

Skill 04: Mechatronics Skill Challenge supported by WorldSkills and FESTO

Referenced to the WorldSkills Technical Description

Special Content for Remote Hybrid Skill Challenge

FESTO

Global Industry Partner of WorldSkills International



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1 Introduction

1.1 Objective of the Online Skill Challenge

2021 is the year of innovation for WorldSkills

Opportunity to develop new possibilities that allows Competitors and trainers/Experts at a national and international level capacity building, specialist training, and skill challenges

Trial and use of online tools, videoconferences, and other innovations that may enhance resources available and expand the work and movement of WorldSkills post pandemic

We need to keep Experts and Competitors engaged throughout 2021

Friendly games / Challenges, that works with the state of the art technology

Development tests for remote examinations

In the Pilot Mechatronic Skill Challenge there isn't any selection process. All Teams are working in each Module A – D.

At the end of the 4 Modules there will be a celebration of 1, 2, 3, Team place and a certificate for all Competitors.

1.2 Name and description of the skill challenge

1.2.1 The name of the skill challenge is

Mechatronics

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

Mechatronics combines skills in mechanics, pneumatics, hydraulics, electrics, electronics, computer technology, production digitalization technology (industrial IoT: RFID, NFC, wireless communication, PLC web-server, Cyber Security, Vision Systems, Augmented reality, etc), robotics and systems development. The computer technology element covers the programming of PLC's, robots and other handling systems and information technology applications, programmable machine control systems, and technology which enable communication between machines, equipment, and people.

Mechatronics technicians design, build, commission, maintain, repair, and adjust automated industrial equipment, and also program equipment control systems and human machine interfaces (HMI). They are also able to handle fluids in the field of industrial applications. Outstanding mechatronics technicians are able to meet a variety of needs within industry. They carry out mechanical maintenance and equipment building. They also deal with equipment for information gathering, components (sensors), and regulating units.

The mechatronics Technician abide by safety procedures and standards for industrial contexts, mostly where machinery is involved. They also know the importance of safety device and can install it.

Industrial applications include automated production and process lines that include assembly, packaging, filling, labelling, and testing, as well as automated distribution and logistics systems.

1.2.3 Number of Competitors

Mechatronics is a team skill with two Competitors per team.

Mechatronics online skill challenge can be realized by one competitor or two competitors (preferred also for the Online Skill Challenge) depending of the level the national structure or selection process.

Every Expert and Competitor must know and understand official Mechatronics Technical Description at WorldSkills Competition.

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

1.3 The relevance and significance of this document

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

1.4 Associated documents

Since this Rules and Technical Description contains only skill-specific information it must be used in association with the following:

- WSI – Technical Description Mechatronics
- WSI – Competition Rules
- WSI – WorldSkills Occupational Standards framework
- WSI – WorldSkills Assessment Strategy
- WSI online resources as indicated in this document
- WorldSkills Health, Safety, and Environment Policy and Regulations.

As far it is relevant also for an Online Skill Challenge!

2 The WorldSkills Occupational Standards (WSOS)

See: WSI – Technical Description Mechatronics

3 The Assessment Strategy and Specification

3.1 General guidance

Assessment is governed by the WorldSkills Assessment Strategy. The Strategy establishes the principles and techniques to which WorldSkills assessment and marking must conform.

Expert assessment practice lies at the heart of the WorldSkills Competition. For this reason, it is the subject of continuing professional development and scrutiny. The growth of expertise in assessment will inform the future use and direction of the main assessment instruments used by the Skill Challenge: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the WorldSkills Challenge falls into two broad types: measurement and judgement. For both types of assessment, the use of explicit benchmarks against which to assess each Aspect is essential to guarantee quality. In a WorldSkills Challenge it could be possible that only some of the total WSSS can be assessed. It depends of the Level of the Skill Challenge

As far as possible the Marking Scheme must follow the weightings within the Standards. The Test Project is the assessment vehicle for the skill challenge, and therefore also follows as far as possible the Standards. The CIS enables the timely and accurate recording of marks; its capacity for scrutiny, support, and feedback is continuously expanding.

The Marking Scheme, in outline, will lead the process of Test Project design. After this, the Marking Scheme and Test Project will be designed, developed, and verified through an iterative process, to ensure that both together optimize their relationship with the Standards and the Assessment Strategy.

4 The Marking Scheme

See: WSI – Technical Description Mechatronics 4.1 to 4.8

4.9 Skill Challenge: Skill assessment strategy

WorldSkills is committed to continuous improvement. This particularly applies to assessment. The SMT is expected to learn from past and alternative practice and build on the validity and quality of assessment and marking.

The Competition Information System (CIS) will perform the calculations required for the allocation of time points.

The following criteria have to be added to the evaluation:

Level 1:

- Function of a Circuit Diagram in Simulation SW to a given Application
- Troubleshooting within a Circuit Diagram
- Troubleshooting within a “Digital Twin” of a Production part or process line
- Evaluation Test

Level 2:

- Function of a PLC program for a given Circuit Diagram Simulation
 - Function of a PLC program for a given production part as a “Digital Twin”
 - Design and Function of a HMI
 - Evaluation Test
- The maximum value of the time points will not exceed 20% of the total mark for the competition.

4.10 Skill assessment procedures

Assessment and marking are an intense process that depends upon skilful leadership, management, and scrutiny.

Assessment “best practices and procedures” are described the Guidelines for Assessment: Skill Mechatronics.

Each Competitor being assessed has to be present during the full assessment procedure when it is required.

4.11 Skill assessment in the online Skill Challenge

The organization of the evaluation for an Online Skill Challenge differs significantly from that of a physical Skill competition.

Therefore, here the special features:



- Assessment Online by 3 experts in a separate chat room
- Multiple cameras (1-2) for Competitors for a better evaluation

5 The Test Project

See: WSI – Technical Description Mechatronics 5.1 to 5.6

5.7 Test Project selection

The Test Project is selected on basics of the used Software for Level 1 and Level 2

Level:	1		2	
For whom?	Single or Team		Single or Team	
Task No.	A	B	C	D
Topic	FluidSIM	CIROS	FluidSIM+	CIROS+
Duration of the Task	1h		1,5h – 2h	
Main based on	 Software (SW)		 Software (SW) + Control technology	
Supported by	Software can be provided by Festo Didactic if not available		Software can be provided by Festo Didactic, Hardware have to come from School, company, Performance center, ...	
Tools	PC with FluidSIM , Festo LX	PC with CIROS , Festo LX	PC with FluidSIM , PLC, EasyPort , HMI, Festo LX , Programming Laptop	PC with CIROS , PLC, EasyPort , HMI, Festo LX , Programming Laptop
Content	Circuit Diagramm, Simulation	"Digital Twin", Simulation, Troubleshooting	Circuit Diagramm, Simulation, Programming, PLC, HMI, Network	"Digital Twin", Simulation, Programming, PLC, HMI, Network,
Assessment of	Circuit Design, Questions, Completion time, Team result	Signal allocation, Questions, Completion time, Troubleshooting, Team result	Circuit Design, Questions, PLC (+HMI) function, FluidSIM process, Completion time, Team result	Signal allocation, Questions, PLC (+HMI) function, CIROS process, Troubleshooting, Process time, Completion time, Team result
CIS, Assessment methode	Send Diagram and answers,	Send HTML file; and answers	Send Diagram and answers, present PLC function / HMI online or via video and pictures	Send HTML file, present PLC function / HMI online or via video and pictures

5.8 Test Project circulation

If applicable, the Test Project is circulated via the website as follows:

The Test Project will not be circulated

5.9 Test Project coordination (preparation for Skill Challenge)

Coordination of the Test Project will be undertaken by the Skill Competition Manager and Festo.

5.10 Test Project change

No Test Project change just before the Skill challenge

5.11 Material or manufacturer specifications

Specific material and/or manufacturer specifications required to allow the Competitor to complete the Test Project will be supplied by the Challenge Organizer. However, note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Competition. These such items may include those for fault finding modules or modules not circulated.

Challenge Level 1:

- FluidSIM (Supplier Festo Didactic)
- CIROS (Supplier Festo Didactic)

Challenge Level 2:

- FluidSIM (Supplier Festo Didactic)
- CIROS (Supplier Festo Didactic)
- EasyPort (Supplier Festo Didactic)

5.12 Future of Test Projects

Depends on the available Equipment and Difficulty level additional Levels and different Tasks could take place to cover the full occupational Standards.

Skill management and communication

5.13 Discussion Forum

Prior to the Skill Challenge, all discussion, communication, collaboration, and decision making regarding the skill Challenge must take place on the skill specific Discussion Forum (<http://forums.worldskills.org>). Skill Challenge related decisions and communication are only valid if they take place on the forum. The Chief Expert (or an Expert nominated by the Chief Expert) will be the moderator for this Forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

5.14 Competitor information

For the first pilot online Mechatronics Skill Challenge the information will be placed in the Forum and by this document.

This information includes for the Skill Challenge:

- Competition Rules
- Technical Descriptions (Skill Challenge)
- Mark Summary Form (where applicable)
- Test Projects (where applicable)
- Infrastructure List (not applicable for the Skill Challenge)
- WorldSkills Health, Safety, and Environment Policy and Regulations and from the origin of the Competitors.
- Other Competition-related information

5.15 Test Projects [and Marking Schemes]

Not applicable for Online Skill Challenge

5.16 Day-to-day management

The day-to-day management of the skill during the Skill Challenge is defined in the Skill Management Plan that is created by the Skill Management Team led by the Skill Competition Manager. The Skill Management Team comprises the Skill Competition Manager, Chief Expert, and Deputy Chief Expert. The Skill Management Plan is progressively developed prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan will be available via the Forum

5.17 General best practice procedures

General best practice procedures clearly delineate the difference between what is a best practice procedure and skill-specific rules (section 9). General best practice procedures are those where Experts and Competitors CANNOT be held accountable as a breach to the Competition Rules or skill-specific rules which would have a penalty applied as part of the Issue and Dispute Resolution procedure including the Code of Ethics and Conduct Penalty System. In some cases, general best practice procedures for Competitors may be reflected in the Marking Scheme.

6 Skill-specific safety requirements

Refer to WorldSkills Health, Safety, and Environment Policy and Regulations for Host country or region regulations.

7 Materials and equipment

7.7 Infrastructure List

The Infrastructure List details all equipment, materials, and facilities provided by the Skill Challenge Organizer.

The Infrastructure List will be provided via the Forum

The Infrastructure List specifies the items and quantities requested by the Skill Management Team for the next Skill Challenge. The Skill Challenge Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Note that in some cases details of specific materials and/or manufacturer specifications may remain secret and will not be released prior to the Skill Challenge. These such items may include those for fault finding modules or modules not circulated.

At each Skill Challenge, the Skill Management Team must review and update the Infrastructure List in preparation for the next Skill Challenge


The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.

7.8 Competitors toolbox


Not applicable for an Online Skill Challenge

7.9 Materials, equipment, and tools supplied by Competitors

Skill Challenge Level 1

Description	Quantity	Photo
<p>PC / Laptop with Webcam</p> <p>System requirements:</p> <ul style="list-style-type: none"> • Intel Core i5 (7. Generation or equivalent) • GB, 200 GB SSD (or better) • Windows 10 1709 64-Bit or later release version • Intel HD 530 or better for showing small models like MPS Robot Station • NVIDIA GeForce GTX 1070 or better for showing large models and for using the included Virtual Reality feature. • CIROS® recommends and tests using HTC VIVE • CIROS® uses OpenVR. To run Ciros in Virtual Reality a free account at Steam is required. 	1	
Monitor, Mouse,	1	
Additional external Webcam (1)		
Internet access	1	
FluidSim P	1	
CIROS Education	1	

Skill Challenge Level 2

Description	Quantity	Photo
<p>PC / Laptop with Wabcam</p> <p>System requirements:</p> <ul style="list-style-type: none"> • Intel Core i5 (7. Generation or equivalent) • GB, 200 GB SSD (or better) • Windows 10 1709 64-Bit or later release version • Intel HD 530 or better for showing small-models like MPS Robot Station • NVIDIA GeForce GTX 1070 or better for showing large models and for using the included Virtual Reality feature. • CIROS® recommends and tests using HTC VIVE • CIROS® uses OpenVR. To run Ciros in Virtual Reality a free account at Steam is required. 	<p>2</p>	
<p>Monitor, Mouse,</p>	<p>2</p>	
<p>Competitors must bring one PLC</p> <p>The PLC must have at least 16 digital inputs and 16 digital outputs. The I/O cables specification will be announced by the Chief Expert in the forum before the competition</p>	<p>1</p>	
<p>Competitors must bring one HMI device.</p> <p>Screen size approx. 5-7" and with at least 16 colour</p>	<p>1</p>	
<p>Competitors must bring one PC-Interface USB/24Volt (EasyPort from Festo Didactic).</p>	<p>1</p>	
<p>SysLink cables (reference Festo Didactic) are used to connect the PLC to the digital interface of the EasyPort (PC Interface USB / 24V). The I/O cables specification will be announced by the Chief Expert in the forum before the competition</p>	<p>2</p>	

Description	Quantity	Photo
The PLC need a wired network/bus system for communication between PLC and HMI device. Therefore, Competitors have to bring with them network/bus system components		
Competitors must supply computers, PLC and HMI device programming software		
Additional external Webcam (1)	1	
FluidSim P	1	
CIROS Education	1	

7.10 Materials, equipment, and tools supplied by Experts

- Experts need PC/Laptop with internet access.
- When the Experts have to bring something with them, then this will be announced in the Discussion Forum at least one month before the competition.

7.11 Materials and equipment prohibited in the skill area

Not applicable for an Online Skill Challenge

7.12 Proposed workshop and workstation layouts

Example workshop layout

See also [Materials, equipment, and tools supplied by Competitors](#)



8 Skill-specific rules

Skill-specific rules for the Skill Challenge do provide specific details and clarity in areas that may vary from skill competition to skill competition. This includes but is not limited to personal IT equipment, data storage devices, Internet access, procedures and workflow, and documentation management and distribution. As far as possible for the Skill Challenge the breaches of these rules will be solved according to the Issue and Dispute Resolution procedure including the Code of Ethics

Important: Participation in the Mechatronics Skill Challenge implies knowledge and compliance with these regulations below.

Topic/task	skill-specific rule
<p>General rules and regulations for the Online Skill Challenge</p>	<p>Each event must be completed within a specific time and objectives, which will allow to determine the allocation of points and its position.</p> <p>Each test developed has as evaluation parameters the test score and the test resolution time.</p> <p>The platform to be used will be automatically closed each time the maximum time allocated for the process of a task expires.</p> <p>If during the process of a task any inconvenience occurs, this must be immediately communicated to the corresponding jury in charge. So then and according to the complexity of the problem, the jury will study and determine the alternative solution in accordance with the procedures established for the Skill challenge.</p> <p>Do not close your browser window, if there is any problem with the connectivity to the task platform, please inform the assigned Support representative immediately.</p> <p>the allocation of points and its position is managed by CIS</p> <p>Each participating team will use the Participant Group Code to validate their entry to the evaluation platform and is responsible for entering it correctly for the processing of their responses.</p> <p>Each participating team will use the Participant Group Code to validate their entry to the evaluation platform and is responsible for entering it correctly for the processing of their responses.</p> <p>If the Skill Challenge starts as a team Challenge, which is preferred, it will be held as a Team Challenge in all Levels</p> <p><u>Only applicable if the Skill Challenge goes via different countries and a selection process is to implement:</u></p> <p>the allocation of points and its position in the table of finalists decide to proceed to the next stage.</p> <p>Only the first 3 places per country will continue to compete for the International Regional stage.</p> <p>Each event has been designed with the help of an organizing committee. Three (3) representatives of the organizing committee make up the qualifying jury, each one in charge of one of the tests.</p>

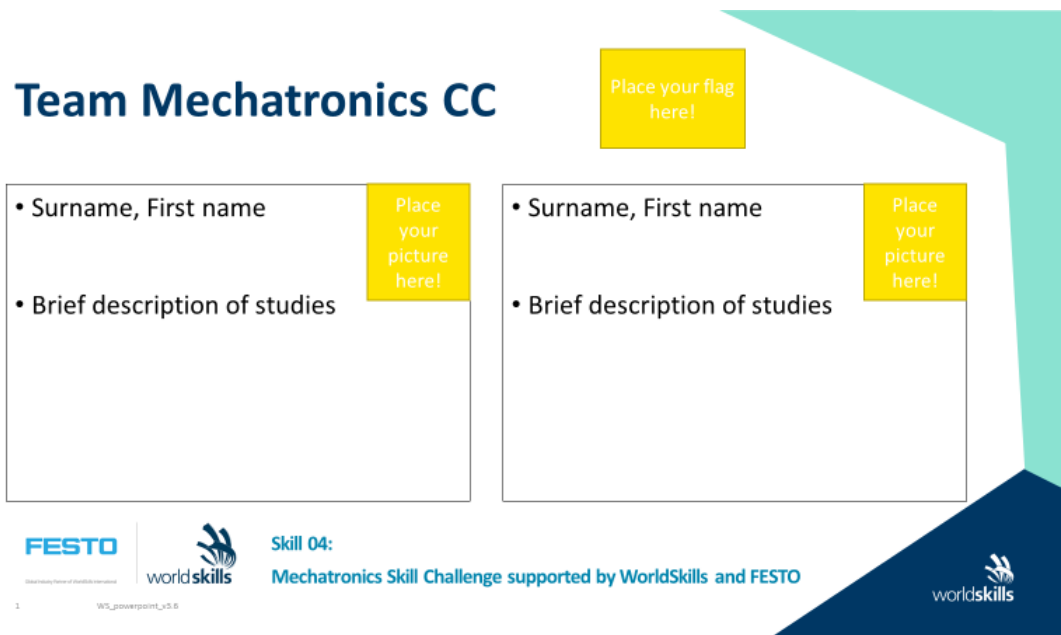
Topic/task	skill-specific rule
About rating:	<p>In the case of two or more participants with the same score, a second validation will be carried out, ordering the scores with the same value according to the delivery time. For this, the accumulated times in the three tests are added, obtaining a total time. You will be in a better position for the score associated with a shorter total time.</p>
About IT resources:	<p>Festo will assign access licenses to specialized software FluidSIM-P/E, which will have a sufficient duration and validity for the use during of the skill challenge process.</p> <p>Festo will assign access licenses to specialized software CIROS, which will have a sufficient duration and validity for the use during of the skill challenge process.</p> <p>Festo will provide access to the FESTO-LX platform by email identification and participant ID. This will be validity for the use during of the challenge process.</p> <p>We recommend the use of the Firefox - or Edge - browser for the best performance of the Task and the use of the software.</p> <p>Festo will send an access link to a Meeting platform like: GoToMeeting / MS-Teams / Meets / ZOOM, that will be the valid means of communication for receiving inquiries and answering answers about the Task. Participants must remain with webcams on and microphones off.</p> <p>Festo will have a Streaming tool for publishing the Tasks in real time.</p> <p>As a general rule, the use of software that is expressly specified by Festo is only permitted.</p> <p>Participants will be able to use spreadsheets, word processor, and Google search engine. But access to email and social networks will be prohibited during the tests.</p>
Use of technology – personal photo and video taking devices	<ul style="list-style-type: none"> • In Level 2 it is allowed to use a mobile phone to take pictures about the HMI Screen and send the picture to the judge for evaluation
Drawings, recording information	<ul style="list-style-type: none"> • The task will be processed jointly by the two competitors who are members of a team, but the answers have to be recorded only by one of them. Duplication is a reason for disqualification. • The participant submits his result visualized in HTML5, as a video record, PDF or CT-file
Equipment failure	<ul style="list-style-type: none"> • Participants will be responsible for the licenses used as well as ensuring their proper functioning on the PC / laptop they use. • The competitors are responsible for the change of equipment, laptop, or any other inconvenience that may arise with this type of resource.

9 Visitor and media engagement

Following is a list of possible ways to maximize visitor and media engagement:

The following ideas may be considered to maximize visitor and media engagement and is the responsibility of the Competition Organizer:

- some web cams could be dispatched on the Competition area and show details of the task to the public and on a website or social Media channels
- Test Project descriptions can provided in a short form;
- Enhanced understanding of Competitor activity;
- Reporting of Competition status;
- Link to a video(s), which show how Mechatronics technicians work, what they do in their everyday work, how the machines work (which they build, maintain and repair), and what they do and learn in schools;
- Competitor profiles - For each Competitor team provide a sticker with the national flag, the name of the Competitor and a brief description of their studies (see below, CC = Country Code);



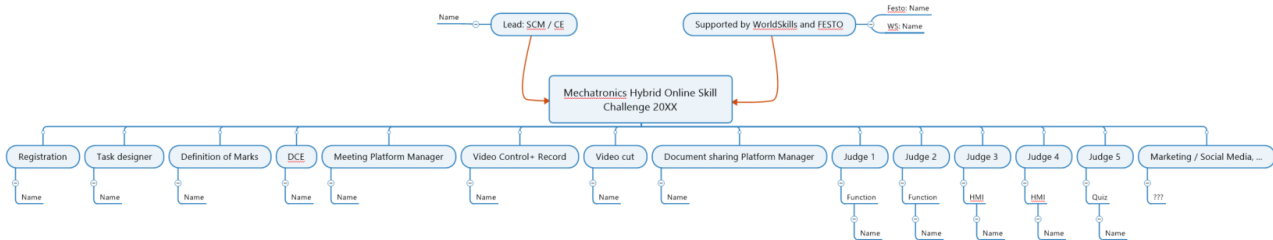
10 Sustainability

This Skill Challenge will focus on the sustainable practices below:

- Transmission of the Test Project digitally to the Competitor's computer.
- Using existing HW and SW that is also usable for the ordinary TVET

11 Results after the 1st Mechatronic Skill Challenge 2021

11.7 Organigram Skill Management



11.8 What we did!

Online Skill Challenge Mechatronics

What we did!

WSOS / Job Competencies and topics for the Skill Challenge

Best practice (WSOS):

- Work organization and management
 - Workpreparation (1,1,2)
 - Communication and interpersonal skills
 - Teamwork (1,1,2)
- Developing mechatronics systems
 - Assembling, Wiring, Tubing
 - Modul and System integration
 - Assembling and commissioning with PLC
 - IO Link, Analogue value processing
- Using industrial computers
 - Commissioning with PLC/HMI based (1,2)
 - Software programming
 - Network communication (PLC/HMI based) (1,2)
 - Working with Simulation Software (1,1,2)
- Circuit schematics
 - Design and reading Circuit Diagrams (1)
 - Analysis, commissioning and maintenance
 - Maintenance, Optimization
 - Troubleshooting (1)

Selected Competencies to evaluate during the Skill Challenge

Task A: (60 Min)
Circuit Diagramm, Simulation, Troubleshooting, also by Knowledge questionnaire
Tools: FluidSim, Festo-LX, MS-Teams

Task D: (90 Min)
"Digital Twin", Simulation, Programming, PLC, HMI, Network, Troubleshooting, Knowledge questionnaire
Tools: CIROS, Festo-LX, MS-Teams, +



Evaluation Level 1

Evaluation Level 2



Online Skill Challenge Mechatronics

Used Tools:

Communication

Festo LX

MS-Teams and Live Production controller

Available / Provided Software!

FluidSIM

CIROS „Digital Twin“

PLC Equipment at Competitor's side!



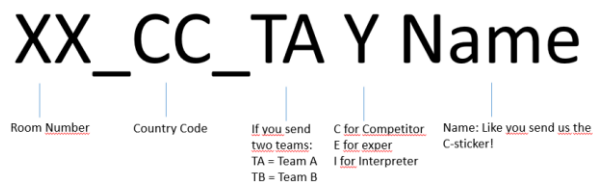
11.9 Experiences from the Skill Challenge:

Naming and delivery of documents at the end of the task.

- Zip File with pictures (*.jpg) and videos (*.mp4):
File_1 = Operation, File_2 = Production, File_3 = Station at end of the task
- Zip file name: CC+Team number+file number (CC= Country code)
- 1 per team
- Subject in E-Mail: XX_CC_TA (XX=Room_CC_Team A, B or C)
- Send via www.WeTransfer.com

Online Room – Managing

- Insert your **name** according to the following scheme



- For ext. Camera only: XX_CC_TA Camera
- If a question arises during the task, only the expert switches back to the main room.
- Participants remain in their room until the end of the task!
- Expert post Questions in the main Meeting

Expert writes in the chat: "Room xy needs help with ... in the Room.". Expert goes back to his room. Someone from the Organization will come and answer the question
Expert writes in the chat: "Room xy: "Question". Expert wait for the answer