Technical Description

Mobile Robotics

Manufacturing and Engineering Technology

worldskills

 TD23 v7.0 WSC2019

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:

Effective 22.08.18

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Chair of the Competitions Committee

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1 INTRODUCTION

1.1 NAME AND DESCRIPTION OF THE SKILL COMPETITION

1.1.1 The name of the skill competition is

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/technologist is a significant and growing work role. Mobile robotics is an important part of the future, with applications in everyday life, diverse industries, including manufacturing, agriculture, aerospace, mining, and medicine.

A robotics technologist works in offices, manufacturing plants or laboratories; he or she designs, maintains, develops new applications and conducts 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 technologist 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. In this instance the robotics technologist uses existing technologies to create solutions to new challenges.

Robotics technologists must be familiar with logic, microprocessors, computer programming, mechanical, electrical, and control system 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 technologists are responsible for cost efficient design, cost-price calculations and quality-control.

Integral to the role of the high performing robotics technologist 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 technological challenges and generating solutions is also essential.

Working across sectors internationally and being able to transfer analytical skills is a feature of the excellent robotics technologist, 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 technologists is likely to expand.

1.1.3 Number of Competitors per team

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 – Competition Rules
- WSI – WorldSkills Standards Specification framework
- WSI – WorldSkills Assessment Strategy WSI Online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations

2 THE WORLDSKILLS STANDARDS SPECIFICATION (WSSS)

2.1 GENERAL NOTES ON THE WSSS

The WSSS specifies the knowledge, understanding and specific skills that underpin international best practice in technical and vocational performance. It should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business (www.worldskills.org/WSSS).

The skill competition is intended to reflect international best practice as described by the WSSS, and to the extent that it is able to. The Standards Specification 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 Standards Specification 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 Specification. This is often referred to as the "weighting". The sum of all the percentage marks is 100.

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

The Marking Scheme and Test Project will follow the allocation of marks within the Standards Specification to the extent practically possible. A variation of five percent is allowed, provided that this does not distort the weightings assigned by the Standards Specification.

2.2 WORLDSKILLS STANDARDS SPECIFICATION

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 the roles, responsibilities and duties of others individually and collectively • The parameters within which activities need to be scheduled	
	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 both paper based and electronic forms • The technical language associated with the skill and technology • The standards required for routine and exception reporting in oral, written 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	
3	**Design**	**15**

	The individual needs to know and understand:
	• The principles and applications of project design
	• The nature and formats of project specifications
	• The bases on which the manufactured item will be appraised
	• Design parameters can include 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	

	The individual shall be able to: • Analyse the briefs or specifications to identify the required performance characteristics of the mobile robot • Identify and resolve areas of uncertainty within the briefs or specifications • Identify the characteristics of the environment in which the mobile robot is 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 a tele-operation control system 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 • Record decisions on the basis of business principles and other essential factors such as health and safety • Prepare documentation for work management and control • 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 technician/engineering • Principles of fabrication and assembly • Principles and practices of safe manufacture and operation	
	The individual shall be able to: • Fabricate frame parts of the mobile robot • Integrate the structural and mechanical parts of the mobile robot • 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 the mechanical, electrical and sensor systems • Install, set up and make all necessary adjustments required for effective tele-operation of the mobile robot • Integrate sensors to gain control of the required tasks	

5	**Programming, testing, and adjustment**	**15**
	The individual needs to know and understand: • Manufacturers' control software • How to program using standard industrial software • How a software program relates to the action of machinery and systems • Principles and applications of wireless communications • Robot navigation by orientation and mapping • Sensor integration • Analytical techniques for fault finding • Techniques and options for making adjustments and repairs • Strategies for problem solving • Principles and techniques for generating creative and innovative solutions	
	The individual shall be able to: • Visualize the process and operation using software • Use the manufacturer provided control software to assert effective autonomous control over the manufacturer provided object management systems • Use industrial standard programming software to assert effective autonomous control over the robot's movement • Use tele-operation to assert effective control over systems • Implement programming methodologies to the control systems • Assert robot movement by implementing orientation and mapping capabilities • Implement a navigation strategy • Install and make physical settings adjustments to sensors • Install cameras on the robot and make appropriate adjustments • Test run individual applications and full functionality • Find and document faults using appropriate analytical techniques • Demonstrate basic IT knowledge • Repair or change components efficiently	
6	**Performance Review and Commissioning**	**40**
	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 the mobile robot against agreed operating criteria • Test the mobile robot's overall performance against agreed operating criteria • Optimize the operation of each part of the system, and the system as a whole, through analysis, problem solving and refinement • Undertake a final test run to commission the system • 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 the design stage meet the required industry standards • Finalize and present a portfolio to the client, the portfolio to include all essential documentation required in a business transaction • Present the mobile robot and portfolio to the client 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 Specification. The Test Project is the assessment vehicle for the skill competition, and also follows the Standards Specification. The CIS enables the timely and accurate recording of marks, and has expanding supportive capacity.

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

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

4 THE MARKING SCHEME

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 standards that represent the skill. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards Specification.

By reflecting the weightings in the Standards Specification, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill 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 Specification, if there is no practicable alternative.

The Marking Scheme and Test Project may be developed by one person, or several, or by all Experts. The detailed and final Marking Scheme and Test Project must be approved by the whole Expert Jury prior to submission for independent quality assurance. The exception to this process is for those skill competitions which use an independent designer for the development of the Marking Scheme and Test Project. Please see the Rules for further details.

Experts and independent designers are required to submit their Marking Schemes and Test Projects for comment and provisional approval well in advance of completion, in order to avoid disappointment or setbacks at a late stage. They are also advised to work with the CIS Team at this intermediate stage, in order to take full advantage of the possibilities of the CIS.

In all cases a draft Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition using the CIS standard spreadsheet or other agreed methods.

4.2 ASSESSMENT CRITERIA

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived in conjunction with the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards Specification; in others they may be totally 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 Specification.

Assessment Criteria are created by the person(s) developing the Marking Scheme, who are free to define 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). It is advisable not to specify either the Assessment Criteria, or the allocation of marks, or the assessment methods, within this Technical Description.

The Mark Summary Form generated by the CIS will comprise a list of the Assessment 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) specified 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, or instructions for how the marks are to be awarded. Aspects are assessed either by measurement or 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 skill in the Standards Specification. 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)

		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, in all circumstances. The marking teams must be organized to ensure that there is no compatriot marking in any circumstances. (See 4.6.)

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)
- 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, with a fourth to coordinate the marking and acting as a judge to prevent compatriot marking.

4.7 ASSESSMENT AND MARKING USING MEASUREMENT

Three Experts will be used to assess each aspect. 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.

4.8 THE USE OF MEASUREMENT AND JUDGEMENT

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

4.9 COMPLETION OF SKILL ASSESSMENT SPECIFICATION

Detailed Criterion Evaluation Criteria will be included in the final criterion descriptions provided to the Competitors at the Competition.

Given section 6 is the result of section 3 to 5, and is therefore the main evaluation criteria Competitors can expect marks will be awarded, for example for the following type of items:

- Successfully following the prescribed path;
- Successfully locating the designated target object;
- Successfully interacting with the target object when it has been found;
- Successfully delivering the target object to a designated location.

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

4.10 SKILL ASSESSMENT PROCEDURES

Final overall standing will be based on the total points scored by a team over the four WorldSkills 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 either where a definite time limit has been pre-set (for example four-minute Test Run duration) or when teams are allowed to take as long as they need to complete the task.

The degree to which a Mobile Robot is able to complete the various competition tasks taking into consideration pre-set performance efficiency standards as the core evaluation criteria.

Marking is to be entered after each section 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.

Team competition

Mobile Robotics is a team competition consisting of two Competitors from each Country/Region. 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.

Entering marks into the CIS

Marks will be entered as soon as available.

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 skills in each section of the WSSS.

The purpose of the Test Project is to provide full, balanced and authentic opportunities for assessment and marking across the Standards Specification, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme and Standards Specification 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 Specification, or affect the balance of marks within the Standards Specification other than in the circumstances indicated by Section 2.

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.

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 Specification. Section 2.1 refers.

5.2 FORMAT/STRUCTURE OF THE TEST PROJECT

The Test Project consists of a real-life Customer Demanded Real Life Mobile Robot Task.

The Test Project describes:

- A short company introduction of the identified customer and their products and/or services;
- A detailed description of the task the customer wants to be solved by a Mobile Robot System;
- All specifications needed about environment, products to be handled, accuracy, repeatability, efficiency, prescribed use of components where applicable, etc.;
- Criteria for assessment and the allocation of marks for each criterion;
- Specifications about the conduction and presentation of the solutions.

5.3 TEST PROJECT DESIGN REQUIREMENTS

The total working time for the complete set of modules will be a maximum 22 hours. The criteria will be presented through descriptive document packages that:

- Define the manner of robot-to-robot direct interaction that will be permitted. Note: None of the test runs 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 Test Court;
- Define the rules of assessment and marking criteria for each aspect.
- During the execution of the Task the robot must preferably be autonomous.
- Core Performance Evaluation will focus on specific performance aspects and can be conducted in wireless mode, hardwire connection mode, autonomous mode, or tele-operation mode.

Any instructions to Competitors will be provided through the Test Project document.

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

The Competition robots will be required to complete Customer Defined Tasks (modules) agreed by the panel of Experts and explained in the Test Project document.

The Test Project will require robots to perform tasks that reflect mobile robots in everyday life.

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

Each session will comprise:

- Robot assembly/programming/troubleshooting/maintenance work/robot performance in the Test Court.

Details defining the particular rules of the Test Court and Marking pattern for each criterion will be presented in the Test Project document.

5.4 TEST PROJECT 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 Who develops the Test Project or modules

The Test Project is developed by an Independent Agency based on a real Customer Demand for a Mobile Robotic Task.

The Mobile Robotics criteria will be developed by the Customer in consultation with the Independent Agency and the Skill Competition Manager.

The Customer's company will ideally be located in the WorldSkills hosting country/region. Experts should propose companies to the WorldSkills Director of Skills Competitions for consideration and selection by WSI.

The Customer's cooperation involves:

- Contribution to the specification of the Mobile Robotic Task to perform;
- A meeting during Competition Preparation Week

5.4.2 How and where is the Test Project or modules developed

The Test Project details will be developed by the Independent Agency prior to the Competition based on the following format:

- *A Competitor Pre-Competition Information Package* will be developed by the Independent Agency.
- *The Competitor Pre-Competition Information Package* will provide generic descriptions defining the broad range of robot/Competitor performance capabilities that Competitors will need to execute at the Competition.
- The Expert meetings held during the preparation days at the Competition will agree on the final Competition tasks based directly on the task variables described in the *Competitor Pre-Competition Information Package*.

5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
At least 15 months ahead of the Competition	Experts propose a customer for the next Competition as described in 5.4.1 to the WorldSkills Director of Skills Competitions.
At least twelve (12) months ahead of the Competition	A customer is selected by WSI for developing the Test Project in consultation with the Independent Agency and the Skill Competition Manager by providing a real-life solution they require from the Mobile Robot System.
Nine (9) months before the Competition	The Competitor Pre-Competition Information Package which defines the guidelines in order to complete the Test Project is finalized by the Independent Agency and circulated on the website.
At the Competition	The final Competition tasks will be agreed by the Experts during the preparation days.

5.5 TEST PROJECT VALIDATION

The Skill Management Team will be responsible for ensuring that:

- The guidelines for the Test Project is published on the website nine months prior to the Competition;
- There are no criteria requirements that cannot be completed;
- The Test Project criteria can be completed in the prescribed time of a maximum 22 hours;
- Proper function is achievable;
- The material/equipment list is accurate;
- Hardware and software used at the competition are available on the market nine months prior to the Competition;
- There will be no changes to the content of guideline nine months prior to the Competition;
- 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.

5.6 TEST PROJECT SELECTION

The final selection of the Test Project is made by the Independent Designer.

5.7 TEST PROJECT CIRCULATION

The Test Project is circulated via the website as follows:

The final Competitor Pre-Competition Information Package will be circulated via the website nine months before the Competition.

- The Mobile Robotic criteria will be disclosed to the Competitors at the Competition site;
- The Test Project descriptions will be provided at the start of the Competition.

5.8 TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

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

5.9 TEST PROJECT CHANGE AT THE COMPETITION

Not applicable. The final Test Project details will be agreed by the Experts during their pre-competition meetings.

5.10 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.

Sponsorship, specifications, supply, and support for the selected hardware and software will be co-ordinated by the Workshop Manager and the Skill Competition Manager. Details will be posted on the Discussion Forum and updated in the Infrastructure List as soon as they are finalized or at the very latest twelve months prior to the Competition.

The supplier/sponsor can send base Mobile Robotic Component Kits to every team seven (7) months before the Competition. The teams are responsible for shipping their own Mobile Robotic System, including all other sponsor-provided components to the Competition.

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 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 skill specific Discussion Forum (http://forums.worldskills.org). 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 the moderator for this Forum. Refer to 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
- Marking Schemes
- Test Projects
- 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 during the Competition is defined in the Skill Management Plan that is created by the Skill Management Team led by the Skill Competition Manager. The Skill Management Team comprises the Skill Competition Manager, Chief Expert, and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan can be viewed in the Expert Centre (www.worldskills.org/expertcentre).

7 SKILL-SPECIFIC SAFETY REQUIREMENTS

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

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 Experts for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Items supplied by the Competition Organizer 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 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.

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.

8.2 COMPETITOR'S TOOLBOX

Competitors can bring a toolbox with a maximum volume of one cubic metre.

8.3 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY COMPETITORS IN THEIR TOOLBOX

Teams may bring small tools for assembly and service of their Mobile Robot System that are not on the Infrastructure List. Tools that are home-made and/or tools that give teams a big advantage to other teams, might be removed by a vote of the Experts.

8.4 MATERIALS, EQUIPMENT, AND TOOLS SUPPLIED BY EXPERTS

Not applicable.

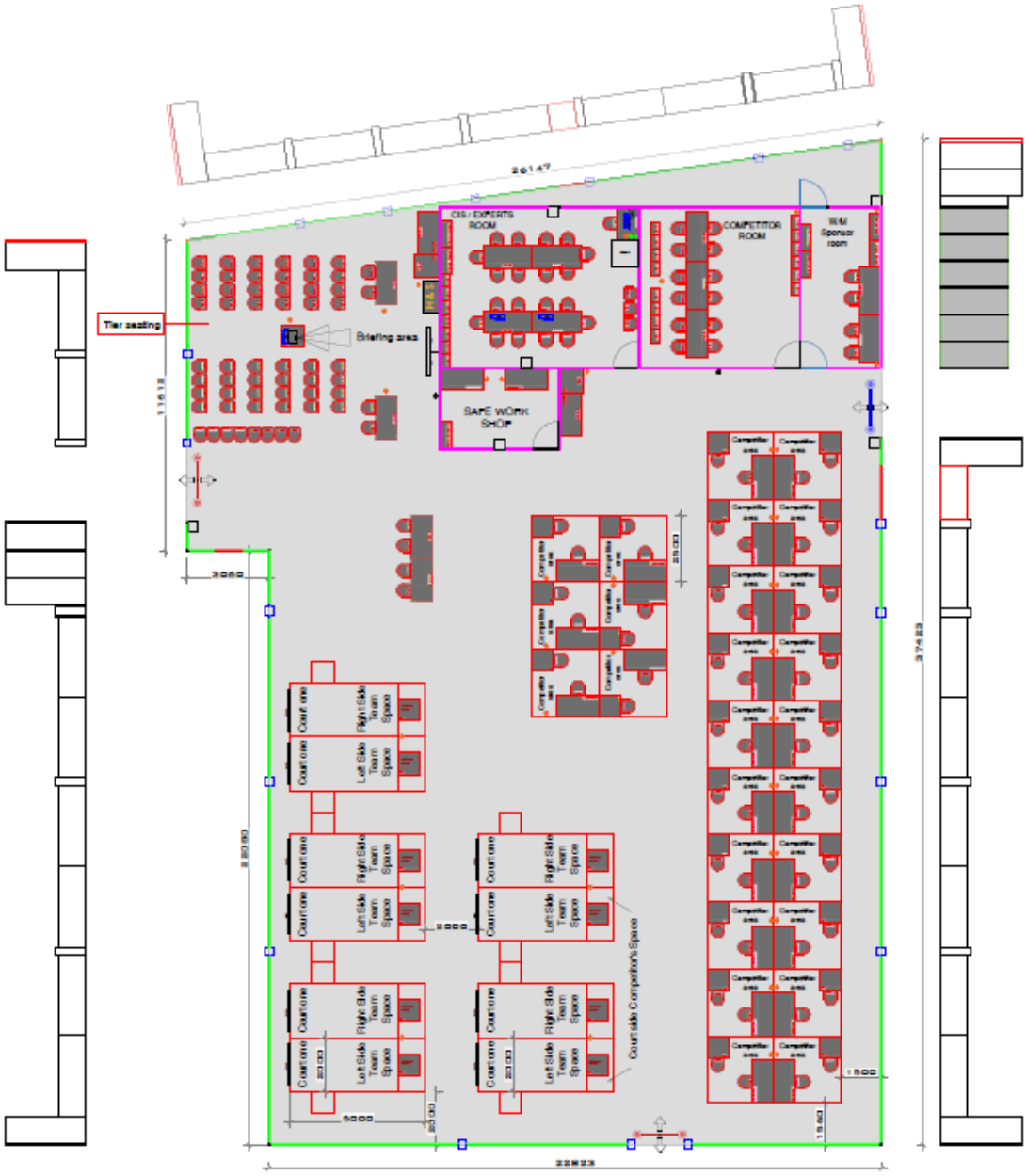
8.5 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

Teams will be limited to the use of one computer when executing the Competition Tasks.

8.6 PROPOSED WORKSHOP AND WORKSTATION LAYOUTS

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

Example workshop layout:



9 SKILL-SPECIFIC RULES

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 work flow, and documentation management and distribution.

TOPIC/TASK	SKILL-SPECIFIC RULE
Use of technology – USB, memory sticks	• One per memory stick per team allowed. During competition days, the USB-stick cannot leave the competition floor and has to be kept in locker.
Use of technology – personal laptops, tablets and mobile phones	• Competitors are allowed one laptop per Competitor in the workstation. • Competitors are allowed one laptop per team during test runs.
Use of technology – personal photo and video taking devices	• Competitors, Experts, and Interpreters are allowed to use personal photo and video taking devices in the workshop outside competition times only.
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 digital. This information may be brought in to the workshop on Familiarization day only, and kept for the duration of the competition. • Competitors may not gather new information during the competition over the internet and/or by consultation.
Equipment failure	• Equipment is a responsibility of the teams. Replacement components during the Competition Days will NOT be provided by the Sponsor. Teams are responsible for bringing their own spare parts.
Health, Safety, and Environment	• Refer to the WorldSkills Health, Safety, and Environment policy and guidelines document.
Toolbox Size	• Competitors can bring a toolbox with a maximum volume of one cubic metre.
Use of Courts	• Competitors must wear shoes on the court.

10 VISITOR AND MEDIA ENGAGEMENT

The following ideas will be considered to maximize visitor and media engagement:

- Court areas have a presentation sound system and a commentator for explanation of the Skill Competences 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.

11 SUSTAINABILITY

Sustainability of the Mobile Robotic skill competition will be put forward by:

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

12 REFERENCES FOR INDUSTRY CONSULTATION

WorldSkills is committed to ensuring that the WorldSkills Standards Specifications 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 Standards Specification 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.**oneto**nline.org/)

Your competition appears to relate closely to *Robotics Technician*: https://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.

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Standards Specification in place for WorldSkills Kazan 2019.

ORGANIZATION	CONTACT NAME
Festo Didactic	Reinhard Pittschellis, Head of Global Research and development