Fact Sheet on ITE-ST Engineering Onboarding Aviation Skills, Knowledge and Innovation Learning Laboratory (Onboarding@SKILL)

Name of Training Facility	ITE-ST Engineering Onboarding Aviation **S**kills, **K**nowledge and **I**nnovation **L**earning **L**aboratory (Onboarding@SKILL)
Location	Block G, Level 2, School of Engineering, ITE College Central
Size	200 sq m

Operation Start Date: Mid-May 2025

Courses Supported

This facility is projected to **train over 380 students & trainees annually**:

- Higher Nitec in Aerospace Engineering (320 students per cohort)
- ITE Work-Study Diploma (WSDip) in Aircraft Engine Maintenance *(50 trainees per cohort)*
- ITE Work-Study Diploma (WSDip) in Aircraft Maintenance Engineering *(50 trainees per cohort)*

Usage

The facility is open for use throughout the term so ITE students will use this facility daily. Under the WSDip programme, Aircraft Maintenance Engineering trainees use the facility once a week while Aircraft Engine Maintenance trainees will use the facility when they have in-campus training (while they are on block release).

Purpose of the Facility

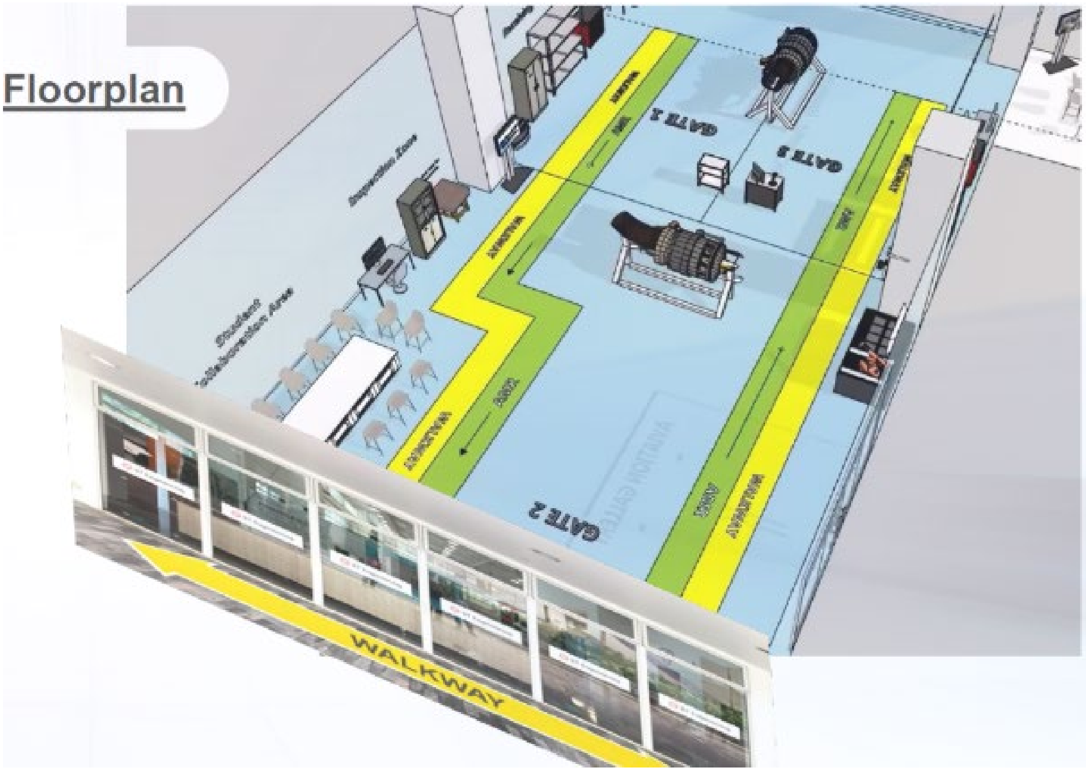
The facility is designed to deliver industry-leading training in aircraft engine Maintenance, Repair, and Overhaul (MRO). The replication of a real-world MRO environment seeks to equip learners with precise skills demanded by the aviation industry, effectively accelerating their onboarding as trainees and interns.

ITE is the first education institution in Singapore to work with ST Engineering on a learning facility focused on engine MRO. This collaboration will support the aerospace industry's growing demand by exposing and training students with industry-leading equipment. The facility mirrors key engine MRO processes as well as smart technologies that ST Engineering employs at its MRO shops. Through the Onboarding@SKILL facility, students from the three-year *Higher Nitec* in Aerospace Engineering course can interact with aerospace professionals from ST Engineering as early as their first year of studies.

Annex

Upon completing the *Higher Nitec* course, students can further their careers by enrolling in one of ITE's two Work-Study Diploma (WSDip) programmes, leading to employment with ST Engineering. This structured pathway allows graduates to become full-fledged technicians, with ST Engineering maintaining contact for future employment opportunities, including post-National Service for male students.

<u>Key Zones in the Facility</u>



Gate 1: Engine Reception and Initial Inspection

Gate 1 serves as the entry point for aircraft engines arriving for maintenance. Here, students will:

- Learn how to book in engines upon arrival
- Perform visual and borescope inspections to assess engine condition and integrity
- Remove line replacement units and other components requiring servicing or replacement
- Program and operate Automated Mobile Robots (AMR) for Dispatching of Parts to dispatch unserviceable parts for cleaning, inspections and repairs.

Gate 2: Cleaning, Inspections and Repair

Gate 2 focuses on the maintenance and repair of the components and parts removed from the engines at Gate 1. Activities in this zone include:

1. **Detailed Inspections and Testing:**
   - Components undergo detailed inspections and testing to identify any issues and determine the necessary repairs
2. **Repair and Overhaul:**
   - Identified issues are addressed through repair or overhaul processes, restoring the components to serviceable condition

3. **Quality Assurance:**
    - Rigorous quality assurance checks are performed to ensure that all repaired components meet the required standards and specifications

Post Gate 1, the serviceable parts are kept at the Kitting Store where they are packed into kits and ready for despatch to Gate 3 to re-assemble these parts into engines.

Gate 3: Reassembly and Final Testing

Gate 3 is dedicated to the reassembly of the engines and final testing before they are cleared for service.

1. **Reassembly:**
    - Students will reassemble the engines using the serviced components from Gate 2, ensuring all parts are correctly installed.
2. **Functional Testing:**
    - Comprehensive functional tests are conducted to verify that the engines operate correctly and safely after reassembly. (A Virtual Test Cell Simulator will be used for this purpose.)
3. **Final Inspections:**
    - A final round of inspections is performed to ensure that the engines meet all regulatory and safety standards before they are released back into service. Utilise Augmented Reality (AR) headgear and smart wearables for technology-assisted dispatch checks, allowing students to overlay digital information onto physical components for better assessment.

<u>Equipment & Technologies</u>

A **Robotic Arm Automated Polishing Machine** will be set up to allow students to understand and operate the machine. In an aerospace engine maintenance facility, robotic arm automated polishing plays a vital role in achieving consistent, high-quality surface finishes on engine components. These machines ensure precise material removal, deburring, and surface preparation, while maintaining tight tolerances and enhancing adhesion for coatings. They improve productivity by reducing manual labour and turnaround times, enhancing workplace safety, and providing consistent quality across multiple parts.

Engines Visual Information Systems (ENVIS) is a system that captures all worksheets and relevant reference documents in a digital format. ENVIS replaces the paper worksheets that had to be printed and manually signed/stamped. It allows an overview of the issued worksheets/tasks progression. This includes enforcement of limit checking for e-worksheet dimensional entries, Control and Validation of Approval status, SAP front-end for time clocking, Material & Outhouse processing. Aside from the above, the HIRA (Hazard Identification and Risk Assessment), Safety Data Sheet (SDS) are listed for user reference.

AMR for Dispatching of Parts is used to dispatch unserviceable parts to Gate 2, which ensures efficient and safe transport of the components within the facility. Students will gain valuable hands-on experience programming and operating these robots, learning to configure their routes, integrate them with digital tracking systems, and troubleshoot navigation or operational issues. This exposure helps them develop skills in automation, logistics, and smart factory management, making them proficient in the latest industry technologies.

The AMR will be used throughout the process delivering parts disassembled at Gate 1 to the next stages of cleaning, inspection and repairs at Gate 2. It then transports these parts for kitting at Gate 2. When ready, the parts at kitting store will be transported to Gate 3 for assembly.

Virtual Aircraft Engine Test Cell Simulator
An Engine Test Cell Simulator is a valuable tool for training aerospace maintenance students. It allows them to safely learn about engine performance, diagnostics, and troubleshooting in a controlled setting. By simulating real engine operations, students can practice interpreting data, identifying issues, and performing maintenance without the risks and costs of using actual engines.

In a vocational training environment, the simulator gives students practical experience with key aspects of engine function, like thrust, fuel use, and temperature control. This hands-on learning helps them understand how maintenance tasks affect engine performance and prepares them to handle complex systems with confidence. Overall, the simulator enhances their technical skills, making them more capable and job-ready for careers in aerospace maintenance.

<u>Specific Skills Development</u>
Through hands-on training with modernised equipment, students will acquire key in-demand skills essential for the aerospace industry. These include:

Technical Proficiency in Aerospace Maintenance: Students will develop expertise in engine inspection, disassembly, minor repairs, reassembly, and final testing. Working with AR tools and digital management systems ensures familiarity with modern industry practices. Inspection – Identifying of Engine parts, Defect identification & measurement (PMTE – Precision Measurement and Test Equipment), Borescope Inspection.

- **Automation & Robotics Operations:** Training with robotic arms, AMRs, and automated polishing machines provides experience in programming and managing automated processes, improving efficiency and precision in maintenance operations.
- **Digital Maintenance & Compliance:** Using ENVIS and other digital tracking systems, students will learn how to document maintenance tasks, track component lifecycles, and ensure regulatory compliance, aligning with industry requirements.
- **Problem-Solving & Teamwork:** Collaboration in inspection zones and repair stations encourages students to analyse issues, consult technical manuals, and make informed repair decisions, fostering teamwork and critical thinking skills.
- **A virtual Aircraft Engine Test Cell simulator**: Offers students a realistic, cost-effective, and safe learning experience by allowing them to simulate the operation, troubleshooting, and failure scenarios of aircraft engines. It provides hands-on training without the need for expensive physical equipment, enabling students to practice complex scenarios, gain real-time feedback, and better understand engine dynamics. This flexible tool enhances learning through repeated practice, helping students build confidence and problem-solving skills in a risk-free environment.

<u>Practical Experiences</u>
- General Maintenance Practices–Handling Common Tools
- POL –HIRA, SDS, PPE.
- Types of fasteners (e.g. cotter pins, tab washers etc.)
- Torque application –Torque wrenches, Torque meter.
- Lockwiring, Safe-T-Cable application.

DESCRIPTIONS OF EQUIPMENT IN FACILITY
Borescope Inspection in Engine Induction
At our Gas Turbine Engine MRO (Maintenance, Repair, and Overhaul) Facility, a borescope inspection is a critical part of the receiving check or induction process, allowing us to assess an engine's internal condition without disassembly. Using a high-resolution flexible or rigid borescope, our technicians inspect key components such as compressor blades, combustion chambers, turbine blades, and bearings for signs of wear, damage, corrosion, or foreign object debris (FOD). This non-intrusive diagnostic method ensures early defect detection, optimises maintenance planning, and provides clear documentation for customers. By performing a borescope inspection upon engine arrival, we enhance efficiency, reduce unnecessary teardown, and ensure compliance with operational and safety standards before further servicing.
ENVIS – Engines Visual Information System
The Engines Visual Information System (ENVIS) marks a major milestone in digital transformation within ST Engineering's engine MRO operations. In an industry where accurate documentation is critical, ENVIS replaces traditional paper-based workflows with intelligent electronic worksheets, significantly improving efficiency and reducing human error. Fully approved by U.S. Federal Aviation Administration (FAA), European Union Aviation Safety Agency (EASA), and Civil Aviation Authority of Singapore (CAAS), this system incorporates digital approval stamps, automated limit checks, and seamless integration with SAP (Systems, Applications & Products) and electronic manuals. The result is a streamlined process that drastically reduces paperwork and administrative tasks, enabling technicians to concentrate on core MRO duties.
Magnus Autonomous Mobile Robot (AMR)
The Magnus AMR is an intelligent indoor mobile robot developed to automate material transport within engine MRO facilities. Capable of carrying up to 300kg, it uses 2D laser scanners, wheel odometry, and orientation sensors to autonomously navigate its environment, detect obstacles, and dock at charging stations. The differential drive system at its core ensures high mobility, including on-the-spot turning. In this showcase, Magnus is equipped with a 3-tier rack for parts movement, relieving technicians of routine transport tasks and allowing them to focus on higher-value work, thus enhancing operational efficiency and shop throughput.
Eddy Current Inspection (ECI) Training
Eddy Current Inspection (ECI) is a vital non-destructive testing (NDT) method widely used in the aerospace industry for detecting surface and near-surface defects in conductive materials. As part of their technical training, students are introduced to ECI to develop the essential skills required for inspecting critical aircraft components such as turbine blades, fastener holes, and landing gear structures. During the training, students learn the fundamental principles of electromagnetism and how alternating current induces eddy currents in metallic surfaces. They are taught how to operate portable ECI equipment, calibrate probes, interpret signal responses, and identify common discontinuities such as cracks, corrosion, and material thinning. Emphasis is placed on precision, documentation, and adherence to safety and industry standards.

Hands-on practice with real aircraft parts and simulated flaws provides students with a realistic understanding of ECI applications in a maintenance environment. This practical experience not only strengthens their technical competency but also reinforces the importance of quality assurance and structural integrity in aviation safety. ECI training equips students with in-demand skills, preparing them for certification and future roles in aerospace maintenance and inspection.

Automated Polishing Machine (Robot Arm)

The polishing robot, featuring a collaborative robot (Cobot), automates the polishing of airfoil vanes — a crucial step to reduce airflow turbulence and improve engine efficiency. The robot autonomously picks up vanes, polishes them, and places them in the output tray, replacing what was once a highly repetitive and labour-intensive manual task. This automation not only saves up to 102 man-hours per engine but also improves workplace safety by minimising technicians' exposure to harmful metallic dust. The solution exemplifies how robotics can streamline production while safeguarding workers' health.

Student Innovation through SLA Printing for Process Improvement

As part of their hands-on learning and continuous improvement mindset, aerospace maintenance students are leveraging Stereolithography (SLA) 3D printing technology to bring their ideas and innovations to life. This initiative empowers students to design, prototype, and test custom aircraft tools, fixtures, and modified parts that address real-world maintenance challenges observed on the shop floor.

By using SLA printers, which produce highly accurate and detailed components, students can rapidly iterate their designs and evaluate fit, form, and function before committing to full-scale production. Projects include ergonomic improvements to hand tools, adapters for complex engine components, and protective housings for sensitive parts during handling or storage. These prototypes not only enhance safety and efficiency but also foster critical thinking, creativity, and a problem-solving mindset in a highly regulated industry.

This initiative demonstrates the students' proactive role in process improvement, encouraging innovation at the ground level while reinforcing practical applications of engineering principles. It also cultivates a culture of continuous learning and collaboration — key traits that prepare them for successful careers in the aerospace sector.

Engine Inspection Using AR Technology

The RealWear HMT-1 is a lightweight, voice-controlled wearable device designed to support hands-free aircraft engine inspections. It features a built-in camera and a small display positioned just below the user's eye level, allowing inspectors to stay focused on the engine while easily accessing digital instructions, input fields, and reference images. Integrated with ARIEX and powered by Vuforia Model Target technology, the device accurately identifies engine components using a pre-scanned 3D model, enabling precise AR marker overlays for guided inspections.

This smart solution streamlines data entry, enhances accuracy, and improves overall efficiency during engine dispatch checks. For students in training, the RealWear device offers a highly interactive and immersive learning experience, allowing them to familiarise themselves with real-world inspection procedures and engine components in a safe, controlled environment. By visualising AR-guided tasks, students can gain deeper understanding, build confidence, and bridge the gap between theory and hands-on practice.

Engine Virtual Test Cell Simulator

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