

The First World Vocational College Skills Competition

Competition Rules

I. Name of the Skill

No.: W03

Chinese name: 工业机器人技术应用

English name: Industrial Robot Technologies Application

Industry: Equipment manufacturing

II. Competition Purpose

This is an innovative competition based on a mechanism integrating competition, competition certification and competition exhibition under the background of the International Summit and Exhibition for Vocational Education. Through the competition, exchange, and cooperation among participating countries, the competition aims to give full play to the leading and exemplary role of the skill competition, facilitate the application and promotion of intelligent manufacturing technology, and serve as a platform for teachers and students from domestic and foreign vocational colleges to compete, cooperate, and exchange.

This Skill covers key technologies in areas of expertise including programming operation, maintenance management, debugging and repair, vision system and integrated application of industrial robots. The competition process is combined with work processes to not only test the professional competency of competitors but also assess their professionalism including

teamwork skill, work efficiency, quality awareness and safety awareness. It is intended to fully demonstrate new technological achievements of automated, intelligent and digital transformation and upgrading of the modern manufacturing technology industry, lead the transformation and upgrading of the intelligent manufacturing technology, the training direction of skilled talents in short supply and the majors in colleges and universities, and cultivate urgently needed high-quality technicians for posts engaged in the installation, debugging, programming, maintenance and integrated application of industrial robots and the machine vision system. It is designated to strengthen the application of industrial robot technology and the development of relevant specialties and drive the conversion of competition results and the international cooperation regarding the industry, universities, research institutes, and application. It closely follows industrial demands, focuses on new professions, pushes forward the development of vocational and technical education in the post-pandemic era, and underlines the importance of vocational education.

III. Competition Content

This Skill takes the training platform for the application of industrial robot and machine vision system as the competition platform. **Three competitors** finish the mechanical installation and electrical connection of the competition platform, the parameter setting and programming & debugging of the industrial robot, the process debugging of the machine vision system, and

the overall operation, debugging and optimization of the system according to the requirements of the Test Project, so that all units work in a continuous and stable manner to implement the whole process of intelligent production including automatic discharging, conveying, defect inspection, sorting & identification (color and shape), grabbing & positioning, discharging & splicing, visual product judgment, finished product warehousing of workpieces.

Competitors shall complete the basic and comprehensive competition tasks by operating according to the relevant data and the Test Project provided by the workshop within the specified time (1 day, 3 consecutive hours in half a day for each module, 6 hours in total). The specific competition contents are as follows:

Implement the competition by using the competition equipment and supporting tools and measuring equipment provided in the workshop according to the requirements in the Test Project of the Competition.

(I) Module I Installation, debugging and programming & operation of mechanical, electrical and vision systems and industrial robots

1. Mechanical installation and electrical connection

Competitors complete the mechanical installation and debugging of the system, the installation and debugging of the control system and the installation of the machine vision system as required in the Test Project. This focuses on the assessment of competitors' practical skills in installation and

wiring.

2. Parameter setting, programming and debugging of industrial robot

Competitors complete the setting of such parameters as the origin of coordinates, communication interface, trajectory planning, input and output signal control, logical processing and point location demonstration of the industrial robot, and the teach programming as required in the Test Project. This focuses on the assessment of competitors' use of the industrial robot programming software, their on-line debugging skills and their ability to apply the common commands of the industrial robot, use the industrial robot teach pendant and perform manual control over the robot.

3. Debugging of machine vision system

- 1) Camera wiring and debugging;
- 2) Type selection, installation and focusing of lens;
- 3) Type selection, installation, wiring and control of light source;
4. Equipment troubleshooting

A fault point is set in one or multiple units of the equipment. Competitors are required to select and use the correct detection tools and standard detection methods to accurately judge and remove the fault.

(II) Module II System integration and joint debugging

1. System integration

Competitors complete the system programming and debugging as required in the Test Project, including

- 1) stereoscopic warehouse discharging
 - 2) visual material identification and sorting (defect detection & elimination and placement, and color identification)
 - 3) Identification, positioning and grabbing of materials
 - 4) Material placement on the tray by the robot
 - 5) Image recognition of finished products
 - 6) Warehousing of finished products
2. Joint debugging

It aims to make the system operate in a more stable and efficient manner and make the comprehensive operation effects of the equipment conform to the specific requirements stated in the Test Project.

3. Professionalism and safety awareness

Teams will be examined in the workshop in terms of their organization management, teamwork, work efficiency, quality and cost control, safety awareness, and other professionalism.

IV. Competition Method

i. Team formation

1. The Competition adopts the “1+1” mode, namely, one group of Chinese competitors (from Chinese schools) and one group of foreign competitors (from foreign schools) join hands to form a team (“Chinese-foreign joint team”). Each group consists of two students and one teacher. Competitors should sign up, compete and win prizes in teams.

2. Domestic competitors must be registered full-time students and full-time teachers from higher vocational colleges, as well as vocational

education undergraduate colleges. Students and teachers of one group should come from the same school.

3. Competitor replacement: If a competitor is unable to participate for any reason during the preparation, the relevant department should issue a written explanation ten working days before the start of the corresponding Competition. The competitor will be replaced after verification by the office of the Executive Committee of the First World Vocational Colleges Skills Competition (the “Executive Committee”). After the Competition starts, the teams are not allowed to replace the competitor.

ii. Competition method

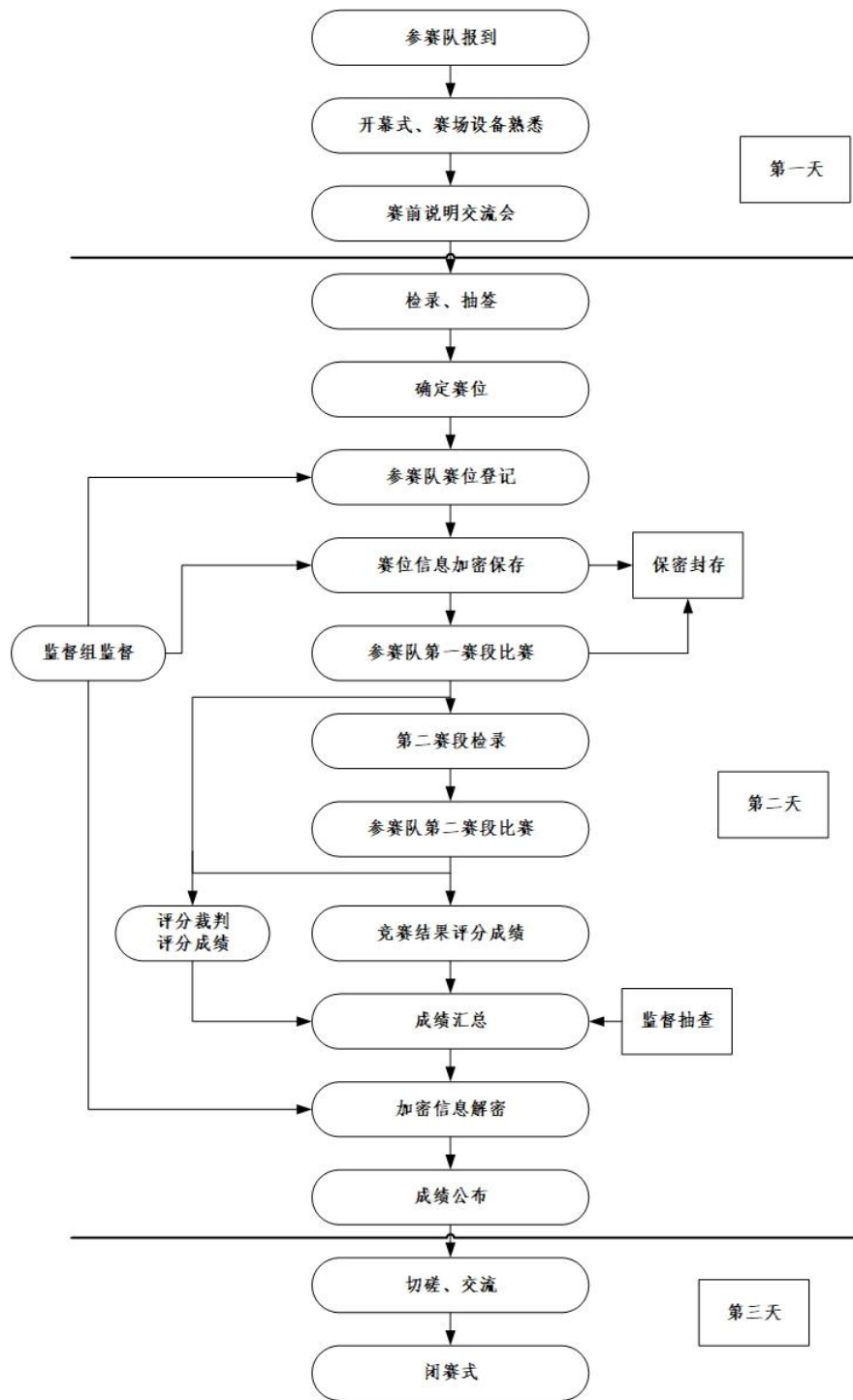
The Competition will be conducted in the forms of on-site Competition + recorded broadcast. Domestic competitors will compete on site; if foreign competitors are unable to attend the on-site competition, they may compete through recorded broadcast. Foreign competitors should send the competition videos that meet the competition requirements to the mailbox designated by the Executive Committee seven days before the official competition day, and the Executive Committee will uniformly conduct examination and trial broadcast of the videos and seal them for the record. On the official competition day, the videos should be unsealed by the jury, and those from the foreign competitors will be broadcast on the big screen on site. The marking criteria will be the same as those for on-site competition.

Requirements for competition video: The file format should be MP4; the resolution should not be lower than 1280*720; the recommended aspect ratio should be 16:9, and the video content should fully display the competition process.

V. Competition Process

The specific competition date will be stipulated by the Executive

Committee of the World Vocational College Skills Competition and the Division Executive Committee. This competition will last 3 days. Competitors should register on the morning of the first day and then participate in the pre-competition briefing and the lot drawing for session and familiarize themselves with the workshop; the official competition will take place on the second day. On the third day, the closing ceremony will be held and the certificates of award will be issued. The competition process is shown in Fig. 1. The competition schedule is shown in Table 1.



	Registration of participating teams
	Opening ceremony and familiarizing with workshop equipment
	Pre-competition briefing session
	Day 1

	Check-in and drawing lots
	Determining workstation
	Workstation registration of participating teams
	Workstation information encryption and saving
	Classified storage
	Supervision by the supervision team
	Stage one competition of participating teams
	Stage two check-in
	Stage two competition of participating teams
	Day 2
	Marking results of marking judges
	Competition and marking results
	Summary of results
	Decryption of encrypted information
	Result announcement
	Discussion and exchange
	Closing ceremony
	Supervision spot check
	Day 3

Fig. 1 Competition Process

Table 1 Competition Schedule (The specific time is subject to the competition guidelines)

Date	Time	Work contents
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Day 1	08:00-10:30	Opening ceremony, and familiarizing competitors with the workshop and equipment
	11:00-12:00	Pre-competition briefing session
Day 2 Morning	07:20-07:40	Competitor check-in and drawing lots for workstations
	07:40-08:00	Entry of competitors into the workshop, and checking the equipment, components, tools, etc.
	08:00-11:00	Competition and marking
Day 2 Afternoon	13:20-13:40	Competitor check-in
	13:40-14:00	Entry of competitors into the workshop, and checking the equipment, components, tools, etc.
	14:00-17:00	Competition and marking
	17:30-22:00	Summary and release of competition results
Day 3	09:00-10:30	Discussion and exchange
	11:00-12:00	Closing ceremony (announcement of results and awards, expert comments, and presenting works

VI. Competition Task Paper

(I) Test Projects will be developed by the Test Project Expert Panel in a confidential and independent environment. Compared with Sample Test Projects, Test Projects will increase workload by 20-30%.

(II) The Test Project will be reviewed by independent experts designated by the Competition Executive Committee.

(III) The competition task paper will be made public in advance. The Competition Test Projects will be published on a designated network information release platform 1 month before the competition.

(IV) A pre-competition briefing session will be held to clarify and answer questions about the Test Project type, structure, key points of examination, marking and precautions.

(V) For the states and test requirements of the competition tasks at the time of marking, the requirements vary with sessions and are the same for the same session. The initial state and test requirements of each task should be given at the start of the corresponding competition, prior to or during task marking in accordance with the assessment requirements.

(VI) Such contents as the task states and test state requirements for different sessions will be published via the network information release platform within one week after the end of the competition.

VII. Competition Rules

(I) Entry mode

i. This is a team competition. The individual result of each competitor will not be considered, but the average result of the competition team will be counted for ranking. This competition is worth a total of 100 points.

ii. The Executive Committee will organize all team leaders to participate in the open draw according to the competition process to determine the order of each team. The participating teams enter the workshop in turn according to the time period determined by the draw.

iii. Workstations in the workshop are numbered in a unified manner. The teams shall receive check-in at the designated place 30 minutes before the competition. Their workstation numbers will be decided by drawing lots 20 minutes before entering the workshop. After drawing lots, they shall enter the workshop immediately according to the workstation numbers drawn and then

complete the tasks specified in the competition at the corresponding workstations. Workstation numbers will be drawn by competitors according to the following steps:

1. Lot drawing will be presided over by the workshop encryption judge;
2. Competitors will randomly draw workstation numbers and sign the workstation record sheet for confirmation;
3. Workstation numbers will not be announced to the public and the lot drawing result will be sealed and kept in a unified manner by the competition office and will be unsealed after the end of marking to count the results.

(II) Preparation (subject to the Guide)

1. Familiarization: The workshop will be open the morning before the Competition day for competitors to become familiar with the workshop.

2. Team leaders' meeting: Team leaders' meeting will be held the morning before the Competition day. The team leaders and instructors are expected to attend the meeting, where they will be informed of the points for attention and pre-competition Q&A. Team leaders will determine the time of their team by drawing lots.

3. Entry: Competitors shall assemble at the designated place 30 minutes before the start of the Competition with their entry permits, ID cards and student ID, and draw their workstation numbers 20 minutes before the Competition. Competitors will enter the workshop according to their workstation numbers and do preparations. The judges will check their identity

information. Competitors are not allowed to enter the workshop 15 minutes after the start nor leave the workshop until 30 minutes before the end of the Competition. Electronic equipment, communication devices and other materials and supplies irrelevant to the Competition are strictly prohibited.

(III) Formal competition

1. The equipment for the Competition will be provided by the Skill Executive Committee. Each team can choose to use the equipment, instruments and tools available on site as required;

2. Having entered the workshop, competitors must follow the unified arrangement and direction of on-site judges. First, they have to check and test the equipment, optional parts, measuring tools and other items. In case of any problem, they shall raise their hand to the judges in time;

3. Instruments, equipment, and workstations for the Competition should be decided by drawing lots and must not be changed or adjusted without permission;

4. Competitors are not allowed to leave the workshop without permission during the Competition. Under special circumstances, they may leave with prior consent from the judges. If competitors take a break, drink water, and use the restroom, these are included in the competition time, and no extra time is scheduled. The Competition shall be timed by the clock equipped at the workshop;

5. During the Competition, competitors are not allowed to bring mobile

phones and other communication tools into the workshop. Competitors of different teams should not transmit information in any way, such as slips of paper, hand gestures, and argots;

6. All competitors must not talk loudly nor affect other competitors from completing their tasks in the workshop;

7. Competitors should protect equipment in the workshop, neither move nor deliberately damage desks, equipment, and other items. During the Competition, competitors must strictly observe the operating procedures, ensure equipment and personal safety, and accept the supervision and warning of judges;

8. When performing tasks, competitors should neither discuss with nor peep other competitors;

9. In case of special circumstances, competitors should raise their hands, negotiate with judges, and follow their opinions;

10. Competitors must store their competition documents in the specified folder on the computer at the workstation;

11. Competitors must strictly follow safe operating procedures and accept the supervision and warning of judges so as to ensure their personal and equipment safety. In case of a personal safety accident or an equipment fault arising from personal misoperation, the Jury President may have the right to discontinue the team. In the event of failure to continue the competition due to an equipment fault arising from non-personal factors of competitors, the Jury

President should make a decision on a case-by-case basis (switched to a backup workstation or rearranged to the last session). If the Jury President confirms that the equipment fault can be troubleshot by technical staff to continue the competition, the team will be given the additional time to make up for such delay;

12. In the second module, competitors will be given ten minutes to check their content made in the first module for consistency with what they have done, and sign for confirmation;

13. To terminate the competition early, team members may raise their hands to signal the judges, who will record their end time. Teams are not allowed to take any action after the competition;

14. Competitors must submit competition results according to procedures, cooperate with judges to keep track of the workshop, and sign and confirm with judges. They must not reject the request;

15. After completing the tasks and handover matters or the competition time is over, competitors should arrive at the designated place and wait for the staff to announce the end of the Competition before leaving;

16. In the course of the Competition, if the competitors cannot finish the programming by themselves, they may waiver, and the technical support personnel will help them to complete this part, but the team will not be scored for the waived part. The time for technical support personnel to help complete relevant tasks shall be included in the total competition time;

17. No misplaced tools, no littering. Please clean the workstation and check tools after tasks are completed. Threads, discarded articles and tools shall never be left on the workstation;

18. Competitors should mind their language and respect judges and other competitors, and neither verbally abuse judges and staff nor fight at the workshop;

19. Anyone should not hint, instruct, or help competitors in any way, otherwise, competitors' results should be deducted in accordance with the severity of consequences;

20. During the Competition, those other than the competitors, judges, and staff of the session and approved personnel are not allowed to enter the workshop. At the end of the Competition, competitors must leave the workshop timely as instructed. Those who do not follow instructions but make trouble out of nothing should be held accountable and a notice of criticism should be circulated;

21. The Jury President should remind competitors two times before the end of the Competition. When the Jury President gives the instruction of ending the Competition, all teams should immediately stop operation and tidy up their workstations rather than delaying the competition for any reason;

22. Competitors are not allowed to take the Competition-related items out of the workshop, such as the Test Project, drawings, scratch paper, and tools. Besides, competitors must be checked by judges before leaving the workshop;

23. Teams should submit their results according to the competition requirements, and the judges and competitors should sign for confirmation.

(IV) Result announcement

1. Organizational labor division

A result management organization consisting of a check-in team, a jury and a supervision and arbitration team is founded under the leadership of the Skill Executive Committee. Specific requirements and division of responsibilities are as follows:

(1) The check-in staff is responsible for registration, identity verification, etc. of teams (competitors). The organizer's staff is responsible for check-in.

(2) The jury is under the “Jury President Responsibility System” with 1 Jury President who is fully responsible for the judging and management of the Competition and deals with the controversial issues arising from the Competition, 24 workstation marking judges, 2 encryption judges, and 2 mark-keeping judges, i.e. a total of 28 judges.

(3) Judges are classified into encryption judges, on-site judges and marking judges according to the requirements of the Competition.

Encryption judges: They are responsible for organizing teams (competitors) to draw lots and encrypting team information and lot code; The encryption judges of each skill should be determined by the Division Executive Committee according to the skill requirements. The encryption judges responsible for the same skill should come from different organizations.

Encryption judges should not participate in marking.

On-site judges: They should make the workshop records properly, maintain the workshop discipline, and evaluate the on-site score of each team.

Marking judges: They are responsible for evaluating the fulfillment and performance of competition tasks of the teams (competitors) according to the skill assessment criteria.

(4) The supervision and arbitration team is responsible for supervising the work of the jury and review the results of the Competition by sampling; it is responsible for accepting appeals against the judging results submitted by Team Leaders, organizing reviews and providing timely feedback on the results of the reviews.

2. Result management procedure

According to the requirements of relevant systems, the result evaluation and management of teams should follow strict procedures.

3. Result marking

(1) On-site marking

The on-site judges should evaluate the teams' operation standardization and performance according to the on-site marking form. The judges should give points step by step to the competitors based on the standardization, reasonableness, and completion quality in the process of step-by-step operation according to the marking criteria. The marking results should be signed for confirmation by competitors, judges and the Jury President.

(2) Review of process marking by sampling

To ensure the accuracy of result statistics, the supervision and arbitration team should review the results of all teams ranked in the top 30% of the overall results of the Competition; the rest of the results should be reviewed on a sampling basis, with a coverage rate of not less than 15%. The supervision and arbitration team should promptly notify the Jury President in writing of any marking errors identified in the review, who will correct the results and sign for confirmation. If the error rate exceeds 5%, it will be identified as a non-small probability event, and the jury should review all the results.

4. Result announcement

(1) Review. After reviewing the result data, the Organizer's information officer should export and print the results recorded in the competition management system, and the Jury President, the supervision and arbitration team and the Skill Executive Committee will sign after reviewing and approving the results.

(2) Submission. The Organizer's information officer should upload the electronic version of results of the Competition confirmed to the competition management system, and also submit the paper printed report card signed by the Jury President and the supervision and arbitration team to the Office of Skill Executive Committee and the Office of Competition Executive Committee.

(3) Announcement The mark keeper should summarize the declassified

results of each team (competitors) into the final competition results, and announce the results after the signature of the Jury President and the supervision and arbitration team (the result announcement method of each skill must be defined in the competition guidelines). The announcement time should be 2 hours. If no one raises objection after results are announced, the leader of the supervision and arbitration team will sign on the report card, upload the results on the online system and announce the competition results at the Closing Ceremony.

XIII. Competition Environment

1. The total area of workshop should be about 500m². The work area of each team should about 21m² (6m×3.5m), in which 1 set of competition platform, 1 workbench, 3 chairs (benches), 2 computer desks and 2 computers (containing relevant application software) should be configured.

2. The main passageway of the workshop should be 3m wide, which conforms to the requirements for emergency evacuation.

3. The workshop should be provided with stable water, electricity, air and power supply emergency equipment, and the staff for security, public security, fire protection, equipment maintenance and power line repair should be on standby in the workshop with the aim to prevent and respond to emergencies.

4. Based on the characteristics of the Competition, baffles should be used to divide the competition area into competition units, and each workstation covers an area of about 6-8m². The interval of workstations should not be less

than 1.5m.

5. According to the requirements of pandemic prevention, 16 workstations should be set in the workshop. The basic configuration is that 16 workstations are provided, accommodating 16 teams (8 groups) for competition at most. Each unit should be equipped with 3-phase 5-wire AC 380V, single-phase AC 220V power supply equipment and 0.8Mpa compressed air source, and provide each competitor with one set of protective articles.

6. Public service areas, such as maintenance service area, medical service area, and supply depots should be available for competitors and staff in the workshop. There is a special passage for instructors to enter the workshop for guidance; there are exit passageways where observers and interviewers of the Competition conduct activities, ensuring that the Competition can be carried out in a safe and orderly manner.

7. The event units are relatively independent, ensuring that competitors compete independently and are protected from external influences; in the Division, toilets, medical aid posts, maintenance service station, life supplies station, and waste classification collector points are set within the scope of the guard line, ensuring that the Competition is carried out in a relatively safe environment.

IX. Technical Specifications

The Competition and teaching contents are linked by reference to the

teaching standards and specialized course standards for relevant specialties such as automation technology under the equipment manufacturing industry and electronic information under the electronic information industry.

(I) Requirements for professional skills involved

Competitors should master the knowledge and skills of mechanical installation and debugging technology, industrial robot technology, machine vision technology, PLC and communication technology, sensor technology, variable frequency motor, pneumatic actuator and other aspects in the teaching contents stipulated by mechatronics technology, industrial robot technology, electrical automation technology, machinery manufacturing and automation, E&M equipment installation, E&M equipment maintenance and management, intelligent control technology, automatic production equipment application and other disciplines.

(II) Technical standards

1. Theoretical standards

(1) ISO 10218-1: Robots and Robotic Devices - Safety Requirements for Industrial Robots

(2) ISO 10218-2: Robots and Robotic Devices - Robot Systems and Integration

(3) ISO 12100: Safety of Machinery - General Principles for Design - Risk Assessment and Risk Reduction

(4) IEC 60204-1: Safety of Machinery - Electrical Equipment of Machines

(5) IEC 61508: Functional Safety of

Electrical/Electronic/Programmable Electronic Safety-related Systems

(6) ISO 13849-1: Safety of Machinery - Safety-related Parts of Control Systems - General Principles for Design

(7) IEC 62061: Safety of Machinery—Functional Safety of Safety-related Electrical, Electronic and Programmable Electronic Control Systems

(8) Digital Still Camera General Specification (GB/T 29298-2012)

(9) Determination of Exposure Index, ISO Speed Ratings, Standard Output Sensitivity and Recommended Exposure Index for Digital Still Cameras (GB/T 20224-2006)

(10) Information Technology Equipment - Safety - Part 1: General Requirements (GB4943.1-2011)

(11) Basic and Safety Principles for Man-machine Interface (MMI), Marking and Identification - Actuating Principles (GB/T 4205-2010)

(12) Methods for Measuring the Focal Length of Camera Lenses (JB/T8248.5)

(13) Method for Determining the Photographic Resolving Power of Camera Lenses (JB/T8248.6)

(14) General Requirements for Numerical Control Systems of Machine Tools (JB/T 8832.1-2001)

(15) Industrial Control System Security (GB/T 30976.1-30976.2)

(16) Industrial Robots - Coordinate Systems and Motion Nomenclatures (GB/T 16977-2005)

(17) Industrial Robots - Graphical User Interfaces for Programming and

Operation of Robots (GUI-R) (GB/T 19399-2003)

(18) Industrial Robots - Safety Specification (GB 11291-1997)

(19) Industrial Robots - General Specifications (GB/T 14284-1993)

(20) Graphical Symbols for Use on Electrical Equipment (GB/T 5465.2-1996)

(21) Safety of Machinery - Electrical Equipment of Machines - Part 1: General Requirements (GB 5226.1-2002)

(22) PROFIsafe - Profile for Safety Technology on PROFIBUS DP and PROFINET IO (GB/Z 20830-2007)

(23) Industrial Communication Networks - Fieldbus Specifications - Part 2: Physical Layer Specification and Service Definition (GB/T 16657.2-2008)

(24) Industrial Communication Networks - Fieldbus Specifications - Type 10: PROFINET IO Specifications - Part 3: PROFINET IO Communication Profile (GB/Z 25105.3-2010)

(25) Manufacturing Information - Technical Terminology (GB/T 18725-2008)

(26) Safety Requirements for the Educational Equipment - General Principles (GB 21746-2008)

(27) Safety Requirements for the Educational Equipment - Basic Requirements for Equipment and Spare Parts (GB21748-2008)

2. Hardware standards

(1) National Occupational standard for electricians (occupation code: 6-31-01-03)

(2) National Occupational standard for fitters (occupation code: 6-20-01-01)

(3) Power cable installation, operation and maintenance workers (occupation code: 6-29-02-11)

3. Software standards

(1) Occupational standard for intelligent manufacturing engineering technicians (occupation code: 2-02-07-13)

(2) Industrial Robots - Graphical User Interfaces for Programming and Operation of Robots (GUI-R) (GB/T 19399-2003)

(3) Industrial Robot - Intermediate Code for Robot (ICR) (GB/Z 20869-2007)

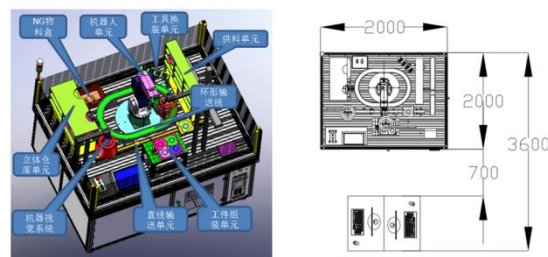
X. Technology Platform

The competition platform adopts the equipment platform of the same specifications, and tools and consumables are provided in a unified manner.

It is a complete simulated loop production line device that is required to be composed of an industrial robot system, a machine vision system, a programmable logic controller (PLC) system, a tool change unit, a four-station feed unit, a circular conveying unit, a linear conveying unit, a workpiece assembly unit, a stereoscopic warehouse unit, a waste recycling basket, various workpieces, an electric control cabinet, a profile training table, a profile computer table, etc. This platform adopts technologies related to industrial automation including industrial robot technology, machine vision technology, PLC control technology, frequency conversion control technology,

industrial sensor technology and motor drive technology. It is capable of operations in the whole process of intelligent production including automatic discharging, conveying, defect inspection, sorting & identification (color and shape), grabbing & positioning, discharging & splicing, visual product judgment, finished product warehousing of workpieces.

The composition of the technology platform is shown in Fig. 2: (Note: this figure shows the schematic diagram of the technology platform, which is



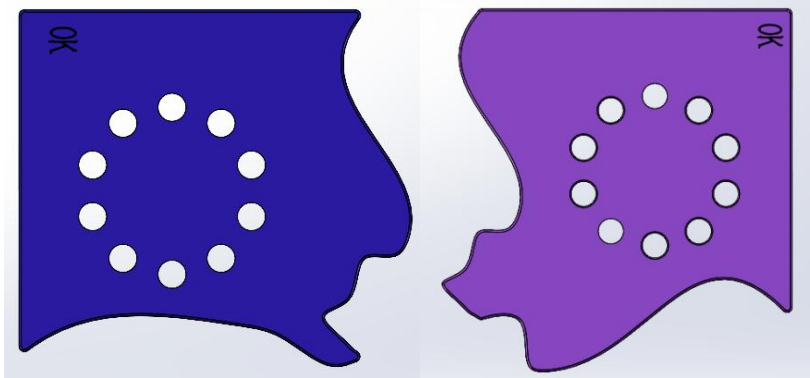
only for information.)

	NG material box
	Industrial robot unit
	Tool change unit
	Feed unit
	Circular conveying line
	Stereoscopic warehouse unit
	Machine vision system
	Linear conveying unit
	Workpiece assembly unit

Fig. 2 Layout Diagram of Technology Platform and Equipment Workshop

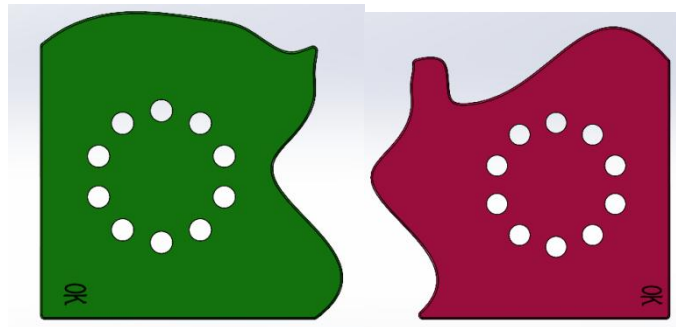
The competition platform mainly does the jigsaw of products. The product is composed of 4 parts (components), as shown in Fig. 3. Parts come

in a variety of colors and the jigsaw can be done according to production requirements to achieve product customization. There may be defective parts, as shown in Fig. 3.



(a) workpiece 1 (blue)

(b) workpiece 2 (purple)



(c) workpiece 3 (green)

(d) workpiece 4 (red)

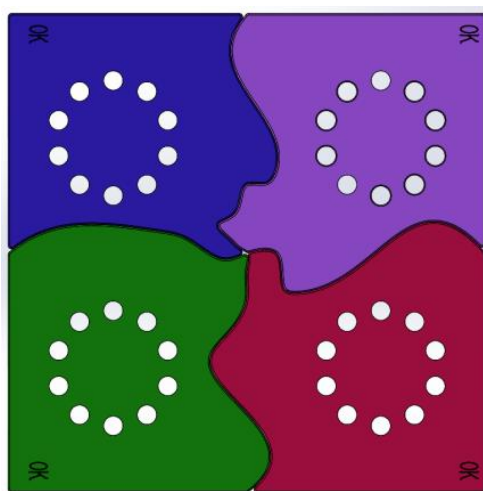


Fig. 3 Part (Component) Example

1. Basic parameters

Table 2 Basic Parameters

System power supply	Single-phase three-wire system AC220V
Equipment weight	≤500kg
Rated voltage	AC220V ±5%
Rated power	1.9kw
Ambient humidity	≤85%
Equipment dimension	1,300 - 2,000mm long, 1,000 - 2,000 mm wide and 1,500 - 1,800 mm high
Safety protection function	Emergency stop button, leakage protection, overcurrent protection and ground protection
PLC	Not less than 32 DI channels and not less than 32 DO channels (protection by relay module)
Frequency converter	0.4kw, single-phase AC220v input
2D camera	Resolution not lower than 1408×1024, pixels not lower than 1.5 million, communication protocol including RS-232, profinet, TCP, UDP, FTP, Modbus TCP and EtherNet/IP, and dimensions not more than 70 mm × 70 mm × 50 mm
Industrial robot	6-axis, accuracy of repetition being not lower than 0.025mm, rated load not lower than 3kg, maximum operating radius not less than 500 mm, and IO quantities being not less than 16 inputs and 16 outputs

2. Functions and composition of the competition platform

This competition platform is composed of a six-degree-of-freedom industrial robot system, a machine vision inspection system, a programmable logic controller (PLC) system, a tool change unit, a four-station feed unit, a circular conveying unit, a linear conveying unit, a workpiece assembly unit, a stereoscopic warehouse unit, a waste recycling basket, various workpieces, an electric control cabinet, a profile experiment table, a profile computer table, etc. It is capable of operations in the whole process of intelligent production including automatic discharging, conveying, defect inspection, sorting & identification (color and shape), grabbing & positioning, discharging & splicing, visual product judgment, finished product warehousing of workpieces being conveyed at a high speed.

(1) Industrial robot system

A 6-axis industrial robot is used. It can be fixed onto the profile experiment table and provided with a supporting teach pendant and controller to program, control and operate the robot. It can be equipped with multiple types of fixtures, suckers, measuring implements and tools for such operations as grabbing, sucking up, handling and assembling workpieces. Besides, it can use a machine vision camera for visual inspection of the product made by assembling workpieces.

Table 3 Industrial Robot Parameters

Number of axes	6
Accuracy of repetition	$\pm 0.01 \sim \pm 0.025\text{mm}$
Rated load	3~5kg
Max. working radius	$\geq 500\text{mm}$
Installation position	Arbitrary
Weight	25~55kg
Protection class	IP30~50
Max. motion range (speed)	$\pm 165^\circ \sim \pm 240^\circ$ (250°~450°/S)
	$+85^\circ \sim +130^\circ / -135^\circ \sim -100^\circ$ (240°~450°/S)
	$+70^\circ \sim +185^\circ / -90^\circ \sim 0^\circ$ (250°~520°/S)
	$+160^\circ \sim +270^\circ / -270^\circ \sim -160^\circ$ (320°~540°/S)
	$+120^\circ \sim +130^\circ / -130^\circ \sim -120^\circ$ (320°~623°/S)
	$+360^\circ \sim +400^\circ / -400^\circ \sim -360^\circ$ (420°~840°/S)
IO quantities	16 inputs and 16 outputs, supporting extended I/O

(2) Machine vision system

Machine vision system - 2D camera

The machine vision system supports AGC or LEVEL, exposure time, LUT, and Gamma correction, hard trigger, soft trigger and free operating mode,



and Gigabit Ethernet interface; in the absence of relay, the transmission distance is up to 100m. Compatible with GigE Vision V1.2 protocol and GenICam standard, it is seamlessly linked to third-party software.

Figure 4 Example of 2D Camera

Table 4 2D Camera Parameters

Model	Name	Network interface area-array camera
Performance	Pixel	Not less than 1.5 million pixels
	Sensor type	CMOS, rolling shutter
	BW/Color	Color
	Pixel format	Mono 8/10/10Packed/12/12Packed
Electrical characteristics	Data interface	GigE
	Power supply	12 VDC, PoE supported
Structure	Lens mount	C-Mount
	IP	IP30 (lens and cables properly installed)
	Temperature	Operating temperature 0~50°C, storage temperature -30~70°C
	Humidity	20% ~ 80%RH (non-condensing)
	Operating system	Windows XP/7/10 32/64 bits, Linux 32/64 bits and MacOS 64 bits
	Protocol/Standard	GigE Vision V1.2, GenICam
	Certification	CE, FCC, RoHS, KC

(3) PLC unit

The PLC unit can be configured with a PLC and a digital expansion module, used to control the motor, cylinder and other actuator actions and coordinate robots, process detection signals of each unit, manage the workflow, data transfer and other tasks.

(4) Tool change unit

The tool change unit is composed of a quick change master, quick change slaves, a gas clamp tooling, a sucker tooling, a visual tooling, a positioning tooling, and a tooling support, etc. The quick change master is installed on the

end flange of the robot, and can be quickly connected with the quick change slaves for automatic circuit and gas circuit, so that the robot can change the fixture tooling automatically based on different tasks. The tooling support is installed on the profile experimental table for the robot to automatically place and take different toolings.

(5) Feed unit

Equipped with nine storage spaces (3×3), the feed unit is used to place parts, and cooperate with the servo motor, module, pushing cylinder, ejection cylinder and photoelectric sensor to push the workpiece in the workpiece magazine to the conveying line or alternatively do combined feeding of different numbers, heights, and colors, and to control the feeding speed.

(6) Circular conveying unit

The circular conveying unit contains an AC speed governing system, which is composed of a frequency converter, a three-phase AC motor, an annular plate chain (belt conveyor) and a through-beam sensor, and installed on the profile experimental table to convey workpieces.

(7) Linear conveying unit

The linear conveying unit contains a speed governing system, which is composed of a DC servo motor and a synchronous pulley, and installed on the profile experimental table to convey workpieces (to be used for tracking and grabbing the workpiece).

(8) Workpiece assembly unit

The workpiece assembly unit is composed of a workpiece box feeding mechanism and a workpiece cover feeding mechanism, and installed on the

profile experimental table for assembling workpiece. It has three workpiece box assembly positions, and can assemble three workpiece boxes simultaneously. It is equipped with a plurality of sensors, and able to check the workpiece for availability and reverse direction. The robot can correct the reversed workpiece box/cover, assemble the workpiece in sequence, and disassemble the workpiece, etc. By placing the workpiece box/cover properly and reversely and changing the sequence of workpiece assembly, the robot can be improved in application flexibility, and investigated with respect to different degrees of application difficulty for diversified experiment and examination.

(9) Stereoscopic warehouse unit

The stereoscopic warehouse unit is equipped with 4 compartments (2×2), which are installed on the profile experimental table to place the assembled components. The assembled components can also be disassembled by robot and classified into the corresponding workpiece magazine.

(10) Waste recycling basket

The waste recycling basket is installed on the left rear side of the profile experimental table for the robot to place the unwanted workpiece or nonconforming products detected automatically.

(11) Electric control cabinet


The electric control cabinet is used for the installation of PLC, frequency converter, speed controller and other electrical components, with perforated screen structure and convenient assembly. Connected to the profile experimental table by two cables, both ends employ the aviation plugs to

separate the EL & ELV for safe and reliable connection.

(12) Industrial switch

The industrial switch combines the PLC, robot controller, and machine vision controller into an Ethernet LAN for mutual data transfer, to achieve high-level applications of industrial field control system. Besides, students can be trained and assessed on the use of industrial network skills.

Table 5 Industrial Network Parameters

	Indicator	Parameter
	Port	Five 10/100/1000M adaptive RJ45.
	Operating voltage	9.6V-60VDC
	Installation method	Guide rail type + wall-mounted
	Features	Three power inputs, redundant backup; EMC high IP grade; WEB management, broadcast storm protection, and port interrupt alarm switch adaptable to complex network environments.
	Protection class	IP30 and above

(13) Material accessories

The material accessories include a material box and workpieces. Qualified workpiece features blue, red, yellow and other colors, and each color has 1-4 numbers, while unqualified workpiece features missing strokes in the number and variegated overlay.

(14) Pre-installed software

Operating system: MS-Windows 10 64-bit

Word processing software: MS-Office 2003 or above

PDF reader

PLC programming software: GX Works3 (1.070Y) or Siemens TIA Portal

V15.1 or above.

Robot programming software: RT Toolbox3 (Version: 1.61P) or RobotStudio 6.0.8 and above.

(II) Main technical parameters

Table 6 Main Technical Parameters of the Competition Equipment

No.	Description	Parameter	Unit	Qty.	Remarks
1	Main platform	System power supply: single-phase three-wire AC220V Device capacity: $\leq 3.0\text{kVA}$ Overall dimensions: 1,300~2,000mm (L), 1,000~2,000mm (W), 1,500~1,800mm (H)	Set	1	
2	PLC	Not less than 32 DI channels and not less than 32 DO channels (protection by relay module)	Set	1	
3	Industrial robot	6-axis, accuracy of repetition being not lower than 0.02mm, rated load not lower than 3~5kg, maximum operating radius not less than 500mm, and IO quantities being not less than 16 inputs and 16 outputs	Set	1	
4	Frequency converter	0.4kw, single-phase AC220v input	Set	1	
5	2D camera	Resolution not lower than 1408×1024, pixels not lower than 1.5 million, communication protocol including RS-232, profinet, TCP, UDP, FTP, Modbus TCP and EtherNet/IP, and dimensions not more than 70 mm × 70 mm × 50 mm	Pcs.	2	
6	Touch screen	The touch screen unit is used for HMI, available to control the operating mode of equipment and monitor the operational state of equipment. It features a 7-inch LCD display, 65536 colors, with industrial Ethernet interface, USB and other interfaces.	Set	1	
7	Electric control	1) To be embedded inside the training platform. 2) Dimensions: $\geq 600\text{mm} \times 600\text{mm}$. 3) Required to install PLC, air switch, switch and other electrical devices.		1	
8	Training platform	1) The training table is required to adopt	Set	1	

No.	Description	Parameter	Unit	Qty.	Remarks
		<p>the integrally aluminium profile frame structure, with dimension of about 1,500~2,000mm (L) * 1,000~2,000mm (W) * 800~1,200mm (H);</p> <p>2) Double door design is required for the front;</p> <p>3) The desktop should be spliced by (20~40)mm×80mm high-quality aluminium profile;</p> <p>4) Below the desktop should be a space available for storage of industrial robot controllers and training accessories;</p> <p>5) The desktop should be used to install training modules, the installation position of which can be adjusted freely according to the competition tasks.</p>			
9	Circular conveying unit	<p>The circular conveying unit should contain an AC gear motor, an annular plate chain (belt conveyor) and a support frame, controlled by frequency converter and installed on the profile experimental table to convey workpieces.</p>	Set	1	
10	Linear conveying unit	<p>The linear conveying unit contains a speed governing system, which is composed of a DC servo motor and a synchronous pulley, and installed on the profile experimental table to convey workpieces (to be used for tracking and grabbing the workpiece).</p>	Set	1	
11	Workpiece assembly unit	<p>1) The workpiece assembly unit should be composed of a workpiece box feeding mechanism and a workpiece cover feeding mechanism, and installed on the profile experimental table for assembling workpiece.</p> <p>2) It has three workpiece box assembly positions, and can assemble three workpiece boxes simultaneously.</p> <p>3) It is equipped with a plurality of sensors, and able to check the workpiece for availability and reverse direction.</p> <p>The robot can correct the reversed workpiece, assemble the workpiece in sequence, and disassemble the workpiece, etc.</p>	Set	1	

No.	Description	Parameter	Unit	Qty.	Remarks
12	Stereoscopic warehouse unit	<p>1) The stereoscopic warehouse unit should be made of aluminum material, and equipped with 9 storage spaces (3×3);</p> <p>2) This unit is installed on the profile training table to place the assembled components;</p> <p>3) The assembled components can be disassembled and assembled by a robot, and placed into the corresponding workpiece magazine.</p>	Set	1	
13	Four-station feed unit	<p>1) The four-station feed unit should be composed of a well-type magazine, a pushing cylinder, an ejection cylinder and a photoelectric sensor;</p> <p>2) It is installed on the profile experiment table to push workpieces from the workpiece magazine to the circular conveying line successively.</p> <p>The four-station feeding design has diversified the way of feeding, enabled either single feeding or combined feeding of different numbers, heights, and/or colors, as well as the control of feeding speed.</p>	Set	1	
14	Tool change unit	<p>1) The tool change unit is composed of a quick change master, quick change slaves, a gas clamp tooling, a sucker tooling, a visual tooling, a positioning tooling, and a tooling support, etc.;</p> <p>2) The quick change master is installed on the end flange of the robot, and can be quickly connected with the quick change slaves for automatic circuit and gas circuit, so that the robot can change the fixture tooling automatically based on different tasks;</p> <p>3) The tooling support is installed on the profile experimental table for the robot to automatically place and take different toolings;</p> <p>The tool change unit is equipped with a quick change master and 4 quick change slaves, with a load of $\geq 3\text{kg}$, 4~6 gas circuits and 6 circuits.</p>	Set	1	
15	Industrial switch	1) Port: Five 10/100/1000M adaptive RJ45;	Set	1	

No.	Description	Parameter	Unit	Qty.	Remarks
		2) Operating voltage: 9.6V-60VDC; 3) Installation method: Guide rail type + wall-mounted; 4) Features: Three power inputs, redundant backup; EMC high IP grade; 5) WEB management, broadcast storm protection, and port interrupt alarm switch adaptable to complex network environments; IP: IP30.			
16	Material accessories	1) Material accessories are required to include a workpiece box and workpieces; 2) Qualified workpiece features blue, red, yellow and other colors, and each color has 1-4 numbers, while unqualified workpiece features missing strokes in the number and variegated overlay; The workpiece tray should be provided with a job slot for placing the workpiece.	Set	1	
17	Workpiece assembly process editing software	The workpiece assembly process editing software dedicated to the equipment should be compiled in PLC in advance, and the assembly process of workpiece can be edited at will by invoking the pre-set interface. The workpiece magazine can be set in any discharging sequence and random discharging. The PLC is matched with robot program to realize the diversified process of workpiece assembly.	Set	1	
18	Robot off-line programming simulation software	The training and assessment platform is equipped with a 6-axis industrial robot to provide the bundled software: 1. The copyrighted robot off-line programming simulation software points matching the robot body. 2. It supports all robot models of the same brand, positioner and guide rail, etc. 3. The operation of the teach pendant is exactly the same as the field application, and the simulation of robot movement is consistent with the real one, so that what you see in the software is the real environment. 4. Rich automatic generation function of offline trails supports a variety of digital and analog import, and automatic generation of	Set	1	

No.	Description	Parameter	Unit	Qty.	Remarks
		<p>robot trails to avoid the heavy and repetitive work arising from manual field debugging.</p> <p>5. Programs created offline can be transferred directly to real robots.</p>			
19	3D industrial automation design software	<p>The product supports the design of 3D mechanism for industrial robot workstations. Based on powerful intelligent parameter modeling technology, the complex design process is simplified to reuse the historical data and design changes quickly. From concept design to product manufacturing, it provides real 3D model design, advanced sheet metal design, complete 2D+3D integrated design and other overall efficiency tools, and integrates the PLC3D simulation function and motor simulation function in one software.</p> <p>1. The software supports the import of NX, Solidedge, Cro/e, SOLIDWORKS, inverntor mainstream 3D native and generic files, the interoperability with Solidedge commercial software file formats, and can directly edit data for design change. It can export 3D and 2D data required by each link, support integration with mainstream PLM/PDM system, and 3D data can be applied to the whole product lifecycle.</p> <p>2. The support software builds 3D virtual environments to realize 25 training projects, such as automatic sealing, automatic packing, temperature and pressure control, palletizing, machining center magazine, electroplating production line, liquid mixing and automatic mixing production lines, water level control in water tower, manipulator control, and automatic robot mine clearance, fully displaying complex process flow. The software supports the use of acquisition card to acquire PLC input and output signals for the PLC and computer communication, in order to control the actions of 3D models in the software, so that the virtual simulation technology can display the PLC operational state in real time; meantime, it is very easy for students to</p>	Set	1	

No.	Description	Parameter	Unit	Qty.	Remarks
		<p>understand the operating process and principle of each control unit.</p> <p>3. The software supports integrated motor simulation function, communication protocol: TCP/IP protocol; development language: C++; supports offline simulation; motor modeling in the form of equation of state, supports custom motors, and includes at least 20 DC motor and 20 asynchronous motor models optional for users; experimental items: DC motor (structure, disassembly and assembly demonstration, simulation assembly, parts display, mechanical characteristic experiment, start-up experiment, speed governing experiment, brake experiment); asynchronous motor (structure, disassembly and assembly demonstration, simulation assembly, parts display, mechanical characteristic experiment, start-up experiment, speed governing experiment, brake experiment). It can demonstrate the instantaneous changes of stator and rotor current and the two rotating magnetic potential changes established by them in the startup process of asynchronous motor, as well as the circular magnetic field while the asynchronous motor is running symmetrically. Experimental comparison: The same type of motor and a number of experimental data are available for multidimensional experiments.</p> <p>4. The software supports synchronous modeling; instead of trying to create a sketch, the system will automatically capture the sketch plane. The whole operation can be done in full 3D or switched to the 2D plane view. Based on the feature of no history tree, the model can be edited and modified according to geometric rules, i.e., to design products using the VGX technique.</p> <p>5. The software supports the structural simulation analysis of finite element analysis (FEA) tool built in Solid Design, which enables design engineers to digitally validate part designs in 3D, thus shortening the product</p>			

No.	Description	Parameter	Unit	Qty.	Remarks
		<p>development cycles.</p> <p>It supports animation and motion simulation. Besides the basic motion animation, it can input motion parameters to the model, in an effort to obtain the stress of each state in the process of motion. The required input force or power can also be derived from the results.</p> <p>6. The software supports the model-based definition, and digital communication speeds up the process from design to manufacturing. The product manufacturing information is directly assigned to the 3D model to generate the propagable 3D PDF and view manufacturing data through intuitive interactive documents.</p>			
20	Network cable	Used for inter-device communication and program download	Set	1	
21	Computer	The device software requirements (an industrial personal computer, equipped with at least two or more network interfaces and POE) to be met	Set	2	

Consumables and accompanying tools are shown in table.

Table 7 Consumables and Accompanying Tools

No.	Description	Model	Specification	Unit	Qty.
1	Tool kit	DL-TC270	400×200×200mm	Pcs.	1
2	Digital multimeter	VC9807A+		Pcs.	1
3	Long nose pliers	DL2106	6"	Pair	1
4	Diagonal pliers	DL2206	6"	Pair	1
5	Vice	DL2008	8"	Pair	1
6	Screwdriver	DL636100	Phillips screwdriver (6.0*100mm)	Pair	1
7	Screwdriver	DL6361001	Large flathead screwdriver (6.0*100mm)	Pair	1
8	Screwdriver	DL633075	Small cross screwdriver (3.0*75mm)	Pair	1

No.	Description	Model	Specification	Unit	Qty.
1	Tool kit	DL-TC270	400×200×200mm	Pcs.	1
9	Screwdriver	DL6330751	Small flat-head screwdriver (3.0*75mm)	Pair	1
10	Allen wrench	DL3090	M1.5-M10 nine-piece suit	Set	1
11	Wire stripper	91201		Pair	1
12	Crimping pliers	HSC86-4	HSC8 6-4	Pair	1
13	PU air pipe scissors			Nr.	1
14	Watch screwdriver	DL3206	Six-piece suit	Set	1
15	Monkey wrench		6" (150×19)	Pair	1
16	Gel pen			Pcs.	2
17	A4 paper			Sheet	5
18	Cable clamp	70683		Pair	1

XI. Result evaluation

(I) Composition of judges

Table 8 Composition of Judges

No.	Technical specialization	Knowledge and capacity requirements	Judging, teaching, and work experience	Professional and technical titles (level of professional qualification)	Number of persons
1	Mechatronics Technology	Ability to read pictures; Capable of pneumatic system installation and debugging; Capable of installation and debugging of M&E products	Experience in judging national or provincial competitions required; at least 3 years of work experience in one or more enterprises; ever involved	Associate Professor or Senior Engineer (or technician) above	12

			in teaching tasks in mechanical design, mechanical manufacturing, hydraulic and pneumatic, automatic control and other teaching tasks.		
2	Electrical Engineering and Automation	Capable of production line installation and debugging; Capable of electrical control system design	Experience in judging national or provincial competitions required; at least 3 years of work experience in one or more enterprises; ever involved in automatic control technology	Associate Professor or Senior Engineer (or technician) above	12
3	Mechanical Design and Automation	Capable of mechanical installation and debugging	Ever involved in teaching tasks in hydraulic and pneumatic, mechanical design and other teaching tasks.	Associate Professor or Senior Engineer (or technician) above	4
Total number of judges	28				

(II) Marking system

The marking system is divided into two modules: The first module is 100

points with a weight of 50%; the second module is 100 points with a weight of 45%; the quality score is 5 points, totaling 100 points. See Tables 9-10 for the proportion of each competition schedule.

Table 9 Marking Rules (Note: Tasks may be adjusted during the formal competition)

Module	Competition content	Score	Marking method	Audit methods	Announcement methods
I	Task 1	10	Marked at the workshop according to the Marking Form	Signed by the competitors, on-site judges and supervision and arbitration team leader	Announced by the Skill Executive Committee
	Task 2	10			
	Task 3	35			
	Task 4	45			
II	Task 1	Check the previous task	Marked at the workshop according to the Marking Form	Signed by the competitors, on-site judges and supervision and arbitration team leader	Announced by the Skill Executive Committee
	Task 2	40			
	Task 3	30			
	Task 4	30			

Table 10 Marking Rules

No.	Module	Task	Description	Assessment areas and points	Score	Sub-total	Proportion in total modules
1	Module 1	Task 1	Circuit wiring	1. Correct connection (6) 2. Neat wiring (4)	10	100	50%
1		Task 2	Assembly of mechanical parts	1. Correct connection of gas circuit (5) 2. Tidy piping (5)	10		
2		Task 3	Installation and debugging of vision system	1. Complete the visual hardware settings (10) 2. Software programming and debugging (25)	35		
3		Task 4	Industrial robot	1. Complete the settings for	45		

4			programming and debugging	tool and workpiece coordinate system of industrial robots (10)			
5				2. Complete the teach programming of the robot (35)			
6	Module 2	Task 1	Check the task accuracy of Competition Schedule 1		0	100	45%
7		Task 2	Joint debugging of vision and industrial robot	1. Complete the debugging of functional modules (20) 2. Realize the sorting and grabbing of raw materials (20)	40		
8		Task 3	Material assorting	1. Complete automatic assorting of qualified materials (30)	30		
9		Task 4	Visual inspection and warehousing of finished products	1. Complete the visual inspection of successful assorting (shape and color) (20) 2. Warehousing of finished products (10)	30		

Table 11 Marking Rules for Professionalism and Safety Awareness

Marking points	Score	Deductions	Module 1	Module 2
Fair play, abiding by the workshop discipline and work standards, zero accident	2 points	1) One point will be deducted for each violation of the competition rules until 0. 2) One point will be deducted for the dropping of tools and savage installation;		
Dress properly and neatly, take good care of equipment, and keep the competition environment clean and orderly	1 point	1) Failure to wear work clothes or work boots will have 1 point deducted; 2) Every failure to wear the safety helmet will have 0.5 points deducted until 0; 3) Every damage of a tool will have 0.5 points deducted; 4) Every tool or part left on the workbench surface will have 0.5 points deducted; 5) Failure to clean the workshop at the end of the Competition will have 1 point deducted.		
Well-defined functions, and calm, efficient and meticulous team	1 point	1) Unclear division of labor, lack of overall consideration, and chaos at scene will have 1 point deducted; 2)		

members		Disorderly placement and ambiguous classification of tools and parts will have 1 point deducted.		
Civilized entry to the Competition, and respect for other competitors and staff	1 point	Any offence or abuse against judges, staff and other workers in the Competition will have 1 point deducted until 0.		
Subtotal				

The task score accounts for 95%, and the quality score 5%.

Total score = Module 1 task score × 50%+ Module 2 task score × 45%+ quality score.

Points will be deducted for violations of Industrial Robot Technologies Application according to Table 12.

Table 12 Points Deduction for Violations

Assessment content		Criteria for deduction
Damage to equipment in the workshop arising from improper operation	Collision of industrial robot into a camera	15 points
	Clash and breakage to industrial robot claws	10 points
	Tray damage	3 points per damage
	Workpiece damage	1 point per damage
Short-circuit fault during debugging		30 points deducted
Improper wiring		1 point per improper wiring
Equipment damage arising from wrong wiring		5-10 points to be deducted as the case may be
Breach of competition rules and disturbing the order in the workshop	Early operation before the Jury President gives the order to start the competition	3 points deducted
	Sign with the competitor's real name or team	5 points deducted
	Disobeying the judge	3 points per disobedience
	Continuing operation after the Jury President gives the order to end the competition	3 points deducted
	Leave the team workstation without permission	Disqualification
	Communicate with competitors in other workstations	Disqualification
	Be loud and unreasonable in the workshop	Disqualification
	No paper, USB flash drive, mobile phone and other items are allowed into the workshop	Disqualification

(III) Result ranking

The hundred-mark system is adopted in the Competition. Competition result: The average result of each team is the final result, and the result is sorted by scores.

If the total result is tied, the team with a higher result in Module 1 ranks higher than that with a lower result. In addition to the total result, if the result of Module 1 is also tied, the team with a higher result in Module 2 ranks higher than that with a lower result. In addition to the total result, if the results of Modules 1 and 2 are also tied, the team with the shortest time ranks higher. The teams with the same total result, Modules 1 and 2 results, and even the same time, will be ranked by drawing lots.

(IV) Marking by judges

1. The jury is responsible for the result evaluation. The teams (competitors) shall operate according to the competition rules, and the judges shall immediately mark the competitors against the Marking Form. Two workstations are manned with 3 judges, to the extent that each workstation shall have no less than 2 judges;

2. Marking by judges: Process marking by the on-site judges against the Marking Form. Judges rotate to mark modules.

3. Under the supervision of a supervisor, two scorekeepers summarize the scores of each team step by step. The results of all steps shall be taken as the final task score of the team, and the final score sheet of each team will be generated, which shall be signed by the Jury President. The paper documents such as Test Project and Marking Form shall be sealed, signed, and transferred to the Executive Committee.

4. All alterations in the Marking Form shall be explained to the Jury President and put on record; any problems found during the review shall be explained to the Jury President and put on record.

5. Result announcement

The mark keeper will summarize the declassified results of each team into the competition results, and announce the results after the signature of the Jury President and the supervision and arbitration team leader. If there is no objection in two hours following the announcement, the final results of the total marks will be entered into the competition management system. After the Jury President and supervision and arbitration team leader have reviewed and signed on the system-derived marking form, the final results will be announced and the certificate issued at the closing ceremony.

6. Video recording shall be made throughout the workshop and the judge site.

XII. Awards and Prizes

A gold, silver and bronze medal will be awarded to each different team, and the teams in the top 50% of the total results (other than the top three) will be awarded the Medallion for Excellence.

XIII. Preliminary Plans for the Competition Venue

1. In the event of equipment power failure, faults, and other accidents during the Competition, the on-site judges need to promptly confirm the situation and contact technical support personnel on the workshop to handle the problem. Moreover, they should record the details and fill in the registration form for the make-up time. After reporting to the Jury President for approval, they can give additional time to the appropriate competitors to make up for the delay.

2. Three complete sets of standby equipment are reserved at the venue. In the event of serious equipment failure or damage due to reasons other than the competitor's own, the competitor shall transfer their information to the standby equipment and continue their tasks with the prior approval of the on-site judge and the confirmation of Jury President, under the support of the technical support staff and the supervision of the judge.

3. Each team works independently during the Competition. In case of an accident and the team will not affect other workstations during the Competition, the team's result will not be affected.

4. The workshop is equipped with two circuit feeding and standby power supply, plus an emergency medical point, to the extent that 120 ambulances and power supply vehicles are available outside the venue.

5. In the event of a large-scale accident or safety issue during the Competition, the identifier should report it to the Skill Executive Committee

immediately. The Skill Executive Committee should take measures such as suspending the competition and quickly evacuating the crowd to avoid further escalation, and report it to the Division Executive Committee immediately. Competition may be suspended in case of a major safety issue, and whether to suspend it should be determined by the Division Executive Committee. After the event, the Division Executive Committee should report the details to the Competition Executive Committee.

XIV. Safety

Event safety is a prerequisite for the smooth development of skill competition and a core issue to be considered in the preparation and operation of the Competition. The Skill Executive Committee shall take effective measures to ensure the personal safety of competitors, instructors, judges, staff, and spectators during the Competition. All staff and competitors are required to complete epidemic prevention and detection in advance. In case of any emergency during the Competition, the local epidemic prevention measures shall be followed.

(I) Competition environment

1. The Executive Committee must specially assigned persons to inspect the workshop, accommodation and transport before the Competition, and make explicit safety requirements. The arrangement of the workshop, the equipment and facilities within the workshop, should comply with the national safety regulations. If necessary, workshop simulation tests can be conducted to

identify possible problems. The Organizer must eliminate potential safety hazards in accordance with the requirements of the Executive Committee before the Competition.

2. A guard line should be set up around the workshop, and all the competitors must enter the workshop with valid documents issued by the Executive Committee to prevent the entry of unauthorized persons in case of accidents. The necessary labor protection should be provided for the competitors with reference to the requirements of occupational positions within the Competition site. In hazardous operations, judges must be on guard against any misoperation by the competitors.

3. The Organizer should provide conditions to ensure the implementation of the emergency response plan. For competitions involving work at heights, possible falling objects, large power consumption, fire prone and other circumstances, policies and emergency response plans must be formulated, plus first aid personnel and facilities.

4. Flammables, explosives, and hazardous goods irrelevant to the Competition shall be strictly prohibited from being brought into the workshop; it is not allowed to bring school bags into the workshop.

5. The workshop must be equipped with advanced instruments, to prevent the use of electromagnetic waves to interfere with the competition. The workshop should be subject to cyber security control to avoid information interaction, fully reflecting the seriousness, fairness and impartiality of the

Competition.

6. The Executive Committee must formulate the staff evacuation plan for the open workshop and experience area in conjunction with the Organizer. In addition to complete indication signs, additional guidance personnel shall be assigned and alternate lanes shall be available in areas with crowded and interlaced traffic and pedestrian flow in the workshop environment.

7. During the Competition, the Organizer of the Competition shall increase efforts in the key positions of workshop management and establish safety management logs.

(II) Living conditions

1. During the Competition, in principle, the Skill Executive Committee will arrange the food and accommodation for the competitors and instructors. The Organizer must respect the beliefs and cultures of ethnic minorities and arrange the diet and daily life for the competitors and coaches of ethnic minorities in accordance with national ethnic policies.

2. The place of accommodation for the Competition should have the business license for hotel/accommodation. Where the university dormitory is used for accommodation, the Executive Committee and the university will be jointly liable for the accommodation, health, and food safety during the Competition.

3. Transport safety of organized visits and observation activities during the Competition is within the responsibility of the Executive Committee. The

Executive Committee and the Organizer shall ensure the transport safety for competitors, instructors, judges and staff during the Competition.

4. Besides the necessary security quarantine measures available, the safety management should be strictly in line with national laws and regulations to protect personal privacy and freedom.

(III) Team responsibility

1. Each school shall arrange to purchase personal accident insurance for the competitors during the Competition when organizing the teams.

2. After the teams of each school are formed, the relevant management policy shall be formulated and safety education shall be provided to all competitors and instructors.

3. The teams shall strengthen the safety management of the competitors and achieve the alignment with the safety management of the workshop.

(IV) Emergency response

If an accident occurs during the Competition, whoever finds it should report to the Executive Committee in the first instance, and also take measures to avoid further deterioration. The Executive Committee should immediately activate the emergency plan to address the problem and report to the Organizing Committee. A Competition may be suspended if there is a major safety issue, and whether to suspend it should be determined by the Executive Committee. After the event, the Executive Committee should report the details to the Organizing Committee.

(V) Penalties

1. If a major safety accident is caused by a team, the team will be disqualified from prizes.

2. Teams involved in a major safety accident risk may be disqualified from continuing with the Competition if they are alerted and warned by the workshop staff but of no avail.

3. Event staff who violate the rules will be held accountable according to the corresponding policies. Where the circumstances are serious and cause major safety accidents, the relevant parties will be held legally accountable by the judicial authorities.

XV. Competition Notice

(I) Notice for teams

1. Each team should use the specified regional team name, and any school name or any other organization or group name is not allowed.

2. Team members should not be replaced, in principle, after their sign-ups are examined and confirmed. However, if a member fails to join the Competition during the preparation for the Competition, his/her provincial competent educational authorities should issue a written explanation, replace him/her with a substitute in line with relevant provisions, and have the substitute reviewed. After the Competition starts, teams should not replace their members. Team members are allowed to miss the Competition.

3. Teams should hold an entry card issued by the Organizing Committee

and valid IDs to participate in the Competition and relevant activities in accordance with the competition schedule.

4. Team members should wear uniforms and comply with the requirements for work safety and competition.

5. Team members should observe the workshop discipline, obey judges, follow instructions and compete in a courteous manner; they should hold entry cards to enter the workshop. It is forbidden to carry communication devices and self-prepared electronic or written materials to the workshop.

6. During the Competition, competitors must strictly observe the operating processes and relevant criteria, ensure personal and equipment safety, and accept the supervision and warning of judges. If a competitor has to interrupt or terminate the Competition due to an equipment fault, the Jury President will decide on a case-by-case basis.

7. During the Competition, if the equipment fails to operate normally due to misoperation by competitors or the competition cannot be continued due to a safety accident, their competition will be terminated.

8. During the Competition, each competitor should complete his/her tasks in the specified work area and post.

9. If a team wants to terminate the competition early, one of its team members should raise his/her hand to signal to the judge, and the end time of the competition should be recorded by judges, and after completing the competition, the team should not operate any more.

(II) Notice for instructors

1. All team instructors carry forward good moral norms, follow the instructions, obey judges and not cheat. Instructors should not be replaced after they have been reviewed and their sign-ups are confirmed. If any competitor is caught cheating, he/she will be disqualified from participating in the Competition and his/her ranking will be invalid.

2. During the competition phase, instructors are not allowed to instruct competitors in the workshop and are prohibited from using communication devices.

3. All team instructors and Team Leaders should implement various regulations of the Competition, reinforce the management of competitors, make pre-competition preparations properly, and urge competitors to carry their certificates and a variety of allowable tools.

4. If a competitor raises an objection to the work of judges or staff, his/her Team Leader must submit a written report to the Supervision and Arbitration Committee within 2 hours. Oral reports or interpretations requested by other people should not be accepted by the Supervision and Arbitration Committee.

5. Team Leaders and instructors should set a good example to obey and execute the supervision arbitration results of the appeal and also persuade competitors to do so.

6. Instructors should carefully study and master the technical rules and

workshop requirements of the Competition and instruct competitors to make all technical preparations and examination-oriented preparations before the Competition.

7. Team Leaders and instructors should give technical summaries and work summaries after the Competition.

(III) Notice for competitors

1. Competitors should strictly observe skill competition rules, skill competition discipline and safe operating procedures, respect judges and workshop staff, and actively maintain the order of the workshop.

2. Competitors should hold their entry cards and wear work clothes to enter the workshop and accept the inspection of judges.

3. Before entering the workshop, competitors must put communication devices such as cellphone in the custody of the relevant workshop staff.

4. Competitors should strictly abide by the provisions for competition time and arrive at the check-in area on time and should not enter the workshop after 15 minutes of the start of the Competition. Competitors are not allowed to leave the workshop without permission after the start of the Competition.

5. The Competition is divided into Module I and Module II. Competitors should complete the corresponding tasks according to the Test Project and can apply for marking to judges.

6. After the end of competition time, competitors should stop operating forthwith and should not delay the competition time.

7. After completing the Competition, competitors must leave the workshop quickly as required by judges and should not stay in the workshop.

8. Competitors should protect the equipment and instruments in the workshop and not damage the competition equipment and instruments.

(IV) Notice for staff

1. Staff should check the certificates of competitors. Competitors should hold their valid certificates to participate in check-in and competition on time; in case of failure to participate in the competition, competitors will be considered to give up the competition automatically.

2. Staff should strictly manage time. Competitors cannot conduct skill competition until the signal of the start of the Competition is sent. During the Competition, if competitors take a break, drink water, and use the restroom, these are included in the operating time. Drinking water will be prepared by the workshop, and staff should provide services properly.

3. Competitors are not allowed to carry any communication devices to the workshop. Once any competitor is caught carrying any communication device to the workshop without permission, he/she will be disqualified from the Competition.

4. If a competitor asks a question with permission, judges must give a straight answer to it.

5. Keep quiet in the workshop. Smoking is not allowed in the workshop. The judge and staff in charge of one workstation are not allowed to enter other

workstations without permission.

6. If a competitor completes the tasks early, he/she should signal to the judge, and the end time of competition should be recorded by the judge.

7. After a signal of end of the competition is sent, staff should supervise competitors to obey the judge's command, and competitors can leave the workshop with the approval of the judge.

8. All staff must wear the badges issued by the Organizing Committee and wear uniforms. Except for the workshop staff, no one is allowed to enter the workshop without permission.

9. News media must be approved by the Organizing Committee before entering the workshop and abide by the arrangement and management of the on-site staff, and cannot affect the Competition.

10. All Team Leaders, instructors and other unrelated personnel shall not enter the workshop without permission; Persons who are allowed to enter the workshop shall obey the arrangement of relevant staff, observe the workshop regulations and maintain the order of the workshop. If any competitor violates the relevant regulations or affect other competitors, the staff should have the right to expel him/her out of the workshop and a notice of criticism should be circulated.

XVI. Appeal and Arbitration

During the Competition, in case of injustice or rule violations by relevant personnel, the Team Leader can submit a written appeal to the supervision and

arbitration team within two hours after the end of the Competition. The content, time, people involved, and basis of the appeal should be adequately and truthfully described in the written appeal that should be signed by the Team Leader in person. Non-written appeals will not be accepted. The Competition adopts the two-level supervision and arbitration mechanism. Each Division should establish its Supervision and Arbitration Committee, and each skill should establish its supervision and arbitration team. The Supervision and Arbitration Committee of the Division works under the leadership of the Competition Executive Committee and is responsible to the Division Executive Committee. The supervision and arbitration team works under the leadership of the Skill Executive Committee and is responsible to the Skill Executive Committee. The supervision and arbitration team will organize a review within two hours after receiving the appeal report and inform the Appellant in writing of the review result in a timely manner. If the Appellant still raises an objection to the review result, the provincial (municipal) Team Leader may file an appeal to the Supervision and Arbitration Committee of the Division. The arbitration award of the Supervision and Arbitration Committee of the Division should be final. The supervision and arbitration award should be signed for by the Appellant and cannot be received on his/her behalf. If the Appellant leaves at the agreed time and place, he/she is considered to have waived the appeal. The Appellant may waive the appeal at any time. The Appellant shall not disrupt the workshop for any reason through drastic

actions.

XVII. Competition Observation

The relevant technology display areas should be set in the workshop with the aim to demonstrate the achievements of the higher vocational education and teaching reform;

(I) Observation object

Observation objects refer to experts, technicians, instructors, etc. of enterprises, organizations, colleges and universities, and industry associations in connection with the Competition.

(II) Observation method

Under the guidance of the workshop guide, observers can enter the workshop in an orderly manner at the specified time in groups.

(III) Observation discipline

1. Observers must wear the observer's badge;
2. During observation, observers should not discuss and talk with each other and are strictly prohibited from communicating with competitors;
3. During observation, observers are prohibited from staying in front of workstations so as to avoid competitors from being affected;
4. During observation, observers are not allowed to ask judges and staff in the workshop;
5. Observers are prohibited from taking photographs during observation.

Whoever violates the aforesaid regulations should be disqualified from

the observation.

XVIII. Live Competition

1. Live streaming method: Video recording equipment without blind spots should be deployed at the workshop to record and display the competition in real time; a large screen or projector should be set outside the workshop to synchronously display the competition in the workshop; Online live competition system should be used properly.

2. Live streaming timeline: During the Opening and Closing Ceremonies, special persons should be appointed to complete interviews and filming. During the Competition, special persons should be appointed to ensure the normal live streaming of the Competition.

3. Live streaming content: Multi-camera shooting is used in the Opening and Closing Ceremonies, and videos on interviews with outstanding competitors and tutors, comments by experts and judges, and interviews with businessmen should be produced to highlight the skills and characteristics of the Competition. Comprehensive information and materials should be provided for publicity, supervision and arbitration, and resource conversion.

XIX. Resource Conversion

The post-competition teaching resource conversion scheme should be established by reference to the Measures for Transformation of Contest Resources in World Vocational College Skills Competition. Under the leadership and supervision of the Competition Executive Committee, a

resource conversion scheme should be submitted to the Office of Competition Executive Committee within 30 days after the end of the Competition, and resource conversion should be completed within the planned time.

(I) Main contents of resource conversion

1. Sample test project and library of questions of the Competition;
2. Assessment rules for skills assessment of the Competition;
3. Description of assessment environment;
4. Video recording of competition process;
5. Comments by judges and experts;
6. Interviews with outstanding competitors and instructors;
7. Interviews with businessmen;
8. Relevant technical data of competition equipment;
9. Resources such as instruction manual and courseware of the Competition.

(II) Basic scheme and form of presentation of resource conversion

Meanwhile, the results of resource conversion should conform to industry standards and curriculum standards, highlight the characteristics of skills, and demonstrate the advantages of the competition. Moreover, shared teaching materials for vocational education should be developed to meet the requirements of vocational education and teaching, reflect advanced teaching models, and imply the advanced level of vocational education. The results of resource conversion should include basic and extended resources, fully

demonstrating the characteristics of the skills assessment of this Competition.

1. Basic resources

Basic resources should contain four major modules, namely talent demonstration, overview of skills, teaching unit and overall teaching resources:

1) Talent demonstration. Videos of comments by experts and interviews with outstanding competitors/instructors are provided for the Competition Executive Committee. A complete set of audio and video materials of the competition process are provided for the Competition Executive Committee. A 15-minute promotion trailer with exquisite footages, beautiful accompanying sound and smooth playback, and a 10-minute demonstration video of winning teams (competitors) are produced in real time after the Competition. They are played on influential media.

2) Overview of skills. The overview of skills should cover skill introduction, a training outline, key points of skills, and assessment indicators.

3) Teaching unit. The teaching unit can be a task module or a skill module, including presentation documents and videos on operational procedures.

2. Extended resources

Based on the original competition resource conversion, resources are added to form the following extended resources of outcomes. Extended resources are mature and support skill teaching and learning processes and can be used in all teaching and training links. Resources are added to form the

following outcome contents:

1) Create sample test projects and libraries of questions, score allocation form and marking form so as to provide a reference for practical training organized by various schools.

2) Based on the technical and skill points involved in the Competition and the competition process, invite enterprise experts to provide targeted comments and tutoring and guide the skill cultivation of students and the building of relevant specialized courses.

(III) Resource conversion method

The competition contents, competition processes and guided teaching and other materials of the Competition are converted into relevant resources through text, courseware and video, and are published on the website designated by the Competition for sharing among vocational colleges around the world.

(IV) Expected outcomes

For expected outcomes, see the Annex.

(V) Technical standard for resources

The results of resource conversion should be demonstrated in the forms of text documents, presentation documents, video files, graphs/images, and web-based resources, and the technical standard shall be implemented in accordance with the provisions of the Measures for the Skill Resource Conversion of the World Vocational College Skills Competition.

(VI) Expected completion time of resource conversion

The skill resource conversion should be handled by the Skill Executive Committee and the organizer. A resource conversion scheme should be submitted to the office of the Competition Executive Committee within 30 days after the Competition. Resource conversion should be completed within half a year.

(VII) Way of submission and copyright of resources

The resources produced are uploaded to the Competition website. For the open skills competitions organized by various Skill Executive Committees, the copyright of the skill resource conversion outcomes should be shared by the Competition Executive Committee and the Skill Executive Committee.

XX. Miscellaneous

Pandemic prevention and control: The local measures for administration of pandemic prevention and control should be implemented.