WORLDSKILLS SINGAPORE 2027
TECHNICAL DESCRIPTION
Unmanned Aerial Systems (UAS)

Skill Competition

1. Background

Unmanned Aerial System (UAS) is gaining prominence in multifaceted environments and applications, including military, societal, agricultural, and environmental purposes, disaster recovery, infrastructure assessment, and wildlife monitoring. Their industrial applications are growing rapidly. Within design and development frameworks and applications led by engineers, the UAS Technician builds, installs, tests, and maintains robot equipment. For this they may use a combination of mechanical, electronic, and computer engineering knowledge and skills.

In detail, the UAS Technician performs troubleshooting and maintenance tasks on unmanned aerial vehicles. They test different electronic components, circuits, and boards used in the UAS to find faulty parts by using various instruments and equipment. They replace faulty boards and components and perform essential surface mounted device (SMD) and de-soldering. They disassemble and assemble different parts of the system for testing and repair works with the different batteries used for the systems' power supplies, with different specifications, and with the different sensors used in various applications. They test different motors, such as Brushless Direct Current (BLDC) motors, Electronic Speed Controller cards, and their connectivity with the motors the flight controller, transmitter and receiver communication, and calibration landing gear, GPS Modules and other sensors, the transmitter, the control box to a receiver of the UAS, and the communication link all device controllers and their programming works on the system's internal software by installing and updating firmware and software packages and completing custom programming of systems is responsible for decision-making, path planning, and executing piloted and autonomous flight tasks.

The individual in this job identifies different applications and occupations in agriculture, mapping, surveillance, photography and videography, firefighting and emergency operations, various inspection tasks, surveying and construction, public safety and security. However, a UAS can be used in many more fields and emerging applications. In summary, the UAS Technician has tremendous potential to work within a range of business models that will create many career opportunities for development and progression.

2. Number of Competitors per team

Unmanned Aerial Systems (UAS) is a single Competitor skill competition.

3. Age limit of Competitors

The competitors must not be older than 22 years in the year of the competition.

4. Competitors toolbox

Competitors are not allowed to bring any toolbox to the Competition. All tools are provided by the Competition Organizer as competitors will not be allowed to bring their own tools.

5. Competition Format

The total duration of competition is 17 hours that is spread across 3 days. The competition will be conducted in a round robin format where the focus is on one / two specialization per day.

6. Modules Overview

Competitors are required to assemble a UAS that operates efficiently in customized environments for real-world scenarios or tasks. In accordance with the WorldSkills Occupational Standards (WSOS), the main Test Project is divided into multiple modules. Competitors are expected to identify the Primary Set of UAS performance requirements by analyzing the information provided in this document:

Module A: Work Organization and Management	Continuous
Module B: UAS Assembly and Manual Flight Test	5 Hours
Module C: Drone Diagnostics and Repair	1 Hours
Module D: Autonomous Programming and Flight Planning	2 Hours
Module E: Advanced Piloting and Vision Skills	3 Hours
Module F: UAS Prototyping, Modelling, and Mounting	3 Hours
Module G: Operational Challenges	3 Hours

Scope of Work

7. Module A: Work Organization and Management

Work Organization and Management primarily assess competitors' basic competencies, including their management of the workspace during the competition, punctuality in work processes, cooperation with other competitors when sharing the venue, and performance in communication with Judges. Assessment is ongoing all day and it will be conducted by a team of Experts.

The following are examples of potential criteria:

7.1 Adherence to the schedule.

7.2 Cooperative behavior with your Compatriot Competitor, Opponent Competitors, and the Experts.

7.3 Organization and management of the workspace.

7.4 UAS assembly Completed on Time.

8. Module B: UAS Assembly and Manual Flight Test

UAS assembly primarily assesses Competitors' assembly and commissioning capabilities; Competitors must complete the mechanical assembly and electrical connection of the UAS within the specified time to meet the assembly standards; Complete the overall commissioning of the UAS to meet the flight standards and complete the flight test.

Competitors will complete the assembly and configuration of the UAS as per the checklist supplied at the start of the module. They will then complete a manual test flight to confirm functionality and tuning characteristics.

9. Module C: UAS Diagnostics and Repair

Based on the given task requirements, competitors will use a supplied commercial UAS (agriculture or VTOL). They will be provided with the complete service and maintenance manual. Competitors will use an equipment inspection checklist. Competitors shall inspect the UAS for faults according to the checklist, record existing fault points, and use the components, tools, and materials provided to eliminate the faults if required.

This involves the following:

9.1 Drone Calibration and Maintenance

9.2 Battery Repair and Replacement

9.3 Motor and Propeller Replacement

9.4 Software Updates and Troubleshooting

9.5 Structural Replacement

9.6 Repair and Replacement of electrical components

10. Module D: Autonomous Programming and Flight Planning

In this Module competitors will use Mission Planner. The goal is to plan a UAS flight to track the desired waypoints or perform a specific task. To support the use of ArduPilot, the Mission Planner software is used to monitor the position and configure the control parameters of the UAS. Simulation test flights will be conducted in the Mission Planner simulation environment to verify the effectiveness of the ArduPilot waypoint navigation control system of the

autonomous flight.

Preparation Tips
Design challenging flight scenarios is essential for testing the capabilities of autonomous drones and improving their performance. The Mission Planner tool is a powerful software that allows users to create, simulate, and execute complex flight plans with precision and flexibility.

Creating Complex Flight Scenarios
Design challenging scenarios, consider incorporating elements such as multiple waypoints, altitude variations, and timed actions. Use the waypoint editor to add points that require precise navigation and set commands like camera triggers or sensor activations to increase complexity.

Adding Multiple Waypoints
Place waypoints strategically to simulate real-world obstacles or mission objectives. Adjust the drone's speed and altitude at each point to test its responsiveness and stability under different conditions.

Incorporating Dynamic Elements
Enhance your scenario by adding timed delays, specific camera angles, or sensor checks. These elements challenge the drone's ability to perform tasks accurately and adapt to changing environments.

Simulating and Testing Your Scenario
Use the simulation feature within Mission Planner to test your designed scenario without risking hardware. Observe the drone's behavior, identify potential issues, and refine your plan accordingly. Once satisfied, upload the mission to your drone for real-world execution. For example, if you want to use a drone for aerial photography, you may create a scenario that involves capturing images of a landscape, a building, or a certain object.

11. Module E: Advanced Piloting and Vision Skills

Competitors will demonstrate their UAS prototypes and complete tasks through autonomous flight programming, visual recognition and autonomous navigation.

Core Skill Sets include:

Drone Programming Essentials

- LUA Scripting
- Overview of MAVLink communication protocol
- Writing simple scripts for takeoff, navigation, and landing

Working with Hardware and Sensors

- Flight controller
- Integrating IMU, and cameras
- Calibrating sensors and configuring parameters

Autonomous Missions

- Designing waypoint-based missions
- Failsafe, and return-to-launch (RTL)
- Real-world testing and flight safety considerations

Extending ArduPilot with ROS2

- Connecting ArduPilot to ROS2 via MAVROS
- Building autonomy with ROS2 nodes
- Integrating computer vision for advanced UAV behaviors

The UAS relies on the on-board visual perception system to independently complete visual recognition, precise hovering, movement and image collection without manual intervention, this requires autonomous navigation stability and mission execution capability throughout the process.

12. Module F: UAS Prototyping, Modelling, and Mounting

This module assesses Competitors' competence in mechanical design, 3D modelling and 3D printing practical operations. It simulates a real operational scenario where UAS components are damaged or new components are required. The parts may be required for any of the UAS listed on the infrastructure list.

Core Skill Sets:

12.1 Knowledge of either Autodesk Inventor or Fusion for the design.

12.2 Competitors will need to develop a range of skills. Key competencies include proficiency in the CAD (computer-aided design) software, an understanding of materials science, and knowledge of 3D printing technologies and processes.

12.3 Ability to read technical drawings and data specifications

12.4 Mathematics and the use of measuring instruments such as rulers and digital calipers.

12.5 Familiarity with post-processing techniques and quality control measures is also beneficial.

13. Module G: Operational Challenges

Module G is based on an operational challenge, and competitors are responsible for decision-making, path planning, and executing piloted and autonomous flight tasks. Competitors will program the UAS to perform autonomous obstacle avoidance, target recognition, and payload delivery and verify these functions in the flight venue. Competitors will use the WS500 UAV Quadcopter Kit.

Assessment

14. Competitors will be assessed and marked by Judgement, Measurement, or both.

The assessment criteria and relative weighting of marks are as follows:

Module A: Work Organization and Management	10%
Module B: UAS Assembly and Manual Flight Test	20%
Module C: Drone Diagnostics and Repair	10%
Module D: Autonomous Programming and Flight Planning	15%
Module E: Advanced Piloting and Vision Skills	15%
Module F: UAS Prototyping, Modelling, and Mounting	15%
Module G: Operational Challenges	15%

Major Equipment, Tools and Materials

15. The major tools and materials used for the competition will be communicated to the competitors during training and reflected on the project papers**.**