several procedures existed in relation to Factory Acceptance Test (FAT). Figure 1 shows the general methodology of FAT which was derived from several sources.



**Figure 1. The General Methodology of Factory Acceptance Test from Two Sources**

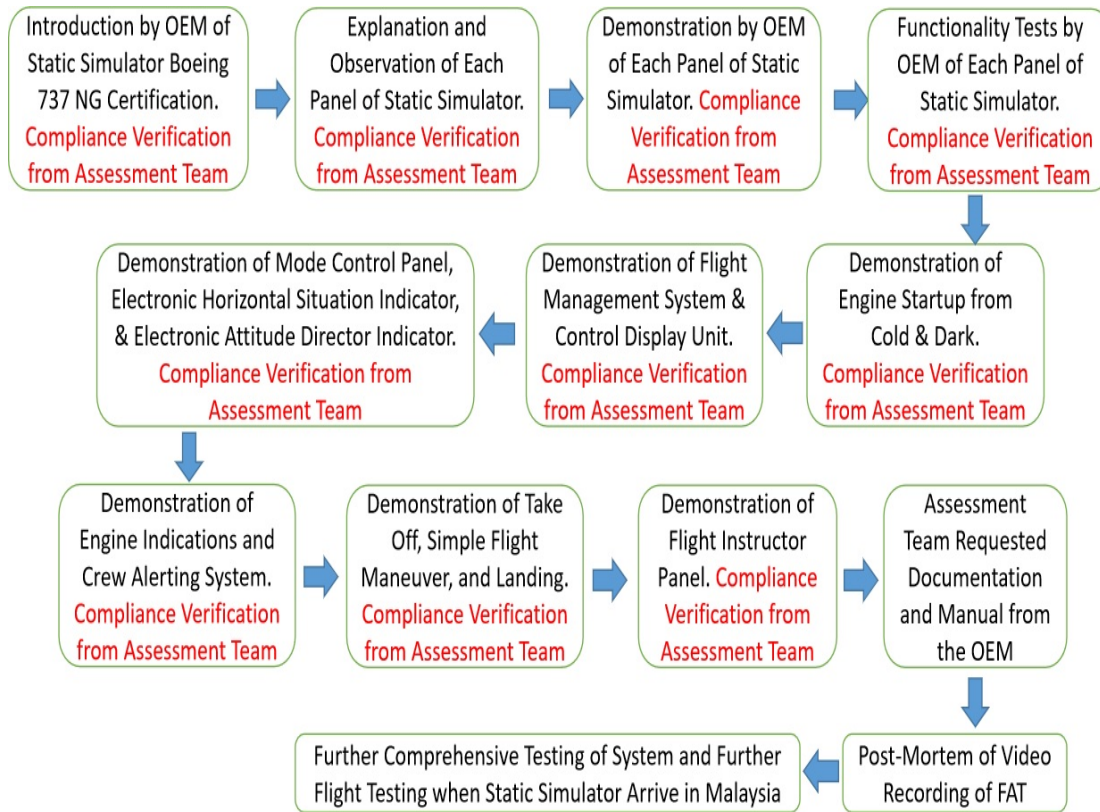
Two sources were taken into account and from these two sources 2 different methodologies of FAT were encountered. But there were components from these two methodologies that were similar or were in parallel. The similar components were Test Activities, which were obviously observed, Gathering of Test Results and Functional Test, which were not obviously seen but somehow were inherent in both sources as Test Activities usually involved data collection and functionality activities.

The methodology that we had utilized was a combination of the 2 sources and was further customized in accordance to the

technicalities and depth of the Static Flight Simulator of Boeing 737 NG. Our methodology was presented in the Results Section of this paper.

### IV. RESULTS

Our FAT methodology is shown in Figure 2 which was utilized by our team. Bear in mind the methodology was also customized in accordance to the medium of assessment and evaluation which is via online.



**Figure 2. Our Customized Methodology of FAT**

A more comprehensive detail of our FAT is shown in Tables 1 and 2.

**Table 1. Entities Evaluated**

STATIC FLIGHT SIMULATOR BOEING 737 NG	
PANELS EVALUATED	<b>Forward Overhead Panel</b> : Flight Controls, AC and DC Metering, Transfer, Standby Power and Generator Bus, Fuel, APU and Engine Start / External Lights, Ice and Rain Protection, Temperature Control, Pneumatics, Hydraulics, Cabin Pressurization, Emergency Exit Lights, Fasten Safety Belts Switch
	<b>Aft Overhead Panel</b> : Emergency Locator Transmitter, Dome Light, Audio Control, Electronic Engine Control, Flight Recorder, Oxygen, Redundant Landing Gear Annunciators
	<b>Electronic Attitude Director Indicator (EADI)</b>
	<b>Electronic Horizontal Situation Indicator (EHSI)</b>
	<b>Backup EADI / EHSI</b>
	<b>Instrument Lighting Control Panel</b>
	<b>Chronometer</b>
	<b>Annunciators</b>
	<b>Upper Engine Indications and Crew Alerting System (EICAS)</b>
	<b>Lower Engine Indications and Crew Alerting System (EICAS)</b>
	<b>Flight Management System and Control Display Units</b>
	<b>Center Pedestal</b> : Thrust Levers, Speed Brake Lever, Flap Lever, Pitch Trim Wheel, Fuel Control Levers, VHF Comm Radios, NAV Radios, Transponder, Audio Control, Lighting, Trim
	<b>Mode Control Panel (MCP)</b>
CONTROL SYSTEM EVALUATED	<b>Tiller</b>
	<b>Roll / Bank</b>
	<b>Pitch</b>

	<b>Yaw</b>
FLIGHT INSTRUCTOR PANEL EVALUATED	Airport, Runway Alignment, Wind Speed, Wind Direction, Data Collected After Each Flight
FLIGHT TESTING ACTUATED	<ol style="list-style-type: none"> <li>1. Engine Off at 24,000 feet</li> <li>2. Engine Start at 24,000 feet</li> <li>3. Stall</li> <li>4. Stick Shaker</li> <li>5. Stall Recovery</li> <li>6. Engine Off at 34,000 feet</li> <li>7. Engine Start at 34,000 feet</li> <li>8. Observation of Engine Start at Different Altitudes</li> <li>9. Change of Center of Gravity During Flight</li> <li>10. Observation of Pitch After Changed of Center of Gravity</li> <li>11. Bank at 30 degrees After Changed of Center of Gravity</li> <li>12. Fire Simulation</li> </ol>

**Table 2. Level of Evaluation and Assessment and Compliance**

Entity	Level of Evaluation / Assessment				Comply (Yes / No)	Comments
	Simple	Moderate	In Depth	Discrete		
Forward Overhead Panel			√		Yes	
Aft Overhead Panel			√		Yes	
Electronic Attitude Director Indicator (EADI)			√		Yes	
Electronic Horizontal Situation Indicator (EHSI)			√		Yes	
Backup EADI / EHSI			√		Yes	
Instrument Lighting Control Panel			√		Yes	
Chronometer			√		Yes	
Annunciators			√		Yes	
Upper Engine Indications and Crew Alerting System (EICAS)			√		Yes	
Lower Engine Indications and Crew Alerting System (EICAS)			√		Yes	
Flight Management System and Control Display Units			√		Yes	
Center Pedestal			√		Yes	
Mode Control Panel (MCP)			√		Yes	
Tiller			√		Yes	
Roll / Bank			√		Yes	

Pitch			√		Yes	
Yaw			√		Yes	
Flight Instructor Panel			√		Yes	
Flight Testing			√		Yes	More Discrete Flight Testing Would be Actuated After the Arrival of The Simulator in Malaysia

### V. DISCUSSION

Figure 2 show the FAT that we had employed. The FAT was fully customized in accordance with the systems and components of the Static Flight Simulator Boeing 737 NG. Each demonstration and testing by the OEM was evaluated and assessed by the team from UniKL MIAT and it's compliance or non compliance was noted. Any deviations from the agreed specifications were also noted. Further testings would be actuated when the simulator arrive in Malaysia.

Table 1 showed in details the systems and components that were demonstrated and tested. The Flight Instructor Panel was quasi tested and demonstrated but it was agreed by the team from UniKL MIAT that the panel far exceeded from the agreed specification based upon the live feed of the panel. Further testings of this panel would be done when the simulator arrive in Malaysia. Several flight tests were actuated by the OEM based upon the requested parameters where the requested parameters can be seen in Table 1. Further flight tests would be actuated upon the arrival of the simulator.

Table 2 showed the depth of evaluation and the compliance of each system and components of the simulator. Overall all the evaluations were in depth and all systems and components comply to the agreed specifications. It had to be noted that the Circuit Breakers were not simulated nor demonstrated as these were under the purview of another OEM. The Circuit Breakers would go though FAT at a later date. The flight simulator acquired by UniKL MIAT is a stepping stone in the alleviation of aviation studies in UniKL MIAT and its utilization would reap numerous benefits.

Another aspect of the flight simulator that could be utilized is the human factor analyses where pilots flying the simulator could be assessed in terms of strain acting upon their bodies during flights. Instead of actuating the assessment in real aircraft, the flight simulator could be used and this somehow would reduce cost. Harridon had laid out a methodology to assess strain of personnel in aviation and this methodology could be utilized for the assessment above [12].

With this in mind, we would like to stress again the importance of FAT where, as indicated by Leung, FAT is an approach to observe whether the acquired product had achieved certain criteria [13].

### VI. CONCLUSIONS

The acquirement of the Static Flight Simulator Boeing 737 NG is vital in the training of individuals in the aviation field. In any purchase, there is a risk involved especially in terms of non compliance to the agreed specifications. To eradicate or minimize the risk of the acquirement of the simulator, Factory Acceptance Test (FAT) was actuated by the team from UniKL MIAT in order to gain the simulator as stipulated by the agreed standards and specifications. The team had developed its own FAT methodology in lieu with the systems and components of the simulator. The assessment by the team were detailed out in this paper and overall the team was satisfied with the simulator.

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