MANUFACTURING AND ENGINEERING TECHNOLOGY

Robot Systems Integration

WorldSkills Occupational Standards

 WSC2022_WSOS63_Robot_Systems_Integration

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WorldSkills Occupational Standards (WSOS)

Occupation description and WSOS

The name of the occupation is

Robot Systems Integration

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

Within the last decade the number of robots installed in the world has increased dramatically. Each year approximately 400,000 robots are installed worldwide, a rate which is steadily increasing (source: IFR: International Federation of Robotics). This requires both the capacity to manufacture these robots, and the skilled human resources to install them.

To be useful, the robot needs to be integrated within an overall process that will benefit from its availability. According to the robot application: pick and place, load and unload, palletization, welding, and so on, the role of the robot integrator is to think about and decide: what is the most appropriate type of robot to use; how to organize the parts flow; how best to program the robot; how to make the robot cell safe, etcetera. These are considerations for the robot manufacturer, the system integrator, and sometimes the end user.

The robot system integrator must provide technical solutions to the robotization of all or part of a system by

- incorporating a multi-articulating arm, together with the associated handling tools or special processes (such as handling, machining, painting, and welding), to increase competitiveness and
- supporting the ergonomics, health and safety of the users and people around them.

Through additional devices the robot can acquire several “senses”, such as sight and touch, in order to perform complex and precise tasks.

The robot system integrator must be aware of technological developments in the manufacturing process, control systems, multi-articulated arm, and the evolution of regulations for robotization. Preliminary study, implementation, electrical connection for power and other automated systems, integration of peripheral equipment, and programming, as well as documentation, maintenance, and troubleshooting, are all essential tasks.

Across the globe, small and medium-sized enterprises (SMEs) outnumber large corporations. Collectively, they employ more people. SMEs represent the majority of businesses that have yet to realize the advantages of automation and robotics, as the big companies like the automobile industry have already done. SMEs can automate by investing in “custom” or “hard” automation, where the automation is designed and built for a specific purpose, or in flexible robot systems. Robot automation offers advantages of increased flexibility for meeting changing production requirements typically found in SMEs as well as lower investment through the use of standard industrial robots.

All in all, robot system integration represents a new, growing, and universal opportunity for skilled and committed technicians.

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).

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.

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Section		Relative importance (%)
1	**Work organization and management**	5

The individual needs to know and understand

- principles and methods of safe work execution
- the purposes, uses, care and maintenance of all equipment together with their safety implications
- environmental and safety principles and applications with regard to good housekeeping in the work area
- principles of effective communication
- principles of effective collaboration
- the scope and limits of one's own and others' roles, responsibilities, and duties, both individually and collectively
- parameters within which activities must be planned
- principles and techniques for time management.

The individual shall be able to

- prepare and maintain a safe, tidy, and efficient work area
- prepare self for the tasks in hand, including full regard to health, safety, and environment
- schedule work to maximize efficiency and minimize disruption
- select and use all equipment and materials safely and in compliance with manufacturers' instructions
- apply or exceed the health and safety standards applying to the environment, equipment, and materials
- restore the work area to an appropriate state and condition
- contribute to team performance both broadly and specifically
- give and take feedback and support.

2	**Communication and interpersonal skills**	5

The individual needs to know and understand:

- organizational cultures and behaviours within business and industry
- the purposes and range of required documentation in paper and electronic forms
- the technical language associated with the occupation and sector
- the standards required for routine and exception reporting in oral, written, and electronic form
- good practice in communication with clients, team members, and others
- the purposes and techniques for generating, maintaining, and presenting records for one's own and others' uses.

Section		Relative importance (%)
	The individual shall be able to: • interact with a range of business and industry, modelling professional conduct at all times • communicate by oral, written, and electronic means to ensure clarity, effectiveness, and efficiency • use a standard range of communication technologies • discuss complex technical principles and applications with others • use active listening and questioning techniques • read, interpret, and extract technical data and instructions from documentation in any available format • complete reports and respond to issues and questions arising • respond to clients' and personnel's needs face to face and indirectly • gather information and prepare documentation as required by the client and other individuals and groups.	
3	**Layout and design**	**15**
	The individual needs to know and understand: • the principles and relevant applications of computing and electronics • the relevant practical applications of engineering science and technology • the relevant practical implications of physical principles and interrelationships • the principles and relevant applications of electrical engineering and pneumatics • the design, uses, repair and maintenance needs of relevant machinery and tools • the principles and applications of robots, robotic tools and equipment mounted on robots and in robotic cells • principles and methods of systems analysis to determine how conditions, operations and the environment will affect outcomes • principles and applications for incorporating and integrating robots within industrial systems, such as: • payload settings • reach studies • motion optimization • principles of CAD and offline simulation tools used for layout and design of robot systems	

Section		Relative importance (%)

	The individual shall be able to:
	• acquire and check instructions and guidance for given assignments
	• identify and resolve areas of uncertainty within the parameters of the brief
	• carry out initial systems design for given industrial applications
	• inspect installation sites or use alternative methods to test the applicability of initial systems design
	• optimize systems designs within the parameters of the given industrial applications
	• incorporate the dimensioning of electrical and pneumatic systems
	• determine the role of pneumatic engineering in the choice and connection of controls and activators
	• carry out systems analyses for risk assessment
	• itemize the requirements and implications of installation and integration in relation to
	  • robots, ancillary equipment, and tools
	  • human resources and time
	  • estimated impacts on production during installation
	  • estimated impacts on production following installation
	  • operating parameters and risk management
	• present proposals for consideration and approval, and adjust as required.	

4	**Installation and connectivity**	**15**
	The individual needs to know and understand: • the norms and cultures of the receiving industrial sites • principles and methods for the safe receipt and ongoing management of equipment, tools, and materials • principles underlying the physical installation of robotics into production systems • principles and methods for assembling pre-manufactured robots in their positions for use • principles and methods for assembling and fixing tools and equipment to the robots • principles underlying the positioning, connection and use of electrical power • principles underlying the positioning, connection and use of pneumatics. • Principles underlying the correct foundations and fixing methods required for installation of industrial robots and peripheral equipment	

Section		Relative importance (%)
	The individual shall be able to: • check that all items have been delivered according to specification, and follow up as required • organize the safe storage of all items, together with arrangements for their checking in and out • check that the pre-manufactured robot has been delivered ready to run, and follow up as required • connect robot system components according to instructions and documentation • assemble, position, and fix robotic tools and equipment according to instructions and documentation • align, fit, or assemble components, using hand tools, power tools, fixtures, or templates, according to specification • liaise with specialists for the correct electrical, pneumatic, and mechanical installation of robots and peripheral equipment • connect Input/Output (I/O) control signals between robot and peripheral equipment, either low voltage (24V) or Ethernet/Bus systems. • perform tests during the installation process to ensure functionality • identify installation issues, consider alternative solutions, and implement selected solution(s) to resolve the issues • respect and take account of the receiving sites' requirements and characteristics, within the bounds of safe working, active risk management, and professionalism.	
5	**Automation and programming**	25

	The individual needs to know and understand:
	• computer capabilities and symbolic logic
	• principles governing the purposes and functions of computer hardware and software
	• principles and options for
	  • manipulating robot coordinate frames, for robot, cell, and tooling
	  • controlling robot motion
	  • controlling robot input/output (I/O) functions
	  • optimizing the user interface and
	  • enabling re-programming and adjustment
	• the principles, reasons or facts that provide the basis for breaking down information or data into separate parts
	• methods for obtaining information and data from all relevant sources
	• principles and methods for processing information and data
	• the software in use
	• sensor integration.
	  • simple digital/electrical sensors
	  • advanced sensors such as Vision or Force sensors	

Section		Relative importance (%)
	The individual shall be able to: • consult with client/personnel to clarify program intent • develop diagrams or flow charts of systems operations • write, analyse, review and rewrite programs, using flow charts and diagrams • create application software programs that are easy to document, understand and maintain • conduct trial runs of programs and software applications to ensure they will produce the desired robot and cell performance • write, update, and maintain computer programs or software packages to handle specific jobs • optimize robot motion performance and I/O handling to minimize cycle time/maximize throughput while retaining reliable operation • correct errors by making appropriate changes and rechecking the program to ensure that the desired results are produced • consult with other personnel to identify problems and suggest changes. • implement new additional software and hardware options based on standard functionality. • Integrate simple and advanced sensors	
6	**Commissioning, maintenance, and troubleshooting**	25
	The individual needs to know and understand: • the formal requirements for successful site acceptance tests • the scope and limits of the technologies, methods operational environment • criteria and methods for testing equipment and systems • strategies for fault finding, problem solving and optimization • techniques and options for replacements and repairs • principles and techniques for generating creative and innovative solutions • principles and options for establishing and maintaining production maintenance regimes	
	The individual shall be able to: • investigate whether the robot and its peripheral equipment are responding to the programs' instructions • revise, repair or expand existing programs to increase operational efficiency or adapt to new requirements • repair or replace components as required • develop Human-Machine-Interface (HMI) applications for the users of the robot system, using HTML or other web technologies • advise on maintenance regimes to maximize efficiency and minimize disruption.	

Section		Relative importance (%)
7	**Documentation, briefing, and reporting**	**10**
	The individual needs to know and understand: • the role and importance of maintaining records of each stage of activity • the required media and formats of records and reports to ensure compliance with contracts, regulations and legislation, verification, and audit • the needs of users and specialists for information, guidance, and instructions in suitable forms (media, content, language, format, and presentation) • clients' specific information needs • basic principles and techniques for briefing and training non-specialist end users • principles and techniques for critical review of own and others' performance. • principles of common PC/Office software	

	The individual shall be able to:
	• liaise with other personnel or departments for project integration
	• document design and development procedures according to requirements
	• compile and write documentation of program development and subsequent revisions, inserting comments in the coded instructions so that others can understand the computer programs
	• present and provide test results from the commissioning process
	• design or contribute to instructions and guidance to guide end users, with an emphasis on clarity and ease of use
	• provide the end user with a set of documentation in appropriate formats, including all necessary robot data such as:
	  • operating instructions
	  • application specific fault messages - I/O Listings
	  • user adjustable parameter (register) descriptions
	• review each part of the process of design, fabrication and assembly, and operation, against established criteria, including accuracy, consistency, time, and cost
	• contribute to individual and collective quality and contract review, responding to questions and challenges appropriately.	

	Total	**100**

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.**onet**online.org/)

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 2022.

This WSOS appears most closely to reflect *Robotics Technician:*
https://www.onetonline.org/link/summary/17-3024.01

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

There were no responses to the requests for feedback this cycle