

INFORMATION AND COMMUNICATION TECHNOLOGY

# IT Network Systems Administration



## Technical Description

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.

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Effective 22.09.2020



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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

IT Network Systems Administration

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

An IT Network Systems Administrator works in small or large organizations in the commercial and public sectors, offering a wide range of IT services which are critical for the operation of daily business. Any 'downtime' is costly for an organization therefore the IT Network Systems Administrator has a responsibility to work professionally and interactively with users in order to meet their needs and ensure continuance of the systems and service levels they require to perform their roles effectively. The IT Network Systems Administrator also offers advice and guidance on the development of systems and services to take the organization forward.

The IT Network Systems Administrator works in diverse environments including network operations centres, internet service providers, data centres, e.g. Amazon and climate-controlled server rooms. He or she offers a wide range of services based on user support, troubleshooting, design, installation/upgrading, and configuration of operating systems and network devices.

The IT Network Systems Administrator may at some stage in their career specialize in user support, design, installation of operating systems or configuration of networking devices. Irrespective of this, work organization and self-management, communication, and interpersonal skills, problem-solving, a dedication to research/keeping up to date with industry developments and a consistently methodical and investigative approach are the universal attributes of the outstanding IT Network Systems Administrator.

In a mobile labour market, the IT Network Systems Administrator may work in teams, or alone, or both from time to time. Whatever the structure of the work, the trained and experienced IT Network Systems Administrator takes on a high level of personal responsibility and autonomy. From ensuring businesses remain consistently in operation, with limited IT systems breakdowns, to contributing to the design of new systems, every process matters and mistakes cost the business money.

With the fast globalization of IT systems and the international mobility of people IT Network Systems Administrators face rapidly expanding opportunities and challenges. For the talented IT Network Systems Administrator there are many commercial, public sector and international opportunities; however, these carry with them the need to understand and work with diverse cultures, and to keep up to date with fast changing industry developments. The diversity of skills associated with IT network systems administration is therefore likely to expand.

### 1.1.3 Number of Competitors per team

IT Network Systems Administration is a single Competitor skill competition.

### 1.1.4 Age limit of Competitors

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

## 1.2 The relevance and significance of this document

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

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

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

## 1.3 Associated documents

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

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

## 2 The WorldSkills Occupational Standards (WSOS)

### 2.1 General notes on the WSOS

The WSOS 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/WSOS](http://www.worldskills.org/WSOS)).

The skill competition is intended to reflect international best practice as described by the WSOS, and to the extent that it is able to. 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 that are set out in the Standards Specification. 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, provided that this does not distort the weightings assigned by the Standards.

## 2.2 WorldSkills Occupational Standards

Section	Relative importance (%)
<b>1 Work organization and management</b>	<b>5</b>

The individual needs to know and understand:

- Health and safety legislation, obligations, regulations, and documentation
- The situations when personal protective equipment (PPE) must be used, e.g. for ESD (electrostatic discharge)
- The ability to seek assistance from peers when lacking in experience or knowledge in a particular area
- The importance of integrity and security when dealing with user equipment and information
- The importance of safe disposal of waste for re-cycling
- The techniques of planning, scheduling, and prioritizing
- The significance of accuracy, checking, and attention to detail in all working practices
- The importance of methodical working practices
- Collaboration and research methods and techniques
- The value of managing own continuing professional development
- The speed of IT systems change and the need to maintain currency

The individual shall be able to:

- Follow health and safety standards, rules, and regulations
- Maintain a safe working environment
- Identify and use the appropriate Personal Protective Equipment for ESD
- Select, use, clean, maintain, and store tools and equipment safely and securely
- Plan the work area to maximize efficiency and maintain the discipline of regular tidying
- Regularly schedule, re-schedule, and multi-task according to changing priorities
- Work efficiently and check progress and outcomes regularly
- Undergo various certification requirements, such as: Cisco, Microsoft, and Linux, specializing in at least one specific area
- Keep up-to-date with “license to practice” requirements and maintain currency
- Demonstrate thorough and efficient research methods to support knowledge growth
- Demonstrate enthusiasm to try new methods, systems, and embrace change
- Collaborate with work colleagues effectively to maximize efficiency and learning
- Work effectively as a member of a project team

Section	Relative importance (%)
<b>2 Communication and interpersonal Skills</b>	<b>10</b>

The individual needs to know and understand:

- The importance of listening as part of effective communication
- The roles and requirements of colleagues and the most effective methods of communication
- The importance of building and maintaining productive working relationships with colleagues and managers
- Techniques for effective teamwork
- Techniques for resolving misunderstandings and conflicting demands
- The process for managing tension and anger to resolve difficult situations

The individual shall be able to:

- Demonstrate strong listening and questioning skills to deepen understanding of complex situations
- Manage consistently effective verbal and written communications with colleagues
- Recognize and adapt to the changing needs of colleagues
- Pro-actively contribute to the development of a strong and effective team
- Share knowledge and expertise with colleagues and develop a supportive learning culture
- Effectively manage tension/anger and give individuals confidence that their problems can be resolved

<b>3 User support and consultancy</b>	<b>10</b>
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The individual needs to know and understand:

- The features of a defined range of IT systems to enable a good breadth of support
- Planning and scheduling techniques to facilitate a consistently high level of service, to meet the needs of the user and the organization
- Different demonstration and presentation techniques to support the development of users' skills and knowledge
- Different methods of assessing user's abilities in order to support immediate needs and encourage personal development
- Coaching techniques to meet individual learning styles
- Trends and developments in the industry and types of improvement which could be introduced to the user
- Negotiation techniques for different situations e.g. a project tender

Section	Relative importance (%)
<p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Pro-actively maintain currency of IT systems knowledge</li> <li>• Respond appropriately within target timescales, to users within an organization and those based remotely, in order to provide the appropriate level of IT support</li> <li>• Plan, schedule, prioritize and regularly re-prioritize requests for IT support in order to meet and balance the needs of the individual and the organization</li> <li>• Accurately determine user requirements and effectively manage expectations</li> <li>• Produce a cost and time estimate for work to be completed</li> <li>• Select appropriate demonstration techniques to suit different levels of experience/capability</li> <li>• Effectively demonstrate IT systems to individuals and teams to enable them to grow their skills and knowledge</li> <li>• Successfully coach individuals “face-to-face” and remotely to resolve IT problems, introduce new products and develop their skills and knowledge</li> <li>• Recognize opportunities to contribute ideas to improve the product and overall level of user satisfaction</li> <li>• Provide accurate up-to-date advice on up-grading and sourcing new IT products and services to support decision-making</li> <li>• Translate needs, making recommendations which meet requirements e.g. budgets</li> <li>• Contribute to bids and tenders for projects</li> </ul>	
<b>4 Troubleshooting</b>	<b>25</b>

The individual needs to know and understand:

- The importance of a calm and focused approach in solving a problem
- The significance of IT systems and the dependency of individuals and organizations on its constant availability
- The common types of hardware/software errors which can occur
- Diagnostic and analytical approaches to problem solving
- Boundaries of own knowledge/skills/authority and sources of support/escalation procedures
- Standard resolution times for common problems

Section	Relative importance (%)
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The individual shall be able to:

- Approach a problem with the appropriate level of confidence to calm the user as necessary
- Check work regularly to prevent/minimize problems at a later stage
- Challenge incorrect information to prevent/minimize problems
- Demonstrate resilience and persistence when dealing with problems
- Recognize and understand problems swiftly and follow a self-reliant and managed process for resolving
- Thoroughly investigate and analyse complex problems/situations and apply fault finding processes
- Select and use diagnostic software and tools to identify problems
- Support users in resolving problems through advice, guidance, and instruction
- Seek support when further expertise is necessary and avoid temptation to 'be consumed' by the challenge of the problem
- Check user satisfaction level after a problem has been addressed
- Accurately record problem and provide resolution report

<b>5</b>	<b>Design</b>	<b>5</b>
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The individual needs to know and understand:

- Network environments and topologies
- Logical and functional diagrams
- The types and location requirements of active network devices e.g. routers and switchers
- Security options and their impact
- Address schemes
- Configuration documentation required e.g. installation instructions

The individual shall be able to:

- Discuss the technical design requirements for operating systems and networking devices at the appropriate level of responsibility and accountability within the client organization
- Give knowledgeable/best advice and possible solutions to customer to meet technical and security requirements
- Match budget/resource restraints with best possible client solutions
- Accurately transfer the customer wishes to a logical diagram
- Prepare configuration documentation
- Undertake pre-acceptance testing of the concept
- Prepare a document and get sign off

Section	Relative importance (%)
<b>6 Install, up-grade, and configure operating systems</b>	<b>25</b>

The individual needs to know and understand:

- The range of operating systems and their abilities to match particular user requirements, given the user budget requirements
- The process for selecting the appropriate driver for different kinds of hardware
- The basic functions of the hardware and the process for setting-up
- The importance of following instructions and the consequences/costs of not adhering to them
- The precautions that need to be actioned before an installation or an up-grade
- The purpose of documenting the completion of the installation or up-grade

The individual shall be able to:

- Closely listen, translate, and accurately identify user needs to ensure expectations are met
- Select the operating system: proprietary/open source, total cost of ownership in relation to customer resources
- Accurately identify the hardware and appropriate software driver required to match user/manufacture specifications
- Consistently check manufacturer's guidance for up-grading regarding "workflow"
- Select the roles and/or features of the operating/server system e.g. Active Directory Domain Services (role) and Windows Server Back-up (feature)
- Discuss the proposed solution for role/feature and agree with relevant parties e.g. users, colleagues, and managers
- Prepare a technical document reflecting the solution in detail for agreement and sign-off
- Configure the appropriate role/feature following manufacturer's instructions or best practice within the organization
- Test and rectify any problems and re-test as appropriate
- Gain user acceptance and record

Section	Relative importance (%)
<b>7 Configuring networking devices</b>	<b>20</b>
<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> <li>• Networking environments</li> <li>• Networking protocols e.g. IPv6</li> <li>• Implement networking services as required by customer</li> <li>• The process for building a network and how network devices can be configured to enable efficient communication</li> <li>• The range of network devices e.g. routers, VoIP, IP devices e.g. security cameras, printers, wireless access points, and inter- networking connectivity</li> <li>• Precautions which need to be taken to avoid issues arising from changing network configuration on operational equipment</li> <li>• The importance of documenting the (rationale for as well as all) final configuration settings</li> </ul>	
<hr/> <p>The individual shall be able to:</p> <ul style="list-style-type: none"> <li>• Interpret user demands and design requirements to industry certification requirements</li> <li>• Work with other team members and follow required procedures to achieve successful configuration</li> <li>• Select appropriate services to meet customer requirements</li> <li>• Apply all types of different configurations, including software and hardware upgrades, on all kinds of networking devices that can appear in a network environment to include: Routing protocols, Network Security, Wi-Fi, VoIP, etc.</li> <li>• Design and implement disaster recovery procedures</li> <li>• Discuss the proposed solution for role/feature and agree with relevant parties e.g. users, colleagues, and managers</li> <li>• Maintain configuration records</li> </ul>	
<b>Total</b>	<b>100</b>

## 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, in order 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 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 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 people 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 Rules for further details.

Experts and Independent Assessors 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)
- 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

WorldSkills is committed to continuous improvement. This particularly applies to assessment. The SMT is expected to learn from past and alternative practice and build on the validity and quality of assessment and marking.

The module groups of Experts will decide on the marking criteria for their own module.

The following is not a definitive list but is an example of possible aspects that are assessed:

- RAID one mirrors exist;
- Five SCSI Hard disk detected;
- Second hard disk contains two partitions;
- Both 10GB in size, formatted and ready to use no DNS timeout;
- Backup includes drive D;
- Backup includes system state;
- Backup includes/usr/local or files representing it;
- Backup schedule show one full backup per week and differential on other days;
- Above scheduled for 12pm every day;
- Linux install completed;
- DNS forwarder set to Linux;
- All DNS root hints cleared;
- DHCP Range created and correct;
- Default gateway 192.168.1.1;
- DNS 192.168.1.2;
- DHCP Lease time two days;
- Domain in 2003 Native Mode;
- RDWeb installed;
- RDWeb only listen/respond on VPN range;
- RRAS setup and set to VPN server. Printouts/Scripts;
- Postfix/Outlook receive Mails;
- Folder redirection for "My Documents";
- PPP with Chap authentication;
- IP Phone Calls Remote.

## 4.10 Skill assessment procedures

Assessment and marking are an intense process that depends upon skilful leadership, management, and scrutiny.

All Experts should be assigned to a module team. With this module organization, the assignment of the Competitor's first day module is done as follows:

- The Competitor will start the first day of the competition at the same module as their compatriot Expert is a part of.
- If the Competitor's compatriot Expert does not belong to or is not a part of a module teams, their Competitor's starting module is by ballot draw as soon as the module teams are formed.

The Competitor's work may not be altered in any way to facilitate marking unless included in the Marking Scheme.

The Experts attending the Competition are divided into smaller marking groups within their module team to mark each specific section of the marking criteria.

Progressive marking for all sections of the Competition

Each module is completed on the assigned day so that progressive marking can take place.

Marking Scheme:

- Each Competitor is provided with the Mark Summary Form
- A full "how-to-Marking Scheme" will only be seen by the Experts. (Reason: the full Marking Scheme would give the answers to the Competitor.)
- No single aspect can be more than 5% of module/day total marks. That is not more than 1.25 marks.

If automated "script marking" determines that an aspect is wrong, the Experts included in the marking group must do a manual check as stated in the "how-to-mark" Marking Scheme.

The marking automated script must be hashed and encrypted with a two-part password (one part held by the CE and the other part held by the module team leader).

## 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 Developer, 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

#### 5.2.1 Format of the Test Project if developed by module teams

Period	Module	Tasks
Module A	Client Server Environment	Installation, configuration, and upgrading
Module B	Networking Environment	Installation, configuration, and upgrading
Module C	IoT, DevOps & Programmability Environment	Installation, configuration, and upgrading
Module D	Troubleshooting & Secret Challenges	-

## 5.2.2 Format of the Test Project if developed by an Independent Test Project Designer

Period	Module	Tasks
Module 1	Work organization and management	See section 1 at 2.2 WorldSkills Standards Specification
Module 2	Communication and interpersonal Skills	See section 2 at 2.2 WorldSkills Standards Specification
Module 3	User support and consultancy	See section 3 at 2.2 WorldSkills Standards Specification
Module 4	Troubleshooting	See section 4 at 2.2 WorldSkills Standards Specification
Module 5	Design	See section 5 at 2.2 WorldSkills Standards Specification
Module 6	Install, up-grade, and configure operating systems	See section 6 at 2.2 WorldSkills Standards Specification
Module 7	Configuring networking devices	See section 7 at 2.2 WorldSkills Standards Specification

## 5.3 Test Project design requirements

Each Test Project module must be:

- At a level of difficulty that a competent Competitor may expect to deal with in normal circumstances;
- With scope and range that Competitors trained at least to the equivalent of the following certification may expect to recognize as within their capability and potential.
- Cisco Certified Network Associate (CCNA) R&S;
- Cisco Certified Network Associate (CCNA) Security;
- Cisco Certified Network Associate (CCNA) Collaboration;
- Microsoft Certified Solutions Expert (MCSE): Mobility Infrastructure;
- Microsoft Certified Solutions Expert (MCSE): Core Infrastructure;
- Advanced Level Linux Certification LPIC-2 or equivalent skill set;
- PCAP – Certified Associate in Python.

*(Please note that this list is purely indicative, since the Marking Scheme and Test Project must reflect current best practice in IT, as expected of an IT Systems Network Administrator.)*

Notes:

Whenever a certification is replaced by a newer and equivalent one, we will use the oldest certification for which an exam can still be taken on C1.

All certification levels and names are discussed, revised, voted, and finally decided by Experts on the WorldSkills Discussion Forum prior to the CPW (Competition Preparation Week) for the upcoming next WorldSkills Competition.

Designed using a standard cover sheet for each section on the WorldSkills International template available on the website;

Self-explanatory requiring minimal translation (Competitor instructions containing a minimum of text);

Each Test Project should have a detailed physical topology image followed by a detailed logical topology image;

Be accompanied by a Marking Scheme that is finalized at the Competition in accordance with the Technical Description;

All operating systems and other software used in the Competition are to be in English language versions.

All software used in the Test Project must be clearly identified, including the source to download it, when the Test Project is made public and at the same time, a repository of this software must be created and made public, including the respective integrity hashes.

## 5.4 Test Project development

The Test Project MUST be submitted using the templates provided by WorldSkills International ([www.worldskills.org/expertcentre](http://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

Option 1 (preferred): The Test Project modules are developed by an Independent Test Project Designer in collaboration with the Skill competition Manager.

Option 2: One, two, or three modules are developed independently while the remaining modules are designed as per option 3 process.

Option 3: The SMT (Skill Management Team) selects the module teams and the Test Projects are then developed by each module team. Test Projects may ONLY be submitted by module development teams, no individual submissions, Experts should submit their ideas and work with the module development team.

### 5.4.2 How and where is the Test Project or modules developed

Where modules are designed by the Experts the Module teams must send their Test Projects to the Chief and Deputy Chief Expert three (3) months prior to the Competition. It is the responsibility of all Experts as a member of a module team, to access and be an active part in the development of their own modules Test Project and in case of voting, cast their votes on the forum. The active work on the module teams Test Projects will and must be done in the closed forum that they are specifically assigned to.

### 5.4.3 When is the Test Project developed

The Test Project/modules are developed according to the following timeline where the modules are designed by the Experts:

Time	Activity
Twelve (12) months prior to the Competition**	SMT contacts the registered Experts to invite them for the upcoming work with the skill management process.
Nine (9) months prior to the competition**	SMT contacts the registered Experts to invite them to be part of the Module team (Module A, B and C) that they prefer. After this the SMT choose and asks experienced Experts to be one of the Module Team Leaders.
Six (6) months prior to the Competition**	SMT allocates Experts to the Module teams and under lead by the Module Team Leader they start designing the outlines and collection of activities suitable for the Test Projects for their Module.
Three (3) months (C-90) prior to the Competition	Proposed Test Projects are developed. Each Module team sends their Test Project to the SMT who will check the quality and consistency and send them to Director of Skills Competition. The Test Projects are then circulated on the WSI website
Two (2) months (C-60) prior to the Competition	A list of possible 30% changes for the Test Projects should be submitted on the forum by the Module teams
One (1) month (C-30) prior to the Competition	Module teams submit the corresponding Marking Scheme for their Test Projects
At the Competition	The final selection of the 30% changes have to be taken from the suggested changes on the C-60 submitted list

\*\* The mentioned twelve (12), nine (9), and six (6) months in the timeline are recommended and may change due to reasons that WorldSkills and the Competition Organizer cannot control.

#### Test Project module team leaders

The Team Leader should be an Expert with previous experience from at least one WorldSkills competition (whenever possible) and be nominated by the Chief Expert after consultation with the Deputy Chief Expert and Skill Competition Manager.

It is the team leader's responsibility to ensure that each module conforms to the Technical Description, complete with proof of testing and a Marking Scheme.

Twelve (12) months prior to the Competition

- SMT and WSS teams will – in consultation with the registered Experts – prepare an up-to-date hardware and software request list for the Country/Region hosting the Competition.
- This list is forwarded to the Host Country/Region not less than six (6) months prior to the start of the Competition.
- The Skill Competition Manager will have unrestricted access to this process and database of outlines and activities.

Nine (9) months prior to the Competition

SMT contacts the registered Experts to invite them to be part of the Module team (Module A, B, and C) that they prefer. After this the SMT choose and asks experienced Experts to be one of the Module team leaders for Module A, B, and C.

Six (6) months prior to the Competition

Each Expert is allocated to a Module team and will continue in that team until the task is completed at the competition. However, in cases where the teams are unbalanced, the SMT may recommend and also decide that an Expert should join or move to another team.

## 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 is expected to identify one or more independent, expert, and trusted individuals initially to review the 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 will ensure that the Test Project/modules can be completed within the material, equipment, knowledge, and time constraints of Competitors.

The Test Projects modules shall be validated by a Test Group appointed by the Chief and Deputy Chief Expert as described below.

The amended Test Project modules (30% changes) are passed onto a Test Group who will check each of the selected projects on complete Competitor workstations. It must be demonstrated that the Test Project/modules can be completed within the material, equipment, knowledge constraints and that the hardware and software list is correct and is provided for use.

The Test Group must check the 30% changes and/or additions and also the corresponding Marking Scheme and provide further changes back to the Module team until agreement is reached and the project is in accordance with section 5.3 Test Project design requirements above.

The Test Project, infrastructure setup and base configurations must be analysed for ambiguity and confusion. Unnecessary resources of any kind must not be made available to Competitors as it may induce the Competitor to make errors.

## 5.7 Test Project selection

The Test Project is selected by the Expert module teams lead by their Team Leaders for each module A, B and C. Regarding module D, the troubleshooting and secret challenges should be developed by external companies under supervision by the QA team (CE, DCE, ESR for CIS and ESR for skill development). The external company (e.g. Cisco, Microsoft, LPI and VMware) must be related to the software or hardware used during the competition, at least to the level of being a partner organization.

Two (2) months prior to the Competition a list of proposed 30% changes for each Test Project is submitted on the WorldSkills Discussion Forum. The final 30% change is decided at the Competition from the proposals put on the WorldSkills Discussion Forum.

## 5.8 Test Project circulation

The Test Project is circulated via the website as follows:

The selected Test Project modules are sent to the WorldSkills Skills Competitions Administration Manager by the Skill Competition Manager at least three (3) months prior to the Competition for publication on the WSI website for download by all participating Members.

Where the Test Project modules are independently designed these are sent to the WorldSkills Skills Competitions Administration Manager and are not released until C1. However, the complete topology, both physical and logical, should be known three (3) months prior to the Competition.

## 5.9 Test Project coordination (preparation for Competition)

Coordination of the independently designed Test Project modules is undertaken by:

- The Skill Competition Manager;

Coordination of the Test Project modules designed by the Experts is undertaken by:

- The Chief Expert assigns Experts to each module team. Each module team is responsible for one Test Project module;

Each module team is allocated a team. The module team leader will work closely with the Chief Expert and the Deputy Chief Expert to allow for the completion of the module. The team leader is responsible for the completion of each module in line with this document and ensure the modules are true and correct.

## 5.10 Test Project change

Test Project modules that are independently designed do not have 30% change at the Competition.

The module teams must add or change a minimum of 30% and produce a corresponding Marking Scheme for their module Test Project and pass the project to the test group for validation (see 3.5 Test Project validation).

Each Test Project should have a detailed physical topology image followed by a detailed logical topology image.

Acceptable changes to the modules include the following:

- Topology;
- Functionality;
- Operating System;
- Software and hardware used.

As soon as possible and at last on C-2, the Test Projects with the included 30% change are given to all Experts and Interpreters. The actual content in the Test Project modules may be shared between Experts and Competitors after this. Summary Marking Schemes will also be given to the Experts, and the content may be shared with the Competitors.

Every Expert has the right to have the same information as any other Expert has about the Test Project and assessment procedures including but not limited to the how-to mark and Marking Scheme.

Every Expert has the right to share whatever information they have with their respective Competitor.

In order to guarantee to the Competitors that each module is complete functional, each module is built at the Expert station by the Experts prior to Familiarization Day. Failure to do so, implies that the items not implemented on the Experts station are removed from the Test Project.

Experts are free to be with and assist their compatriot competitors during the entire familiarization period.

The Test Project and the 30% changes must be accompanied by a table displaying a direct certification mapping. Failing to do this will result in the aspect being removed from the Test Project.

## 5.11 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](http://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 such items may include those for fault finding modules or modules not circulated.

The Infrastructure List could include the requirement for a total virtualization environment to be built, tested, and managed on site by an external company (or sponsor) with someone onsite during competition time in that case.

The Competition Organizer should provide US keyboard for all PCs.

## 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](http://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](http://www.worldskills.org/testprojects) and the Competitor Centre ([www.worldskills.org/competitorcentre](http://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](http://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
Competitors - Experts	<ul style="list-style-type: none"> <li>• Experts are NOT to enter their compatriot Competitor's workstation alone at any time.</li> <li>• Experts are NOT touch their compatriot Competitor's equipment at all and anytime. The other Experts do this under the marking-process of your Module, as an example.</li> <li>• Experts are NOT to talk to their compatriot Competitor on their own during the competition time, but if it is necessary, only together with another Expert and in a language that both Experts understand.</li> <li>• ALL questions from the Competitors have to be written. If it is recognized that there is an error or unclear parts in the competition documents, regarding to the questions, the SMT must show ALL Competitors both the questions and the answers. Remember to clarify this for the following days of the competition.</li> <li>• Competitors are NOT allowed to leave the skill competition workshop without permission (e.g. toilet etc.). In this case one Expert will follow them and wait outside. If anyone leaves without permission it is deemed they have ended that competition day.</li> </ul>

## 7 Skill-specific safety requirements

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

Task	Sturdy shoes with closed toe and heel
General PPE for safe areas	√
All processes at the workstation	√

## 8 Materials and equipment

### 8.1 Infrastructure List

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

The Infrastructure List is available at [www.worldskills.org/infrastructure](http://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 such 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.

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

It is not applicable for the IT Network System Administration skill competition for Competitors to bring materials, equipment, and tools to the Competition. However, Competitors are allowed to bring three (3) keyboards and three (3) mouse each on the morning of C-2 (Familiarization Day). It is recommended that these tools be brought in the luggage of the Competitor or purchased locally.

### 8.4 Materials, equipment, and tools supplied by Experts

Experts are not required to bring materials, equipment, or tools. All is supplied by the Competition Organizer.

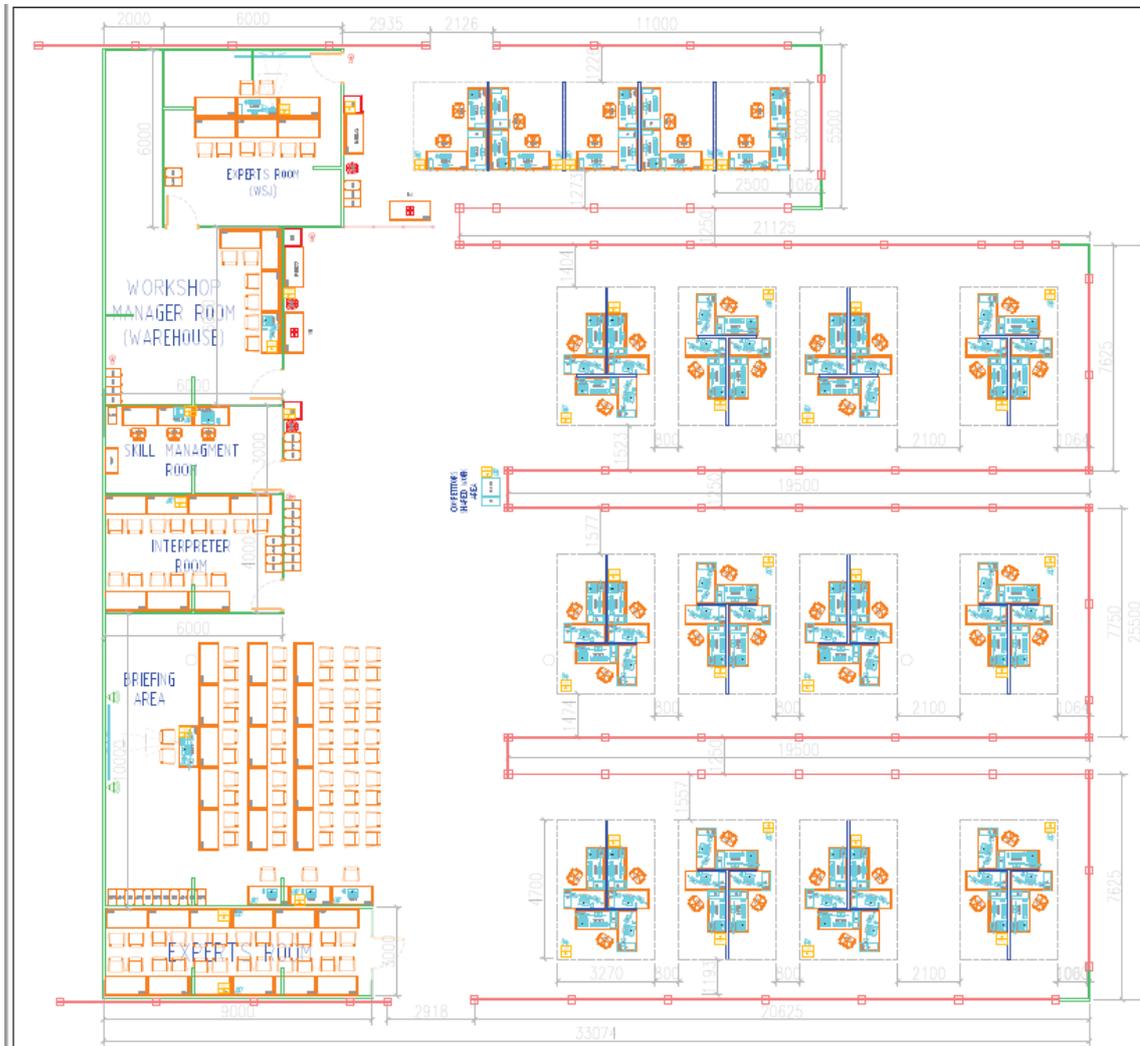
### 8.5 Materials and equipment prohibited in the skill area

Regarding the use of electronic equipment within the competition area. Devices such as tablet, cell phones, media players, recorders, etc. are to follow WSI rules and/or by the SMT presented rules for the actual Competition.

## 8.6 Proposed workshop and workstation layouts

Workshop layouts from previous competitions are available at [www.worldskills.org/sitelayout](http://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 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.

Topic/task	Skill-specific rule
Use of technology – USB pen drives and portable storage devices	<ul style="list-style-type: none"> <li>• Chief Expert, Deputy Chief Expert, Competitors, Experts, and Interpreters - Only USB pen drives or other portable storage devices that are supplied by the Competition Organizer and the SMT for the skill preparation and competition tasks are allowed in the workshop from C-4 until the end of C4. The Skill Competition Manager is exempt from this rule.</li> <li>• Skill Competition Manager, Chief Expert, Deputy Chief Expert, Competitors, Experts, and Interpreters given a USB pen drive or other portable storage device in any form as "give-aways" etc. to or from other participants must store this in their own locker immediately or as we strongly recommend, give them in the morning or evening outside of the workshop area.</li> </ul>
Use of technology – personal laptops	<ul style="list-style-type: none"> <li>• Chief Expert, Deputy Chief Expert, and Experts - No personal laptops are allowed for the preparation work. The Competition Organizer will supply laptops for this work. These are required to stay in the workshop in the locker during lunchtime and after each working day. If you bring your own laptop with you for personal use during lunch or free time, it must be placed in the locker when on duty in the workshop. These can be taken at the end of the day. The Skill Competition Manager is exempt from this rule.</li> <li>• Interpreters - Personal laptops without wireless functions enabled, used for the translation work are allowed to be brought into the workshop however they are required to stay in the workshop in the locker during lunch-time and after each working day. It is a requirement that these laptops have all wireless functions (Wi-Fi, Bluetooth, 3G, 4G and so on) disabled. These can be taken at the end of the day.</li> </ul>
Use of technology – mobile phones and tablets	<ul style="list-style-type: none"> <li>• Experts and Interpreters - No mobile devices (smart watches, phones, or tablets) are allowed for personal use while working with Test Projects or Marking Schemes.</li> <li>• Competitors – No mobile devices (smart watches, phones, or tablets) or music-players are allowed in the workstation. If these are brought into the workshop, then they should be locked in the locker and only removed at lunch time and at the end of the day.</li> </ul>
Use of technology – personal photo and video taking devices	<ul style="list-style-type: none"> <li>• Taking photos or video inside the workshop with mobile phones, tablets, or personal cameras is only allowed after agreement with CE or DCE.</li> </ul>

## 10 Visitor and media engagement

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

- Video description of trade. For example: “Warriors of the Net”;
- Dual displays – public can observe work being done by Competitor in detail;
- Test Project descriptions;
- Competitor profiles;
- Career opportunities;
- Daily reporting of competition status.

## 11 Sustainability

This skill competition will focus on the sustainable practices below:

Workstations are organized into modules corresponding to the skill sets (day one to four) being tested. Competitors are divided into these groups for the purpose of reducing the need for a large number of networking devices.

## 12 References for industry consultation

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/](http://www.onetonline.org/))

This WSOS (Section 2) appears most closely to relate to *Network and Computer Systems Administrators*:

<https://www.onetonline.org/link/summary/15-1142.00>

and *ICT Network Technician*:

<http://data.europa.eu/esco/occupation/64c7d461-152c-477f-a8e2-c2c537e9d617>

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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 Occupational Standards in place for WorldSkills Shanghai 2021.

Organization	Contact name
Ridgeon Network (United Kingdom)	Jordan Reynolds, IT Systems Engineer
Huawei Technologies Co., Ltd. (Global)	Zeng Xudong, Director of Huawei Authorized Learning Partner Business/PM of Huawei ICT Competition