BRICS 2022 CHINA

2022 BRICS Skills Competition

(BRICS Future Skills Challenge)

TECHNICAL DESCRIPTION

Industry 4.0 (Offline)

Contents

1. Introduction

1.1. Name and Description of the Skill

1.1.1. Name of Skills

Industry 4.0

1.1.2. Description of the Skills

The organization of the BRICS Skills Competition Industry 4.0 Technology (Offline) is based on the Industry 4.0 Technology Application System Competition Platform, which conducts offline work assessments for the Competitors.

Industry 4.0 technology is a team skills competition with two Competitors per team.

1.1.3. Competition System

The offline competition of the Industry 4.0 technology will be carried out with the Industry 4.0 technology application system as the carrier. The system closely focuses on the latest technology development trend of "Industry 4.0", and integrates "Internet +", "IT technology and security", "smart sensors", "digital twin simulation", "PLC control technology", "intelligent electromechanical equipment", Advanced technologies such as "logistics technology" can enable students to learn and master the latest knowledge and skills of Industry 4.0.

1.2. The Relevance and Significance of This Document

This document contains information about the standards required to compete in this skill competition, and the assessment principles, methods and procedures that govern the competition.

Every Expert and Competitor must know and understand this Technical Description.

In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.

2. The Skills standards specification

2.1. General notes of skills standards

The skills standards specifies the knowledge, understanding and specific skills that underpin international best practice in technical and vocational performance. It should reflect a shared global

understanding of what the associated work role(s) or occupation(s) represent for industry and business

The skill competition is intended to reflect international best practice, and to the extent that it is able to. The Standards Specification is therefore a guide to the required training and preparation for the skill competition.

The Standards Specification is divided into distinct sections with headings and reference numbers added. Each section is assigned a percentage of the total marks to indicate its relative importance within the Standards Specification. This is often referred to as the "weighting". The sum of all the percentage marks is 100.
The weighting determine the distribution of points in the grading scale

The Marking Scheme and Test Project will assess only those skills that are set out in the Standards Specification. They will reflect the Standards Specification as comprehensively as possible within the constraints of the skill competition.
The scoring scheme will be based on the points assigned in the criteria to the extent practical. A variation of five percent is allowed, provided that this does not distort the weightings assigned by the Standards Specification.

2.2. Skill standard Specification

Section	Relative Importance (%)
1 Work organization and management	5

The Individual need to know and understand:

- The principles and parameters of integrated automated production
- Their specific roles within integrated automated production
- principles, applications, accountabilities and techniques for project
- Principles and application of safe work practices
- the purpose, use, care and maintenance of equipment, facilities and
- principles and methods for organizing, controlling and managing work and its outcomes
- their personal strengths and limitations relative to the roles, projects and tasks assigned

The Individual shall be able to:

- set up and maintain a safe, clean and efficient work area
- maintain an appropriate state of preparation and readiness to receive, schedule and act on requests and assignments efficiently, effectively and safely
- order, select, use and care for all equipment, facilities and materials in accordance with manufacturers' instructions and accepted good practice
- conduct self and all operations with care and consideration for other personnel, cost efficiency and the environment
- monitor progress, modifying or changing plans or approaches through a rational process, within their personal authority
- complete assignments or tasks, and restore the work area to its state of readiness for future use
- reflect on and review their personal performance, as part of continuing professional development.

2	Communication and interpersonal skills	5

The individual needs to know and understand:

- The importance of building and maintaining customer confidence
- Roles and responsibilities of relevant colleagues
- The value of building and maintaining productive working relationships
- The importance of establishing and maintaining industry-accepted attitudes
- Interpersonal skills for effective teamwork

Section	Relative Importance (%)
• The importance of quickly resolving misunderstandings and conflicts • Human factors related to work environment and standards	
The Individuals should be able to: • Actively contribute to the team, showing concern and consideration for the welfare of others and the performance of the team • Conduct investigative discussions, such as resolving technical issues • Periodically inform/update colleagues on planned maintenance procedures • Negotiate schedules to minimize negative impact on work/productivity levels • Identify and respond to other support organizations such as logistics suppliers and engineering management	
3. Design, assembly and commissioning	**20**
The individual needs to know and understand: • principles and applications for the hardware and peripherals • •practical applications of engineering science and technology to the design and production of goods and services virtually and really • principles and directions for integrating local/artificial intelligence with wider communication capacities • principles and applications for the • design • assembly • connectivity and commissioning of hardware and peripherals to meet the requirements of the Internet of Things • Software 3D modeling technology • Principles and methods for integrating self-made subsystems and components • Principles and applications of data collection, storage, networking and use	
The individual shall be able to: • read and interpret instructions, using questioning techniques and research to check, verify and prepare • test and implement according to design solutions • assemble machines and equipment Select and apply sensor technology, communication technology and related equipment to realize motion control and network control • System debugging	

Section	Relative Importance (%)
4. **programming and debugging**	30

The Individual need to know and understand:

- PLC and HMI working principle
- Structure and function of industrial controllers
- Virtual commissioning of electromechanical concepts
- Industrial network
- Virtual network
- Digital twin technology
- Data type application
- Principle of motion control
- Principle of sensor works

The individual shall be able to:

- PLC programming and debugging with computer
- On-site programming and debugging according to the control requirements of the electromechanical system
- Quickly design solutions according to customer needs
- Set up virtual network connections
- Make HMI configuration screen
- Create a digital twin of the electromechanical concept
- Application of the sensors.

5 **Software design and implementation**	10

The Individual need to know and understand:

- Mathematics and Applications
- Computer Skills
- Computer hardware and software and applications
- Code specifications, style guides, user interface design, standards required to manage directories and files
- Principles and applications of human-machine communication

The individual shall be able to:

- write, analyze, review, and rewrite programs
- correct errors by making appropriate changes and rechecking that the desired results are produced
- perform or direct revision, repair, or expansion of existing programs，to increase operating efficiency or adapt to new

Section	Relative Importance (%)

requirements

- Understand a specific job，such as storing or retrieving data, or controlling other equipment
- conduct trial runs of programs applications to ensure the program is correct
- prepare detailed workflow charts and diagrams that describe input, output, and logical operation, and convert them into a series of instructions coded in a computer language
- compile and write documentation of program development and subsequent revisions, using protocols to ensure that others can understand the programs

6. Networking and Cyber Security 10

The individual needs to know and understand:

- principles for the design and execution of disaster recovery plans
- development environment software
- network protocols and topology
- network monitoring software

The individual shall be able to:

- design and implement network protocols and topologies
- perform risk assessments and conduct tests of data processing systems to ensure safe functioning of data processing and security measure
- modify computer security files to incorporate new software, correct errors, or change individual access status
- monitor the use of data files and regulate access to safeguard information
- train users and promote security awareness to ensure system security
- improve server and network efficiency

7. Testing, maintenance, and fault finding 20

The individual needs to know and understand:

- principles and applications of smart maintenance, based on data, to enable condition monitoring
- data analysis and correlation
- predictive maintenance
- the use of augmented reality and other emerging technologies and tools
- operational parameters/process data

Section	Relative Importance (%)
• the use of constraints and variables, restrictions, alternatives, conflicting objectives, and numerical parameters for conceptualizing and defining problems • principles and methodologies for designing alternatives and making decisions and recommendations • the purposes and nature of maintenance records	
The individual shall be able to: • identify the parts of the production system to which to apply smart • maintenance • establish the parameters for the parts' operation • use the access tools at the appropriate data points, or on a mobile • basis • monitor the condition of each part, using augmented reality or other tools as helpful • discuss and check findings with relevant personnel • undertake preventive or predictive maintenance by reviewing alternative courses of action and scheduling or recommending the optimal measure(s) • use the available technology and measures to effect maintenance with least disruption to production.	
Total	**100**

3. Marking Scheme

3.1. Marking Method

The scoring method of this competition is based on measurement points, and several scoring groups are set up according to the tasks, and each group is composed of 3 or more judges. All judges in each group discuss together, and finally give only one score after reaching an agreement on the actual score of the competitors in this item. If a competitor cheats or violates rules during the competition, the referee will deal with according to the competitor's violation. In serious cases, the score will be cancelled.

3.2. Marking Rule

1.The Competitor with the highest total scores will be ranked first;

2. For Competitors with the same total scores, they will be ranked in order of score for

Module E, Module D, Module C, Module B and Module A.

If a ranking cannot be made according to the above two rules, the Competitors will be ranked according to the time they spend on the Skill Competition, and the Competitor who spends less time wins.

3.3. Assessment Terms

During the competition design process, the standard and assessment method chose is determined by
assessment plan and Test Project.

The assessment terms contain but not limited to:

- The integrity and specification degree of the working process
- The precision of the parameter adjustment for device motion and status
- If the fastening bolt is accord with the standard torque's requirement
- The process, integration, and correction condition for the parts assembly
- Troubleshoot of the defects of equipment and components
- The result of fault repair
- The personal protection condition

4. Test project

4.1. General notes

Whether it is a single entity, or a series of stand-alone or connected modules, the Test Project will enable the assessment of the skills in each section of the Skill Specification.

The purpose of the Test Project is to provide full, balanced and authentic opportunities for assessment and marking across the Standards Specification, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme and Standards Specification will be a key indicator of quality, as will be its relationship with actual work performance.

The Test Project will not cover areas outside the Standards Specification or affect the balance of marks within the Standards Specification.

The Test Project will enable knowledge and understanding to be assessed solely through their applications within practical work.

4.2. Test project format/framework

The test project is five separate modules:

- Module A: Hardware Assembly and Commissioning
- Module B: PLC and HMI programming
- Module C: Single Station Mechanism Simulation
- Module D: Networking and WEB Application Development
- Module E: Industry 4.0 system debugging

4.3. Time allocation and scoring weight of test projects

Module	Time（min）	Score（%）
Module A: Hardware Assembly and Commissioning	90	10
Module B: PLC and HMI programming	120	15
Module C: Single Station Mechanism Simulation	120	20
Module D: Networking and WEB Application Development	120	20
Module E: Industry 4.0 system debugging	150	30
Professionalism		5
Total	600	100

4.4. Contents and requirements of each module work

The content of the competition covers sensor detection technology, motor drive technology, RFID technology, replacement and installation of mechanical components, system maintenance and fault detection technology, MES technology and application, IT technology

and information security, etc., and comprehensively examine the maintenance of the competitor's Industry 4.0 technology work ability.

Module No.	Module Name	Scope of work
A	Hardware Assembly and Commissioning	1. Analysis of design requirements 2. Mechanical assembly 3. Electrical wiring 3. Modbus RTU communication configuration 4. HMI screen configuration
B	PLC and HMI programming	1. Sensor signal adjustment 2. Step motion configuration 3. Servo motion configuration 4. HMI screen configuration 5. PLC programming
C	Single Station Mechanism Simulation	1. HMI screen design and configuration 2. PLC programming 3. Communication network construction 4. Mechanical and electrical concept design 5. Signal Mapping 6. Virtual debugging
D	Networking and developing WEB applications	1. Gateway configuration 2. IP settings 3. Network formation 4. Software development 5. Kanban interface construction
E	Integrate commissioning of Industry 4.0 Systems	1. Overall signal processing 2. Data interaction between PLCs 3. Data interaction between PLC and MES 4. Debugging of the overall process

4.5. Test project announce

The test project will be announced through the website: http://en.brskills.com/event/BRICSSkillsCompetition/2022-07-14/268.html

4.6. Test project change

Before the official competition, the test projects will be changed by 30%.

5. Skill Management and Communication

5.1. Expert team

The skill expert group is composed of a chief skill expert and experts selected from various countries, jointly responsible for further revision of the technical documents and daily skill management of the remote finals of this competition.

5.2. Discussion Forum

For questions about software and hardware preparation, test environment deployment, etc. before the competition, participants can enter the forum or communication group in the Industry 4.0 technical training competition platform for feedback.

The training exchanges, pre-competition, in-competition and post-competition exchanges will also be carried out through the forum or communication group.

6. Safety Requirements

Refer to the following detailed documentations.

7. Materials and Equipment

7.1. List of infrastructure

The infrastructure list details all the equipment and facilities that the participants need to prepare, see "2022 BRICS Skills Competition-Industry 4.0 Technology-Infrastructure List”

The competitor bring their own Practical tools, the following is recommended tools list

Allen key	7 piece set
adjustable wrench	small
Needle nose pliers	160mm

wire stripper	
Crimping Tool	
Diagonal pliers	160mm
Phillips screwdriver	3×75mm
Flat screwdriver	3×75mm
Steel ruler	20cm
Electrical tape	
marker pen	
Multi-meter	digital

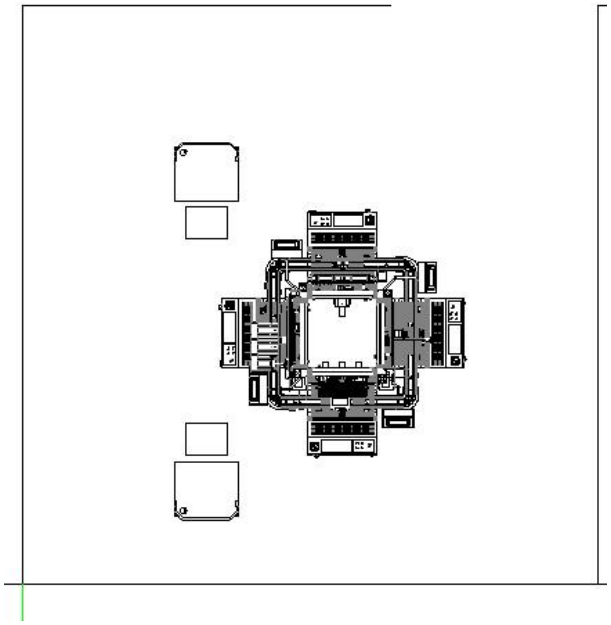
7.2 Proposed site and workstation layout

7.2.1 Exam layout requirements

1. Competition workstations: Each workstation covers an area of about 4.5M in length and 4.3M in width, marked with the workstation number, and equipped with 1 set of competition platform, 2 sets of computer tables and chairs, and laptop (the competitor bring their own).

2. Each station in the field is provided with 220V single-phase three-wire AC power supply with independent control and leakage protection device, air source with pressure of 0.6-0.8MPa. The computer power supply is supplied separately, and the power supply and air supply system have necessary safety protection measures.

3. The reference site layout is shown in the figure



7.2.2. competition layout

The size of the site is about 63 meters long and 25 meters wide