worldskills

Technical Description

Autonomous Mobile Robotics

Skill 23

WorldSkills International, by a resolution of the Competitions Committee and in accordance with the Constitution, the Standing Orders, and the Competition Rules, has adopted the following minimum requirements for this skill for the WorldSkills Competition.

The Technical Description consists of the following:

1 Introduction

1.1 Name and description of the skill competition

1.1.1 The name of the skill competition is

Autonomous Mobile Robotics

1.1.2 Description of the associated work role(s) or occupation(s)

Mobile Robotics is a fast evolving, solutions orientated, industry within which the robotics technician is a significant and growing work role. Mobile robotics is an important part of the future, with applications in everyday life, diverse industries, including autonomous vehicles, manufacturing, agriculture, aerospace, mining, and medicine.

A robotics technician works in offices, manufacturing plants or laboratories; they design, maintain, develop new applications, and conduct research to expand the potential for robots. The role begins with a strong focus on a specific business problem, in a particular sector. For example, in manufacturing there may be a need to increase capacity by creating robots for tasks that can be automated. Mobile robots may also be designed to explore areas that are inaccessible or dangerous for human beings.

Careful, deep client consultation is required, resulting in an accurate specification. The design phase follows and a prototype is assembled. The robot is then programmed and tested to ensure high, consistent performance. At the heart of every robot is a robotics technician who thinks about what a robot needs to do and works with several disciplines to design and put together the optimal piece of equipment, demonstrating a commitment to attention to detail. The robotics technician uses existing technologies to create solutions to new challenges.

Robotics technicians must be familiar with logic, microprocessors, computer programming, mechanical, electrical, and control systems so that they can design and prototype the right robot for each application. They must also prepare specifications for the robot's capabilities as they relate to the everyday life. In addition, robotics technicians may be responsible for cost efficient design, cost-price calculations and quality-control.

Integral to the role of the high performing robotics technitian are a range of skills related to work organization and self-management. Excellent communication and interpersonal skills, with a particular strength in working well in a team, are equally important. An ability to be innovative and creative in resolving technicall challenges and generating solutions is also essential.

Working across sectors internationally and being able to transfer and apply their analytical skills is a feature of the excellent robotics technician, together with a commitment to continuing specialist, and professional development and a determination to resolve problems through experimenting and risk taking within self-managed boundaries. In an increasingly global industry, which is ‘breaking new ground’ and altering the way we live and work, there are significant opportunities for sustainable careers in robotics. The opportunities carry with them the need to work with diverse cultures, industries and fast paced technological change. The diversity of skills associated with robotics technicians is likely to expand.

1.1.3 Number of Competitors per team

Autonomous Mobile Robotics is a team skill competition with two Competitors per team.

1.1.4 Age limit of Competitors

The Competitors must not be older than 22 years in the year of the Competition.

1.2 The relevance and significance of this document

This document contains information about the standards required to compete in this skill competition, and the assessment principles, methods, and procedures that govern the competition.

Every Expert and Competitor must know and understand this Technical Description.

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

1.3 Associated documents

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

- WSI – Code of Ethics and Conduct
- WSI – Competition Rules
- WSI – WorldSkills Occupational Standards framework
- WSI – WorldSkills Assessment Strategy
- WSI online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations
- WorldSkills Standards and Assessment Guide (skill-specific)

2 The WorldSkills Occupational Standards (WSOS)

2.1 General notes on the WSOS

The WSOS specifies the knowledge, understanding, skills, and capabilities that underpin international best practice in technical and vocational performance. These are both specific to an occupational role and also transversal. Together they should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business (www.worldskills.org/WSOS).

The skill competition is intended to reflect international best practice as described by the WSOS, to the extent that it can. The Standard is therefore a guide to the required training and preparation for the skill competition.

In the skill competition the assessment of knowledge and understanding will take place through the assessment of performance. There will only be separate tests of knowledge and understanding where there is an overwhelming reason for these.

The Standard is divided into distinct sections with headings and reference numbers added.

Each section is assigned a percentage of the total marks to indicate its relative importance within the Standards. This is often referred to as the “weighting”. The sum of all the percentage marks is 100. The weightings determine the distribution of marks within the Marking Scheme.

Through the Test Project, the Marking Scheme will assess only those skills and capabilities that are set out in the WorldSkills Occupational Standards. They will reflect the Standards as comprehensively as possible within the constraints of the skill competition.

The Marking Scheme will follow the allocation of marks within the Standards to the extent practically possible. A variation of up to five percent is allowed, if this does not distort the weightings assigned by the Standards.

2.2 WorldSkills Occupational Standards

Section		Relative importance (%)
1	**Work organization and management**	**10**
	The individual needs to know and understand: • Principles and applications of safe working generally and in relation to manufacturing • The purposes, uses, care, and maintenance of all equipment and materials, together with their safety implications • Environmental and safety principles and their application to good housekeeping in the work environment • Principles of team working and their applications • Personal skills, strengths, and needs relative to the roles, responsibilities, and duties of others individually and collectively • The parameters within which activities need to be scheduled.	

Section		Relative importance (%)
	The individual shall be able to: • Prepare and maintain a safe, tidy, and efficient work area • Prepare self for the tasks in hand, including full regard to health and safety • Schedule work to maximize efficiency and minimize disruption • Take account of the rules and regulations in force for robotics technician/engineering • Select and use all equipment and materials safely and in compliance with manufacturers' instructions • Apply or exceed the health and safety standards applying to the environment, equipment and materials • Restore the work area to an appropriate state and condition • Contribute to team performance both broadly and specifically • Give and take feedback and support.	
2	**Communication and interpersonal skills**	**10**
	The individual needs to know and understand: • The range and purposes of documentation and publications in electronic forms • The technical language associated with the skill and technology • The standards required for routine and exception reporting in oral and electronic form • The required standards for communicating with clients, team members and others • The purposes and techniques for maintaining and presenting records, including financial records.	
	The individual shall be able to: • Read, interpret and extract technical data and instructions from documentation in any available format • Use research for problem solving and continuing professional development • Communicate by oral, written and electronic means to ensure clarity, effectiveness and efficiency • Use a standard range of communication technologies • Discuss complex technical principles and applications with others • Explain complex technical principles and applications to non-Experts • Complete reports and respond to issues and questions arising • Respond to clients' needs face to face and indirectly • Arrange to gather information and prepare documentation as required by the client • Complete reports and respond to issues and questions arising • Prepare documentation for work management and control • Record decisions on the basis of business principles and other essential factors such as health and safety.	

Section		Relative importance (%)
3	**Design**	**10**
	The individual needs to know and understand: • The principles and applications of project design • The nature and formats of project specifications • The basis on which the manufactured item will be appraised • Design parameters including the following: ◦ Options appraisal ◦ Selection of components, materials and work processes ◦ Prototype development ◦ Manufacture ◦ Assembly ◦ Refinement ◦ Commissioning • Principles and applications for: ◦ Designing, assembling, and commissioning mobile robotics systems ◦ The components and functions of electrical and electronic systems ◦ The components and applications of add-ons ◦ The components and applications of mobile robotics systems • Principles and applications of design and assembly of mechanical, electrical and electronic systems, their standards and their documentation • Principles and methods for work organization, control and management in relation to the product • Principles and techniques for generating creative and innovative solutions.	
	The individual shall be able to: • Analyze the briefs or specifications to identify the required performance characteristics of mobile robots • Identify and resolve areas of uncertainty within the briefs or specifications • Identify the characteristics of the environment in which the mobile robots are required to operate • Identify hardware requirements to support the mobile robots' performance • Generate designs for the manufacture of a functioning item within given timescales • Generate designs for tele-operation control systems independent of the base unit • Develop strategies to solve mobile robotics tasks including navigation and orientation • Generate innovative solutions to design challenges • Identify and appraise options for selection, purchase and manufacture of materials, components and equipment	

Section		Relative importance (%)
	• Complete the design stage within given limits of purpose, cost and time.	
4	**Prototyping**	**10**
	The individual needs to know and understand: • Basic principles of mechanical, electrical and electronics engineering • Principles of fabrication and assembly • Principles and practices of safe manufacture and operation • Techniques and options for making adjustments and repairs.	
	The individual shall be able to: • Fabricate frame parts of mobile robots • Integrate the structural and mechanical parts of mobile robots • Integrate the electronic control circuits • Install, set up and make all necessary physical and software related adjustments required for effective use • Install, set up and make all necessary adjustments to mechanical, electrical and sensor systems • Repair or change components efficiently.	
5	**Navigation and localization**	**8**
	The individual needs to know and understand: • Robot navigation by orientation and mapping • Principles of localization • Path planning in known and unknown environments • The impact of navigation strategies on accuracy and efficiency • Types of sensors used for navigation (e.g. encoders, lidar, IR, US).	
	The individual shall be able to: • Implement navigation strategies • Develop strategies to use robot sensors to detect the environment • Implement and test a robot's ability to use a given map of the environment • Implement and test a robot's ability to generate a map of the environment • Assert robot movement by implementing orientation and mapping capabilities • Use industrial standard programming software to assert effective autonomous control over robots' movement.	

Section		Relative importance (%)
6	**Vision**	**8**
	The individual needs to know and understand: • The impact of light conditions on visualization sensors • Methods for recognizing color, patterns, objects and object orientation • Application of different camera types (e.g. IR, depth-camera, Lidar).	
	The individual shall be able to: • Install cameras on robots and make appropriate adjustments • Implement vision systems to detect the environment and specific task elements • Use algorithms for image processing and object recognition.	
7	**Robot environment interaction**	**8**
	The individual needs to know and understand: • Usage and application of different actuators • How software programs relate to the action of machinery and systems • Principles and applications of wireless communications.	
	The individual shall be able to: • Implement actuators (hardware and software) to interact with the environment • Use tele-operation to assert effective control over robot actions • Install and make physical settings and adjustments to sensors needed to properly interact with the environment • Use the manufacturer provided control software to assert effective autonomous control over manufacturer provided hardware.	
8	**Testing and fault finding**	**8**
	The individual needs to know and understand: • Analytical techniques for fault finding • Techniques and options for making adjustments and repairs • Strategies for problem solving.	
	The individual shall be able to: • Test run individual applications and full functionality • Find and document faults using appropriate analytical techniques.	

Section		Relative importance (%)
9	**Performance Review and Commissioning**	**28**
	The individual needs to know and understand: • Criteria and methods for testing equipment and systems • Criteria and methods for operating test runs • The scope and limits of the technologies and methods used • Strategies for thinking creatively and generating innovation • The possibilities and options for making incremental and/or radical changes.	
	The individual shall be able to: • Test each part of a mobile robot against agreed operating crhiteria • Test mobile robots' overall performance against agreed operating criteria • Optimize the operation of each part of systems, and the systems as a whole, through analysis, problem solving and refinement • Undertake final test runs to commission systems • Review each part of the process of design, fabrication and assembly, and operation, against established criteria, including accuracy, consistency, time and cost • Ensure that all aspects of a design stage meet the required industry standards • Finalize and present portfolios to clients, the portfolios to include all essential documentation required in business transactions • Present mobile robots and portfolios to clients and respond to questions.	
	Total	**100**

3 The Assessment Strategy and Specification

3.1 General guidance

Assessment is governed by the WorldSkills Assessment Strategy. The Strategy establishes the principles and techniques to which WorldSkills assessment and marking must conform.

Expert assessment practice lies at the heart of the WorldSkills Competition. For this reason, it is the subject of continuing professional development and scrutiny. The growth of expertise in assessment will inform the future use and direction of the main assessment instruments used by the WorldSkills Competition: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the WorldSkills Competition falls into two broad types: Measurement and Judgement. For both types of assessment, the use of explicit benchmarks against which to assess each Aspect is essential to guarantee quality.

The Marking Scheme must follow the weightings within the Standards. The Test Project is the assessment vehicle for the skill competition, and therefore also follows the Standards. The CIS enables the timely and accurate recording of marks; its capacity for scrutiny, support, and feedback is continuously expanding.

The Marking Scheme, in outline, will lead the process of Test Project design. After this, the Marking Scheme and Test Project will be designed, developed, and verified through an iterative process, to ensure that both together optimize their relationship with the Standards and the Assessment Strategy. They will be agreed by the Experts and submitted to WSI for approval together, to demonstrate their quality and conformity with the Standards.

Prior to submission for approval to WSI, the Marking Scheme and Test Project will liaise with the WSI Skill Advisors for quality assurance and to benefit from the capabilities of the CIS.

4 Assessment Design and Practice

4.1 General guidance

This section describes the role and place of the Marking Scheme, how the Experts will assess Competitors' work as demonstrated through the Test Project, and the procedures and requirements for marking.

The Marking Scheme is the pivotal instrument of the WorldSkills Competition, in that it ties assessment to the standard that represents each skill competition, which itself represents a global occupation. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards.

By reflecting the weightings in the Standards, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill competition and its assessment needs, it may initially be appropriate to develop the Marking Scheme in more detail as a guide for Test Project design. Alternatively, initial Test Project design can be based on the outline Marking Scheme. From this point onwards the Marking Scheme and Test Project should be developed together.

Section 2.1 above indicates the extent to which the Marking Scheme and Test Project may diverge from the weightings given in the Standards, if there is no practicable alternative.

For integrity and fairness, the Marking Scheme and Test Project are increasingly designed and developed by one or more Independent Test Project Designer(s) with relevant expertise. In these instances, the Marking Scheme and Test Project are unseen by Experts until immediately before the start of the skill competition, or competition module. Where the detailed and final Marking Scheme and Test Project are designed by Experts, they must be approved by the whole Expert group prior to submission for independent validation and quality assurance. Please see the Competition Rules for further details.

Experts and Independent Test Project Designers are required to submit their Marking Schemes and Test Projects for review, verification, and validation well in advance of completion. They are also expected to work with their Skill Advisor, reviewers, and verifiers, throughout the design and development process, for quality assurance and in order to take full advantage of the CIS's features.

In all cases a draft Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition. Skill Advisors actively facilitate this process.

4.2 Assessment Criteria

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived before, or in conjunction with, the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards; in others they may be different. There will normally be between five and nine Assessment Criteria. Whether or not the headings match, the Marking Scheme as a whole must reflect the weightings in the Standards.

Assessment Criteria are created by the person or people developing the Marking Scheme, who are free to define the Criteria that they consider most suited to the assessment and marking of the Test Project. Each Assessment Criterion is defined by a letter (A-I). **The Assessment Criteria, the allocation of marks, and the assessment methods, should not be set out within this Technical Description. This is because the Criteria, allocation of marks, and assessment**

methods all depend on the nature of the Marking Scheme and Test Project, which is decided after this Technical Description is published.

The Mark Summary Form generated by the CIS will comprise a list of the Assessment Criteria and Sub Criteria.

The marks allocated to each Criterion will be calculated by the CIS. These will be the cumulative sum of marks given to each Aspect within that Assessment Criterion.

4.3 Sub Criteria

Each Assessment Criterion is divided into one or more Sub Criteria. Each Sub Criterion becomes the heading for a WorldSkills marking form. Each marking form (Sub Criterion) contains Aspects to be assessed and marked by Measurement or Judgement, or both Measurement and Judgement.

Each marking form (Sub Criterion) specifies both the day on which it will be marked, and the identity of the marking team.

4.4 Aspects

Each Aspect defines, in detail, a single item to be assessed and marked, together with the marks, and detailed descriptors or instructions as a guide to marking. Each Aspect is assessed either by Measurement or by Judgement.

The marking form lists, in detail, every Aspect to be marked together with the mark allocated to it. The sum of the marks allocated to each Aspect must fall within the range of marks specified for that section of the Standards. This will be displayed in the Mark Allocation Table of the CIS, in the following format, when the Marking Scheme is reviewed from C-8 weeks. (Section 4.1 refers.)

		CRITERIA								TOTAL MARKS PER SECTION	WSSS MARKS PER SECTION	VARIANCE
		A	B	C	D	E	F	G	H			
STANDARDS SPECIFICATION SECTION	1	5.00								5.00	5.00	0.00
	2		2.00					7.50		9.50	10.00	0.50
	3								11.00	11.00	10.00	1.00
	4			5.00						5.00	5.00	0.00
	5				10.00	10.00	10.00			30.00	30.00	0.00
	6		8.00	5.00				2.50	9.00	24.50	25.00	0.50
	7			10.00				5.00		15.00	15.00	0.00
TOTAL MARKS		5.00	10.00	20.00	10.00	10.00	10.00	15.00	20.00	100.00	100.00	2.00

4.5 Assessment and marking

There is to be one marking team for each Sub Criterion, whether it is assessed and marked by Judgement, Measurement, or both. The same marking team must assess and mark all Competitors. Where this is impracticable (for example where an action must be done by every Competitor simultaneously, and must be observed doing so), a second tier of assessment and marking will be put in place, with the approval of the Competitions Committee Management Team. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (Section 4.6 refers.)

4.6 Assessment and marking using Judgement

Judgement uses a scale of 0-3. To apply the scale with rigour and consistency, Judgement must be conducted using:

- benchmarks (criteria) for detailed guidance for each Aspect (in words, images, artefacts, or separate guidance notes). This is documented in the Standards and Assessment Guide.
- the 0-3 scale to indicate:
  - 0: performance below industry standard
  - 1: performance meets industry standard
  - 2: performance meets and, in specific respects, exceeds industry standard
  - 3: performance wholly exceeds industry standard and is judged as excellent

Three Experts will judge each Aspect, normally simultaneously, and record their scores. A fourth Expert coordinates and supervises the scoring, and checks their validity. They also act as a judge when required to prevent compatriot marking.

4.7 Assessment and marking using Measurement

Normally three Experts will be used to assess each Aspect, with a fourth Expert supervising. In some circumstances the team may organize itself as two pairs, for dual marking. Unless otherwise stated, only the maximum mark or zero will be awarded. Where they are used, the benchmarks for awarding partial marks will be clearly defined within the Aspect. To avoid errors in calculation or transmission, the CIS provides a large number of automated calculation options, the use of which is mandated.

4.8 The use of Measurement and Judgement

Decisions regarding the choice of criteria and assessment methods will be made during the design of the competition through the Marking Scheme and Test Project.

4.9 Skill assessment strategy and procedures

WorldSkills is committed to continuous improvement including reviewing past limitations and building on good practice. The following skill assessment strategy and procedures for this skill competition take this into account and explain how the marking process will be managed.

Performance/quality

The quality and results of the performance task are evaluated according the accuracy, efficiency, reliability, and repeatability.

Time to complete

Time taken can be a factor in particular when two teams and/or robots both successfully complete the task. Teams taking less time can be deemed more efficient and marked accordingly.

Team Competition

Autonomous Mobile Robotics is a team competition consisting of two Competitors from each country/region. The task division, teamwork and cooperation within the team can be taken in consideration during the evaluation.

5 The Test Project

5.1 General notes

Sections 3 and 4 govern the development of the Test Project. These notes are supplementary.

Whether it is a single entity, or a series of stand-alone or connected modules, the Test Project will enable the assessment of the applied knowledge, skills, and behaviours set out in each section of the WSOS.

The purpose of the Test Project is to provide full, balanced, and authentic opportunities for assessment and marking across the Standards, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme, and Standards will be a key indicator of quality, as will be its relationship with actual work performance.

The Test Project will not cover areas outside the Standards or affect the balance of marks within the Standards other than in the circumstances indicated by Section 2. This Technical Description will note any issues that affect the Test Project's capacity to support the full range of assessment relative to the Standards. Section 2.1 refers.

The Test Project will enable knowledge and understanding to be assessed solely through their applications within practical work. The Test Project will not assess knowledge of WorldSkills rules and regulations.

Most Test Projects and Marking Schemes are now designed and developed independently of the Experts. They are designed and developed either by the Skill Competition Manager, or an Independent Test Project Designer, normally from C-12 months. They are subject to independent review, verification, and validation. (Section 4.1 refers.)

The information provided below will be subject to what is known at the time of completing this Technical Description, and the requirement for confidentiality.

Please refer to the current version of the Competition Rules for further details.

5.2 Format/structure of the Test Project

The Test Project is a series of at least four (4) separately assessed modules.

It consists of real workplace scenarios within the industry, or customer demanded mobile robot tasks.

The Test Project describes:

- A short company introduction of the internal processes, standards, and maintenance activities linked with the assessed modules;
- A detailed description of tasks that a customer wants to be solved;
- Some specifications needed about the environment and objects to be handled.

The format of the Test Project (TP) document should be more picture based with supporting text. The pre TP and the final TP must be inline with each other.

5.3 Test Project design requirements

Test Projects should reflect the purposes, structures, processes, and outcomes of the occupational role they are based on. They should aim to be a small-scale version of that role. Before focusing on practicalities, SMTs should show how the Test Project design will provide full, balanced, and

authentic opportunities for assessment and marking across the Standards, as set out in Section 5.1.

The criteria are presented through descriptive document packages that:

- The Test Project must have at least four independent modules focused on industry related tasks, having in mind that the teams are required to design, prototype, assemble, maintain, repair, program and operate mobile robots;
- The Test Project must have a performance review module focused on a customer driven task that respects the following:
  - None of the elements of the task should have a destructive robot behaviour;
  - The execution of the task should give preference to the autonomy of the robot but human support, or teleoperation can take place';
  - Less human intervention while solving the task will benefit the teams score;
  - The various operational environments of the competition should be defined;
  - Competitors must generate all programmes required by their Mobile Robots;
- Any specific instructions to Competitors besides the industry standards can be provided through the Test Project document.;

Different Modules of the Test Project can be developed by the Independent Test Project Designer(s) prior to the Competition and should be submitted to the Skill Competition Manager to group them and create the final Test Project.

5.4 Test Project coordination and development

The Test Project MUST be submitted using the templates provided by WorldSkills International (www.worldskills.org/expertcentre). Use the Word template for text documents and DWG template for drawings.

5.4.1 Test Project coordination (preparation for Competition)

Coordination of the Test Project/modules will be undertaken by the Skill Competition Manager.

5.4.2 Who develops the Test Project/modules

The Test Project/modules are developed by Independent Test Project Designer (ITPD) in collaboration with the Skill Competition Manager.

The Autonomous Mobile Robotics criteria can be developed by industry specialists and fictional customers whose company would ideally be in the Host Country.

5.4.3 When is the Test Project developed

The Test Project/modules are developed according to the following timeline:

Time	Action
Fifteen (15) months prior to the Competition	The ITPD is identified and a Confidentiality Agreement between WSI and the ITPD is organized.
Nine (9) months prior to the Competition	Test Project document is circulated on the WorldSkills website without any technical or detailed information.
No later than two (2) months prior to the Competition	The Test Project documents are sent to the WorldSkills International Skills Competitions Administration Manager.

Time	Action
At the Competition at the beginning of each Competition Day.	The Test Project/modules are presented to the Experts and Competitors.

5.5 Test Project initial review and verification

The purpose of a Test Project is to create a challenge for Competitors which authentically represents working life for an outstanding practitioner in an identified occupation. By doing this, the Test Project will apply the Marking Scheme and fully represent the WSOS. In this way it is unique in its context, purpose, activities, and expectations.

To support Test Project design and development, a rigorous quality assurance and design process is in place (Competition Rules sections 10.6-10.7 refer.) Once approved by WorldSkills, the Independent Test Project Designer (ITPD) is expected to identify one or more independent expert(s), and trusted individuals initially to review the Independent Test Project Designer's ideas and plans, and subsequently to verify the Test Project, prior to validation.

A Skill Advisor will ensure and coordinate this arrangement, to guarantee the timeliness and thoroughness of both initial review, and verification, based on the risk analysis that underpins Section 10.7 of the Competition Rules.

5.6 Test Project validation

The Skill Competition Manager coordinates the validation of the Test Project/modules and will ensure that it can be completed within the material, equipment, knowledge, and time constraints of Competitors.

5.7 Test Project circulation

The Test Project/modules are not circulated prior to the Competition. The Test Project/modules are presented to Competitors at the beginning of each Competition Day.

The Pre-Test Project document is circulated nine (9) months prior to the Competition via the WorldSkills website. No detailed or technical information is circulated.

5.8 Test Project change

Due to the Test Project being developed by Independent Test Project Designer(s) (ITPD) and validated by the Skill Competition Manager, there is no change required to be made to the Test Project/modules at the Competition. Exceptions are amendments to technical errors in the Test Project documents and according to infrastructure limitations.

5.9 Material or manufacturer specifications

Specific material and/or manufacturer specifications required to allow the Competitor to complete the Test Project will be supplied by the Competition Organizer and are available from www.worldskills.org/infrastructure located in the Expert Centre. However, note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be

released prior to the Competition. These items may include those for fault finding modules or modules not circulated.

All Competitor teams will be provided with a new and unused component collection at the Competition on Familiarization Day: This will contain:

• 1x WorldSkills Mobile Robotics Component Collection;

Sponsorship, specifications, supply, and support for the selected hardware and software are co-ordinated by the Workshop Manager and the Skill Competition Manager. Details are updated in the Infrastructure List as soon as they are finalized.

The Mobile Robotic component kit must provide all components needed to design and assemble a Mobile Robotic System able to run the Mobility Aspects of the Test Project robot programmes in self-contained independent mobile robotic functioning.

The supplier/sponsor makes a commitment to comply with the WSI approved timelines.

The manufacturer/sponsor will support sufficient spare parts during the competition but will NOT be responsible for servicing the robot systems in case of malfunction or breakdown. This is the Competitors responsibility.

6 Skill management and communication

6.1 Discussion Forum

Prior to the Competition, all discussion, communication, collaboration, and decision making regarding the skill competition must take place on the WorldSkills skill-specific Discussion Forum. (http://forums.worldskills.org). Skill related decisions and communication are only valid if they take place on the WorldSkills Discussion Forum. The Chief Expert (or an Expert Lead appointed by the Skill Management Team) will be the moderator for this Discussion Forum. Refer to the Competition Rules for the timeline of communication and competition development requirements.

6.2 Competitor information

All information for registered Competitors is available from the Competitor Centre (www.worldskills.org/competitorcentre).

This information includes:

- Competition Rules
- Technical Descriptions
- Mark Summary Form (where applicable)
- Test Projects (where applicable)
- Infrastructure List
- WorldSkills Health, Safety, and Environment Policy and Regulations
- Other Competition-related information

6.3 Test Projects and Marking Schemes

Circulated Test Projects will be available from www.worldskills.org/testprojects and the Competitor Centre (www.worldskills.org/competitorcentre).

6.4 Day-to-day management

The day-to-day management of the skill competition during the Competition is defined in the Skill Management Plan that is created by the Skill Management Team. The Skill Management Team comprises the Skill Competition Manager, Chief Expert, and the Expert Leads. The Skill Management Plan is progressively developed in the six (6) months prior to the Competition and finalized at the Competition. The Skill Management Plan can be viewed in the Expert Centre (www.worldskills.org/expertcentre).

6.5 General best practice procedures

General best practice procedures clearly delineate the difference between what is a best practice procedure and skill-specific rules (section 9). General best practice procedures are those where Experts and Competitors CANNOT be held accountable as a breach to the Competition Rules or skill-specific rules which would have a penalty applied as part of the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System. In some cases, general best practice procedures for Competitors may be reflected in the Marking Scheme.

Topic/task	Best practice procedure
Shoes for courts	• Competitors must have a second pair of shoes to use on the court that do not leave marks. These do not need to be safety shoes, an alternative to a second pair of shoes would be to use proper shoe covers.
Equipment failure	• The Sponsor will provide replacement parts for items contained in the provided component collection that fail during the competition. • Competitors are responsible for the failure of all components they introduce/provide to supplement the originally provided component collection.

7 Skill-specific safety requirements

7.1 Personal Protective Equipment

Refer to WorldSkills Health, Safety, and Environment Policy and Regulations for Host country or region regulations.

Task	Safety glasses with side protection	Cut protection gloves (without breakage)	Sturdy shoes with closed toe and no heel	Hearing protection	Dust mask
General PPE for safe areas			√		
Shared workshop area – material manipulation such as drilling, cutting and grinding	√	√ (optional for material removal only)	√	√	√
Shared workshop area – soldering	√	√ (optional for material removal only)	√	√	√
General work at workstation			√		

8 Materials and equipment

8.1 Infrastructure List

The Infrastructure List details all equipment, materials, and facilities provided by the Competition Organizer.

The Infrastructure List is available at www.worldskills.org/infrastructure.

The Infrastructure List specifies the items and quantities requested by the Skill Management Team for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These items may include those for fault finding modules or modules not circulated.

At each Competition, the Skill Management Team must review and update the Infrastructure List in preparation for the next Competition. The Skill Competition Manager must advise the Director of Skills Competitions 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 for the upcoming WorldSkills 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.

All manual hand tools and general powered tools required for the Competition will be supplied by the Competition Organizer.

8.2 Competitors toolbox

Each Competitor team may bring or send one toolbox with a total external volume not exceeding x 0.06 m^3.

Volume = Length x Width x Height)

This size should not include the outside packing used to transport the toolbox. Any other special requirements of the toolbox must be specified here, for example the number allowed.

8.3 Materials, equipment, and tools supplied by Competitors

Competitors may manufacture and create custom components for their mobile robot. Some restrictions will be enforced and checked before the Competitors may build their robots. Further information and details will be provided in the circulated Test Project (TP) document. Refer to section 5.4.3.

The only powered tools Competitors are allowed to bring are electric screwdrivers (maximum of two units).

Furthermore, Competitors are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

8.4 Materials, equipment, and tools supplied by Experts

Experts are required to supply their own Personal Protective Equipment as specified in section 7 skill-specific safety requirements.

Experts are responsible that Interpreters bring their own PPE.

8.5 Materials and equipment prohibited in the skill area

Competitors and Experts are prohibited to bring any materials or equipment not listed in section 8.3 and section 8.4.

Competitors must not bring own replacement parts for items contained in the provided component collection if not explicitly agreed on in the discussion forum before the start of the competition.

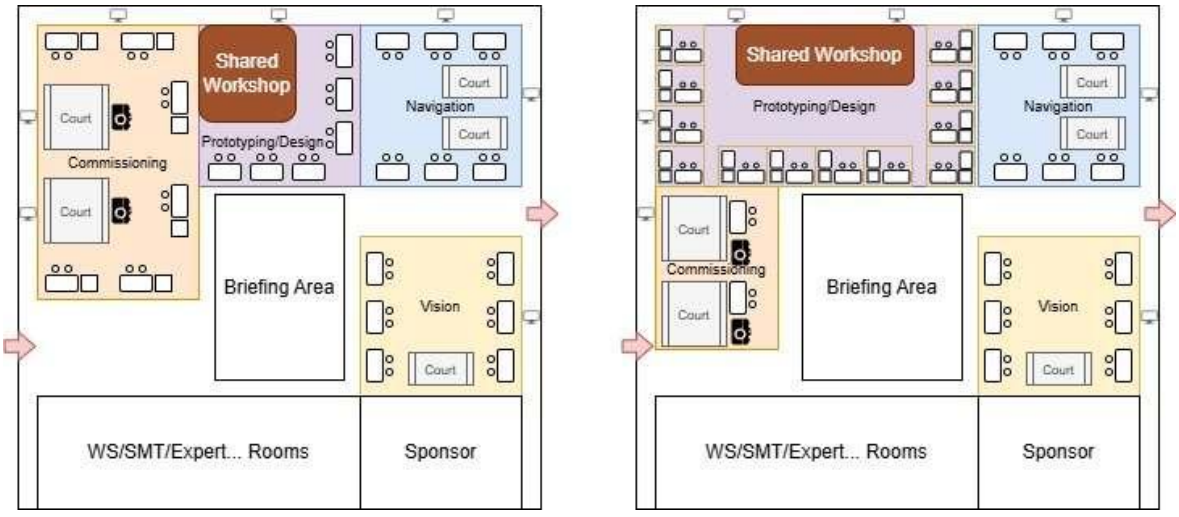
No powered tools are permitted other than itemized in 8.3.

Competitors will not ship to the Competition the robot they create during their competition preparation experiences.

8.6 Proposed workshop and workstation layouts

Workshop layouts from previous competitions are available at www.worldskills.org/sitelayout.

Example workshop layout



Future layout of the autonomous mobile robotics workshop will change to accomodate areas to where different modules can be evaluated. The SMT will investigate various layouts and propose a new layout and design. Changes could be expected for future competitions.

9 Skill-specific rules

9.1 General notes

Skill-specific rules cannot contradict or take priority over the Competition Rules. They do provide specific details and clarity in areas that may vary from skill competition to skill competition. This includes but is not limited to personal IT equipment, data storage devices, Internet access, procedures and workflow, and documentation management and distribution. Breaches of these rules will be solved according to the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System.

9.2 Skill-specific rules

Topic/task	Skill-specific rules
Use of technology – USB, memory devices	• The Test Project will indicate if Competitors are allowed to bring USB memory stick(s) per Competitor team into the workshop on Familiarization Day. During competition days, the USB memory devices cannot leave the competition floor and must be kept in a closed envelope with the Workshop Manager to be used only in exceptional cases to recover a critical state. It can be removed from the workshop at the end of the competition on C4 only. • Experts, and Interpreters are not allowed to bring USB memory devices into the workshop. • The Skill Competition Manager and Chief Expert can bring USB memory devices for competition organization purposes only. They can be removed from the workshop at the end of the competition on C4 only.
Use of technology – personal laptops, tablets, and mobile phones	• Competitors are not allowed to bring any laptop or tablets into the workstation. • Competitors can only use allocated laptops by organization during test runs. • The number of laptops allowed per team will match the Test Project (TP) and the specific task. • Experts are not allowed to bring laptops or tablets into the workshop. If these items are brought, they must be locked in the personal locker and can only be removed at the end of the day. The Skill Competition Manager and Chief Expert are exempt from this rule. • Interpreters are allowed to use laptops or tablets during translation of textual information only. • Competitors are not allowed to bring mobile phones into the workshop. If these items are brought, they must be locked in the personal locker and can only be removed at lunch time and at the end of the day. • Skill Competition Manager, Chief Expert, Experts, and Interpreters are allowed to bring mobile phones into the workshop and they can remain in their pocket, but shouldn't be used in public except for emergencies.

Topic/task	Skill-specific rules
Use of technology – personal photo and video taking devices	• Skill Competition Manager, Chief Expert, Competitors, Experts, and Interpreters are allowed to use personal photo, video taking devices and wearable devices in the workshop outside competition times only. This rule applies C-4 until C+1. • A skill competition camera will be available in the workshop that can be used by the SMT or Experts to take photos, from C-4 untill C+1, that may contribute to the enhancement of the skill for future competitions.
Templates, aids, etc.	• Competitors are allowed to bring and use aids for positioning their robot. • Competitors are allowed to bring and use manipulator tools to hold the robot during assembly and wiring.
Drawings, recording information	• Teams can bring all kinds of information on paper and/or digitally. This information may be brought into the workshop on Familiarization Day only and kept in the workshop for the duration of the competition. • Competitors may not gather new information during the competition over the Internet and/or by consultation.

10 Expert knowledge and experience

10.1 Requirements

Experts appointed for this skill competition must have the following knowledge and experience for the appropriate occupation or work role as documented in **section 1.1.2**.

- A minimum qualification of a Bachelor's degree in Mechatronics, Robotics, Electrical/Electronic Engineering, Mechanical Engineering, Automation, or a closely related discipline.
- Alternatively, a relevant technical diploma/TVET qualification combined with substantial industry experience (minimum five years) in robotics, automation, or mechatronics.
- At least three to five years of professional or teaching experience in robotics, mechatronics, automation, or related engineering fields.
- Applied project experience in the design, integration, commissioning, or maintenance of autonomous or semi-autonomous robotic systems.
- Strong background in mechanical, electrical, electronic, and control systems applied to robotics.
- Proficiency in microprocessors, embedded systems, and programming (e.g. C/C++, Python, ROS, PLCs).
- Expertise in the selection and implementation of sensor systems, preferably in robotics.
- Capability in testing, commissioning, and fault finding in technical systems, preferably mobile robots and subsystems.
- Awareness of cost-efficient design, quality assurance, and sustainability practices in robotics and automation projects.
- Ability to interpret and apply international occupational standards, marking schemes, and assessment criteria fairly and consistently.
- Strong teamwork, communication, and cross-cultural collaboration skills, with a commitment to impartiality and the WorldSkills Code of Ethics.
- Commitment to continuous professional development in robotics, automation, and engineering education.

11 Visitor and media engagement

11.1 Engagement methods

Following is a list of possible ways to maximize visitor and media engagement:

- Court areas have a presentation sound system and a commentator for explanation of the WorldSkills Occupational Standards and the test run tasks;
- Passageway screens may show an event presentation running on loop throughout the Competition. Content could include:
  - An animation 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;
    - Robot interaction with the public
- An information display could be available to the visitors to inform them about the events and activities Competitors are involved in during the competition.

12 Sustainability

12.1 Sustainable practices

This skill competition will focus on the sustainable practices below:

- Encourage media coverage;
- Increase industrial applicability;
- Keeping the amount of necessary work pieces as small and re-usable as possible.

13 References for industry consultation

13.1 General notes

WorldSkills is committed to ensuring that the WorldSkills Occupational Standards fully reflect the dynamism of internationally recognized best practice in industry and business. To do this WorldSkills approaches a number of organizations across the world that can offer feedback on the draft Description of the Associated Role and WorldSkills Occupational Standards on a two-yearly cycle.

In parallel to this, WSI consults three international occupational classifications and databases:

- ISCO-08: (http://www.ilo.org/public/english/bureau/stat/isco/isco08/)
- ESCO: (https://ec.europa.eu/esco/portal/home)
- O*NET OnLine (www.onetonline.org/)

13.2 References

The WSOS appears to relate closely to Robotics Technician:
ttps://www.onetonline.org/link/summary/17-3024.01

and Robotics Engineering Technician:
http://data.europa.eu/esco/occupation/7833d5cd-873d-4fdd-b2f8-9762d68494a7.

Adjacent occupations can also be explored through these links.

ILO 3119.

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Occupational Standards in place for WorldSkills Shanghai 2026.

Organization	Contact name
Micropolis Robotics	Amer Ghazal, Senior Robotics Software Engineer - Team Lead

14 Appendix

14.1 Appendix information

Not applicable.