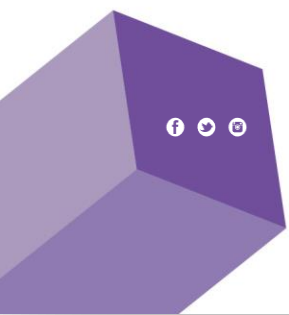
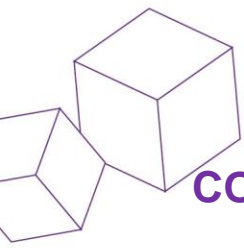


TEST PROJECT MOBILE ROBOTICS

WSA2023\_TP23 EN JUNIOR

Submitted by: James Taylor  
Member Country or Region: Canada





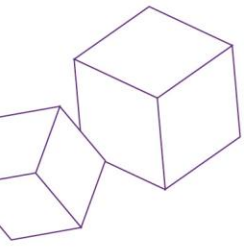
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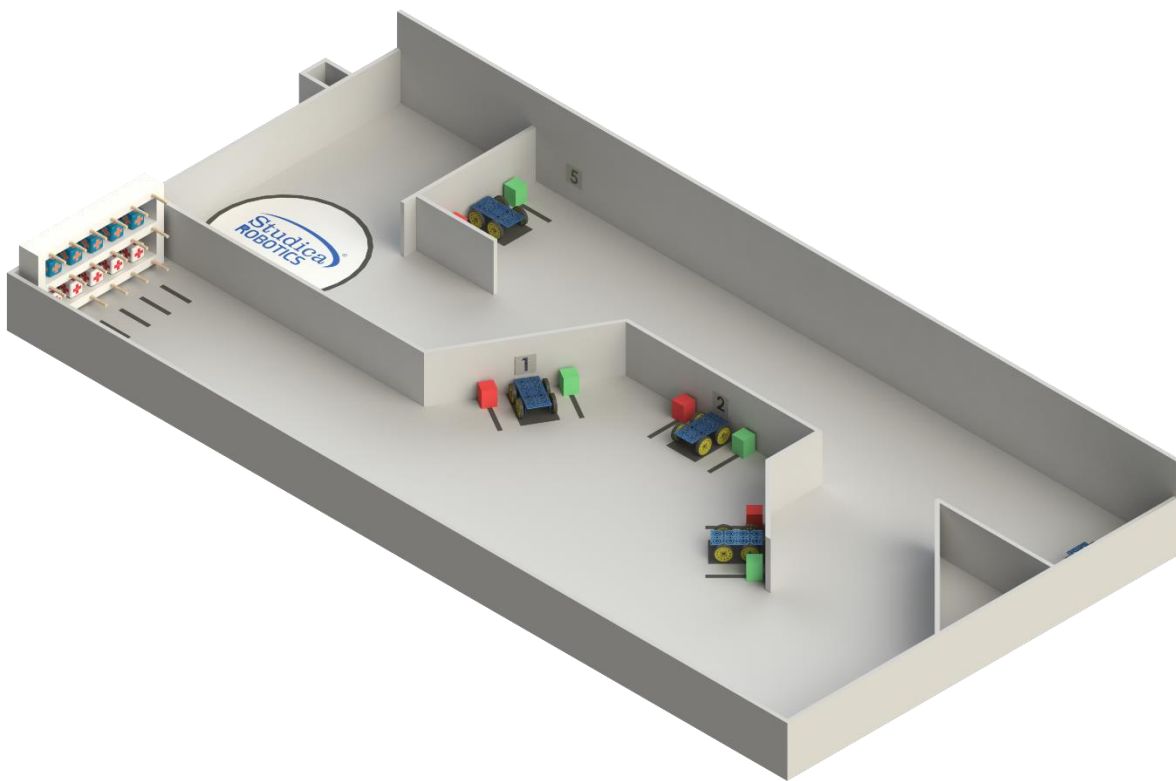
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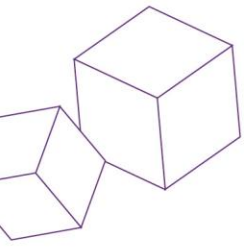




## 1. INTRODUCTION

Mobile Robots are playing an increasing role in supporting medical staff in hospital settings. Amongst other responsibilities, Mobile Robots are used to manage the distribution of essential items in a hospital environment. The WorldSkills Asia JR 2023 Mobile Robotics Test Project requires competitors to Design, Build and Operate a Mobile Robot capable of addressing ALL the performance requirements set by the Asia Hospital Network.





## 2. DESCRIPTION OF PROJECT AND TASKS

Teams of two students / competitors are required to design and build a mobile robot that will efficiently operate in a simulated hospital environment.

The robot must be built to function autonomously and with remote control. Competitors will be provided with a World Skills Mobile Robotics Junior Collection on-site. Additional components and parts allowed to be brought by competitors are listed in this document.

Competitors are expected to identify the Primary Set of Mobile Robot Performance Requirements through analysis of the information provided in this document:

1. Robots are required to Move in Autonomous and Remote-Control Mode throughout the provided performance evaluation environment, and,
2. Robots are required to Take control of the various target objects (Cubes) from different initial locations and deliver them to various destination locations in the performance environment.

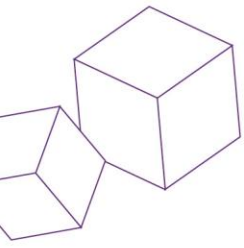
**Note:** The Primary Task Competitors must complete on C1 is the assembly of their robot in time to make it available to complete the C1 set of Evaluated Core Robot Experiences.

**Competitors are advised to bring the wiring from the robot they created during their competition preparation experiences** to Abu Dhabi. This will enable them to start their C1 Competition Robot Assembly Process with wires that are cut to the required lengths and have the necessary end of the wire connectors in place.

Competitors will be provided with their WS Asia Jr Competition Component Collection on C-1 Familiarization Day. In addition to the supplied collection, competitors can purchase in advance and bring additional Studica Robotics parts (only) to a value of up to \$250 US. Costs for these components will be checked onsite by the Studica staff. Each team must also provide a spreadsheet that shows the Part Number, Name, Quantity, Unit Cost and Total Cost of all additional Components. A team will receive 0.0 Marks for the most expensive cost and 1.0 Marks for the cheapest cost; all other teams will receive proportional marks between both.

Competitors will be allowed 3D printed parts and parts made from sheet stock as per the requirements specified in this document.





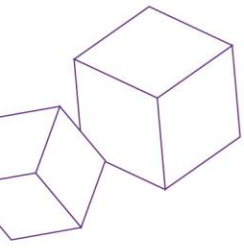
On C-1 Competitors are Allowed to examine all components in their WS Asia Jr Competition Component Collection.

On C-1 Competitors **will have some time allowed** to start the assembly of their competition robot.

Note: On Competition Day 1 Session 1, when the focus is on Individual Robot Performance Elements, the robots will need to function/complete all the Individual Evaluated Performance Elements in Autonomous Control Mode and/remote (gamepad) operated mode.

The performance environment detailed in this document will be the performance environment used on C1 Session 1 through to C3 Session 2.





## 3. INSTRUCTIONS TO THE COMPETITOR

### Competition Requirement

#### 3.1 Activities to be completed before the competition.

1. Portfolio
  2. Wiring harness's
  3. Backup image of the VMX/VMX
  4. Procurement of allowed additional components.
  5. Manufacture of all 3D printed materials/sheet stock for the robot
- 
- a. All sheet-based elements must be created using any polycarbonate material with a maximum overall sheet size of 1000mm by 1000mm by 4mm thick. These components will be inspected on-site prior to assembly on C-1.
  - b. ALL 3D-Printed elements must be created using ABS, PLA, Nylon, PETG, HIPS, ASA, or Carbon Filled Fibre with a maximum overall weight of 1.2 kg. These components will be inspected and weighed on-site prior to assembly on C-1.
  - c. The Challenge Evaluation Process will assign marks based on compliance with these restrictions.

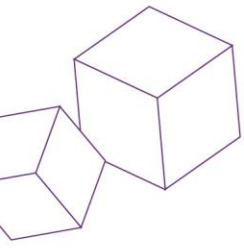
#### 3.2 Activities to be attempted during the Competition.

1. Mechanical Assembly of complete robot.
2. Electrical/electronic assembly of all individual components, less wiring harness.
3. All programming of the robot tasks.
4. Testing of Robot.
5. Core performance tasks
6. Any surprise test projects.

Each Team will develop at the event:

**One mobile robot capable of transporting the cube elements only. A robot may be on possession of a maximum of 2 cube elements at any time. Gurneys will not need to be moved or transported however they may be placed anywhere in the court area as obstacles.**

***Surprise Test Projects – the Surprise Test Projects will be released to the competitors for one hour on Familiarization Day. No notes may be taken at this time. These projects will be selected prior to the competition by the external evaluators.***



## 4. EQUIPMENT, MACHINERY, INSTALLATIONS, AND MATERIALS REQUIRED

### 4.1 Equipment provided by Competition Organizers

All equipment, tooling, and materials in the infrastructure List – see MTC WorldSkills Discussion Forum and Technical Description.

All competitors will be provided on C-2 with a Studica worldskills mobile robotics Junior collection.

All competitors will use a VMX and Titan. All other components must be Studica Robotics equipment or sensors. There is a \$250 US budget restriction on the number of components used except for 3D printed and Polycarbonate materials (rules previously defined).

The Studica Robotics Junior Collection described at: <https://www.studica.co/shop> will serve as the equipment source for competitors attempting this Test Project.

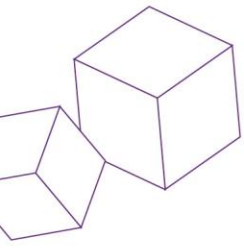
### 4.2 Equipment and material brought by competitors.

- Computer or Laptop with appropriate IDE installed. Teams may have a maximum of 2 computers in the competition space. Competitors **MUST BRING** their laptops and USB Memory Sticks into the Competition Space on Familiarization Day (C-2) and these items **MUST NOT LEAVE** the Competition Space at any time before the end of Competition Day Four.
- VMX controller with competitor image installed.
- Backup SD Card of Competitor software image
- Ethernet Cable as required.
- Wiring harness and spare wiring connections as required.
- Competitors **MAY BRING** and **USE** in the Competition Space Programme Files they have created.
- Competitors can bring a toolbox with small tools for assembly and service of their Mobile Robot System that are not on the Infrastructure List.

Examples: Screw Drivers, Socket Set, Pliers, Wire Cutter etc.

NOTE: The type of “Power Tools” competitors are allowed to have in their assigned workstations are Battery Chargers, and Battery Powered Screw Drivers.





### 4.3 Equipment and material not permitted.

Memory sticks/Digital Storage (Not specified in Section 4.2)

Electronic Organizers

Wireless communication devices including a mobile phone.

Competitors are NOT ALLOWED to access the Internet while they are in the Competition Space.

Any additional software not provided by Competition Organizers unless approved by experts.

Pre- programmed SD Cards

Purchased parts not already included as per this document.

All raw materials, components, parts, purchased items, tools. And equipment not permitted in the Technical Description and List of Materials Allowed and Not Allowed for the skill.

Teams are NOT Allowed to have Material Removal Powered Tools (Jig Saw, Drill, Grinder) or

Soldering Equipment in their Assigned Workspace.

**NOTE:** A Shared Use Safe Room and the tools required for use in the Safe Room will be provided to enable competitors to safely complete any material removal or soldering work they may need to perform on-site.

### 4.4 Additional Components Restrictions

Maintaining an equal level of access to resources is an essential requirement for maintaining an equal level of opportunity for success on the part of all Competitors.

All ready-to-use performance or related structural components must be obtained through Studica to ensure compatibility with the 2023 WorldSkills Mobile Robotics Component Collection.

Competitors can incorporate "Competitors Designed / Created Components" into their robot design based on the following restrictions:

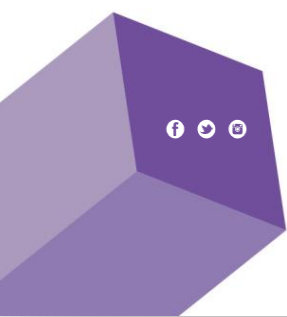
- d. All sheet-based elements must be created using any polycarbonate material with a maximum overall sheet size of 1000mm by 1000mm by 4mm thick.
- e. ALL 3D-Printed elements must be created using ABS, PLA, Nylon, PETG, HIPS, ASA, or Carbon Filled Fibre with a maximum overall weight of 1.2 kg.
- f. The Challenge Evaluation Process will assign marks based on compliance with these restrictions.

### 4.5 Other Required Components

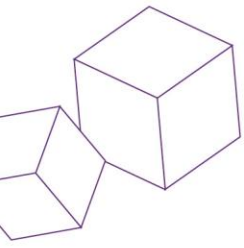
**Gurneys and Cube Elements for home country preparation (Available through Studica)**

<https://www.studica.co/>

*NOTE: Cad file available above so teams can create their own non-official version for training and local use.*

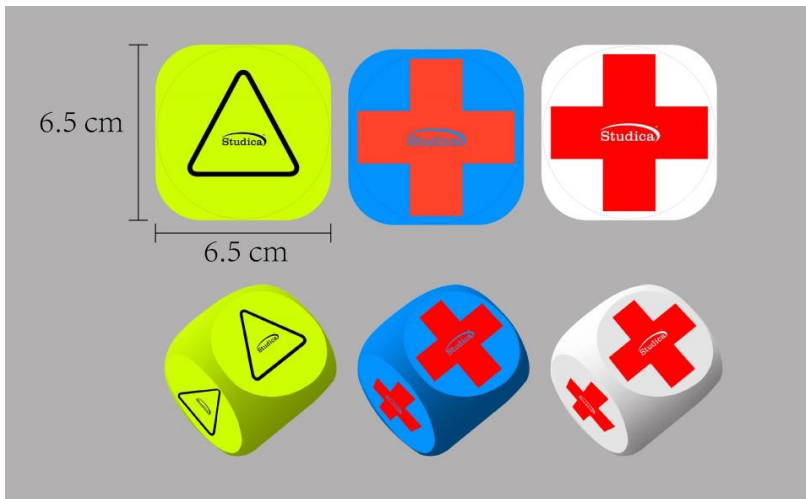






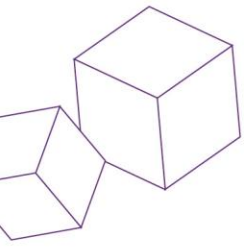
Gurney #75102		
Qty	Product	Part #
1	192mm x 96mm Flat Bracket	76066
2	L Bracket (2 pack)	76087-2
2	6mm x 140mm D-Shaft	76164
4	Bronze Bushing 6mm ID x 14mm OD	76301
4	75mm Drive Wheel - 60A, 12.5mm wide, 1/2" Inner Hex, Black	76271
1	Shaft Spacer Plastic 6mm ID x 10mm OD x 1mm L (24 pack)	76305-24
1	6mm Shaft Hub (4 pack)	76284-4
1	M3 Kep Nut (pack of 100)	76204-100
1	M3 x 10mm Socket Head Cap Screw (pack of 100)	76201-100

**Target Object Cube Sets (Available through Studica)**  
 Shanghai Challenge Elements - 15 pack

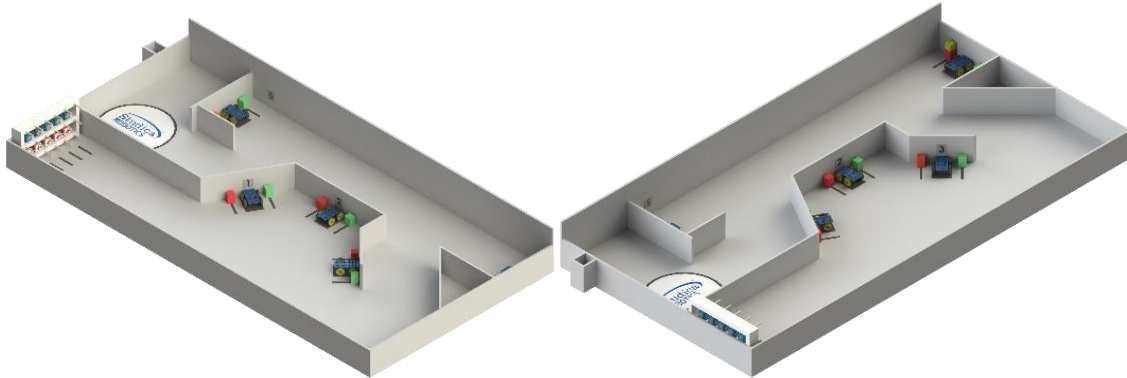


*NOTE: 65MM X 65MM Cubes can be used locally, graphics are available for download,*





## 4.6 Court Design and Layout



### Core Court

Found in the attached drawing files. The same court will be used on all days of the competition.

### Dispensary Shelving Unit

Found in the attached drawing files. For Junior competition only the lower 2 shelves will be used.

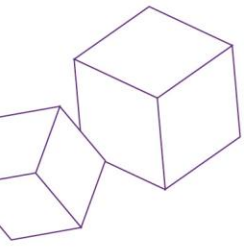
### Cube Pads and Gurney Stands

Found in the attached drawing files.

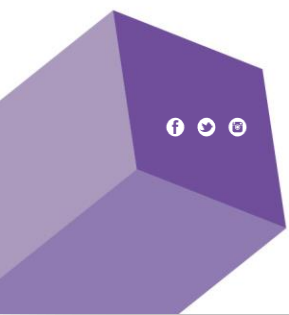
### Court Tape Lines

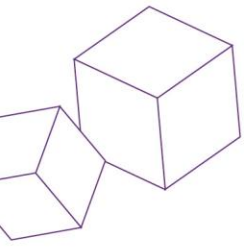
The court Tape Lines will be created using Black Tape – 19mm ( 3/4")



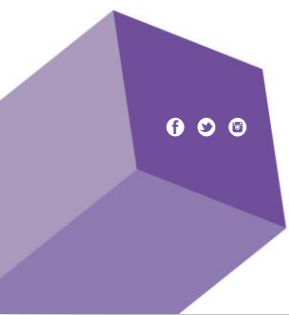


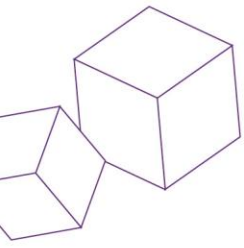
<b>Patient Room</b>	<b>1</b>
<b>Patient Room</b>	<b>2</b>
<b>Patient Room</b>	<b>3</b>





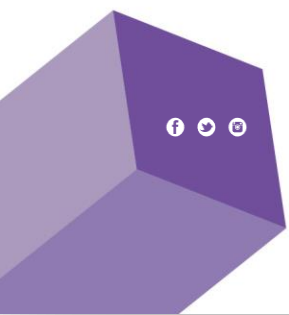
<p><b>Patient Room</b></p>	<p><b>4</b></p>
<p><b>Patient Room</b></p>	<p><b>5</b></p>

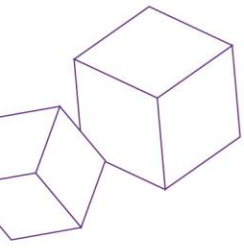




# Hazardous Material Bin

# Home Sanitation Station





## 5. MARKING SCHEME

All Competitor Assessment experiences will be conducted in compliance with the WorldSkills ASIA Computer Information System (CIS) Guidelines. The overall marking pattern is based directly on "Section 2.2 WorldSkills Junior Standards Specification". The essential details defining the categories are listed below:

A. Portfolio and Brochure	10	Marks Total
B. Robot Inspection (Design, Prototyping and Assembly)	6	Marks Total
C. Core Robot and Object Management System Evaluation	12	Marks Total
D. Test Project evaluation Run 1	18	Marks Total
E. Test Project evaluation Run 2	18	Marks Total
F. Test Project evaluation Run 3	18	Marks Total
G. Test Project evaluation Run 4	18	Marks Total

### 5.1 Portfolio and Brochure Sub Criteria A

Maximum Marks: 10 Marks

- The portfolio will be presented on Familiarization Day (C-2) and will be assessed during the Competition. All portfolios are to be produced in English.
- The portfolio is also to be presented and handed in on a USB memory stick.
- The portfolio is to be presented and handed in on a USB memory

A video will be displayed explaining to the public how the robot operates. This video will be presented in the portfolio folder on the USB stick in WMV format.

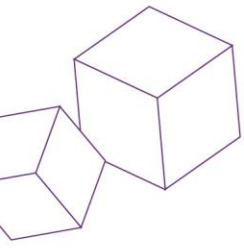
#### ***Video Section: Marks per Aspect: 5 Marks***

To Include:

1. Video time between 240 and 300 seconds

Demonstration of the basic operation of the robot:

2. Connecting and Enabling the Robot for Remote Control (Gamepad Use)
3. Moving the Robots and OMS (front, back, turns, OMS Demonstration)
4. Details of the team members (Team member's pictures, country, School, major roles on the team)
5. Quality of video (i.e., usage of additional effects, quality of shooting, quality of video editing, etc. Assessment will be by judgement process.



*Evaluation process:*

Experts will check if the video is complete and meets minimum requirements which include the captions and language used being English.

The Team should provide the video on a USB stick on Familiarization Day in the a.m.

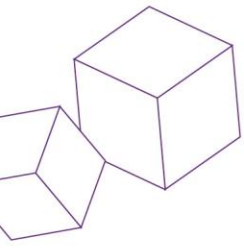
***Sale brochure Section: Marks per Aspect: 5 Marks***

Each Team will provide 3 copies if a sales brochure for their product in English. A further 2 copies will be provided in a second language of the team's choosing. All Sales brochures (in both languages) must be handed in by 10:00 am on familiarization day.

- The brochure should be designed to market the product to the general public.
- The brochure should include a minimum of 3 pictures of the robot.
- The brochure should include a minimum of four reasons/unique selling points to purchase the robot.
- The brochure should include an explanation of all functions of the robot.
- The brochure should be produced in full colour.

The brochures will be evaluated according to the judgement scale of 0 to 3. Applying scale "3" for brochures that are above industry standards, "0" scale for brochures that are below industry standards.





## 5.2 Robot Inspection (Design, Prototyping, and Assembly) Sub Criterion B

Maximum Marks: 6 Marks

Assessment will be based on the inspection of the Competitors Assembled Robot submitted on Day C1 by a panel of 3 experts. The focus is on Robot compliance with technical requirements in the following areas/items. There will be a checklist to use. (See attached)

Wiring	2
Robot Base	2
Object Management System and Structural Elements	2

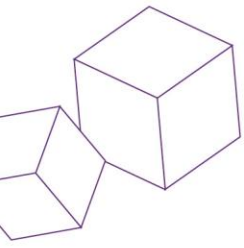
## 5.3 Core Robot and Object Management System Evaluation (Sub Criterion C)

Maximum Marks: 12 Marks

Aspect ID		Core Performance Element Evaluation
D1	Cube Management 1	The robot will be positioned in the vicinity of the Dispensary Shelves and is required to move into position and retrieve a cube from the middle shelf
D2	Cube Management 2	The robot will be positioned in the vicinity of the Dispensary Shelves and is required to move into position and retrieve a cube from the bottom shelf
D3	Cube Management 3	The robot will be positioned in the vicinity of the Dispensary Shelves and is required to move into position and deposit a cube on the middle shelf
D4	Cube Management 4	The robot will be positioned in the vicinity of the Dispensary Shelves and is required to move into position and deposit a cube on the bottom shelf
D5	Cube Management 5	The robot will be positioned in the passageway outside a Patients room, IN possession of a cube, and is required to move into the patient room and place the cube on the correct stand
D6	Cube Management 6	The robot will be positioned in a Patients Room in possession of a HazMat cube and will be required to move to the HazMat Bin and deliver the HazMat cube into the HazMat Bin
D7	Robot Movement Management 1	The robot will be positioned in front of the HazMat Bin and will be required to move onto the cleaning pad and rotate 540 degrees.
D8	Robot Movement Management 2	The robot will be positioned on the cleaning pad and will be required to move to patient room 1
D9	Robot Safety Management 1	The robot will start moving by hitting the start button on the control panel. Once the robot starts moving, the E-Stop should be pressed, and the robot should stop.
D10	Remote Management 1	The robot will be positioned on the cleaning pad and the competitor must remotely control the robot and drive it to in front of the Dispensary Shelf.
D11	Remote Management 2	The robot will be positioned in front of the Dispensary Shelf and will be required to retrieve a cube from any shelf controlled by the competitor remotely.
D12	Remote Management 3	The robot will be positioned outside a patient room in possession of a cube. The competitor will be required to drive the robot into the room and place the cube on the medicine stand.







Sub Criterion C - Core Performance Element Evaluation has a Total Value of 12 Marks. Each evaluation is worth 1 mark. While the evaluation focuses on a singular element, each of these experiences involves a small set of support steps required to complete the evaluation performance element. Core evaluation element marking is conducted when the evaluation attempt has been completed and is marked on a Complete/Incomplete Basis. No partial marks will be awarded. The three Experts involved in the marking must agree on the outcome.

Competitors will be provided with ONE evaluation experience for each of the Core Performance Aspects being marked.

#### 5.4. Test Project evaluation Run Sub Criteria D to G share the following common Marks Distribution Pattern.

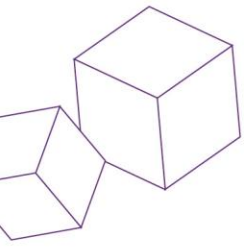
- a. Competitors will have separate Test Project Runs on competition C2 Session 1 and 2, C3 Session 1 and 2.
- b. The robot will use the same hospital layout for each day.
- c. Competitors will have one attempt to complete each of the Evaluated Test Project Runs each competition day.
- d. Evaluated Test Project Runs have a value of 18 Marks each.
- e. Evaluated Test Project Run marks are distributed over the following categories:
  - Are Target Objects in the correct locations? Note: The mark value per Target Object will vary depending on the number and type of Target Objects involved in each Evaluated Test Project Run.
  - Time Marks will be available ONLY to competitors whose robot completes all Evaluated Test Project Run elements in less than 601 seconds.
  - Time Marks will be calculated using the following formula:

Time Mark Awarded = (Fastest Team's Time / Marked Team's Time) X Total Available Time Marks

- In ALL Evaluated Test Project Runs, robots are expected to avoid contaminating clean objects (Cubes / Gurneys). For marking purposes, this means IF a robot is observed, by the three marking Experts, taking possession of a Clean Object AFTER it has been in possession of a Contaminated Cube and WITHOUT traveling to and rotating on the Sani-Pad, then the Experts will END the Evaluated Test Project Run.

Competitors will be awarded marks for all work successfully completed before the Evaluated Test Project Run was terminated.





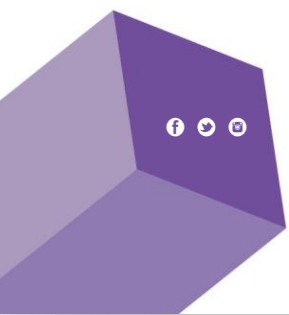
## 6. DAILY COMPETITION SCHEDULE

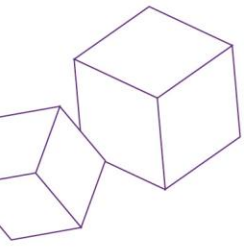
These will include a Start of the day Competitor Information/Question and Answer Session and Compatriot Expert Communication Session.

**Competition Day 1:** Competitors have the day to complete robot assembly and the Core Performance Evaluation Elements based on a completely known in advance court layout.

Competitors will be provided with ONE evaluation experience for each of the Core Performance Aspects being marked.

Competitor Information / Question and Answer Session 1	8:00am – 8:15am
Competitor and Compatriot Expert Communication Session 1	8:15am – 8:30am
Robot assembly and Testing	8:30am – 12:00 pm
Break	12:00 pm – 1:00 pm
Robot assembly and Testing	1:00 pm – 3:30 pm
Core Performance Evaluation Begins	3:30 pm





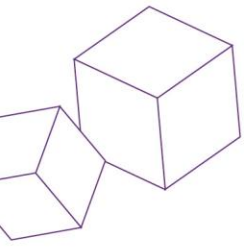
## Competition Day 2 and 3

**NOTE: All assessment experiences are with teams waiting in a common area. Competitors will not be allowed to work in their area at this time. This is to introduce the HazMat cube locations right before the assessment. Running simultaneously will prevent any advantages to a team not running at the same time.**

Competitor Information / Question and Answer Session 1	8:00am – 8:15am
Competitor and Compatriot Expert Communication Session 1	8:15am – 8:30am
Local Court Time and Task Preparation/Practice Session 1	8:30am – 11:30am
Assessment Experience Window Session 1	11:30 – 12:00 pm

**NOTE: Competitors will be assigned a 15-minute window for assessment. While this is a 15-minute window, the maximum time allocated for a complete test run is 10 minutes.**

Break	12:00 pm – 1:00 pm
Competitor Information / Question and Answer Session 2	1:00 pm – 1:15 pm
Competitor and Compatriot Expert Communication Session 2	1:15 pm – 1:30 pm
Local Court Time and Task Preparation/Practice Session 2	1:30 pm – 4:30 pm
Assessment Experience Window Session 2	4:30 pm – 5:00 pm



## 7. EXAMPLE TEST PROJECT RUN

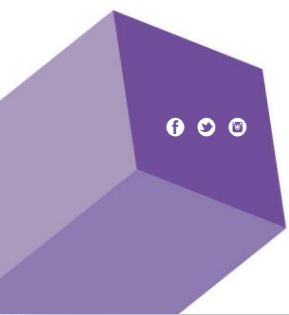
Below is an example run that competitors will receive on C2 Session 1 or C2.

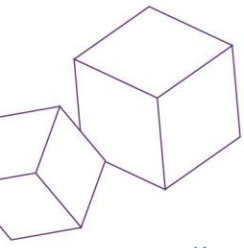
Work order known in advance.

Based upon instructions provided at the Competitor Information meeting on each day, the robot should be able to:

- a. Move from the Home Space into the Dispensary area.
- b. Retrieve the cubes from the dispensary area.
- c. There are 5 patient rooms that may require a delivery, and each has two stands. White cubes must be delivered to red stands and blue cubes to green stands).
- d. If a waste cube is detected in a room the robots must retrieve the waste cube from the patient room and deliver the cube to the appropriate receptacle in the Waste area. A robot cannot be in position of a waste cube and a medical cube at the same time.
- e. At the start of a competition run the cubes will be arranged on the dispensary stand as per the layout diagram.
- f. If a competitor interferes with the robot during any teleoperation period that run will be assigned a score of Zero (0)
- g. The test run ends when the time has expired, and competitors must stop their robot.

*The above is a sample and the exact task based upon this information will be confirmed at the daily competitor information session.*

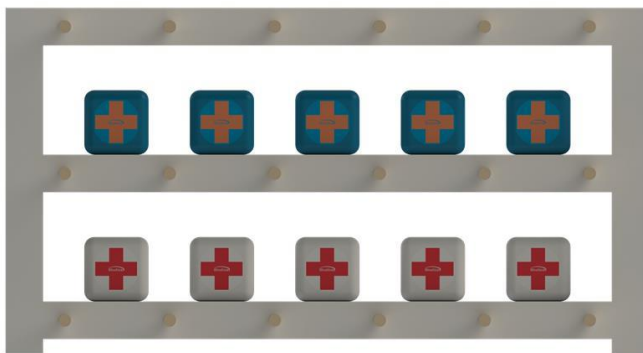




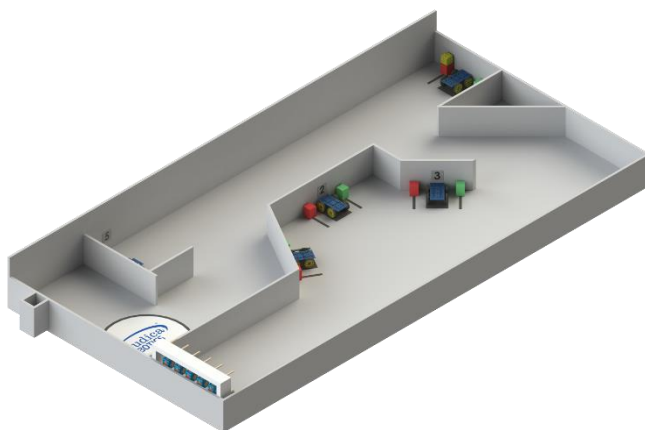
### Known In Advance Order

	R1	R2	R3	R4	R5	NS
D						
E						
L						
I						
V						
E						
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T						

### Dispensary Shelf



### Court Layout



HazMat Cube is in patient room 4.

