worldskills

Technical Description

Industry 4.0

Skill 48

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

Industry 4.0

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

Information and communication technologies (ICT) are impacting on manufacturing and production processes to the extent that their effects are likened to a “fourth industrial revolution”; hence the term “Industry 4.0”. Others use terms such as “smart production”. The business case for introducing ICT is most immediately clear with large scale, complex manufacturing, where significant gains can result from early adoption. However, in diverse ways ICT will have a far-reaching impact, forcing rapid adaptation to the work people do, and the knowledge, skills and attributes that they need to do it with ICT enables

- variety and individualization in products and services;
- shortened response times for production processes;
- greater productivity through reduced time and costs;
- information to be collected, shared and used in different ways for new purposes.

For the Digital Production Systems Technician, implementing Industry 4.0 requires contextual awareness, including the business case as it affects their responsibilities. In the short term at least, the Technician may lack sufficient knowledge, skills and attributes to be able to grasp an assignment as a whole, since their initial and continuing training may have been in production technologies, or ICT. They may also not have gained the wider perspectives and understanding that are less crucial in more static environments. Therefore initially, and perhaps permanently in larger organizations, the required expertise and perspectives may need to come together in two or more personnel.

The role of the Digital Production Systems Technician is to understand the business case for enhancement, and to design and implement technical responses accordingly. Assembled and commissioned hardware in virtual and real context using various digital tools and technology provide the basis for programming, and the design and implementation of cyber security measures on real and virtual production processes. Responding to the business need, smart maintenance may be a universal enhancement. Optimization may be more business specific and take several paths, especially in relation to the role of hardware, connectivity, the location of data points, and the purposes and types of information and intelligence.

A flexible and open approach, combined with strong technical expertise, alertness to risk and security needs, and a recognition of the endless possibilities for optimization, are the hallmark of the outstanding and successful Digital Production Systems Technician.

1.1.3 Number of Competitors per team

This skill competition is a team skill with two Competitors per team.

Recommended:

- One participant is a Mechatronic/Mechanic/Electrotechnical/Automation Technician (ME)
- One participant is a Computer Science/an IT Technician (IT)
- Both participants are Digital Production System Technicians (in the future)

1.1.4 Age limit of Competitors

The Competitors must not be older than 25 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**	**5**
	The individual needs to know and understand: • The principles and parameters of integrated automated production • Their specific roles within integrated automated production • Principles, applications, accountabilities and techniques for project management • Principles and applications of safe working practice broadly and specifically • The purpose, use, care and maintenance of equipment, facilities and materials • Principles and methods for organizing, controlling and managing work and its outcomes	

Section		Relative importance (%)
	• Their personal strengths and limitations relative to the roles, projects and modules assigned.	
	The individual shall be able to: • Set up and maintain a safe, clean and efficient work area • Maintain an appropriate state of preparation and readiness to receive, schedule and act on requests and assignments efficiently, effectively and safely • Order, select, use and care for all equipment, facilities and materials in accordance with manufacturers' instructions and accepted good practice • Conduct self and all operations with care and consideration for other personnel, cost efficiency and the environment • Monitor progress, modifying or changing plans or approaches through a rational process, within their personal authority • Complete assignments or modules, and restore the work area to its state of readiness for future use • Reflect on and review their personal performance, as part of continuing professional development.	
2	**Communication and interpersonal skills**	**5**
	The individual needs to know and understand: • Their personal strengths and limitations ◦ In perception and awareness ◦ In communication with known and unknown others ◦ In working as a colleague, leader, learner, or assistant • Principles of communication and purposeful social learning • Standards and protocols for formal and informal, direct and indirect communication with team members, managers and clients • The technical language required for the role, including the content and structures of the English language • Standards and protocols for communicating electronically • The scope and purposes of documentation in hard copy and electronic format • The requirements for routine and exception reports, in all formats • Principles and methods for analysing, synthesizing, using and communicating data.	
	The individual shall be able to: • receive assignments, identify their salient points, and ask questions for clarification and confirmation • read, interpret and extract technical data and instructions from given documentation in all available formats • discuss and plan with relevant others the complex, joint and overlapping elements of assignments	

Section		Relative importance (%)
	• communicate verbally, in writing, and electronically, using methods that ensure clarity, efficiency and effectiveness • make and retain reports on progress, issues and actions, in the required formats • give and take feedback and support to and from others • review the team's performance, one's own contribution, and individual and collective learning points.	
3	**Design, assembly, and commissioning**	**15**
	The individual needs to know and understand: • Practical applications of engineering science and technology to the design and production of goods and services in virtual and real contexts • Principles and directions for integrating local/artificial intelligence with wider communication capacities • Principles and applications for ◦ Design ◦ Assembly ◦ Connectivity and Commissioning of hardware and peripherals to meet cyber-physical requirements • Principles and methods for integrating autonomous subsystems and components • Principles and applications for data collection, storage, networking and use.	
	The individual shall be able to: • Read and interpret instructions, using questioning techniques and research to check, verify and prepare • Design systems for the automation and communication of production modules, with the given parameters for cyber-physical systems • Test and implement design solutions • Assemble machines and equipment • Select and apply sensors, communication technologies, and devices for motion control, position sensing, pressure testing and electronic communication • Test the performance of electrical, electronic, mechanical and integrated systems and equipment, relative to their intended purpose • Apply mechatronic or automated solutions to the transfer of materials, components or finished goods • Integrate the equipment and sub-systems to ensure readiness for data capture, networking, exchange and use • Commission the system • Create and maintain project files.	

Section		Relative importance (%)
4	**Software design and implementation**	**20**
	The individual needs to know and understand: • Mathematics and their applications • Principles and applications of industrial automation • Computer capabilities, subject matter, and symbolic logic • Computer hardware and software, and their applications • The required standards for code conventions, style guides, user interface designs, managing directories, and files • Principles and applications of human-machine communication.	
	The individual shall be able to: • Write, analyse, review, and rewrite programs • Correct errors by making appropriate changes and rechecking that the desired results are produced • Perform or direct revision, repair, or expansion of existing programs to increase operating efficiency or adapt to new requirements • Write, update, and maintain computer programs or software packages to handle specific jobs such as tracking inventory, storing or retrieving data, or controlling other equipment • Conduct trial runs of programs and software applications to ensure they produce the desired information and the instructions are correct • Principles of databases and data storage/retrieval • Create, modify and maintain databases • Prepare detailed workflow charts and diagrams that describe input, output, and logical operation, and convert them into a series of instructions coded in a computer language • Compile and write documentation of program development and subsequent revisions, using protocols to ensure that others can understand the programs • Consult with others to define and resolve problems in running programs • Perform systems analysis and programming modules to maintain and control the use of computer systems software. • Write or contribute to instructions or manuals to guide end users • Investigate whether networks, workstations, the central processing unit of the system, or peripheral equipment are responding to a program's instructions. • Implement functions to allow for data exchange using common industrial protocols • Implement functions to allow for data exchange using M2M protocols	

Section		Relative importance (%)
5	**Networking and cyber security**	**20**
	The individual needs to know and understand: • The scale and nature of the organization's vulnerability to breaches in information security • The nature and causes of incidental and accidental data breaches, both human and systemic • Principles and methodologies for establishing and maintaining maximum information security and data integrity • Principles and methodologies for addressing minor breaches • Development environment software • Network protocols and topology • Network monitoring software • Web platform development software.	
	The individual shall be able to: • Design and implement network protocols and topologies to ensure secure and effective exchange of information between devices • Implement network protocols • Develop plans to safeguard computer files against accidental or unauthorized modification, destruction, or disclosure, and meet emergency data processing needs • Maintain levels of preparedness and the availability of preventative and defensive tools commensurate with risks and trends in malicious attacks • Encrypt data transmissions and erect firewalls to conceal confidential information during transmitted, and to keep out tainted digital transfers • Conduct tests of data processing systems to ensure safe functioning of data processing and security measures • Modify computer security files to incorporate new software, correct errors, or change individual access status • Monitor the use of data files and regulate access to safeguard information • Review violations of procedures and take steps to prevent their repeating • Document computer security and emergency measures, policies, procedures and tests • Train users and promote security awareness to ensure system security and improve server and network efficiency.	
6	**Testing, maintenance, and fault-finding**	**10**

Section		Relative importance (%)
	The individual needs to know and understand: • Principles and applications of smart maintenance, based on data, to enable ◦ Condition monitoring ◦ Data analysis and correlation ◦ Predictive maintenance • The use of augmented reality and other emerging technologies and tools • The use of simulation models, reconfiguration and virtualization • Operational parameters/process data • The use of constraints and variables, restrictions, alternatives, conflicting objectives, and numerical parameters for conceptualizing and defining problems • Principles and methodologies for designing alternatives and making decisions and recommendations • The purposes and nature of maintenance records.	
	The individual shall be able to: • Identify the parts of the production system to which to apply smart maintenance • Establish the parameters for the parts' operation • Use the access tools at the appropriate data points, or on a mobile basis • Monitor the condition using augmented reality or other tools • Undertake preventive or predictive maintenance by reviewing alternative courses of action and scheduling or recommending the optimal measure(s) • Use the available technology and measures to effect maintenance with least disruption to production.	
7	**Enhancement and optimization**	**15**
	The individual needs to know and understand: • The potential for smart production systems to be enhanced to ◦ Enable greater flexibility and individualization in production ◦ Shorten reaction and response time in production ◦ Reduce time and cost in production ◦ Collect, share and use information for continuous enhancement • Principles and methods for identifying, analysing and pursuing opportunities for enhancement • The implications of increased data storage and exchange • Principles and methods for cost benefit analysis • Principles and methods for work organization and workforce planning and development.	

Section		Relative importance (%)
	The individual shall be able to: • Reduce costs by removing waste ad consumption caused by ◦ Over-production ◦ Stock and storage ◦ Over- and unnecessary processing ◦ Poor quality ◦ Transport and movement ◦ Waiting time • Analyse and recommend opportunities for optimization using ◦ Simulations ◦ Prototyping ◦ Digital shadows/twins • Identify and exploit opportunities for ◦ Energy efficiency and sustainable practice ◦ Greater lateral and vertical integration ◦ The use of the Cloud • Identify the cost-benefit implications, financial and human, of optimization.	
8	**Analysis, evaluation, and reporting**	**10**
	The individual needs to know and understand: • Principles and applications of critical thinking and complex problem-solving • The uses and availability of self-monitoring equipment and tools • The bases, techniques and tools for creating and using analytical models of performance, including ◦ Performance targets or specifications ◦ Numerical and quantifiable parameters ◦ Data requirements ◦ Constraints and variables ◦ Alternatives • How to conceptualize, define and evaluate problems referred to them, and to derive recommendations for solutions • The content, structure and presentation for reports serving different purposes • Principles and applications to presentations for management, peers and clients • Cost benefit analysis, and its uses for recommending alternative courses of action.	
	The individual shall be able to: • Take account of requirements for monitoring, review and evaluation in the design of the system and sub-systems • Optimize the use of self-monitoring equipment and tools to the extent feasible	

Section		Relative importance (%)
	• Design and apply an appropriate model for monitoring and evaluating performance relative to specification • Anticipate requests for feedback and reports, and prepare accordingly on a data rational basis • Prepare reports in appropriate formats for routine and exception reporting • Make presentations customized to particular groups and individuals • Maintain awareness of new possibilities and options for improvement, making recommendations on the basis of return on investment.	
	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.

The following performance must be assessed:

- Mechanical assembly of all components (assembly must ensure correct functioning of the system)
- Digitalization of a production system
- Implementation of industrial IoT systems
- Development of web services connecting OT and IT
- Configuration of databases and design of dashboards
- Cyber Security
- Simulation and Digital Twin
- Smart/Preventive Maintenance
- Integration of an Energy monitoring system
- Work with MES and other IT software
- Analysis, evaluation, optimization, reporting

The Sponsor’s technical support team will provide spare and replacement parts for Competitors only during competition time. Exceptions are announced by the Chief Expert.

Procedure for testing PLCs and programming software prior to being used:

- Competitors will get the module description, all files and documents needed for the module execution in digital form.
- The system must be prepared by the Competitors for the Assessment as given in the specific module description.
- If applicable, additional equipment may be used by the assessment team during the assessment procedure (e.g. tablets, additional computers, software tools…).
- The server computer is used for the assessment of the module specific demands. Competitor devices (computers, tablets) must be disconnected from the system network, described in the specific module.
- The assessment team is not allowed to modify either HW nor SW solution(s) of the Competitors during the assessment of the specific module, except when the marking scheme specifies it (example: removing a network cable to assess network monitoring). It should not have any effect on the rest of the assessment.
- In case of uncertainty, the Competitors will be called to prove the evidence.
- The Competitors are allowed to enter the workplace:
  - Only on an invitation of the assessment team to show a solution/a way how the team came to the solution
  - The Experts give clear and direct instructions to the Competitors;
  - Competitors are not allowed to discuss the assessment with the Experts;
  - As soon as the evidence is shown, the competition team member(s) will be asked to get back to the briefing area, in front of the workplace.

The WorldSkills Standards and Assessment Guide will be available on the WorldSkills website for every Expert to get guidance on Assessment.

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 four (4) separately assessed modules.

Parts of the result of a module can be required for a following module, so that the modules create a consistent authentic story.

Technical equipment will be provided before each module as required for the execution.

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 Test Project must fulfil the following requirements:

- To be based on a true story:
  - To retrofit/upgrade an existing "Industry 3.0" based production system to an "Industry 4.0" one, providing digital transformation I3.0 to I4.0

- To produce a product based on a customer's specific needs
- To be accompanied by a marking scale;
- To be validated according to the section 5.5;
- For modules;
- To create a consistent authentic story, with a limit of 15% dependency between modules (points). Contain four (4) modules;
- To be supplied with documentation clarifying the operation of special or new equipment to finalize the Test Project
- To be supplied with a library of photographs or drawings to clarify requirements of the modules (if necessary);
- The modules are closely associated to the hardware used;
- To keep the competition fair, the Independent Test Project Designer must keep the modules secret. A trusted third party – an auditor – can monitor the preparation of the competition, receiving the completed modules from the Skill Competition Manager three (3) months prior to the competition.

Information on the modules is distributed strictly on a need-to-know basis: Information will only be given to those involved in development who need to know, and they will only get the information they need to make their contribution. Each person involved in the development process must sign a Confidentiality Agreement prior to receiving any competition-sensitive information.

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 an Independent Test Project Designer (ITPD) in collaboration with the Skill Competition Manager and the main sponsor.

5.4.3 When is the Test Project developed

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

Time	Activity
Fifteen (15) months prior to the Competition	The ITPD is identified and a Confidentiality Agreement between WSI and the ITPD is organized.
Six (6) months prior to the Competition	The known stations are announced in the Worldskills Discussion Forum. The Skill Competition Manager and the Independent Test Project Designer check the concept of the eight (8) modules;
No later than two (2) months prior to the Competition	The Test Project documents are sent to the WorldSkills International Skills Competitions Administration Manager.
At the Competition on C-2	The Test Project/modules are presented to the Experts.

Time	Activity
At the Competition on the beginning of each module	The Test Project/modules are presented to the 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 Experts on C-2 and to Competitors at the beginning of each module.

5.8 Test Project change

Due to the Test Project being developed by an Independent Test Project Designer (ITPD), 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.

- A document called “Software requirements” as well as all necessary Apps for the Server PC (MES PC) and tablets are specified and circulated six (6) months prior to the Competition via the WorldSkills Discussion Forum;
- The Competitors are responsible for the provision of power supply connectors, adaptors, plugs, and interfaces suitable for the Host Country;
- Competitors are allowed to test the air infrastructure, the MES Server PC with installed software and the base modules of the equipment during Familiarization Day on C-2;
- When some special tools are needed, then this is announced in the WorldSkills Discussion Forum;
- A server computer will be provided by the Competitor Organizer;

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
Drawings, recording information	• Drawings of the hardware layout/configuration is provided by the Chief Expert.
Equipment failure	• Sponsor's Technical Support Team provides spare and replacement parts to Competitors only during competition time. Exceptions are announced by the Chief Expert.
Health, Safety, and Environment	• Workshop Manager will introduce the safety instructions prior to the start of the competition. • The Team of Experts will ensure the working place for all Competition Teams fulfil healthy and safety requirements prior to the Competition start.
Infrastructure	• Working places are equipped with sufficient electrical and air supply. • Competitors are allowed to check air infrastructure during Familiarization Day.
Supervision of Competitors	• It is done by the team of Experts.

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.

Note: These rules can be overwritten by the venue, where competitions are taking place.

Module	Safety glasses with side protection	Safety shoes with protective cap	Sturdy shoes	Tight fitting work clothes (long trousers)	Ear protection
General PPE for safe areas			√	√	
During working/ commissioning time in the workshop	√	√		√	
During mechanical assembly and operating system under pneumatic pressure	√	√		√	
When Experts and interpreters entering the Competitor's workstation	√	√		√	
During Modules execution, if the environment is too loud in addition to all other PPE required, depending on situation					√

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.

8.2 Competitors toolbox

Competitors are not allowed to send a toolbox to the Competition. All tools are provided by the Competition Organizer.

8.3 Materials, equipment, and tools supplied by Competitors

Competitors are not allowed to bring their own tools to competition area. All necessary tools will be provided by Organiser and a list of tools will be shared in advance on WorldSkills Forums (C-6 months).

Competitors are able to provide own laptops (one per competitor + one spare laptop);

Monitors will be provided by the Organiser - announcement will be provided on WorldSkills Forums in advance to ensure correct Teams' preparation.

Each Team may bring wired keyboard and mouse (one participant – one PC)

Competitors are required to supply their own Personal Protective Equipment as specified in Section 7 “Skill-Specific Safety Requirements” of this document.

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.

Experts to provide at least one stopwatch for their team – to be used by timekeepers.

In case Experts are expected to supply any other items, such information must be announced on the WorldSkills Discussion Forum at least one (1) month prior to the Competition.

8.5 Materials and equipment prohibited in the skill area

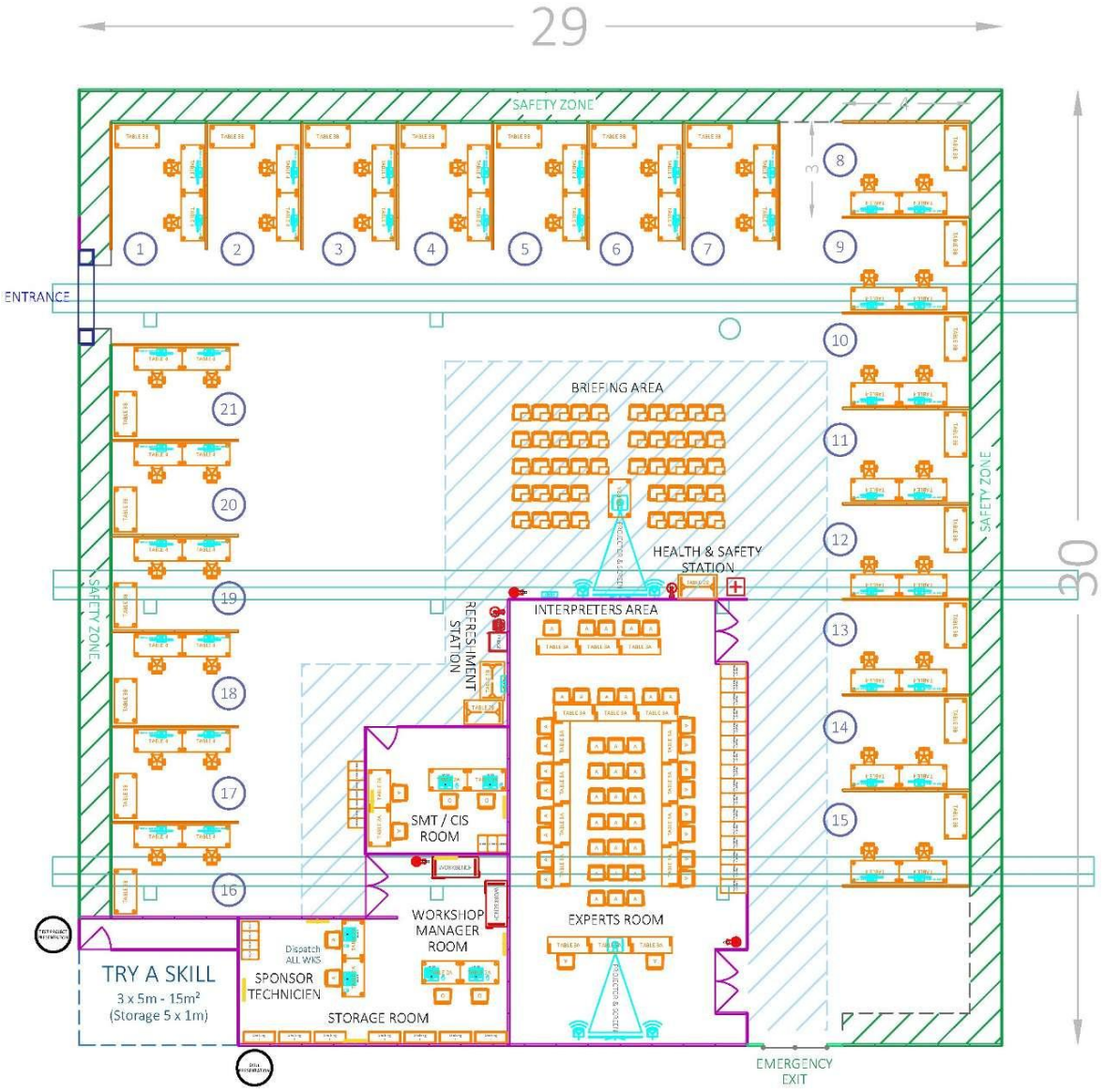
Competitors and Experts are prohibited to bring any materials or equipment not listed in section 8.3 and section 8.4.

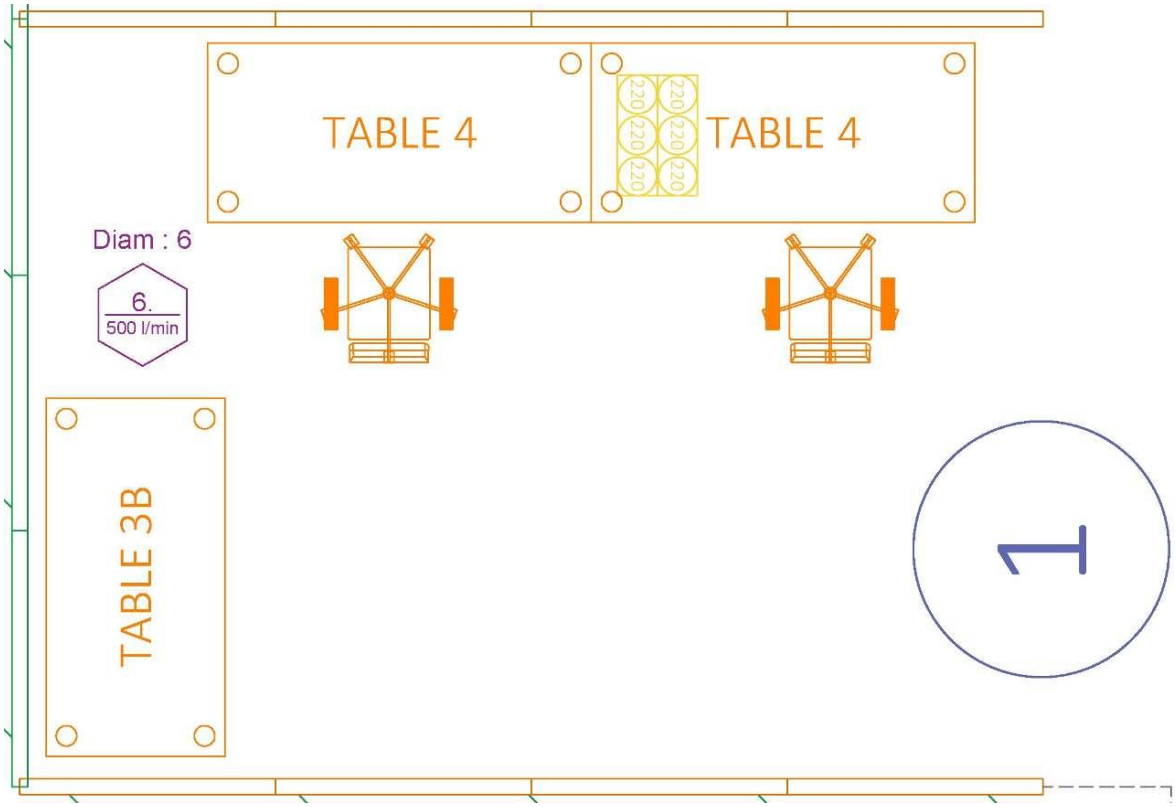
- Competitors are not allowed to use prepared cables and tubes, brought to competition area in advance;
- The use of knives is prohibited due to the risk of injury.

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

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	Best practice procedure
Use of technology – USB, memory sticks	• If required, competitors are allowed to use memory sticks provided exclusively by the Chief Expert. • The name of each Competitor's Team is clearly indicated on the USB, delivered to the Team by the Chief Expert. • Memory sticks or any other portable memory devices provided by the Chief Expert cannot be taken outside the workshop. • Memory sticks or other portable memory devices are to be submitted to the Chief Expert at the end of each module for safe keeping.
Use of technology – personal computers, laptops, tablets, and mobile phones	• Skill Competition Manager, Chief Expert, Experts, and Interpreters are allowed to use personal laptops, tablets, and mobile phones in the Expert room only. If these are brought into the workshop, then they must be locked in the locker each day and can only be removed from the workshop at the end of C4. This rule is valid for C-2 until C4. • By the decision of Skill Competition Manager, personal mobile phones can be taken outside of workshop at the end of each day's module. • Tablets that may be used for task execution and evaluation will be supplied by the Organizer. This means teams are not required to bring their personal tablets – if that happens, these will not be allowed in workshop area during task execution. • If personal mobile phones and tablets are brought to the workshop, then they must be locked in the personal locker and can only be removed at lunchtime and at the end of each day. • Each Competition Team is responsible for bringing suitable laptops (one participant – one laptop, plus one extra laptop, as a spare one) for the sole purpose of the competition (programming and managing chosen hardware). The laptops will be controlled on C-2 and then stored into the appropriate locker. • Although it is highly recommended to bring all three laptops per team, it is not mandatory – all required work can be done by just using MES PC supplied.

Topic/task	Best practice procedure
	• At the end of each module, computers used by competitors should be switched off and disconnected from the main system – MES PC, and all other hardware. Teams will be asked to disconnect their devices by the end of the module, before the assessment process begins. • Interpreters must bring their own keyboards to be used with supplied PCs/laptops for translating the tasks. • On C-3, SMT and Technical Support Team will install all required language packages on PCs/laptops used for translating the tasks. • One PC/laptop will be available per interpreter during translation process.
Use of technology – personal photo and video taking devices	• Skill Competition Manager, Chief Expert, Competitors, Experts, and Interpreters are allowed to use personal photo and video taking devices in the workshop at the conclusion of the competition on C4 only.
Use of technology: Other electronic devices	• Any electronic device, allowing any kind of text/audio/video communication or taking photos/videos, is not allowed in the complete workshop area, from C-2 until the end of C4. • If the Competitors bring their own electronic devices to the workshop, those must be locked immediately in the teams' lockers.
Technical documentation - Manuals, dataheets	• A list of all standard documentation, datasheets and manuals will be provided to all Teams via forums C-6 months. If there are any changes/updates to the software/hardware used which reflects changes in documentation an update will be shared via Forums. • All documentation will be supplied in English – where applicable. There may be rare occasions where manufacturer has released documentation in other language.
Technical documentation - team's responsibility	• It is Team's responsibility to download latest technical documentation to their personal laptops prior to competition and if necessary, translate it to their local language. • During competition, latest technical description will be supplied on MES PCs or shared using supplied USB sticks – in English only.
Language for documentation	• Any written Test Project documentation must be in English. Grammar won't be assessed, but the design (layout, user friendliness) of the document.
Organization of work Area	• Competitors may freely organize their own working place, within safety limits set by venue organisers and Workshop Manager, announced on Familiarisation day.

Topic/task	Best practice procedure
Technical Support	The Technical Support Team consists of representatives of the supporting company (Festo, Siemens) providing and supporting hardware and software for the competition. **1. Responsibility** The technical support team is providing support for the supplied equipment. In case an equipment is not functionating as intended they either fix it or replace it. If equipment is missing or broken on the familiarization day, the technical support team provides replacement. If any equipment is missing or broken during the competition, the technical support team is providing replacement if available. If there is a technical difficulty with the software provided and running on a supplied PC (MES PC) the technical team identifies if it is a bug or not and informs the team. If a bug was found, all teams must be informed about it in the form of an announcement. **2. Out of scope** Technical questions by the competitors (such as “How can I do this?”) are not answered by the technical team. The technical support team is not responsible for the equipment brought by the competitors. Technical difficulties on the competitors’ laptop (including software from Festo and Siemens) are the responsibility of the competitors themselves. Communication between competitor laptops and any provided equipment is also out of scope. On rare occasions, if there are assumptions that the issue with communication is caused by supplied hardware, the technical team can assist only during Familiarisation Day. The technical team is not responsible for any software installed by the competitors, even if it is Festo or Siemens software and even if it is installed on the provided PC. **3. Technical support tokens** Every team gets 3 technical support tokens on each competition day, with the remaining tokens to be returned by the end of each day. When they request technical support, they must give the token to the technical support team. If the result of the technical check is that they did something wrong, they lose the token, but if it was really a technical issue, they get it back. If the team runs out of tokens, they cannot request more technical support. With this we can reduce the number of unnecessary technical support calls. **4. Process of technical support request** a. One of the competitors informs the timekeeper expert that they have some technical issue and want to request the technical support team.

Topic/task	Best practice procedure
	b. The timekeeper asks them if they can continue the work, or they want to stop the time. If they want to stop the time, the timekeeper makes notes about the actual time and sends the team to the briefing area. c. If none of the Technical Team Members is available, the time it takes for member to arrive will be granted back to the team, regardless of the decision outcome. d. When the technical team arrives, one of the competitors (in a presence of an Interpreter – if required) explains the issue (including showing it on the provided equipment, if required) and provides a technical support token. e. While the technical team is solving the issue at the competitor's work area, both competitors must stay at the briefing area. f. The technical support team identifies the problem: • If it was really a problem with the provided equipment, they solved it. In this case the team gets extra time (equal to the time they were outside of their working area during technical intervention plus time of waiting for the technical team) and can continue the work. They also get back the technical support token. • In this case the technical support team explains to the teams (in a presence of Interpreter – if required) what the issue was, and if it is relevant for the other teams as well, they report an announcement. • If the issue was caused by the team, they are losing the time of the technical support and the token. They do not lose the time they spend waiting for the technical support team to arrive. If a part was damaged, it will be replaced by technical support, and the team can continue the work. • In this case the technical support team does not inform the team about the issue

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**.

Minimum Qualification

- **Technical Diploma or Degree**
  A minimum of a technical diploma or bachelor's degree in fields such as Mechatronics, Automation, Electrical Engineering, Computer Science, or Industrial Engineering.
- **Basic Programming and Networking Skills**
  Proven ability to program PLCs, microcontrollers, or industrial software and understand industrial communication protocols

Expected Industry and/or TVET Experience

- **Practical Industry Experience in Industry 4.0 Environments**
  At least 3 years working in smart manufacturing, automation, or digital production environments implementing Industry 4.0 solutions.
- **Experience in TVET or Vocational Training**
  Minimum 1-2 years' experience in technical education or training, preferably delivering competency-based learning in Industry 4.0-related subjects.
- **Project and Team Management Skills**
  Demonstrated ability to lead technical projects and work collaboratively within multidisciplinary teams.
- **Experience with Skills Competitions**
  Familiarity with Skills assessment methods and standards, ideally through prior involvement in national or international competitions.

Areas of Specialism (at least one)

- **Expertise in IoT and Sensor Integration**
  Specialization in deploying and managing IoT devices and sensors within manufacturing processes.
- **Data Analytics and Cloud Computing**
  Skills in applying data analytics, machine learning, or cloud platforms to optimize production and maintenance.
- **Cybersecurity for Industrial Systems**
  Knowledge of protecting industrial control systems and networks from cyber threats.
- **Digital Twin and Simulation Technologies**
  Experience using simulation software and digital twins for process modeling, testing, and optimization.

11 Visitor and media engagement

11.1 Engagement methods

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

- Display screens: Some web cameras could be dispatched in the Competition area and show details of the module to the public and on a website;
- Test Project descriptions;
- Competitors:
  - Enhanced understanding of activity;
  - Profiles
  - Status Daily Report.

12 Sustainability

12.1 Sustainable practices

This skill competition will focus on the sustainable practices below:

- Recycling;
- Use of “green” materials;
- Use of completed Test Projects after Competition;
- Transmission of the Test Project digitally to the Competitor’s computer immediately before starting the module.

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

These two roles relate most closely to Mechatronic Technician:
http://data.europa.eu/esco/occupation/edf2e989-d7c5-496e-b365-81fc5cb9eb39

and a technician version of Mechatronics Engineers:
http://data.europa.eu/esco/occupation/a7c1d23d-aeca-4bee-9a08-5993ed98b135

And to IT System Developer:
http://data.europa.eu/esco/occupation/a7c1d23d-aeca-4bee-9a08-5993ed98b135

and Software Developers, Systems Developers:
https://www.onetonline.org/link/summary/15-1133.00 .

ILO 3115 and 2511

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
Bühler AG	Denis Forster, Leader Vocational Trainer
MSW - Mechatronic Schule Winterthur	Olivier Riesenv, Vocational trainer of education Automatic technician

14 Appendix

14.1 Appendix information

Not applicable.