TECHNICAL DESCRIPTION
INTERNET O THINGS

The technical description includes the following sections:

1. INTRODUCTION

1.1. PROFESSIONAL SKILL NAME AND DESCRIPTION

1.1.1 Professional skill name

Internet of Things (IoT).

1.1.2 Professional skill description

Internet of Things (IoT) is a concept that involves the use of a huge number of devices (things) interacting not only with the human, but also with each other, as well as with other information systems.

As a result of rapid growth in the number of devices within the Internet of Things, the amount of data will grow exponentially at a rate never seen before in the market. By 2020 the amount of data created will reach 40 ZB (10^{21} MB). This growth in the number of devices and the amount of data across various industries creates new challenges for traditional ways of data analysis and business management.

According to Gartner analytical reports, the number of connected devices in the consumer electronics segment will increase from 2.9 billion in 2015 to 13 billion by 2020. And the automotive industry will experience the highest growth of 96%. McKinsey analysts support Gartner's findings and forecast an increase in the number of devices and gadgets connected to the Internet from about 10 billion connected devices today to 30 billion devices by 2020 – an increase of about 3 billion new devices per year.

The "Internet of Things" skill aims at training and testing the knowledge of specialists able to develop Internet of Things related solutions. Specialists of this skill are now of great demand in the labor market. As a level of the required skills and competences of a competitor in the Internet of Things skill, we use the requirements for employees who pretend to be specialists in the Internet of Things development solutions (Solution Architect / Solution Developer)

Key knowledge, skills and competences of a competitor in the "Internet of Things" skill area are:

- Analysis and structuring of the customer's needs, development of technical requirements to the solution, taking into account existing business requirements;
- Understanding the methodologies of functional, data and process modeling in various notations (eEPC, BPMN, UML);
- Knowledge of IoT protocols and communication protocols of industrial equipment;
- Understanding processes and technologies for ensuring data transfer safety;
- Understanding the principles of building high-load systems and their scaling up;
- Deep understanding of the stack of technologies, including operating systems (OS), databases (DB), middleware, principles of applications building, data virtualization, cloud and network technologies;
- Understanding the principles of building client-server applications;
- Understanding the principles of object-oriented programming and basic knowledge of programming languages (C, Java, Js, etc.);
- Hands-on proficiency in SQL, XML;
- Ability to work with data and understanding the principles of machine learning;
- Understanding the fundamentals and principles of designing user interfaces;
- Ability to reasoned, logical and convincing oral and written presentation;
- Teamwork orientation. Readiness for interaction with both IT specialists and customer business specialists;

1.2. RELEVANCE AND SIGNIFICANCE OF THIS DOCUMENT

The document contains information on standards imposed on competitors in order for them to be able to participate in the competition, as well as the principles, methods and procedures which regulate the competition. Therewith WorldSkills Russia (WSR) has acknowledged the WorldSkills International (WSI) copyright.

Furthermore, WSR acknowledges the WSI intellectual property rights in relation of assessment principles, methods and procedures.

Every expert and competitor must know and understand this Technical Description.

1.3. ASSOCIATED DOCUMENTS

Since this Technical Description contains only the information pertaining to the relevant professional skill, it must be used in association with the following documents:

- WSR, Competition Standing Orders;
- WSR, online resources referenced in this document.
- WSR, Policy and statutory regulations
- Skill-specific occupational health and safety instruction

2. WORLDSKILLS STANDARDS SPECIFICATION (WSSS)

2.1. GENERAL WORLDSKILLS STANDARDS SPECIFICATION (WSSS) INFORMATION

The WSSS (WorldSkills Standard Specification) determines knowledge, understanding and specific skills that underpin best international practices of technical and professional work performance levels. It should reflect a shared global understanding of what associated working specialty or profession means for industry and business.

The skill competition purpose is to demonstrate best international practices as described by the WSSS to the extent they are able to be implemented. The WSSS is therefore a guide to the required training and preparation for the skill competition.

In skill competitions knowledge and understanding will be checked through the assessment of the performance of practical work. There will be no separate tests of knowledge and understanding.

The WSSS is divided into clearly-defined sections with numbers and headings. Each section is assigned with a relative percentage of importance within the WSSS framework. The sum of all relative importance percentages is 100.

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

The marking scheme and the test project will reflect the allocation of marks within the WSSS to the maximum possible extent. 5% fluctuations are allowed upon the condition they will not distort the weightings specified by the WSSS conditions.

No.	Section	Importance
1	Organization, management and operation safety	5

A specialist shall know and understand:
- Principles and terms of safe operation as a whole and with regard to production;
- Basics and principles of lean production;
- The purposes, principles of use, care, and maintenance of all equipment and materials, together with their safety implications;
- Principles of ecological sustainability and safety and their application in successful operation;
- Team work principles and their application;
- Personal skills, strengths and needs regarding roles, responsibilities and liabilities in relation to other people and collectively;
- Activity parameters for planning.

A specialist shall know how:
- Prepare and maintain a safe, neat and effective work booth;
- Prepare self for the current tasks, in order to prevent negative impact on health and safety;
- Create operation schedule for maximum effectiveness and downtime minimization;
- Choose and use all equipment and materials in a safe manner and in accordance with manufacturer's instructions;
- Adhere to or surpass standards for health and safety, applied to environment, equipment and materials;
- Return workstation into appropriate state and order;
- Contribute to team performance both in a team and individually;
- Gain and ensure feedback and support, while working in a team.

No.	Section	Importance
2	Communication and intersocial skills	5

A specialist shall know and understand:
- Scope and purpose of documentation and publications both on paper and in electronic forms;
- Technical language related to professional skill and technology;
- Standards required for routine reporting and exclusions in verbal, written and electronic form;
- Standards required for communication with clients, team members and other people;
- Targets and methods for maintaining and providing reporting, including the finances.

A specialist shall know how:
- Read, interpret and extract technical data and instructions from documentation in any available format;

- Perform necessary research for decision-making and continuous professional growth;
- Use verbal, written and electronic communication tools to ensure clarification, increase effectiveness and performance;
- Use a standard set of communication technologies;
- Discuss complicated technical principles and applications with other people;
- Explain complicated technical principles and applications to non-specialists;
- Prepare full reports and answer any questions;
- Respond to customer requests both in person and indirectly;
- Organize data collection and prepare documentation in accordance with customer's requirements.

3	Development and description of a solution	15

A specialist shall know and understand:
- Principles for organizing work on a project;
- Meaning and formats of project specifications;
- Basics and criteria, allowing to assess the executed project;
- Principles and ways to apply constructions and builds of mechanical, electric and electronic systems, as well as their standards and documentation;
- Principles and methods to organize operation, control and manage the product;
- Internet of Things paradigms;
- Reference model and basic business-models;
- Trends (technology convergence);
- What are cyberphysical systems and fourth industrial revolution;
- Market possibilities, driving factors and use templates.
- Ontology and semantics of Internet of Things;
- Switching model and data communication protocols;
- Basics for designing cyberphysical systems;
- Application of methods for imitational simulation for project assessment;
- Threats and ways to secure applications of Internet of Things;
- Principles for organizing machine-to-machine and man-to-machine interaction and for creating corresponding interfaces.

A specialist shall know how:
- Analyze discussion materials or specifications in order to identify required operation characteristics of the system;
- Define uncertain areas in discussion results or specifications;
- Determine conditions and properties of environment where the system should operate;
- Determine requirements to equipment in order to ensure system capacity;
- Determine characteristics of the system, which should be adhered to;
- Determine thresholds, which cannot not be surpassed;
- Determine desired characteristics;

	• Analyze existing resources and make decisions on theire distribution and usage; • Determine components necessary for the system to function and algorithm of their interaction; • Determine necessary data set and algorithm for data exchange; • Determine and use data visualization methods, including creation of application web-pages; • Identify and assess options for selection, purchasing and manufacturing the materials, parts, equipment and software, necessary to perform the tasks; • Document the decisions made on the project based on business principles and other important factors, such as health and safety; • Prepare documentation on organizing operation and control compliance; • Finish design stage according to requirements regarding goal, expenses and time.	
4	Organize connection to a thing and ensure its management	15

A specialist shall know and understand:
- Concepts of Internet of Things technologies;
- Technologies for organizing cooperation between the connected devices;
- Principles of the best possible and reliable storage and transformation of data, as well as of fast and convenient access to them (ETL technologies: Extract/Transform/Load);

A specialist shall know how:
- Ensure connection between devices and Internet of Things platform;
- Organize collection and processing of data, necessary for the system to function;
- Perform installations on the site and connect necessary data sources and controlled objects;
- Install, configure and make all necessary physical and software adjustments, needed for the system to function;
- Organize acquisition of necessary data and procedures for storage, processing and analyzing, including using Data Mining, Pattern Recognition, Machine Learning, Big Data, etc.
- Install and use software by the vendor;
- Use analytical methods to search for bugs; find bugs in the system using corresponding analytical methods;
- Perform necessary system configuration for troubleshooting and repair;
- Install sensors and configure their parameters;
- Configure parameters of executive devices;
- Perform test launch of separate application modules and verify their full functionality.

| 5 | Description of solution data model and analyzing the data | 35 |

A specialist shall know and understand: • Principles of collection, processing and storage of data; • Methods used to design data structures; • Structural and event programming; • Principles for separation of access rights to information and data processing capabilities.		
A specialist shall know how: • Develop applications for collection, processing and storage of data using Internet of Things platform; • Structure the incoming data; • Build application logic according to description of role models.		
6	Development of monitoring and control interface for things.	15
A specialist shall know and understand: • Principles of designing the graphical user interface in the systems for data collection and analysis, including using animation, virtual and augmented reality technologies; • Principles of data collection, methods for data extraction, building and validation of models; • Solution principles, allowing to perform predictive tasks DAD (Discover/Access/Distill); • Principles of business processes data analysis helping create economic forecasts or make managerial decisions; • Principles of algorithm creation, helping automate processing based on artificial intelligence technologies.		
A specialist shall know how: • Build data analysis systems which help perform forecasts and make right decisions; • Visualize data using text, table and graphical methods of information representation; • Use technologies of animation, augmented and virtual reality, when it's needed to increase effectiveness of data representation according to the properties of the production tasks; • Select the best possible way to represent data for certain production tasks; • Create algorithms of data processing based on artificial intelligence.		
7	Solution testing and debugging	10
A specialist shall know and understand: • Criteria and methods for testing the equipment and systems; • Criteria and methods for test operations; • Scale and thresholds of the technologies and methods in use; • Possibilities and options of gradual and/or drastic changes.		
A specialist shall know how:		

• Verify each part of the system based on relevant criteria for operation execution; • Verify full functionality of the system based on approved operational criteria; • Optimize capacity of each part of the system and system in its entirety based on analysis, troubleshooting and consecutive improvements; • Perform final test run for complete system acceptance; • Review each part of such stages as designing, construction, installation and operation regarding the existing criteria, including accuracy, conformity, time and cost; • Ensure that all aspects of designing stage comply with the required industry standards; • Improve and present portfolio to the customer, including all necessary documentation, needed for business cooperation; • Present the system, its technical documentation and portfolio to the client and answer the questions.	
Total	**100**

3. ASSESSMENT STRATEGY AND TECHNICAL FEATURES OF ASSESSMENT

3.1. MAIN REQUIREMENTS

The Strategy establishes the principles and techniques to which the WSR assessment and marking must conform.

Expert assessment is the cornerstone of WSR competitions. For this reason, it is the subject of continuous professional improvement and scrutiny. The accumulated assessment experience will determine the future use and development direction of main assessment tools used on WSR competitions: The Marking Scheme, competition task and Competition Information System (CIS).

Assessment on the WSR competitions falls within one of the two categories: objective (measurable) and subjective (judicial). 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 WSSS weightings. The Test Project is the assessment vehicle for the skill competition, and should also follow the WSSS.

The CIS enables timely and accurate recording of marks, and has an expansive supportive capacity.

The Marking Scheme, in outline, will lead the process of Test Project design. During the further development the Marking Scheme and the Test Project will be designed and developed through an interactive process in order to ensure joint optimization of inter-relations within the scope of the WSSS and the Assessment Strategy. They will be submitted to the Skill Competition Manager for approval together in order to demonstrate their quality and conformity with the WSSS.

4. MARKING SCHEME

4.1. GENERAL GUIDANCE

The Marking Scheme is the main tool of WSR competitions and defines the compliance of the Test Project assessment with the WSSS. It is intended for the allocation of points between each assessed aspect which can be related to only one WSSS module.

Through the reflection of the weightings specified in the WSSS, the Marking Scheme sets out the Test Project development parameters. Depending on the skill nature and the requirements to its assessment it can be helpful to develop the Marking Scheme in detail early on so it can be used as a guide for the Test Project development. Otherwise the Test Project development shall be based on the generalized Marking Scheme. Further development of the Test Project is accompanied by the development of assessment criteria.

Section 2.1 specifies the maximum acceptable variation percentage, the Test Project Marking Schemes based on the weightings provided in the Standards Specification.

The Marking Scheme and the Test Project may be developed by one person, or a group of experts, or a third-party developer. Detailed and final Marking Scheme and Test Project shall be approved by the Skill Competition Manager.

Furthermore, all experts are encouraged to submit their proposals on the development of marking schemes and test projects to the Discussion Forum for their further review by the Skill Competition Manager.

In all cases a complete marking scheme approved by the Skill Competition Manager shall be entered into the CIS at least two days prior to the competition, with the use of a standard CIS spreadsheet or other agreed-upon methods. The Chief Expert is responsible for this process.

4.2. ASSESSMENT CRITERIA

The main headings of the Marking Scheme are the assessment criteria. In some skill competitions assessment criteria may match the WSSS section headings; in others they may be completely different. There are usually from five to nine assessment criteria, that said, there should be at least three assessment criteria. Whether or not they match the headings, the Marking Scheme must reflect the weightings specified in the WSSS.

The Assessment Criteria are created by a person(s) developing the Marking Scheme, who is free to define the criteria he or she considers most suited to the assessment of the Test Project performance.

The Mark Summary Form generated by the CIS will comprise a list of the assessment criteria.

The number of points allocated to each criterion is calculated by the CIS. This will be the cumulative sum of points awarded to each aspect within that assessment criterion.

4.3. SUB CRITERIA

Each assessment criterion is divided into one or more sub criteria. Each subcriterion becomes a heading in the Marking Scheme.

Each (sub criteria) marking form is specified with a certain date on which it will be filled.

Each (sub criteria) marking form contains assessable aspects that are subject to assessment. Each assessment method is assigned with a special marking form.

4.4. ASPECTS

Each aspect describes in detail one of the assessed indicators, as well as possible marks or marking instructions.

A marking form lists in detail each marked aspect together with the number of points allocated for its assessment.

The sum of the points allocated to each Aspect must fall within the range of points specified for each skill section in the WSSS. It will be displayed in the CIS point allocation spreadsheet (for example, Table 1).

Table 1. Sample point allocation spreadsheet

		Criteria				Total points for the WSSS section	WSSS POINTS FOR EACH SECTION	VARIANCE
		A	B	C	D			
WorldSkills Standard Specification (WSSS) Sections	1	1.25	1.25	1.25	1.25	5	5	0
	2	1.25	1.25	1.25	1.25	5	5	0
	3	15.00	0	0	0	15	15	0
	4	0	10	5	0	15	15	0
	5	0	0	19	16	35	35	0
	6	0	0	6	9	15	15	0
	7	3	0	2	5	10	10	0
Total points for criterion		20.50	12.50	34.50	32.50	100	100	0

4.5. JURY'S OPINION (JUDGEMENT SCORE)

Decisions are made using a scale of 0–3. In order to apply the scale in a clear and consistent manner the jury must carry out a decision with due regard to:

- (criteria) comparison standards as detailed guides to each aspect
- 0–3 scale, where:
  - o 0: performance does not meet the industry standard;
  - o 1: performance within the industry standards, i.e. quality is acceptable for the use by a user/customer. But from the viewpoint of an expert, the work can be done better;
  - o 2: performance is in the upper limits of industry standards and even exceeds them to a certain extent, the expert can see no faults;

o 3: performance wholly exceeds the industry standard and is assessed as excellent.

Each aspect is assessed by three experts, each expert must perform assessment, after that the alloted marks will be compared. In case the expert marks vary by more than 1 point, the experts must bring up the assessment of this aspect for discussion and eliminate the variance.

4.6. MEASURABLE ASSESSMENT

Each aspect shall be assessed by three experts. Unless otherwise specified, only the maximum mark or zero will be awarded. If within some aspect it is possible to award marks below the maximum one, it shall be described in the Marking Scheme with the specification of measurable parameters.

4.7. USE OF MEASURABLE AND JURY'S ASSESSMENTS

The final understanding of measurable and jury's assessments will become available after the approval of the Marking Scheme and the Test Project. The provided table (Table 2.Division of judicial and measurable aspects by criteria) contains approximate information and is intended for the development of the Marking Scheme and the Test Project.

Table 2. Division of judicial and measurable aspects by criteria

Criterion		Points		
		By judging panel	Measured	Total
A	Development of design of monitoring and control system	4.25	16.25	22.5
B	Setup of data gathering and remote device control	2.75	9.75	12.5
C	Setup of flexible process control	6.75	27.75	34.5
D	Development of monitoring and control interface	10.25	22.25	32.5
Total		24	76	100

4.8. SKILL ASSESSMENT SPECIFICATION

The Test Project assessment will be based on the following criteria (modules):

- Module 1. Development of monitoring and control draft system The main task of the competitors in this module is to develop a solution and describe it in the required format. The judges check the presented materials according to the Marking Scheme.

- Module 2. Setup of data gathering and remote device control. The main task of the competitors in this module is to arrange connection to the remote thing (equipment), receive all necessary information from it and control it. According to the Marking Scheme, the judges check on the site the fact of connection to the remote thing, receipt of necessary parameters of the thing and its control.

- Module 3. Setup of flexible process control The main task of the competitors in this module is to realize the logic required to execute the task set in the Test Project. According to the Marking Scheme, the judges check the execution accuracy for the task set in the Test Project through work modeling.

- Module 4. Development of monitoring and control interface. The main task of the competitors in this module is to create user interfaces required in the Test Project. If the required interfaces has not been set forth in the Test Project, the competitors shall develop such interfaces that allow to solve the task specified in the Test Project. According to the Marking Scheme, the judges check the compliance of developed interfaces with the solution, as well as the information completeness and composition convenience to solve the assigned tasks.

Besides the technical execution of all modules, the judges assess the workstation preparation and condition during the work, internal team interaction,

interaction with experts, compliance with the safety standards for work with the equipment at the workstation, and communication skills.

4.9. ASSESSMENT PROCEDURE

The Chief Expert and the Deputy Chief Expert shall discuss and divide the experts into groups (a group is composed of at least three people) for marking. Each group shall include at least one experienced expert. An expert shall not assess a competitor from his own organization.

By the Chief Expert's decision the competitors can be allowed to be assessed by Independent Experts and technical specialists (representatives of partner organizations) in the capacity of experts.

On interregional qualification or federal level competitions a competitor (team) can not be assessed by an expert from the same region of origin as the competitor.

If any disputable issue arise in assessment, the assessment decision shall be made by the Chief Expert.

5. TEST PROJECT

5.1. MAIN REQUIREMENTS

Sections 2, 3 and 4 govern the Test Project (TP) development. The recommendations in this section provide additional explanation of the TP content.

The Test Project performance shall take not less than 15 and not more than 22 hours.

In order to qualify for the performance of this Test Project the competitors must be from 17 to 28 years old.

Regardless of the number of modules, the TP shall include the assessment of each of the WSSS sections.

The test project shall not fall outside of the WSSS.

A competitor's knowledge shall be assessed exclusively through the practical performance of the Test Project.

Knowledge of the WSR rules and regulations is not assessed during the Test Project performance.

The Test Project can be secret or published. The secret Test Project shall be disclosed only on the eve or immediately before the beginning of performance of a module and no less than 15 minutes shall be allocated for getting familiar with each module. Publication dates of the published test project are specified in section 5 hereof. 30% of amendments shall be included in the published test project (or in the published modules if a part of the test project is secret) by the present experts collegially. At least 2 hours shall be allocated for becoming familiar with a test project after incorporation of 30% of amendments in it.

5.2. TEST PROJECT STRUCTURE

In the general case, a test project shall include 4 modules:

1. Development of monitoring and control draft system
2. Setup of data gathering and remote device control.
3. Setup of flexible process control
4. Development of monitoring and control interface.

5.3. TEST PROJECT DEVELOPMENT REQUIREMENTS

All the versions of the test projects of Internet of Things skill may be conditionally divided into the following three directions: SCO (Smart Connected Operations), SCP (Smart Connected Product) and SCS (Smart Connected Systems). Notion of "Smart Connected Thing" shall form the basis of each direction. The TP for each specific competition shall be compiled depending on the age category of the competitors, WSP competitions range and partners ready to provide their hardware and software.

A test project in the SCO (Smart Connected Operations) direction or smart manufacturing meeting the requirements of Industry 4.0 is recommended for use in the framework of inter-university competitions and senior age category competitions.

The test project used in this category shall provide for development of an automated monitoring system of the condition of a conventional manufacturing facility.

For the purpose of this skill the object of automation (production) can be understood as production or operational systems of any level and associated operating processes (operations) that allow scaling and parallel operation. If necessary (primarily for security purposes), some of the work items or operations can be replaced by their simulations, including the replacement by some standardized training components.

By agreement with the skill management of the equipment of the skill site with which the competition competitors deal may be replaced by a similar equipment providing the functionality required for the test project implementation.

A TP in the SCP (Smart Connected Product) or smart products ("greenhouse" TP) direction are recommended for use for the junior age category. "Smart city" and "Smart building" TPs also belong to this direction.

The junior age category TP may focused on the use of the end equipment and arrangement of cooperation of the "Internet of Things" platform. For instance, correct connection of the equipment sensors to the data collection module may be a part of Module 2. In this case, the skill partner shall guaranty availability of this equipment for sale as well as shall provide methodical support for the equipment and its connection to the Internet of Things cloud platform starting from the moment of publication of the test project of the corresponding competition.

The test project shall possibly be compiled taking into account the potential level of mastering of the related skills by the target group of the competitors.

Therefore, the test project of the 14–16 year age group shall not includes the requirements on statistical data analysis and forecast models building (in Module 3) or on development of a monitoring system project (in Module 1).

5.3.1. COMPETITION SITE REQUIREMENTS

The "Internet of Things" skill site shall be equipped considering the following four zones:

- The competitors' workstation zone includes a preset number of workstations equipped with personal computers and divided by partition panels;
- The zone of the FMS workcell and other equipment of the skill partners;
- The briefing and presentation zone;
- The utility room zone, including the meeting room, Chief Expert's room, technical room, and the competitors' room.

The workstations of the competitors shall be equipped by installing the desks with PCs (two desks per team) connected to one local area networks of the competition site. One of the team PCs shall be equipped with the image translation system of the PC monitor image to the secondary monitor (TV set) to display the competitors work to the competition visitors. If technically feasible, the competitors PCs shall be equipped with the software of remote display of the desk to ensure sequential display of the work of the competitors on the common display stand.

A briefing zone provided with enough seats for sitting all the competitors, experts and technical specialists shall be arranged on the skill site. This zone shall be desirably fitted with a marker board or a flip chart for records keeping during discussion. The briefing zone shall be supplied with a PC connected to the site LAN as well as to the multimedia equipment for presentations holding. This equipment may also be used for demonstrations and during the experts work.

If a local version of the "Internet of Things" cloud platform is used in the competition, a technical room containing all the appropriate server equipment shall be arranged on the skill site. Such server equipment shall be provided with power backup. If required, a portable computer (a laptop) equipped with its own battery may be used.

The skill site shall have an experts' meeting room equipped with at least two computers connected to the skill site LAN. It is preferable to outfit these computers with a system for image translation to separate video panels (TVs) in order to facilitate the work of experts on the assessment of competitors' performances. The experts' meeting room shall be equipped with a reproducing equipment (a MFD) connected to at least one of the installed computers.

If a test project includes a task on control of the process equipment requiring powerful electric energy supply and observance of special safety arrangements, the skill site shall be provided with the special zone of installation of such equipment. This zone shall be connected to the required power supply according to the manufacturer's direction and shall have access to the site LAN.

The chief expert's room shall be provided with an Internet connected PC shall be arranged on the skill site. The chief expert's room shall be also provided with a reproducing equipment (MFD) connected to this PC.

The technical room shall have Internet access (by cable if possible) with the forced shutdown capability for the solution of possible software configuration and update tasks.

The experts room shall be furnished with a lockable locker meant for storage of valuable belongings of the competitors (phones, laptops) which are not allowed for use on the skill site during the TP performance.
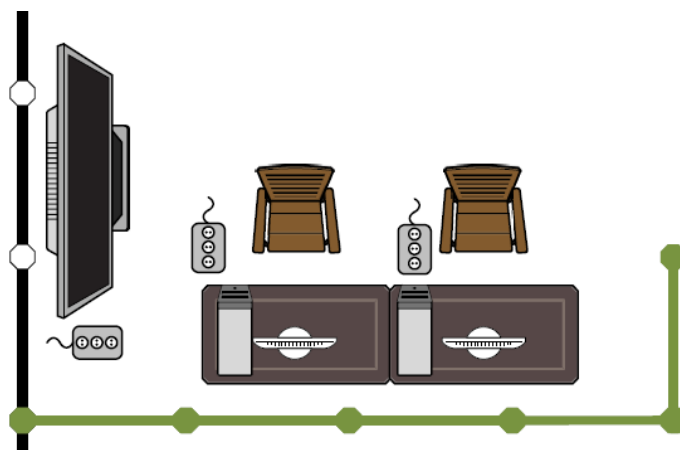
Figure 1. Example of the competitor's workstation layout (for reference)

5.4. TEST PROJECT DEVELOPMENT

The test project is developed based on the samples provided by the Skill Competition Manager on the WSR forum (http://forum.worldskills.ru). The provided Test Project samples shall be changed once a year.

Test projects for each competition are developed based on the unified Test Project approved by the Skill Competition Manager and posted on the Discussion Forum. Test projects can be developed both in their entirety or in modules. Test project can be developed by the experts community in person or online. The developed test project may be available on the Discussion Forum.

5.4.1. WHO DEVELOPS TEST PROJECTS/MODULES

The Skill Competition Manager is responsible for overall management and the Test Project approval. The following individuals may be involved in the Test Project development:

- Certified WSR experts;
- Third-party developers;
- Other interested parties.

In case of the introduction of 30 % of changes into the Test Project, the following individuals participate in the process of preparation to each competition:

- Chief Expert;
- Certified skill expert (if present at the competition);
- Assessing experts (if required to be involved by the Chief Expert).

The introduced 30 % of Test Project changes shall be approved by the Skill Competition Manager in a mandatory manner.

When introducing 30 % of changes into the Test Project, the above referenced people shall be guided by the principles of objectivity and impartiality. The changes shall not affect the test project complexity or relate to other professional areas not described in the WSSS, as well as exclude any WSSS units. Furthermore, the

introduced changes shall be performable using the infrastructure list approved for the competition.

5.4.2. WHEN THE TEST PROJECT IS DEVELOPED

The Test Project is developed in accordance with the following schedule which defines documentation preparation periods for each competition type.

Time frames	Local competition	Qualification competition	National competition
Test Project template	The test project of the previous National Competition shall be taken from the Discussion Forum in the unmodified form	The test project of the previous National Competition shall be taken from the Discussion Forum in the unmodified form	It is developed based on the previous competition taking into account the skill competition execution experience and the industry standards 6 months prior to the competition
Approval of the Chief Competition Expert responsible for the TP development	2 months prior to the competition	3 months prior to the competition	4 months prior to the competition
TP publication (if applicable)	1 month prior to the competition	1 month prior to the competition	1 month prior to the competition
Introduction and approval of 30 % of changes into the TP by the Skill Competition Manager	On Day C-2	On Day C-2	On Day C-2

5.5. TEST PROJECT ASSIGNMENT APPROVEMENT

The Chief Expert and the Skill Competition Manager render a decision on the performability of all modules and if required should prove the feasibility of its performance. Time, available software and hardware shall be taken into consideration.

A Test project may be approved in any form convenient for the Skill Competition Manager.

6. SKILL MANAGEMENT AND COMMUNICATION

6.1 DISCUSSION FORUM

All pre-competition discussions take place on the Forum at the following address: http://forum.worldskills.ru. The decisions on skill development shall only be made after a preliminary discussion on the forum. Also the notification on all important events relevant to the skill shall take place on the forum. This forum is moderated by the International Expert and (or) the Skill Competition Manager (or an Expert assigned by them).

6.2. INFORMATION FOR COMPETITORS

The information for competitors is published in accordance with the Standing Orders of the carried out competition. The information may include:

- Technical description;
- Test projects;
- Assessment Summary Form;
- Infrastructure List;
- OHSE Instruction;
- Additional information.

6.3. ARCHIVE OF TEST PROJECTS

The test projects are available at http://forum.worldskills.ru.

6.4. SKILL MANAGEMENT

General skill management is carried out by the International Expert and the Skill Competition Manager with a potential involvement of the expert community.

Skill management within a specific competition is carried out by the Chief Skill Expert in accordance with the Competition Standing Orders.

7. OCCUPATIONAL SAFETY AND HEALTH REQUIREMENTS

7.1 OCCUPATIONAL HEALTH AND SAFETY REQUIREMENTS AT THE COMPETITION

Refer to the OHSE documentation provided by the Competition Organizing Committee.

7.2 SKILL-SPECIFIC OCCUPATIONAL HEALTH AND SAFETY AND ENVIRONMENTAL REQUIREMENTS

"Internet of Things" skill shall include development by the competitors of the process equipment monitoring and control automated system. Terms of use of the computer hardware forming a local area network shall used on the competition site in this connection.

Depending on a specific test project, on the skill site in a special limited area, some industrial equipment may be installed. In this case, an OHSE expert shall in a mandatory manner familiarize all the competitors with additional requirements for safe conduct on the site. In any case, this area shall be fenced with a safety barrier (fencing, marker tape) taking into account the safe distance and the competitors shall not have access to this area. Safety correct parameters ensuring for the given equipment shall be included in the area of responsibility of the technical specialists of the corresponding skill partner.

Access of the experts to the above-said additional equipment may be provided by agreement with the chief expert after being appropriately briefed by the technical specialists of the corresponding skill partner.

The end data collection and control equipment with which the competitors shall deal while performing the test project shall be electrically safe (weak-current and low-voltage) and shall provide for solderless mounting of the required elements. Connection of this equipment to the data transmission networks shall be wireless or via the RJ45 (8P8C) standard connector without dismantling the connector.

Connection of wires by twisting them or use of conductors with damaged insulation shall not be allowed.

Deliberate infringement of the OHSE rules by the competitors shall be constitute grounds for disqualification of the team.

8. MATERIALS AND EQUIPMENT

8.1. INFRASTRUCTURE LIST

The infrastructure list includes all the infrastructure, equipment and expendable materials required for the Test Project execution. The Infrastructure List must contain an example of such equipment and its clear and coherent characteristics in case it is possible to obtain this equivalent analogs.

During the development of an infrastructure list for a specific competition, the process must be guided by the Infrastructure List posted on the Discussion Forum by the Skill Competition Manager. It is mandatory for all infrastructure list changes to be agreed upon by the Skill Competition Manager.

At each competition, the Technical Expert should maintain accounting of infrastructure elements. The list should not include elements that were asked to be included by the experts or the competitors, as well as prohibited elements.

Following the competition results, if required, the Technical Expert and the Chief Expert must present to the Competition Organizing Committee and the Skill Competition Manager recommendations on the Infrastructure List changes.

8.2. MATERIALS, EQUIPMENT AND TOOLBOX TOOLS

"Internet of Things" skill test project includes development of a monitoring and control automation system. Depending on the part of the test project on dealing with the end data collecting and control equipment (Module 2), the zero toolbox (all the equipment is present on the site) or a specific toolbox (only the test project related equipment is present on the site) shall be used.

The competitors shall have the right to bring to the site one electronic media (USB-flash drive) containing the necessary reference materials and printed documentation.

8.3. MATERIALS AND EQUIPMENT PROHIBITED ON SITE

Any communication and computational devices (tablets, computers) brought by the competitors shall be prohibited for use on the competition site.

8.4. PROPOSED COMPETITION WORKSHOP LAYOUT

See below possible competition workshop layout (see Figure 2. Contest ground layout).

Figure 2. Contest ground layout

Some lockable lockers shall be installed in the experts rooms meant for storage of valuable belongings of the competitors and experts.

Rooms shall be provides with some coatstands and trash cans.

Experts meeting room and competitors room shall be desirably furnished with hot and cold water dispensers.

9. SPECIAL RULES FOR THE 14–16 AGE GROUP

The Test Project performance time shall not exceed 4 hours per day.

During the development of the Test Project and the Marking Scheme, it is required to consider the specific features and the limitations of the applied OHSE rules for this age group. It is also required to take into account anthropometric, psychophysiologic and psychological characteristics of this age group. This way, the Test Project and the Marking Scheme can cover not all of the WSSS units and areas depending on the specific features of the skill.