



Technical Description

Mobile Robotics

Technical Committee has adopted the following minimum requirements for this skill for the WorldSkills ASEAN Competition.

The Technical Description consists of the following:

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Indra Adji Sulistijono
Technical Committee Chair

1. INTRODUCTION

1.1 Name and description of skill

1.1.1 The name of the skill is Mobile Robotics.

1.1.2 Description of skill

The theoretical and practical training of the Mobile Robotics technician is concerned with the mechanical and control systems of mobile robots.

Mobile Robotics technicians assemble, set up, manage and maintain mechanical systems within a mobile robot as well as install, operate and trouble shoot mobile robot control systems.

1.2 Scope of application

1.2.1 Every Expert and Competitor must know this Technical Description.

1.2.2 In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.

1.3 Associated documents

1.3.1 As this Technical Description contains only skill-specific information it must be used in association with the following:

WSI - Competition Rules

WSI - Competition Manual

WSI - Online resources as indicated in this document Host

Country - Health and Safety regulations

2. COMPETENCY AND SCOPE OF WORK

The Competition is a demonstration and assessment of the competencies associated with this skill.
The Test Project consists of practical work only.

2.1 Competency specification

The Competitor must be able to:

Solve logic problems.

Carry out mobile robot system design.

Assemble a mobile robot according to manufacturer's documentation.

Design a mobile robot control program.

Connect a mobile robot to its control system.

Commission a mobile robot to carry out its correct function to solve a series of practical operational problems as set by the Experts.

Interpret hardcopy and/or electronic forms of manufacturer's technical documents.

2.2 Theoretical knowledge

- 2.2.1 Theoretical knowledge is required but not tested explicitly.
The Competition Tasks will consist of practical work only.
Theoretical knowledge is limited to that necessary to carry out the practical work related to installation and operation of mobile robot mechanical and control systems. This may include the reading and interpreting of manufacturer's drawings, sketches or schematic diagrams.
Knowledge of rules and regulations related to the field of mobile robotics will not be examined.
- 2.2.2 Knowledge of rules and regulations is not examined.

2.3 Practical work

There will be two Competitors per team. Team composition may include a mechanical systems specialist and a control systems specialist or involve Competitors with Expertise in both areas. The Competition may include team and individual tasks.

3. THE TEST PROJECT

3.1 Format / structure of the Test Project

The format of the Test Project is a series of 3 standalone modules involving Robots plus Competitor's prepared add-on components

3.2 Test Project design requirements

The total working time for the complete set of modules will be between 18 and 22 hours.

There will be new modules assigned each of the three WorldSkills ASEAN Competition days. The modules will consist of practical work only.

Teams will work for three Competition days

Robots with sensor and camera are provided by sponsor. Additional components/attachments to robot are to be prepared by Competitors.

Note: None of the modules allow destructive robot behaviour.

Define the various operational environments in which the competition robots must function.

Define the different functional mobility and target object management tasks that the competition robots must accomplish.

Define the nature of the relationship between the Competitors and their competition robot when it is performing in the Mobile Robotics Competition Arena. Define the rules of play and scoring criteria for each module.

Any instructions to Competitors will be provided through the module documents.

The teams of Competitors will be required to assemble, maintain, repair and operate mobile robots.

The Competition robots will be required to complete various tasks (modules) set by the panel of Experts.

The modules will require Competition robots to perform tasks that reflect industrial / commercial mobile robots at work.

Competitors must generate all programs required by their mobile robots for the automated tasks.

Individual Mobile Robotic modules will require the production / preparation of robots for performance in the Competition Arena during each session.

There will be a 3 hour morning and a 3 hour afternoon sessions each day.

Each session will comprise:

Robot programming / Assembly / Troubleshooting / Maintenance work / Robot performance in Competition Arena

Each module will include details defining the particular rules of the Competition Arena game and scoring pattern that will be applied in that module.

Each module will be unique, however they will all address two primary robot performance areas:

- 1 Overall Robot Mobility Tasks
- 2 Target Object Management Tasks

Each module will have a unique Competition Arena Presentation, however they will follow one of two core patterns.

- 1 Independent Mobile Robotics Competition Arena Space where individual robots are in the Competition Arena alone and
- 2 Shared Mobile Robotics Competition Arena Space where two or more robots are active in the Competition Arena at the same time.

A variety of structures may be added to the Mobile Robotics Competition Arena to define unique competition environments for each of the Mobile Robotics modules.

The Competition Arena floor setup for each module will be unique.

3.3 Test Project development

The Test Project MUST be submitted using the Word template for text documents and DWG template for drawings.

3.3.1 Who develops the Test Project / modules

The Test Project/modules are developed by all Experts.

The Mobile Robotics modules will be developed by the Mobile Robotics Experts in consultation with the Chief Expert and the Robot Manufacturer Product Manager.

The design team is open to any country/region to provide suggestions

3.3.2 How and where is the Test Project / modules developed

The Test Project / modules are developed jointly on the 1st Technical Committee Meeting

The Test Projects will be developed through the 1st Technical Committee Meeting and during the preparation days prior to the Competition based on the following format:

A *Competitor Pre-Competition Information Package* will be developed through the 1st Technical Committee Meeting and an expected publication date of the first week in May 2016. The *Competitor Pre-Competition Information Package* will provide essential generic descriptions defining the broad range of robot / Competitor performance capabilities that Competitors will need to execute in Kuala Lumpur. The Expert meetings held during the preparation days at the Competition will set the final Competition tasks based directly on the task variables described in the *Competitor PreCompetition Information Package*.

3.3.2 When is the Test Project developed

The *Competitor Pre-Competition Information Package* which defines the Test Project variable collection is developed by 6 months before the Competition.

3.4 Test Project marking scheme

Each Test Project must be accompanied by a marking scheme proposal based on the assessment criteria defined in Section 5.

3.4.1 The marking scheme proposal is developed by the person(s) developing the Test Project. The detailed and final marking scheme is developed and agreed by all Experts at the Competition.

3.4.2 Marking schemes should be entered into the CIS prior to the Competition.

3.5 Test Project validation

It must be demonstrated that the Test Project/modules can be completed within the material, equipment, knowledge and time constraints. This will this be demonstrated by the Skill Management Team:

The Skill Management Team will be responsible for ensuring that:

The Mobile Robot modules are accurate and complete.

The Mobile Robot modules can be completed in the prescribed time of 6 hours.

Proper function is achievable.

The material/equipment list is accurate.

Competitor instructions are kept to a minimum of text, and that they do not exceed the available space permitted on the approved instruction sheet for any one module.

The Mobile Robot modules are complete in all aspects. This part of the preparation must be completed five (5) months prior to the WorldSkills Competition.

3.6 Test Project selection

The Test Project is selected by a combination of vote of Experts on the Discussion Forum and vote of Experts at the current Competition.

3.7 Test Project circulation

The Test Project is circulated via WorldSkills ASEAN website as follows:

The Mobile Robotic modules will be disclosed to the Competitors at the Competition site. Test Project descriptions will be provided at the start of the session

3.8 Test Project coordination (preparation for Competition)

Coordination of the Test Project will be undertaken by the Skill Management Team

3.9 Test Project change at the Competition

Not applicable. Final Test Project details (Robot Court Layout / Target Object Selection) will be set by the Mobile Robotics Experts during their pre-competition meetings.

3.10 Material or manufacturer specifications

Sponsorship, specifications, supply and support for the selected hardware and software will be coordinated by the host Member Workshop Supervisor and the Chief Expert. Details will be posted on the 1st Technical Committee Meeting as soon as they are finalised or at the very latest 5 months prior to the Competition.

4. SKILL MANAGEMENT AND COMMUNICATION

4.1 Discussion Forum

Prior to the Competition, all discussion, communication, collaboration and decision making regarding the skill must take place on the skill-specific 1st Technical Committee Meeting. All skill-related decisions and communication are only valid if they take place on the forum. The Chief Expert (or an Expert nominated by the Chief Expert) will be moderator for this forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

4.2 Competitor information

All information for registered Competitors is available from the Competitor Centre:

<http://www.wsasean.org/forums>

This information includes:

- Competition Rules
- Technical Descriptions
- Test Projects
- Other Competition-related information

4.3 Test Projects

Circulated Test Projects will be available from website

4.4 Day-to-day management

The day-to-day management is defined in the Skill Management Plan that is created by the Skill Management Team led by the Chief Expert. The Skill Management Team comprises the Jury President, Chief Expert and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalised at the Competition (agreed by Experts and submitted to the Chair/Vice Chair of the Technical Committee). The Chief Expert is to regularly share updates of the Skill Management Plan via the Forum.

5. ASSESSMENT

This section describes how the Experts will assess the Test Project / modules. It also specifies the assessment specifications and procedures and requirements for marking.

5.1 Assessment criteria

This section defines the assessment criteria and the number of marks (subjective) awarded. The total number of marks for all assessment criteria must be 300.

Each full day module will carry a value of 100 marks.

Module marks will be entered at the end of each day.

It will take only 1 days for all Competitors to complete a module

5.2

Section	Criterion	Marks		
		Subjective (if applicable)	Objective	Total
A	Module 1 (Day 1)	0	30.00	30.00
B	Module 2 (Day 2)	0	33.50	33.50
C	Module 3 (Day 3)	0	36.50	36.50
Subjective marking				
Total =		0	100.00	100.00

5.3 Skill assessment specification

Evaluation will be based directly and exclusively on mobile robot performance in the Competition Arena.

The overall framework for the modules will be developed in the 1st Technical Committee Meeting and finalized during the pre-Competition meetings.

All modules will involve the following primary elements:

Managing overall Robot mobility within the competition court environment utilizing all of the Mobile Robots mobility management capabilities.

Robots will work in court environments that are structured to provide either exclusive use of a court space or shared use of the court involving direct robot to robot interaction.

Interacting with Target Objects within the Competition court environment which may involve:

- Searching for and locating designated Target Objects
- Interacting with designated Target Objects including:
 - taking full possession of these objects
 - delivering these objects to designated locations

The 1st Technical Committee Meeting will focus on the creation of a *Competitor PreCompetition Information Package*. This package will be finalized through Discussion Forum Poll and published to Competitors in April 2016.

5.4 Skill assessment procedures

Final overall standing will be based on the total points scored by a team over the three WorldSkills ASEAN Competition days combined.

Time to complete

'Time taken to complete the task' will be one of the most significant components used to evaluate mobile robot performance. In a properly designed module, the majority of the competing mobile robots will be able to complete the assigned tasks to some degree. However, it should be anticipated that more than one robot will complete the module entirely. Just as is the case in industry, degree of efficiency will become the important relative measure. If it is determined that multiple Competitors have indeed completed the assigned task set equally then time taken becomes the critical, distinguishing, objectively measurable and transparent critical variable. This will apply equally both where a definite time limit has been preset (for example four-minute game duration) or when teams are allowed to take as long as they need to complete the task.

All marking will be objective in accordance with the marking scale set out in each Mobile Robotics module.

The three days competition periods will carry equal weight in the overall evaluation process. The degree to which a Mobile Robot is able to complete the various competition tasks taking into consideration preset performance efficiency standards as the core evaluation criteria. Marking is to be entered after each module has been completed. A sample marking scale and instructions for referees is to be included in each module.

Experts/Referees are to complete an Objective Marking Sheet for each module completed, for each team.

One courts

There will be only One Distinct Competition Robot Courts, which will use exclusively for Autonomous and also have a Combined Autonomous Performance. Competitors must adapt Competition Court environments.

Team competition

Mobile Robotics is an individual team competition. The rules for all modules will require all Competitors to focus on maximizing their own score. Teams may not act in a supportive partnership with an opponent.

6. SKILL-SPECIFIC SAFETY REQUIREMENTS

Refer to Host Country Health & Safety documentation for Host Country regulations.

Competitors observed by the Experts to be exercising unsafe work place practices will be directed to stop working and required to demonstrate to the Experts that they have corrected the safety concern before they will be allowed to resume working.

All Competitors must use safety glasses when using any hand, power or machine tools or equipment likely to cause or create chips or fragments that may injure the eyes.

7. MATERIALS & EQUIPMENT

7.1 Infrastructure List

The Infrastructure List lists all equipment, materials and facilities provided by the Host Country.

The Infrastructure List specifies the items & quantities requested by the Experts for the next Competition. The Host Country will progressively update the Infrastructure List specifying the actual quantity, type, brand/model of the items. Host Country supplied items are shown in a separate column.

At each Competition, the Experts must review and update the Infrastructure List in preparation for the next Competition. Experts must advise the Secretary General of any increases in space and/or equipment.

At each Competition, the Technical Observer must audit the Infrastructure List that was used at that Competition.

The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.

7.2 Materials, equipment and tools supplied by Competitors in their toolbox

- 2 laptop computers. The *Competitor Pre-competition Information Package* will address the questions of (a) whether teams will be allowed to use two computers in their workspace, (b) the minimum specifications for the competitor computers and (c) whether competitors need to bring a spare computer for back-up purposes in the event of major computer hardware failure. Teams will be limited to the use of one computer in the court area.
- 1 set of screwdrivers, plus other small hand tools and small portable power tools which is deemed necessary to maintain their robot
- 1 two meter measuring tape
- Competitors should bring a USB Flash Drive for the purpose of storing back-up files and for transferring files between the Team's two lap top computers. Note: These USB Flash Drives will be kept in the Competition area at all times during the four Competition days. Mobile robots for use in the modules Robotino from Festo Didactic

** Quantities specified are the minimum – Competitors may bring more than one.*

7.3 Materials, equipment and tools supplied by Experts

1 stopwatch with 1-second accuracy
Competition Target Object Collection for use in the modules
Mobile Robot Parts Collection for use in the modules
1 set of notepad, pencil, pen etc.

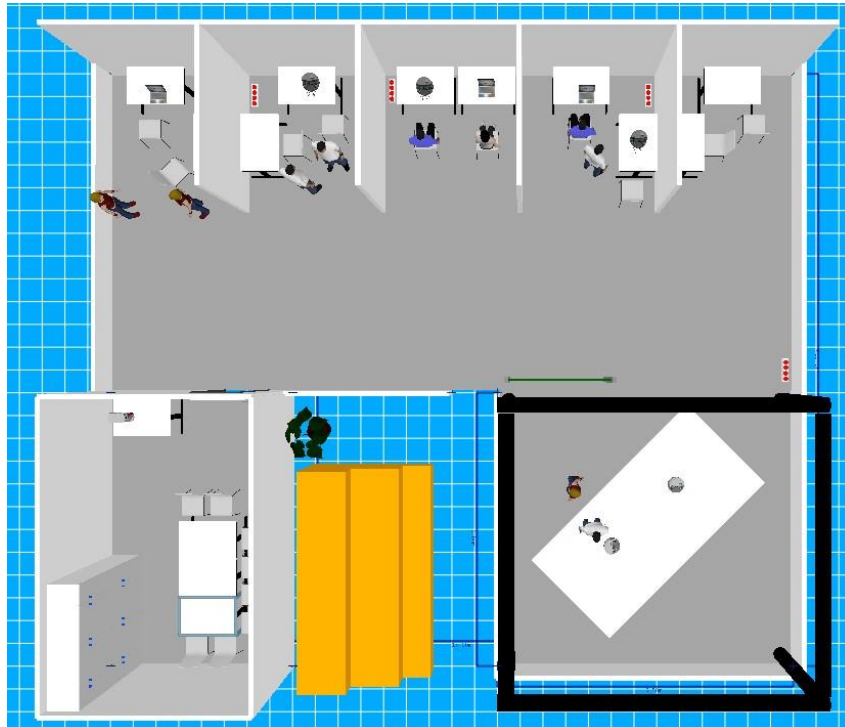
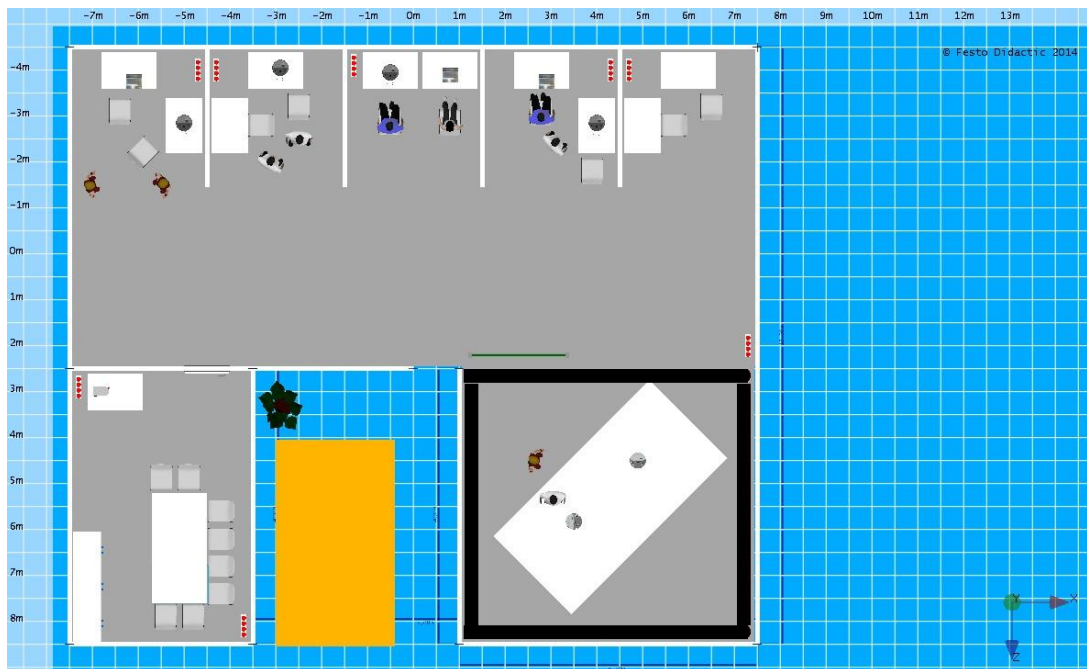
7.4 Materials & equipment prohibited in the skill area

No CDs/DVDs, floppy disks, flash memory or any other digital storage device containing prepared robot programs may be brought into the Competition area.

Teams will be limited to the use of one computer in the court area.

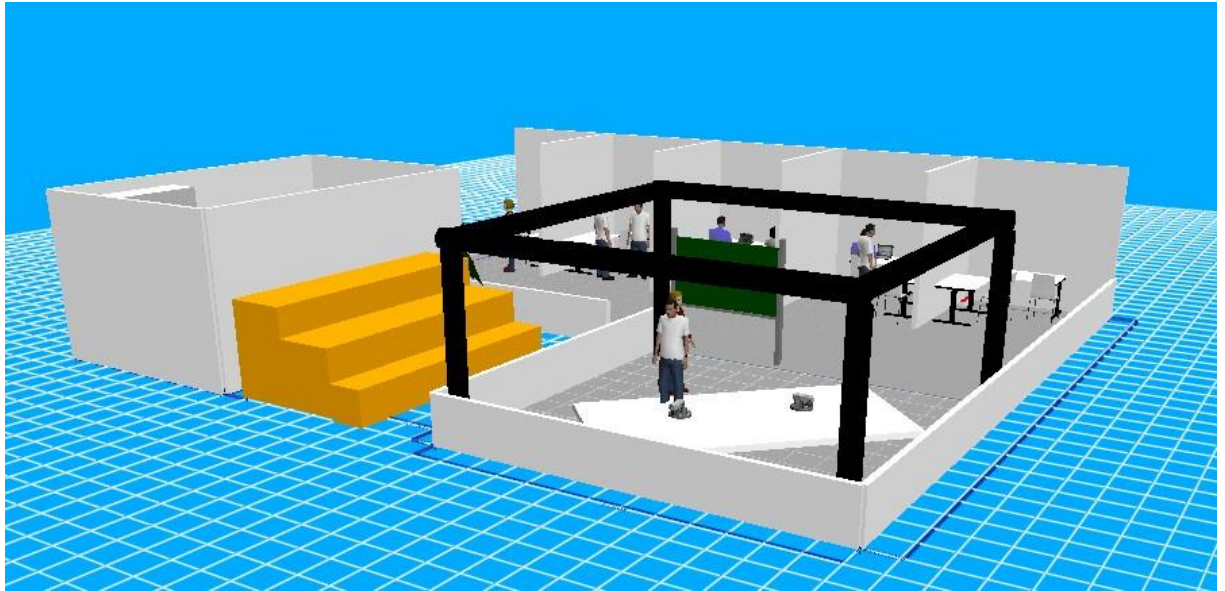
7.5 Sample workshop and workstation layouts

Workshop and workstation layouts



Proposed Workshop layout for the current Competition:

In this draft workshop layout the two Mobile Robot Competition Courts are situated inside area of a Building. Note: this layout is subject to change.



8. MARKETING THE SKILL TO VISITORS AND MEDIA

8.1 Maximising visitor and media engagement

The following ideas will be considered to maximise visitor and media engagement.

Court areas may have a presentation sound system and a commentator

Passageway screens may show an event presentation running on loop throughout the Competition. Content could include:

- An image of a robot completing either the actual competition module or something similar.
- The marking scheme 'Scoring Pattern' for each module along with descriptive text defining the module and what the robot is doing.
- Images of Mobile Robots at work.

8.2 Sustainability

Recycling

Use of 'green' materials