Train Students Like WorldSkills Champions: Prepare Technicians for Smart, Connected Manufacturing

FESTO



Skills competitions are true career accelerators and meaningful opportunities for teaching and learning—at school and on the competition floor.

Skill 48 Industry 4.0 is a rapidly growing discipline within WorldSkills competitions. First introduced in 2019 as a future Skill, it was formally established as an official skill in 2022. Competitors from around the world train and compete using our CP Lab learning factory and its ecosystem of software tools, building advanced automation capabilities aligned with modern, digitized industrial environments.

Whether you take part in a competition or not, explore how the mechatronics skills competition standard, practical tasks, and training equipment can inspire your teaching and support industry-relevant training for your students.

worldskills

Develop Core Skills for Digital Production Systems Technicians

The integration of digital technologies in industry demands technicians who can implement Industry 4.0 within businesses by designing and integrating systems, deploying both software and hardware, and supporting digital production operations, particularly in the area of cybersecurity. WorldSkills translates these industry requirements into its Industry 4.0 Occupational Standard.



Key responsibilities

Install and commission systems
Integrate digital technologies
Operate and monitor equipment
Program and maintain controls
Diagnose and correct faults
Secure networks and data
Optimize system performance
Maintain documentation

Key competencies

Smart production systems knowledge
Digital system integration and commissioning
Industrial software and programming skills
Networking and cybersecurity awareness
Data analysis and system optimization
Diagnostic and problem-solving skills
Safety and standards awareness
Communication and teamwork

Why use the standard as a starting point for teaching?

The occupational standard is an **industry-validated framework** that defines what students need to know and be able to do at a professional level. More than just competition documentation, it serves as a high-value teaching and curriculum resource for smart manufacturing, information technology, control and electrical engineering technology, and factory automation programs.

Educators can use the standard in multiple ways:

- Prepare students for skills competitions or enrich regular coursework using competition-level criteria
- Align instruction with real workplace expectations
- Design hands-on projects and challenges grounded in authentic job scenarios

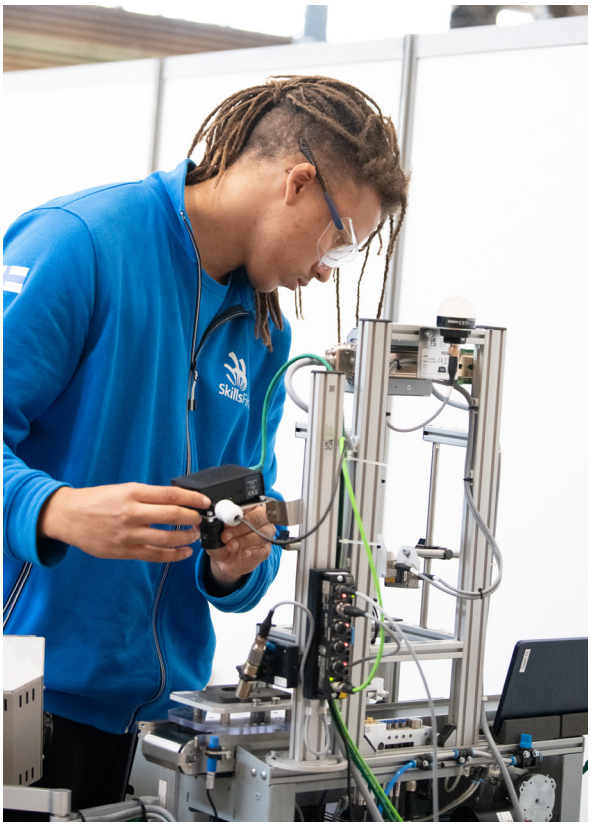
From standard to tasks: How the competition shapes learning

The Industry 4.0 competition brings the Occupational Standard to life through a multi-module, project-based challenge that focuses on the interface between shop-floor equipment and factory IT systems. Working from a common technical and business brief, competitors:

- Design, assemble, and commission production modules
- Develop and program software applications
- Connect operational technology (OT) and IT systems
- Implement industrial networking and cybersecurity
- Simulate and optimize production using digital twins
- Process, monitor, and visualize data
- Document and report on system performance

The Industry 4.0 and the Mechatronics Skills Competitions have different focus:
Industry 4.0: programming, connecting, retrofitting, and optimizing existing production systems and their IT infrastructure.
Mechatronics: designing, building, and commissioning physical production systems.





Overview of the WorldSkills Industry 4.0 Occupational Standard

→ View the full occupational standard

Section	What Competitors Do
Work Organization and Management	Plan, organize, and execute work safely and efficiently in automated environments; prepare tools and resources, monitor progress, adapt plans, complete tasks to specification, and reflect on performance for continuous improvement.
Communication and Interpersonal Skills	Interpret technical documentation, clarify requirements, collaborate with multidisciplinary teams, communicate effectively using verbal, written, and digital methods, document work activities, and contribute to team learning and feedback.
Design, Assembly, and Commissioning	Design, assemble, integrate, test, and commission cyber-physical production systems by selecting components, configuring sensors and actuators, validating system functionality, and maintaining accurate technical documentation.
Software Design, and Implementation	Develop, test, debug, and maintain industrial software by implementing control logic, HMIs, databases, and industrial communication protocols, and adapting programs to changing production requirements.
Networking and Cyber Security	Design and implement secure industrial networks by configuring protocols and topologies, enabling reliable data exchange, applying cybersecurity measures, monitoring network activity, and maintaining security documentation and awareness.
Testing, Maintenance, and Fault-Finding	Test, commission, and analyze production systems; diagnose faults, collect and analyze operational data, apply predictive and preventive maintenance techniques, and minimize downtime through targeted interventions.
Enhancement and Optimization	Analyze and optimize production systems by reducing waste, improving flexibility and efficiency, using simulations and digital twins, integrating data and cloud services, and evaluating cost-benefit impacts.
Analysis, Evaluation, and Reporting	Monitor and evaluate system performance using defined metrics, analyze data against specifications, prepare technical and management reports, present findings, and recommend improvements based on measurable outcomes.

Meet the CP Lab and its Ecosystem, the Official Competition Equipment

The CP Lab is a small-scale, smart learning factory that integrates physical automation equipment with digital systems, as well as higher-level software and IT layers. It lets students and professionals learn how smart, connected factories actually work—by building, programming, and networking one themselves.



What can be learned with the CP Lab and its digital ecosystem:

- Real and virtual cyber-physical production systems
- Design and structure of flexible production plants
- Batch size 1 and mass customization
- Plug-and-produce and rapid changeover
- PLC-based control systems and embedded controllers
- Mobile robotics
- Identification and tracking (RFID, NFC)
- Intelligent sensors and data acquisition
- Industrial communication using open standards
- Industrial Internet of Things (IIoT)
- Cloud connectivity and cloud computing
- Big data and analytics
- Manufacturing Execution Systems (MES)
- ERP system interfaces
- Energy monitoring and efficiency optimization
- Remote access and monitoring
- IT and OT security
- Push notifications and messaging

Bring Industry 4.0 technologies and concepts to life

At the hardware level, the CP Lab consists of modular, industry-ready stations including conveyors, sensors, actuators, and PLC-controlled HMIs. These components form a flexible production system that reflects real shop-floor workflows, allowing learners to experience material flow, automation, and product-driven manufacturing in a realistic environment.

At the software level, the CP Lab connects automation to higher-level digital systems such as MES, Industrial IoT platforms, data analytics, and cloud solutions. Using open communication standards, production data flows seamlessly from machines to dashboards and enterprise systems, enabling transparency, optimization, and advanced use cases like energy monitoring, cybersecurity, machine learning, and digital twins.

Key characteristics

- Realistic Industry 4.0 learning factory on a manageable, small-scale setup
- Combines real automation hardware with digital and IT systems
- Modular and expandable for different course levels and learning objectives
- Uses industry-grade PLCs, sensors, networks, and software
- Enables hands-on learning across automation, digitalization, and smart manufacturing
- Supports project-based and competency-based teaching approaches
- Bridges theoretical knowledge with real industrial processes
- Covers a wide range of topics, from basic control to advanced Industry 4.0 use cases
- Designed for efficient integration into manufacturing and automation curricula

Get more information about the CP Lab
→ on our website

The CP Lab and its ecosystem offer a comprehensive environment for developing industry-relevant competencies, including:

Factory Planning and Simulation
Realistic 3D simulations enable learning and experimentation with virtual factories to design, validate, and optimize production systems.

MES and Data Processing
A Manufacturing Execution System (MES) uses a service-oriented architecture with open interfaces to control production in real time and facilitate data analysis.

Industrial IoT and Dashboards
Open interfaces enable IIoT connectivity and the development of dashboards for visualization, monitoring, and analysis.

PLC and HMI Programming
Each station is equipped with a PLC and touch panel, communicating via modern industrial protocols such as PROFINET and OPC UA.

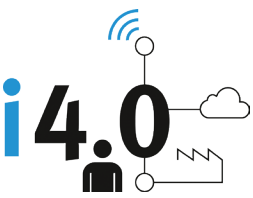
Web Shop
The system is extended to e-commerce via open interfaces, covering web presence, customer management, and real-time order monitoring and analysis.

Energy Monitoring
The configuration and use of energy monitoring dashboards increase transparency, understanding, and efficiency of energy consumption.

Identification with RFID
RFID-equipped workpiece carriers enable product-driven control, where each product directs its own processing in an Industry 4.0 environment.

Smart Sensors and IO-Link
Seamless sensor data integration supports real-time monitoring and diagnostics within higher-level automation and Industry 4.0 applications.

IT Security
Industrial communication networks form the backbone of Industry 4.0, making IT security an essential element of professional qualification.



Machine learning
Trained machine-learning models support automated analysis of production data for industrial use cases such as quality control.

Recommended Training Packages for Industry 4.0

Choose the package that fits your needs. Optional accessories expand learning possibilities—ideal for both competition preparation and classroom training. Contact our experts to build the right package for your needs.

Package 1 | Tools for software-based tasks

This package focuses on the core elements making the production digital, connected, secure and efficient. It's ideal to start preparation for the competition at affordable conditions.



CIROS enables factory simulations to analyze and optimize production efficiency by linking real and virtual systems for production planning.



MES4 is used to manage and monitor production by configuring workflows and analyzing data generated during the manufacturing process.



The **Energy Monitoring** Software allows learners to understand energy efficiency and flexibility through predefined monitoring dashboards.



The **Web Shop** links e-commerce orders to shop-floor production, allowing competitors to configure order processing via the MES.



Smart sensors with IO-Link communication enable system retrofitting and monitoring in real time monitoring



The **IoT Gateway** is an edge-computing device that connects shop-floor devices such as PLCs to a central IIoT cloud infrastructure.



The **Energy Management Box** measures electrical energy and compressed air consumption using data from the power supply and integrated sensors.



The **NetLab** software enables IT security and support scenarios using two managed switches and two firewall routers.

Package 1 includes:

- 1x CIROS license
- 1x Smart sensors TP 1312
- 1x IT Security TP 1333 (with one NetLab license)
- 1x Energy Measurement Box
- 1x IoT Gateway
- 1x MES4
- 1x Web Shop App
- 1x Energy Monitoring

With this package, teachers can train students to:

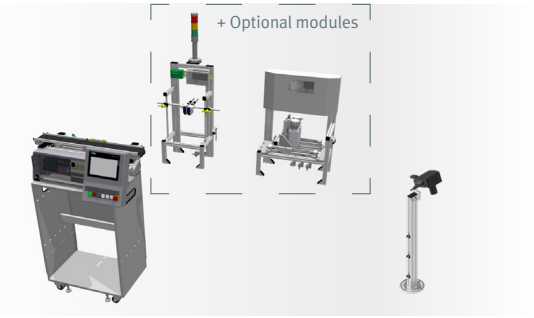
- Design, implement, and analyze a digital twin of a production system integrated with a manufacturing execution system (MES) and an ERP-enabled webshop.
- Stream sensor data from the shop floor to cloud visualizations using IoT and edge computing.
- Apply measures to secure shop-floor network communication.

Important note: As official sponsor, Festo provides all the hardware and software required for the competition. However, in accordance with WorldSkills regulations, each competitor is required to bring a laptop computer.

Equipment used during the competitions may be purchased at a special price after the event. Please contact your local Festo representative for information on availability and sales conditions.

Package 2 | A compact mix of software and hardware

This package enables hands-on Industry 4.0 training on a simple cyber-physical production system and tap into machine learning and AI-based quality inspection.



The **CP Lab Conveyor Station** bridges digital simulation and real production, enabling I4.0 technologies to be tested and applied to a real-world process.

The **IIoT Kit** Machine Learning supports training machine-learning algorithms for tasks such as camera-based quality inspection and verification.

Package 2 includes:
- 1x Package 1
- 1x CP Lab Conveyor Station (with PLC, HMI, trolley, power supply) and accessories
- 1x IIoT Kit Machine Learning
- Optional: one or two CP Application Modules

With packages 2 and 3, teachers can train students to:
- Commission and operate a cyber-physical production system.
- Enhance PLC and HMI programs with production-relevant data and implement IoT communication using technologies such as OPC UA and MQTT.
- Develop, train, and deploy an industrial machine-learning image classification application.

Note: Package 3 focuses exclusively on advanced technical topics, enabling the development of multiple smart production scenarios across different educational levels.

Package 3 | A complete production system

This package expands the scope and depth of learning through a complete cyber-physical production line with multiple processes.



The **CP Lab 404** represents a networked production system, made up of 4 pallet transfer systems accompanied with a magazine, measuring, drilling, and output application modules. This enables system-level optimization, orchestration, and data-driven decision-making across an entire smart factory.

Package 3 includes:
- 1x Package 1 + Package 2
- 4x CP Lab Conveyor Stations (with PLC, HMI, trolley, power supply)
- 1x CP Application Modules Drilling, Magazine, Measuring, and Workpiece Output



+ Digital learning option

Find ready-to-use learning content for your equipment on the digital portal Festo LX.
- AI-powered content creation tools
- Wide expanding library of learning content
- Various subscription options
- LMS integration available

Explore past WorldSkills I4.0 project tasks:
create your free account on → **Festo LX**

Ready to Move Forward?



Whether your objective is to prepare students for WorldSkills competitions or to integrate competition-grade training into everyday teaching, we support you in building a learning environment aligned with your needs and educational aspirations.

Considering embarking on the WorldSkills journey with your students?
Here are the main steps to get started:

Step 1
Learn about the competition on your national WorldSkills website.

Step 2
Identify motivated and committed students to represent your institution.

Step 3
Register them for the regional skills competition, the first step on the pathway to higher-level events, such as national and international competitions.

Step 4
Develop a training program based on the occupational standard and tasks from past competitions.

Step 5
Select training equipment suited to the required skills and learning objectives.

Contact your Festo local company.
Leverage expert guidance, practical advice, and technical insight from our specialists.

Recommendation: This skill competition is intended for students with experience in mechatronics and/or IT systems and software. We recommend forming a team with complementary strengths—for example, one student with a strong software background and another with solid mechatronics expertise.

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