

The First World Vocational College Skills Competition

Competition Rules

I. Name of the Skill

No.: W04

Chinese name: 增材制造技术

English name: Additive Manufacturing Technology

Industry: Equipment manufacturing industry

II. Competition Purpose

The World Vocational College Skills Competition aims to bring together standards, technologies, equipment, teachers and students in the field of vocational and technical education at home and abroad, adhere to promoting Chinese vocational education to go global and serve international cooperation in production capacity, build an important platform for teachers and students of international vocational schools to deepen friendship, exchange skills and show styles, and promote the construction of a world community of skills. Through skills competitions, displays and experience exchanges, the best practices of international vocational and technical education are shared, the influence of Chinese vocational and technical education in the world in this field is enhanced, and China's vocational and technical education is aligned with global vocational and technical education.

The Competition closely follows industrial demands, focuses on new professions, and covers the typical tasks of additive manufacturing technology, such as digital design, equipment installation and debugging, and manufacturing processes. Meanwhile, it is designated to strengthen the application of additive manufacturing technology and the development of relevant specialties, drive the conversion of competition results and the international cooperation regarding the industry, universities, research institutes, and application, push forward the development of vocational and technical education in the post-pandemic era, and underlines the importance of vocational education.

III. Content of the Competition

i. Competition timeline

Module number	Module	Competition duration (temporary)
A	Module of disassembly, assembly and debugging	(3 hours)
B	Module of innovative and creative design	(3.5 hours)
C	Module of 3D printing processes	(1.5 hours)
D	Module of work demonstration	
E	Module of professional quality	
Total		8 hours

ii. Module content

1. Module of disassembly, assembly and debugging (3 hours)

Prior to the onsite competition, teams should complete the design of the 3D digital model of the sample to be printed in this module, in accordance with the requirements for the sample drawing (consistent with the drawing of the formal questions) in the sample Test Projects, and prepare a presentation document to explain modeling ideas.

During the onsite competition, teams should, in line with the assembly diagram provided onsite (an assembly drawing and a schematic diagram of the electrical control principle) and correct assembly processes, complete the mechanical assembly, device installation of the control system, and circuit connection of a 3D printer, by using the 3D printing module kit (Equipment 1) provided onsite and reasonably selecting tools and measuring instruments. Then, the assembled 3D printer should be debugged to meet the working and technical requirements specified in the Test Project.

Moreover, for a 3D printer with pre-set faults (Equipment 2) provided by the workshop, teams should describe the faults, explain the method to remove them, properly fill in the corresponding form, and correctly repair the equipment.

In accordance with the Test Project and drawing requirements, Equipment 1 and 2 should be used to print the digital model of the sample designed prior to the competition. Besides, the presentation document should be supplemented and improved.

2. Module of innovative and creative design (3.5 hours)

Prior to the onsite competition, teams should complete the preliminary design, according to the sample Test Projects published, and describe design ideas, creative points and the main modeling process in the presentation document.

During the onsite competition, specific parameters in the formal Test Projects should be altered, based on the sample Test Projects. Competitors should accordingly modify the preliminary design. In consideration of time differences, the formal questions should be released to international competitors who do not join the competition in China 12 hours in advance according to Beijing Time.

This module contains four tasks that should be published in the Test Project. Specific requirements are as follows:

Task I: Innovative and creative design

A creative product solution should be designed to address problems, according to the given scenario or task requirements. This task primarily assesses competitors' competence to analyze and address problems with their professional knowledge and skill to utilize advanced technologies to express their design schemes.

Task II: Mechanism design

In line with the requirements of the Test Project, innovative design ideas, and professional knowledge, such as mechanical principles and mechanical design, the internal movement

mechanism of the product should be designed, based on the characteristics of the manufacturing processes of 3D printers. Competitors' comprehensive design competence should mainly be assessed.

Task III: Appearance design

Competitors should, based on the movement mechanism designed, complete the 3D modeling of relevant parts and components, design and complete the 3D modeling of the appearance of the product, and make the final product. This task assesses whether competitors can design aesthetic appearance and reasonable and smooth curves and conform to ergonomic principles, while meeting functional requirements, and whether they can design an integrated structure (and processes for integrated part manufacturing) based on the characteristics of the manufacturing processes of 3D printers.

Task IV: Design of movement simulation

Movement simulation should be designed, based on the completed digital model of the product. This task mainly assesses whether competitors can comprehensively handle the overall appearance as well as movement and assembly relations of the product when simulating mechanical movement.

3. Module of 3D printing processes (1.5 hours)

Competitors should set parameters and process the product, according to data on the 3D model of the product completed in the module of innovative and creative design as well as 3D printers and software provided by the workshop. Besides, the presentation document should be further improved, based on the printing process and results.

This task primarily assesses competitors' competence to use 3D printers to design a designated and integrated structure with high quality (integrated manufacturing of parts) through the optimal path and method within the prescribed time, and competence in the post-processing of the 3D model.

4. Module of work demonstration

The presentation document should be improved, based on Modules 1-3, to demonstrate teams' ideas, creativity, and results of each module, and submitted as a work.

5. Module of professional quality

This module primarily assesses the following aspects of teams:

- (1) Standardization of equipment operation;
- (2) Use of tools and measuring instruments;
- (3) Safe and ethical production onsite;
- (4) The planning and logic for completing tasks, and response to problems.

IV. Competition Method

- i. Team formation requirements

1. "0.5+0.5" hand-in-hand Chinese-foreign mixed team ("mixed team") is adopted, which consists of two Chinese students and two foreign students. Competitors should sign up, compete and win prizes in teams.
2. Domestic competitors must be full-time enrolled students majoring in additive manufacturing and relevant majors from higher vocational colleges, as well as vocational education undergraduate colleges.
3. Foreign competitors must be foreign full-time students in related majors of vocational schools or colleges and universities providing vocational education, and international students of undergraduate schools in China are also encouraged to participate.
4. 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. After the Competition starts, the team is 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 will compete through recorded broadcast. Foreign competitors must send the competition video that meets the competition requirements to the mailbox designated by the Executive Committee seven days before the official competition day, and the Executive Committee will check and try to broadcast 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 should be broadcast on the big screen on site. The marking criteria should be the same as those for on-site competition.

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

V. Competition Process

1. Competition rules and sample Test Projects should be released publicly in advance. The difference ratio between sample Test Projects and formal Test Projects should not exceed 30%;
2. Teams should be formed and sign up for the competition within two weeks after the release of the competition rules;
3. The specific arrangements for competition phases are as follows:

Date	Time	Work contents	Site
Day 1	10:00-10:30	Team leader meeting (Pre-competition briefing)	The Lecture Hall
	10:30-11:30	Competitors should get familiar with the workshop and equipment, receive pre-competition safety training, and sign the Safety Responsibility	Workshop

		Agreement.	
	13:00-14:00	Training for judges and competition-related staff	Workshop
	14:00-14:30	Check-in and entry to the workshop of competitors	Workshop
	15:00-	The Opening Ceremony (participated in by non-competitors)	-
	14:30-17:30	Competition (Module of disassembly and assembly)	Workshop
Day 2	9:00-9:30	Check-in and entry to the workshop of competitors	Workshop
	10:00-17:00	Competition (Modules of design and printing, including two hours for lunch and the noon break)	Workshop
	17:00-18:00	Result assessment	The judges' site
	18:00-19:00	Result verification, entry, and review and award verification	The judges' site

Note: Competition duration and workshop is subject to the competition guidelines released prior to the Competition.

VI. Competition Task Paper

See the attachment for details. The competition task paper will be publicly released in advance. Test projects will be released one month in advance on an online information release platform designated by the Competition.

VII. Skill-Specific Competition Rules

1. Familiarization

The executive committees of divisions should arrange teams to get familiar with the workshop in a unified and orderly manner on the first day of the competition. It is strictly forbidden to communicate with on-site staff. Please refrain from making unfounded remarks that can cause damage to the overall image of the Competition. All rules for the competition should be strictly observed. In order to avoid accidents, crowding and talking loudly are forbidden.

2. Entry into the workshop

Competitors should arrive at the workshop 30 minutes in advance and have their identities, qualifications, and relevant documents verified by staff. Workstations should be decided by drawing lots and should not be changed or adjusted without permission. During the Competition, competitors are not allowed to leave the workshop without permission. In case of special circumstances, the approval of judges must be obtained. Competitors should not bring articles not related to the competition to the workshop, such as mobiles, wireless network cards, portable storage equipment, and documents.

3. Formal competition

(1) All competitors in the workshop should not intervene in the tasks of other competitors. They should not take the position of another team member or perform the duties of other team members. Additionally, verbal and personal attacks against judges and staff should be prohibited.

(2) Competitors must strictly follow safety operating procedures and receive the supervision and warning of judges so as to ensure their personal and equipment safety. In case of a personal safety accident and an equipment fault due to the personal mis-operation of competitors, the jury president should have the right to stop the team from continuing the competition. 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 based on the specific situation (shifting the team to a standby workstation or rearranging the team to the last competition session). If the jury president confirms that the equipment fault can be removed by technical support staff and the team can continue the competition, the competitors should be given additional competition time to make up for the delay.

(3) Competitors are not allowed to leave the workshop without permission after entering it. If it is necessary to leave the workshop or stop competition, because of an illness or other reasons, competitors should give a sign to judges. Only after obtaining the consent of the jury president of the workshop and signing the relevant record form can competitors leave the workshop and go to the designated place as ushered by staff.

(4) Competitors must submit competition results in conformity with procedures, support judges to record information about the workshop, and sign such records for confirmation. When a judge asks a competitor to sign, the competitor should not reject the request without a reason.

(5) When the jury president gives the instruction of ending the competition, all teams that have not finished their tasks should immediately stop operation and clean up their workstations rather than delay the competition for any reason.

4. Result announcement

(1) Prior to the Closing Ceremony, competition results, upon statistics, summary, and sorting by staff, should be submitted to the Executive Committee of the Competition and the jury for joint review. After judges' work is confirmed to have no mistakes, teams and their corresponding workstation numbers should be recorded for verification by the jury.

(2) The Executive Committee of the World Vocational College Skills Competition should assign designated staff to announce competition results at the Closing Ceremony, after listening to jury' opinions on result assessment and verifying such results.

(3) Competition results should be published on an online information release platform designated by the Executive Committee of the World Vocational College Skills Competition at the end of the competition.

VIII. Competition Environment

1. Workstations: The workshop is expected to cover a total area of approximately 200 square meters with a clear height of no less than three meters. Each workstation should not be smaller than 20 square meters, and should be labeled with a workstation number and

equipped with a competition platform. Additionally, each workstation should come with a workbench for competitors to write and place tools and the corresponding number of cleaning supplies.

2. Each workstation in the workshop should be offered three 3D printers of different models, two computers, and a set of grinding and repair tools. In addition, it should come with three power strips with power protection devices and safety measures, each of which should have no fewer than eight single-phase and three-phase 220 V AC electrical sockets each, with a power supply load of no less than 2 kW. Electric wires in the workshop should be arranged with wire covers.

3. Also, the workshop should include a check-in zone and an interaction and exchange zone. There should be two interactive and intelligent all-in-one machines for electronic conferencing, which should be connected to the Internet and satisfy network requirements for international competitions.

4. Workstations should be separated with separation labels or fences to ensure that competitors should not be free from external influences. Meanwhile, stable lighting and the supplies of water, power, and emergency power supply equipment should be available in the workshop.

5. The workshop is expected to be spacious and bright with a flat and dry floor and good ventilation.

6. Staff for security protection, firefighting, equipment maintenance, and power lines repair should be on standby at the workshop to prevent and respond to emergencies. In the meantime, public service facilities, such as maintenance services, medical services, and supply depots should be available for competitors and staff in the workshop.

7. There should be network cameras to shoot the whole process of the competition.

8. Specific areas of the workshop should be open to the public so that they can watch the competition within the prescribed time.

IX. Technical Specifications

Universal international standards and specifications will be referred to.

X. Technology Platform

1. Software platform

Software developers that can offer training services overseas should be selected. Domestic software developers are preferred. Chinese and English versions should be available.

(1) Operating system: Windows 7 and above

(2) Word processing software: MS-Office 2010 and above

(3) 3D design software: 3D physical design software and CAD 2D drawing software.

(4) 3D printing software system: Supporting process software for printers.

2. List of equipment for the Competition

(1) Equipment 1: FDM 3D printing installation and debugging equipment

Item	Detailed parameters
Product type	Delta parallel arms (Cartesian oblique coordinates), removable
Printing plates	Heat beds + heat-resisting glass plates with sandblasted and oxidized T6 aluminum alloy surface
Printing size	φ 150 × 200 mm
Resolving accuracy of layer	0.15 mm, 0.2 mm (100 microns)
Positioning accuracy	≤ 0.0125 mm
Printing speed	10-200 mm/s
Nozzle diameter	0.4 mm
Display screen	A 3.5-inch full color touchscreen that enables switching between Chinese and English interfaces

(2) Equipment 2: FDM 3D printing equipment for making the product

Item	Detailed parameters
Product type	Delta parallel arms (Cartesian oblique coordinates)
Device dimension (mm)	430 × 430 × 750
Net weight (kg)	25
Forming size (mm)	φ 230 × 280
Nozzle specification (mm)	0.4
Printing accuracy (mm)	0.1-0.3
Layer thickness (mm)	0.05-0.4
Printing heat beds	Heat beds + textured paper/heat-resisting crystal glass
Data format	STL, OBJ, AMF, etc.
Supporting system	Windows XP/7/8/10
Operation interface	A 3.5-inch LCD touchscreen
Leveling	Automatic leveling + manual leveling
Lighting system	LED indicators
Input and output voltages	AC220/DC24V
Insulation cover	Made of aluminum, semi-closed
Software name	Cura

(3) Device 3: LCD 3D printing equipment for making the product

Item	Detailed parameters
Forming principle	LCD light curing forming
Printing size	192 × 120 × 235 mm
Operation screen	A 5-inch full color touchscreen
Printing screen	An 8.9-inch 4 K black-and-white screen, resolution: 3,840 × 2,400, service life: 2,000 hours
Thickness of the printing layer	0.01-0.2 mm
Quick printing	1-4 s/layer
Printing consumables	Photosensitive resin
3D nano-release technology	Significantly reduce draft resistance and raise the printing speed and the success rate
Wavelength/light source	A 405 nm/integral light source, with light uniformity of 95%, better than a parallel light source
Printing method	USB flash disk off-line printing/Wi-Fi printing

Structural design of the Z axis	Super-stable dual guide rails + ball screws, with higher positioning accuracy
Air filtration	With an air filtration system
Cloud platform	Model data can be shared and stored in the cloud model library. After a model is uploaded, the 3D slicer within the application can be used to cut an uploaded model, and a g-code file can be generated on the mobile. 3D photos can be converted into models. Users can register a personal account and log in to the platform. Videos, images, and models can be uploaded. Thumbing up, commenting, sharing and downloading are supported.
Overall dimension	432 × 292 × 595 mm
Operating system and file type	Operating system: Windows 7/8/10, etc. File type: STL and SLC

(4) Auxiliary equipment: Auxiliary equipment and tools necessary for the competition, such as curing and cleaning machines. Specific parameters are omitted.

XI. Result Evaluation

i. Marking principles

Process assessment should be combined with result assessment, and competence assessment should be combined with professional quality. In order to ensure just, fair, and open assessment, the following measures should be adopted:

1. Assessment content, sample test projects, and assessment criteria should be released one month prior to the competition.
2. Technical staff should conscientiously debug all equipment for the competition to ensure the consistency of assessment conditions.
3. The jury should receive closed training prior to the competition to learn unified assessment and judgment criteria.
4. Question confidentiality should be strengthened.

ii. Marking scheme

The full mark is 100 points. Marking scheme are described below:

Marking scheme

Content of the competition	Marks	Notes
<p>A. Module of disassembly, assembly and debugging: Prior to the onsite competition, teams should complete the design of the 3D digital model of the sample to be printed in this module, in accordance with the requirements for the sample drawing (consistent with the drawing of the formal questions) in the sample Test Projects, and prepare a presentation document to explain modeling ideas.</p> <p>During the onsite competition, teams should, in line with the assembly diagram provided by the workshop (an assembly drawing and a schematic diagram of the electrical control principle) and correct assembly processes, complete the</p>	20 points	

<p>mechanical assembly, device installation of the control system, and circuit connection of a 3D printer, by using the 3D printing module kit (Equipment 1) provided by the workshop and reasonably selecting tools and measuring instruments. Then, the assembled 3D printer should be debugged to meet the working and technical requirements specified in the Test Project.</p> <p>Moreover, for a 3D printer with pre-set faults (Equipment 2) provided by the workshop, teams should describe the faults, explain the method to remove them, properly fill in the corresponding form, and correctly repair the equipment.</p> <p>In accordance with the Test Project and drawing requirements, Equipment 1 and 2 that have been assembled and debugged should be used to print the digital model of the sample designed prior to the competition. Besides, the presentation document should be supplemented and perfected.</p>		
<p>B. Module of innovative and creative design: Prior to the onsite competition, teams should complete the preliminary design, according to the sample Test Projects published, and describe design ideas, creative points, and the main modeling process in the presentation document.</p> <p>During the onsite competition, specific parameters in the formal Test Projects should be altered, based on the sample Test Projects. Competitors should accordingly modify the preliminary design. In consideration of time differences, the formal questions should be released to international competitors who do not join the competition in China 12 hours in advance in Beijing Time. This module contains four tasks that should be published in the Test Project. Specific requirements are as follows:</p> <p>Task I: Innovative and creative design A creative product solution should be designed to address problems, according to the given scenario or task requirements. This task primarily assesses competitors' competence to analyze and address problems with their professional knowledge and skill to utilize advanced technologies to express their design schemes.</p> <p>Task II: Mechanism design In line with the requirements of the Test Project, innovative design ideas, and professional knowledge, such as mechanical principles and mechanical design, the internal movement mechanism of the product should be designed, based on the characteristics of the manufacturing processes of 3D printers. Competitors' comprehensive design competence should mainly be assessed.</p> <p>Task III: Appearance design Competitors should, based on the movement mechanism designed, complete the 3D modeling of relevant parts and components, design and complete the 3D modeling of the appearance of the product, and make the final product. This task assesses whether competitors can design aesthetic appearance and reasonable and smooth curves and conform to ergonomic principles, while meeting functional requirements, and whether they can design an integrated structure (integrated manufacturing for parts) based on the characteristics of the manufacturing processes of 3D printers.</p> <p>Task IV: Design of movement simulation Movement simulation should be designed, based on the completed digital model of the product. This task mainly assesses whether competitors can comprehensively</p>	40 points	

handle the overall appearance as well as movement and assembly relations of the product when simulating mechanical movement.		
<p>C. Module of 3D printing processes: Teams should set parameters and process the product, according to data on the 3D model of the product completed in the module of innovative and creative design as well as 3D printers and software provided by the workshop. Besides, the presentation document should be further improved, based on the printing process and results.</p> <p>This task primarily assesses teams' competence to use 3D printers to design a designated and integrated structure with high quality (integrated manufacturing for parts) through the optimal path and method, and competence in the post-processing of the 3D model.</p>	25 points	
<p>D. Module of work demonstration: The presentation document should be improved, based on Modules 1-3, to demonstrate teams' ideas, creativity, and results of each module, and submitted as a work.</p>	Ten points	
<p>E. Module of professional quality: (1) Standardization of equipment operation; (2) Use of tools and measuring instruments; (3) Safe and ethical production onsite; (4) The planning and logic for completing tasks, and response to problems.</p>	Five points	

iii. Result ranking

Teams should be ranked by their total results from high to low. If the total results of two teams are the same, the team that has spent less time completing all tasks should be ranked higher.

iv. Marking by judges

1. The jury should consist of a jury president and several judges. The competition is subject to the jury president responsibility system. The jury president is responsible for the overall judgment and management of the Competition.

2. Requirements for judges of the competition are listed below:

No.	Professional and technical directions	Requirements for knowledge and competence	Judging, teaching and work experience	Professional and technical titles (level of professional qualification)	Headcount
1	Mechanical engineering, industrial design, machinery manufacturing,	Familiar with the identification and production of mechanical drawings, and	Served as the leader of the expert panel or jury president of a provincial or national	Senior title	1

	additive manufacturing, etc.	additive manufacturing technology	competition and have strong professionalism		
2	Mechanical engineering, industrial design, machinery manufacturing, additive manufacturing, etc.	Be familiar with the identification and production of mechanical drawings and understand 3D modeling methods	Served as an expert or judge at a provincial competition	Professional teachers or other engineers and technicians	9
3	Mechanical engineering, industrial design, machinery manufacturing, additive manufacturing, etc.	Have an engineering background and have relevant professional knowledge	Good oral and written English and Chinese.	Professional teachers or interpreters	2
4	Mechanical engineering, industrial design, machinery manufacturing, additive manufacturing, etc.	Familiar with the identification and production of mechanical drawings, and additive manufacturing technology	Served as an expert or judge at a relevant provincial professional Competition	Professional teachers or other engineers and technicians	4
Total number of judges	16				

3. Judges should be classified into onsite judges and marking judges, according to competition requirements. Onsite judges should not participate in marking.

4. Marking. The specific division of responsibilities is as follows:

(1) Onsite judges should record information about the workshop and maintain the order of the workshop, as stipulated.

(2) Marking judges should assess the skills, data recorded onsite, compliance with operation specifications, and works of competitors, in accordance with assessment criteria, and make a statistical summary of their results.

5. Judges should receive training prior to the competition so as to implement unified judgment criteria.

6. Competitors should operate in line with the Test Project and record the content that should be recorded in the competition task paper according to operational requirements.

The content that must be confirmed by judges must be signed by judges for confirmation, otherwise, points would not be awarded.

7. Assessment on ethical production is a deduction, including work attitude, awareness of safety, professional norms, and environmental protection.

8. The jury should mark based on onsite records by judges, the Test Project, and assessment criteria, in line with the principle of being “just, fair, open, reasonable, standardized, and transparent without objection”, and lastly determine winners according to marking and points.

9. The final score should be marked based on the 100 points. After being reviewed for accuracy, results should be confirmed and signed by the jury president and arbitrators. Results will be submitted simultaneously to the competition system.

XII. Awards and Prizes

One gold medal, one silver medal and one bronze medal will be awarded by the Competition to three teams respectively, and the teams in the top 50% of the overall results (other than the top three) will be awarded the winning prize.

XIII. Preliminary Plans for the Competition Venue

i. Contingency plan for pandemic prevention and control

The executive committees of divisions should take the lead in formulating a contingency plan for pandemic prevention and control for their respective divisions, while the Executive Committee of the Competition (“Executive Committee”) should implement such plans to ensure pandemic safety.

ii. Contingency plan for guaranteeing power supply

1. The organizer should communicate with local power supply departments in advance to ensure a normal power supply on the competition day. The workshop should be equipped with two-circuit feeding and standby uninterrupted power supply (UPS) as double security to ensure normal power supply of the workshop.

2. In the event of equipment power failure, faults, and other accidents during the Competition, onsite judges need to promptly confirm the situation and arrange technical support staff 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 arrange to give additional competition time to the corresponding competitors to make up for the delay.

3. For the workshop layout, the power plugs of computers should be hidden to make it hard for competitors to reach them and avoid competitors from kicking them off.

iii. Contingency plan for guaranteeing and handling computers

1. After all software required in the competition rules is installed, the technical support provider should test the function of each computer for each workstation, in accordance with the list of functions to be tested to ensure normal operation.
2. In the workshop, 10-15 spare workstations and adequate spare computers and accessories should be reserved and can be used by staff of the workshop to timely replace those with power failure, faults, and other accidents not because of competitors, upon recognition by onsite judges and the jury president.
3. In case of crashed or slow computers or other equipment faults during the Competition, after competitors request maintenance, technical support staff should promptly fix the problem. Additional time, equivalent to the maintenance time, should be given to the competitors, according to relevant rules. Besides, reporting and filing procedures should be gone through, in accordance with relevant rules.
4. Teams should operate independently during the Competition, so that results would not be affected by the connection to unified and real-time competition processes and marking-related servers. For instance, if an accident happens to competitors of a workstation, the operation and results of other workstations will not be affected.

iv. Contingency plan for result submission

Results should be submitted through LAN and online.

1. Enhanced efficiency of paper submission: In order to enhance the efficiency of paper submission, a separate server is offered in the workshop, and LAN is established to make it convenient for competitors to submit their results.
2. Confirmation of submitted results: By the sequence of submission, each competitor would be asked to confirm the number of files submitted and data size to ensure the correct submission of results. After confirmation, competitors should sign for confirmation.
3. Computers (including spare computers) for the competition should have a “one-key reset” system. The workshop should be closed, at the end of this session of competition. All computers should remain on. They should be reset, after it is confirmed that the results of this module are correctly submitted.

v. Contingency plan for medical treatment and safety

1. An emergency ambulance and a power supply vehicle should be on standby outside the workshop.
2. A medical rescue zone should be set in the workshop. During the Competition, doctors should be arranged to handle medical emergencies at any time.
3. In the event of a large-scale accident or safety problem during the Competition, the identifier should report it to the Executive Committee immediately. The Executive Committee should take measures such as suspending the competition and quickly evacuating the crowd to avoid further deterioration, and report it to the executive committee of the division immediately. A Competition may be suspended if there is a major safety problem, and whether to suspend it should be determined by the executive committee of the

division. After the event, the executive committee of the division should report the details to the Executive Committee.

XIV. Safety

Event safety is a prerequisite for the smooth running of all work of the skills Competition and a core issue that must be considered in the preparation and operation of the Competition. The Executive Committee shall take practical and effective measures to ensure the personal safety of competitors, judges, staff, and audience during the Competition.

1. Competition environment

(1) The Executive Committee shall organize a special inspection on the workshop, accommodation places 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 relevant national safety regulations. If necessary, workshop simulation tests can also be conducted to identify possible problems. The organizer must exclude hazards in accordance with the requirements of the Executive Committee before the Competition.

(2) A cordon should be set up around the workshop 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 the relevant occupational posts within the Competition site. In the section with dangerous operation, the judges should take strict precautions against the wrong operation of the competitors.

(3) The organizer should provide conditions to ensure the implementation of the contingency plan. For competitions involving work at height, possible falling objects, large electricity consumption, fire prone and other circumstances, policies and plans must be specified, and first aid personnel and facilities must be equipped.

(4) The Executive Committee shall 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 opened in areas where there are crowded and intersecting traffic and pedestrian flow in the workshop environment.

(5) During the Competition, the organizer of the Competition shall strengthen the posts in the management of the workshop and establish a security management log.

(6) It is strictly forbidden for competitors and judges to bring communication and photographic recording equipment or recorders into workstations and workplaces. If necessary, it will be allocated and managed by the workshop. Security check equipment will be deployed as needed to check the people entering the important parts of the workshop.

2. Living conditions

(1) During the Competition, in principle, the Executive Committee will arrange the food and accommodation for the competitors uniformly. The organizer shall respect the culture and beliefs of international teams and ethnic minorities and arrange the food and

accommodation for the international competitors and coaches, competitors and coaches of ethnic minorities in accordance with relevant policies.

(2) The place of accommodation arranged during the Competition should have the business permit for hotel/accommodation. If the school dormitory is used for accommodation, the Executive Committee and the school providing the dormitory will be jointly responsible for the accommodation, health, and food safety during the Competition.

(3) Transport safety of organized visits and observation activities during the Competition is under the responsibility of the Executive Committee. The Executive Committee and the organizer shall ensure the transport safety for competitors, judges, and staff during the Competition.

(4) The security management of each Competition, in addition to the necessary security quarantine measures that can be taken, should strictly comply with the relevant national laws and regulations to protect personal privacy and personal freedom.

3. 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 are formed, the relevant management policy shall be formulated and safety education shall be provided to all competitors.

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

4. Emergency response

If an accident occurs during the Competition, whoever finds it should report to the Executive Committee immediately, and also take measures to avoid further deterioration. The Executive Committee should immediately activate the contingency plan to address the problem and report to the corresponding executive committee of division. A Competition may be suspended if there is a major safety problem, and whether to suspend it should be determined by the executive committee of division. After the event, the executive committee of division should report the details to the Executive Committee of the World Vocational College Skills Competition.

5. Anti-pandemic measures

(1) All relevant departments are expected to attach great importance to requirements for pandemic prevention and control. In conformity with local requirements, relevant preparations should be made to ensure that the competition would be safe and smooth.

(2) Team members should follow the anti-pandemic regulations issued by the National Health Commission of the People's Republic of China and the regulations for pandemic prevention and control of Tianjin City. All teams and all relevant organizations should check the body temperature and monitor the health status of all participants from the 14th day before the Competition. Participants who have physical abnormalities and who are identified to have physical abnormalities should receive the nucleic acid test, in line with

the principle that “participants with physical abnormalities should be tested, and other participants would be tested if they are willing to do so”.

(3) All teams and all participants should check their Travel Cards and the Health Codes of Tianjin by themselves before departure. All participants should have the “Green” Health Codes of Tianjin and should not have left Tianjin City within 14 days. Those who have left Tianjin City within 14 days must have a certificate of negative results of the nucleic acid test within 48 hours. Only with a normal body temperature and personal protective equipment can participants can join the competition. Besides, they need to wear a medical surgical mask when entering the workshop.

(4) All participants can enter the workshop only when their body temperature is below 37.3°C. For those with physical abnormalities, organizers would support health authorities to organize experts from disease control and medical institutions to give the nucleic acid test to them and give professional suggestions.

(5) Other anti-pandemic matters not covered herein should be subject to local anti-pandemic policies.

6. Penalties

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

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

(3) Staff who violate rules will be held accountable according to the corresponding policies. Where the circumstances are serious and cause major security incidents, the relevant parties will be held legally accountable by the judicial authorities.

XV. Competition Notice

i. Notice for teams

1. Team members should not be replaced, in principle, after their sign-ups are confirmed. However, if a competitor 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 competitor qualifications, and have the substitute reviewed. After the competition begins, teams should not replace members. If a member is absent, it would be considered that the team forfeits the competition.

2. Organizers shall purchase personal accident insurance for the competitors during the Competition when organizing the teams.

3. Teams should carefully read all documents released by the Executive Committee of the World Vocational Students Skills and learn the timeline and judgment details to join the competition smoothly.

4. Teams should hold an entry card issued by the Executive Committee of the World Vocational Students Skills and valid IDs to participate in the competition and relevant activities, in accordance with the Competition Process.

5. Teams will have their competition sites and sequence decided by drawing lots.
6. The jury would have the right to make a decision on behavior not covered herein. In the event of a dispute, the decision by the supervision and arbitration team would be considered as the final decision, and no media information would be referred to.

ii. Notice for competitors

1. Equipment, instruments, and tools for the competition should be provided by the Executive Committee in a unified manner. All teams can choose and use them.
2. Competitors should check in at the designated site 30 minutes before the start of the competition and have their identities, qualifications, and relevant documents checked by staff. Competitors who do not arrive when the competition timer starts are considered a waiver of eligibility.
3. Instruments, equipment, and workstations for the competition should be decided by drawing lots and should not be changed or adjusted without permission.
4. Competitors are not allowed to leave the workshop without permission during the Competition. In case of special circumstances, they must obtain the approval of judges. If competitors take a break, drink water, and use the restroom, these are included in the Competition time, and no extra time will be allocated. The Competition timing is based on the clock set at the workshop.
5. During the Competition, competitors are not allowed to bring communication tools, such as mobiles, to the workshop, and no information can be transmitted in any way between competitors who are not from the same team.
6. All people in the workshop should neither talk loudly, nor affect other competitors from completing their tasks.
7. Competitors should protect equipment in the workshop, and should not move desks, equipment, and other items or deliberately damage equipment and instruments. During the Competition, competitors must strictly abide by relevant operating procedures to ensure personal and equipment safety, and are subject to the supervision and warning of judges.
8. When performing tasks, competitors should not discuss with or peep other competitors.
9. In case of special circumstances, competitors should raise their hands, negotiate with judges, and follow judges' opinions.
10. Competitors must store their competition documents in the specified folder on the computer at the workstation.
11. During the Competition, competitors must strictly abide by safety operating procedures to ensure personal and equipment safety. In case of a personal safety accident and an equipment fault due to the personal mis-operation of competitors, the jury president should have the right to stop the team from continuing the competition. 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 based on the specific situation (shifting the team to a standby workstation or rearranging the team to the last competition

session). After confirming an equipment fault, the jury president can assign technical support personnel to remove the fault, let the team continue the competition, and give the team additional competition time to make up for the delay.

12. If it wants to end the competition earlier, a team should raise his/her hand to give a sign to its judge. The judge will record its end time of the competition. The team should no longer perform any operation after ending the competition.

13. Competitors must submit competition results in conformity with procedures, support judges to record information about the workshop, and sign and confirm together with judges. They should not reject to sign.

14. Competitors should not leave tools about or scatter litter. They should tidy up workstations, including tools, wires, and wastes, and should not leave them on the workstation.

15. Competitors should wait in a designated place at the end of the competition, and leave with the permission of judges.

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

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

18. During the Competition, except for the competitors, judges, and staff of the session and approved personnel, other people are not allowed to enter the workshop. At the end of the competition, participants should timely leave the workshop, 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.

19. The jury president should remind competitors 15 minutes 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 delay the competition for any reason.

20. Competitors are not allowed to take items related to the competition out of the workshop, such as the Test Project, drawings, scratch papers, and tools. Besides, competitors must be checked by onsite judges and obtain their approval before leaving the workshop.

iii. Notice for staff

1. The staff shall, under the leadership of the Executive Committee of the World Vocational Students Skills, abide by professional ethics, adhere to principles, and act according to rules. Besides, judges should perform their duties in a strict, conscientious, just, accurate, and ethical manner.

2. The staff must wear the badge and the uniform, have a tidy and clean appearance and good manners, and talk politely.

3. The staff must attend the pre-competition training organized by the Executive Committee of the World Vocational Students Skills.
4. The staff should keep competition secrets during the Competition rather than disclose or imply such secrets to team leaders, coaches, and competitors of divisions.
5. The competition time should be strictly observed and should not be shortened or extended without permission.
6. The staff should strictly conform to competition disciplines. Except for the guidelines for competitors, staff should not give a hint to or answer competitors' questions related to the competition. Furthermore, they should not provide instructions or convenience to competitors.
7. The staff should remain at their posts rather than take others' posts without permission, and should not be late or leave early.
8. The staff should supervise competitors to observe skill-specific competition rules and safe operating procedures, and properly handle issues that occur during the Competition, and should not intervene with competitors.
9. The staff should follow the principle of justice and equity, maintain discipline at the workshop, perform judging duties properly, and record information about the workshop truthfully.
10. The staff should timely check and repair equipment faults occurring at each round of competition, and promptly report those that cannot be fixed.

XVI. Appeal and Arbitration

During the Competition, in case of injustice or rule violations by relevant personnel, teams 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 team members in person.

The supervision and arbitration team should organize a review within two hours after receiving the appeal report and timely inform the appealing party in writing of the review result. If the appealing party still disagrees with the review result, the team leader may submit an appeal to the Supervisory Arbitration Committee of the division. The arbitration award of the Supervisory Arbitration Committee of the division shall be final.

The arbitration award should be signed for by the appealing party and cannot be received on his/her behalf. If the appealing party leaves at the agreed time and place, he/she is considered to have waived the appeal. The appealing party should not reject the arbitration award for any reason and can waive the appeal at any time. The complaining party shall not disrupt the workshop for any reason through drastic actions.

XVII. Observation of the Competition

1. Competition of the disassembly and assembly of 3D printing equipment (Day 1)

Teams should complete the assembly, debugging, and troubleshooting of equipment onsite by using the 3D printing equipment and module kit provided by the workshop, in line with the drawing of 3D printing equipment. Besides, they should meet the working and technical requirements specified in the Test Project and use the equipment assembled onsite to print samples.

The first 40 minutes of the competition is the focus of observation, during which time competitors quickly assemble 3D printing equipment to demonstrate their vocational competence and quality. Additionally, the assembled printer will be used to print samples at the end of this phase of the competition.

2. Competition of the design of additive manufacturing processes (Day 2)

In line with task requirements, teams should design 3D digital models in an innovative and creative manner onsite, and use the additive equipment provided onsite to rapidly produce models.

At the end of this phase of the competition, each team is expected to form a model that can achieve required functions and indicate competitors' skills. Hence, it is the focus of observation in this phase of the competition.

XVIII. Live Competition

The competition should be livestreamed as required by the Executive Committee of the World Vocational College Skills Competition.

- i. Video recording equipment without blind spots should be deployed at the workshop to record and display the competition in real time.
- ii. Online live competition systems can be used.
- iii. 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.
- iv. Comprehensive information and materials should be provided for publicity, arbitration, and resource conversion. Videos can be submitted to the Executive Committee as a part of the competition results and historical information of the competition for the reference of subsequent competitions. The competition process of competitors can be converted into teaching materials to promote the teaching and learning development of relevant majors.

XIX. Resource Conversion

The resource conversion should be conducted through the cooperation with participating schools and enterprises, based on this international competition, so as to drive the international exchange of the vocational education of majors related to additive manufacturing technology.

- i. The skill resource conversion should be handled by the Executive Committee. A plan for resource conversion should be submitted to the office of the Executive Committee within 30 days after the competition. Resource conversion should be completed within half a year.

ii. The skill resource conversion should include: A question library, the conversion of competition materials into courses, teaching resources and materials, or relevant papers, feature films, a case study on competition assessment and marking, work experience, comments by experts and judges, and interviews with outstanding competitors and tutors.

iii. The results of the skill resource conversion should include basic and extended resources, fully demonstrating the characteristics of the skills and assessment of this Competition. Meanwhile, the results of the skill 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.

1. Basic resources should contain three major modules, namely an overview of skills, a training unit, and training resources. The overview of skills should cover skill introduction, a training outline, key points of skills, and assessment indicators. The training unit can be a task module or a skill module, including presentation documents and videos/animations on operational procedures. Training resources can include teaching schemes, training instructions, tasks, and experimental/practical resources. The module of training resources can be separated or included in training units.

2. Extended resources are mature and diverse auxiliary resources that mainly reflect skill characteristics and support skill teaching and learning and can be used in all teaching and training processes. For example: Videos on comments and interviews and the libraries of questions, cases, and materials.

3. The results of the resource conversion should be demonstrated in the forms of text documents, presentation documents, video files, Flash files, graphs/images, and web-based resources, all of which should meet the technical standards specified in the Measures for the Skill Resource Conversion of the National Vocational Students Skills Competition.

4. Converted resources of the Competition should be uploaded to a website designated by the competition. Copyrights should be shared by the Executive Committee of the World Vocational College Skills Competition and the Executive Committee, and used and managed by the Executive Committee in a unified manner. High-quality resources, such as relevant question libraries and the typical operational procedures of posts, should be edited and published together with the organizer and relevant experts of this Competition as well as publishing houses.

XX. Miscellaneous

During the Competition, exhibition and experience processes should be arranged simultaneously to enrich the competition and promote the international exchange and cooperation of vocational education.