MOBILE ROBOTICS

Competitor Information Document

Prepared by: Bob Tone

Mobile Robotics Independent Test Project Designer

Tech On *eh!* bobtone@rogers.com

WSC2019_TP23_pre_EN

CONTENTS

1 INTRODUCTION

This document presents the Worldskills Kazan 2019 Mobile Robotics Competition Test Project.

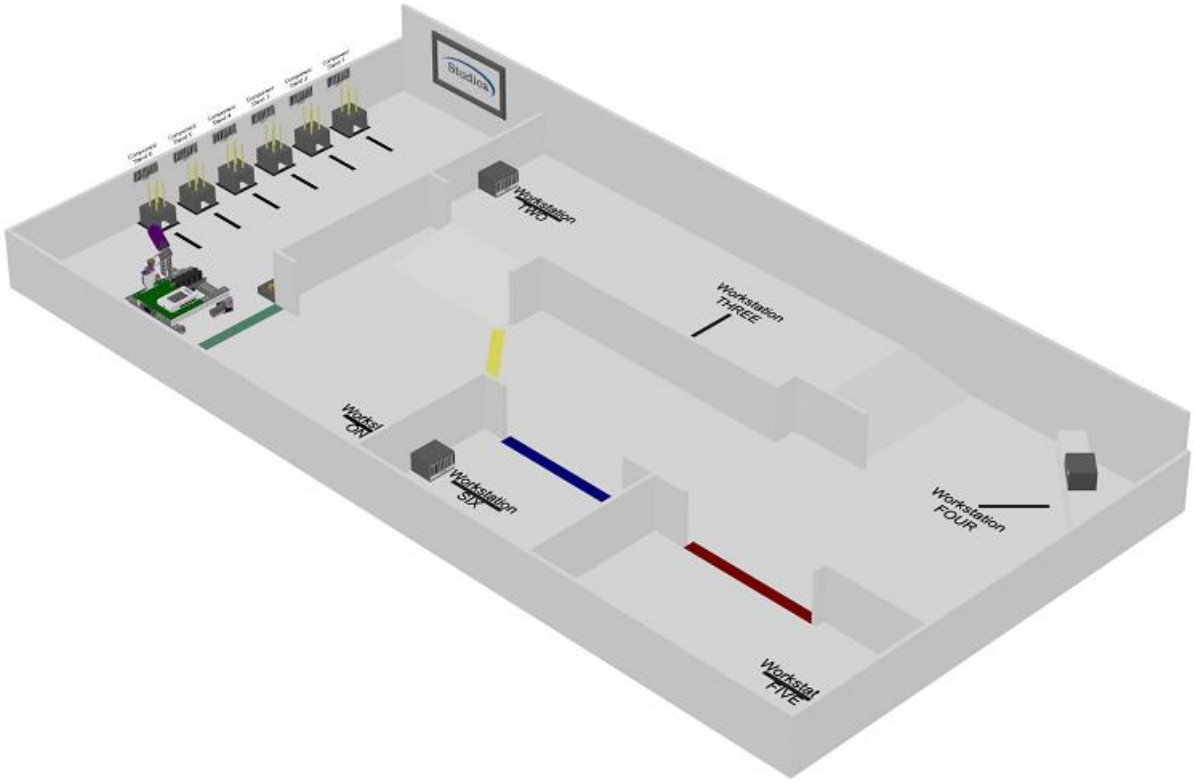
The Test Project has been prepared by Bob Tone, Worldskills Kazan 2019 External Test Project Developer.

JSC KAMAZ has agreed to serve as our Kazan Mobile Robotics Test Project "End User Client". KAMAZ logistics systems are moving forward with automating the relationship between 'Parts Source Locations' and in the factory "Assembly Workstations".

Dmitry Ageev, Deputy Director of development Department on project management Logistics Centre of JSC "KAMAZ" stated:

"In September of this year, we are launching a system of automated delivery of parts from the warehouse to the Assembly lines (conveyors). As part of the system will be used robotic vehicles AGV, as well as tractors for road trains."

Assembly Workstation Support Robot



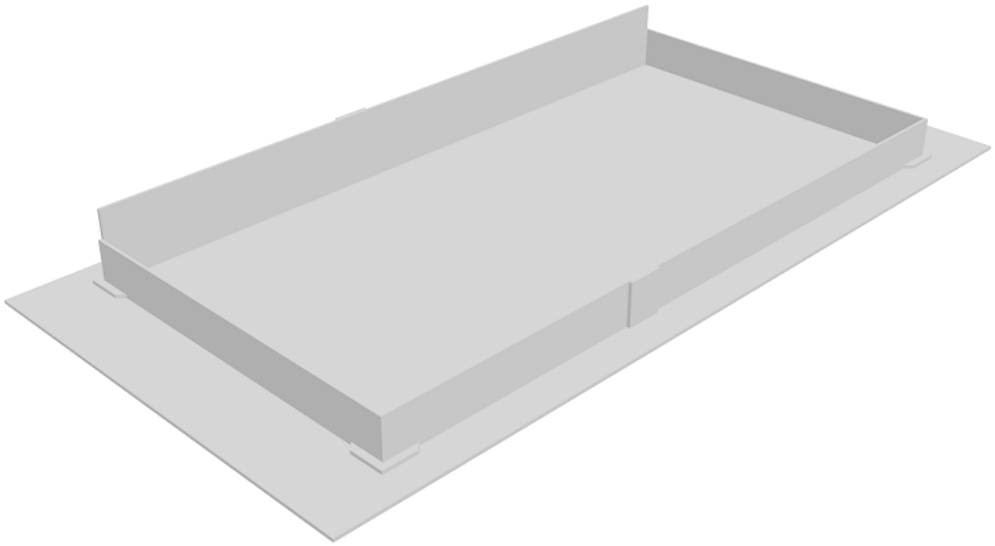
2 COMPETITION PERFORMANCE ASSESSMENT ENVIRONMENT

The Competition Performance Assessment Environments (Courts) support a "Simulated Factory" and as such do not have many of the features found in an actual automated factory layout such as:

- Sensors imbedded in the floor
- A Local Area Positioning System mounted on the ceiling
- Human traffic in the factory aisles
- Other robots travelling in the factory aisles
- Signal Lights monitoring Aisle Intersections
- Actual Truck Components in the Parts Department

The "Simulated Factory" Competition Performance Assessment Environments (Courts) provide:

- An Overall Exclusive Use 4 by 2 Meter Performance Space
- A smooth, hard, white floor surface
- Smooth, white perimeter and aisle walls

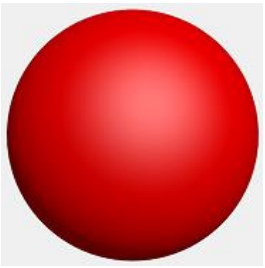


The above image displays a Core Single Team, Inclusive Use One Team Performance Environment

"Simulated Truck Parts" (Components) in the form of coloured standard and whiffle golf balls serve as the "Truck Parts" in ALL Evaluated Test Project Experiences. Note: The Colour of the Balls in this document DO NOT represent the exact colour of the competition balls.

Blue standard gold ball

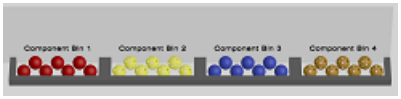
Yellow whiffle golf ball



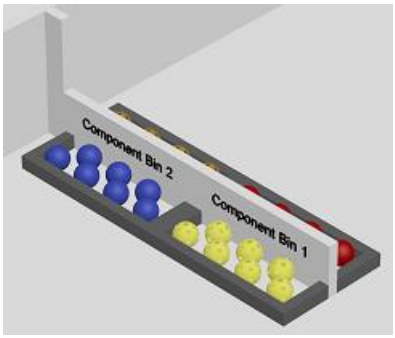
Red standard golf ball

Orange whiffle golf ball

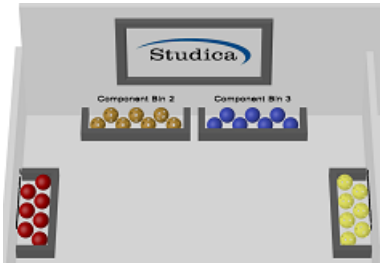
- Component Bins are positioned in a variety of patterns in the various Factory Layouts used for Evaluated Test Project Experiences.



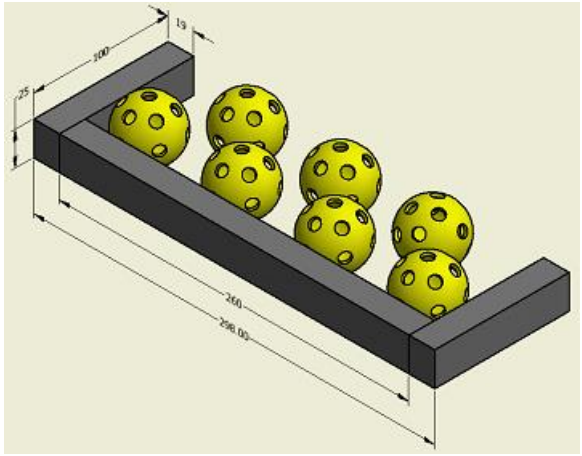
Straight Line of Component Bins



Island of Component Bins



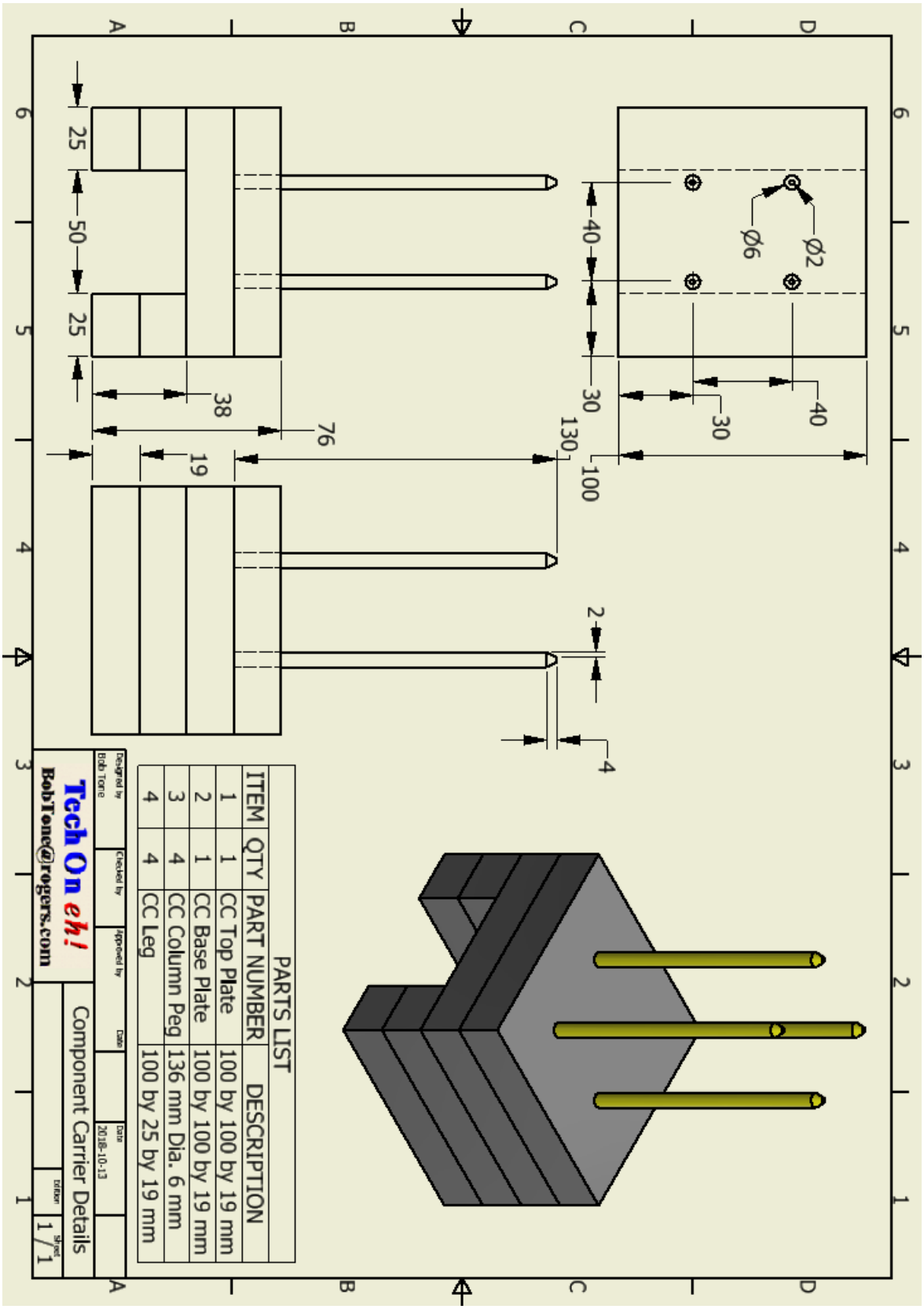
U Shaped Component Bins Pattern



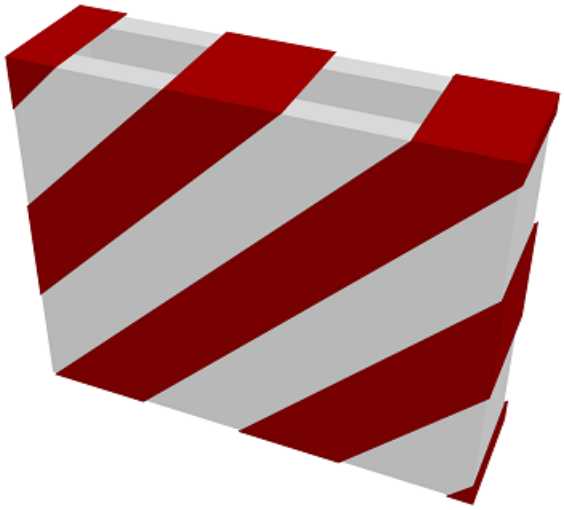
Note: The Component Bin Wall Elements will be wrapped in Grey Duct Tape to distinguish them from the surrounding White Floors and Walls.

- Each Component Bin holds SEVEN "Truck Parts / Golf Balls".
- Component Bins are always On the Floor and positioned Against a Wall
- Component Carriers (CC) measure 100 mm X 100 mm X 57 mm
- Component Carriers are Blocks of two 100 mm X 100 mm X 19 mm Plates and two 100 mm X 38 mm X 25 mm Legs.
- Component Carriers have an On the Top Column, formed by Four 130 mm Dia. 6 mm wooded dowels, designed to hold a maximum of 3 Components (Truck Parts / Golf Balls)
- The Top Ends of the Column Posts are Chamfered based on values of 2 and 4 mm (see image on next page).

Note: The Component Carriers will be wrapped in Grey Duct Tape to distinguish them from the surrounding White Floors and Walls.

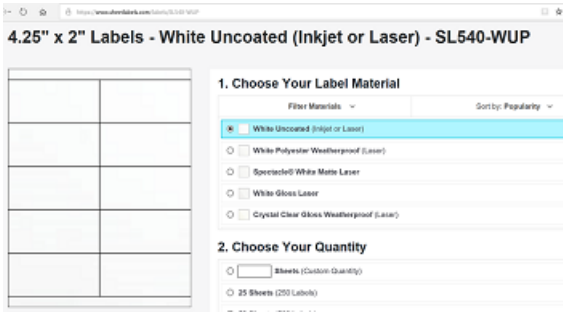

PARTS LIST
ITEM QTY PART NUMBER DESCRIPTION
1 1 CC Top Plate 100 by 100 by 19 mm
2 1 CC Base Plate 100 by 100 by 19 mm
3 4 CC Column Peg 136 mm Dia. 6 mm
4 4 CC Leg 100 by 25 by 19 mm
Tech On eh!
BobTonic@rogers.com
Component Carrier Details
2018-10-13
1/1

- Competitors MUST understand that their Robot may be transferred to a different Factory and as a result it must be prepared to work in a variety of Factory Layouts.
- Competitors MUST also understand that when 'Maintenance' is required in the factory that an Aisle Entrance may be Blocked.
- Equipment requiring maintenance often emerge as an "Unknown in Advance" situation.
- Competitors will be informed by Mid-morning IF an Aisle Entrance, in the "Assigned for the Day Factory Layout" is going to be Blocked due to unscheduled maintenance.

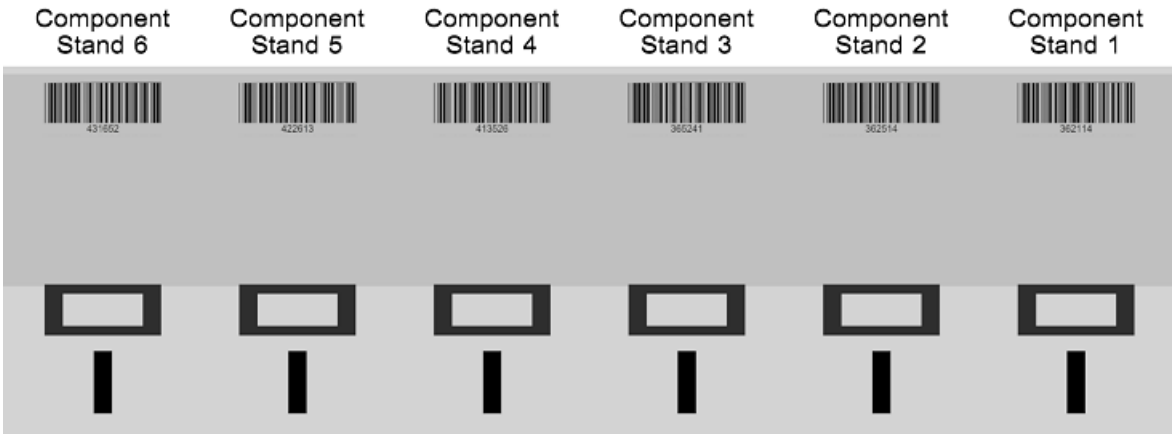


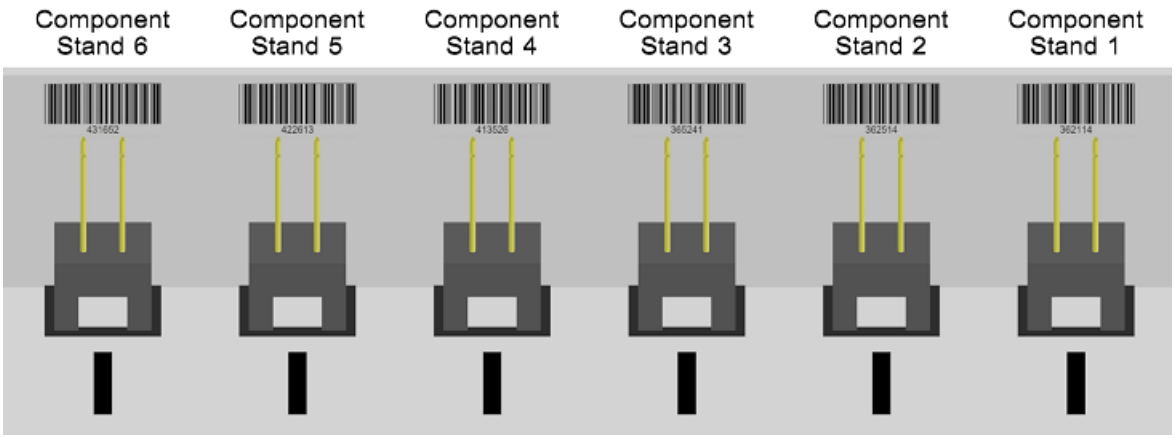
- If an Aisle is blocked for maintenance, then it will remain blocked for the remainder of that Competition Day.
- Component Carrier Stand and Workstation Positions are identified by Workstation Barcode Labels

Workstation barcode sample



Workstation barcode labels source

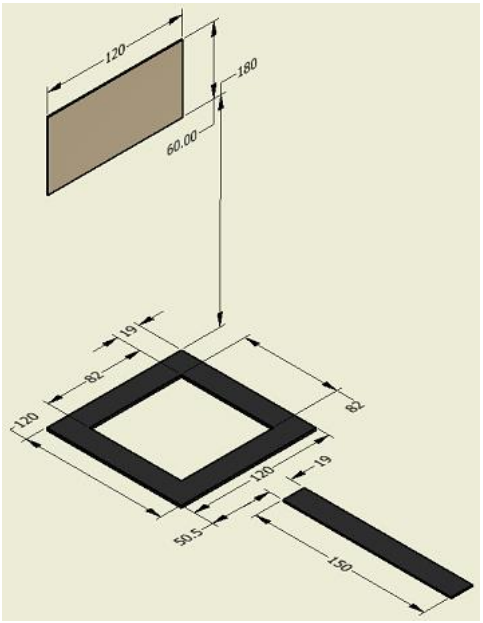




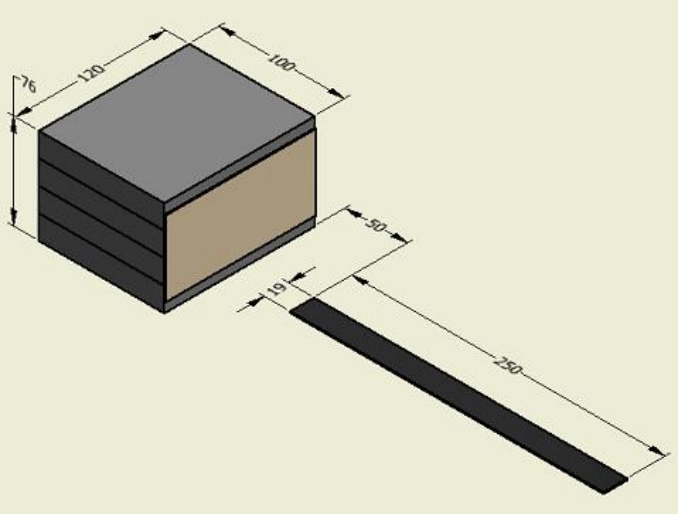
The Component Carriers are Generic and can be assigned to any Workstation.

The SIX Competition Workstation Barcodes will be presented to the Competitors on Familiarization Day (C-2) and **will NOT change throughout the Four Competition Days**.

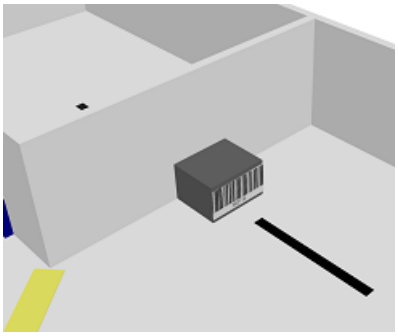
- Component Carrier Stands define the Start of the Test Project Carrier Positions and include:
- A Black Tape Line Square
- A Black Tape Line leading to the Center of the Black Tape Line Square
- A Barcode mounted on the court wall identifying the Workstation that is paired with the Component Carrier positioned on the Tape Line Square.



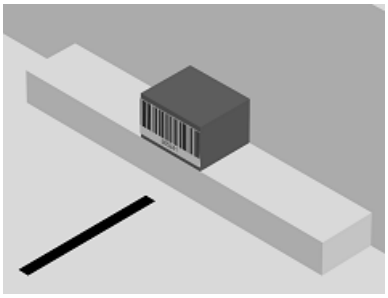
- Workstations are 120 mm X 100 mm X 76 mm Blocks / Platforms for receiving Component Carriers
- Robots MUST be IN FRONT of the Workstation when delivering a Component Carrier onto a Workstation. The Front of a Workstation is the Face where the Workstation's Barcode is positioned.
- Workstations are positioned on Workstation Platforms that range in height from 0 mm (WS is positioned on the factory floor) to a height of 114 mm.



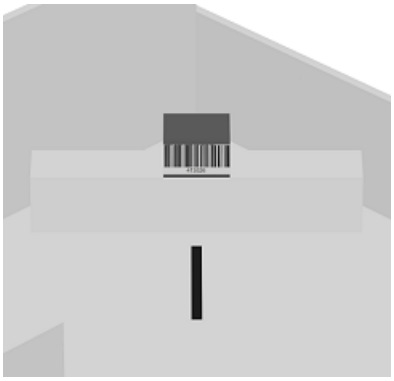
Note: The Workstations will be wrapped in Grey Duct Tape to distinguish them from the surrounding White Floors and Walls.



Workstations may be positioned on the court floor



Workstations may be positioned on the 57 mm tall platforms



Workstations may be positioned on 114 mm tall platforms

3 COMPETITOR COMPETITION SPACE COMPUTERS/TOOLS

- Teams may have a **Maximum** of two laptop Computers in the Competition Space.
- Teams may have a **Maximum** of two USB Memory Sticks for use 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.
- Competitors are **NOT ALLOWED** to bring Cell/Mobile Phones, Tablets or any other communication devices into the Competition Space.
- Competitors are **NOT ALLOWED** to access the Internet while they are in the Competition Space.
- Competitors **MAY BRING and USE** in the Competition Space Programme Files they have created during their Competition Preparation Experiences.
- As stated in the Technical Description Document: Competitors can bring a toolbox with a maximum volume of one cubic metre.

  NOTE: This is a Maximum Size Limitation. Teams are encouraged to bring tool boxes that are considerably smaller in size.

  NOTE: The Competitor's **Robot IS** included when calculating "Tool Box Size".
- As stated in the Technical Description Document: Teams may bring 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.

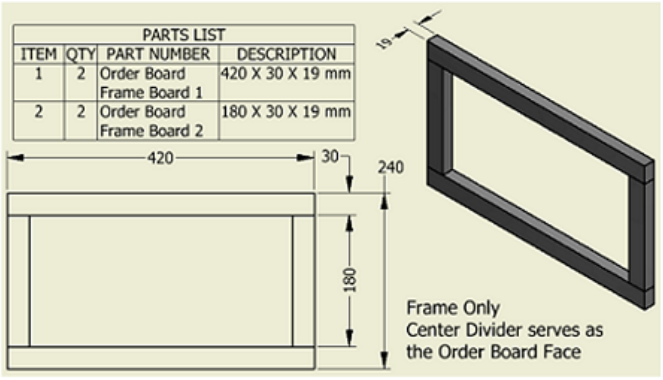
  NOTE: Teams are NOT Allowed to have Material Removal Powered Tools (Jig Saw, Drill, Grinder) or Soldering Equipment in their Assigned Workspace.

  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.
- As stated in the Technical Description Document: Tools that are home-made and/or tools that give teams a big advantage over other teams, might be removed by a vote of the Experts.

4 PERFORMANCE TEST PROJECT ELEMENTS

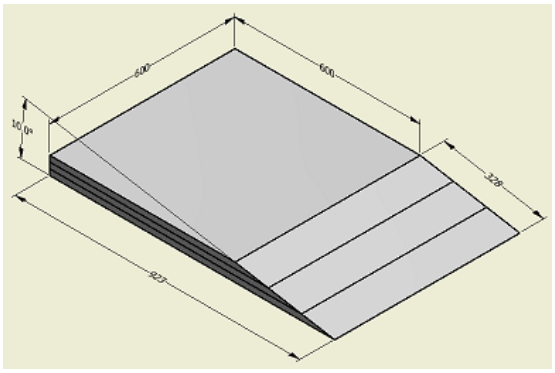
- Move autonomously between Parts Department Component Source Bins, Component Carrier Stands and Workstations in the Assembly Factory
- Able to "Know" the pattern of components requested based on reading Bar Codes displayed on the Parts Department Order Board or through "Known in advance pre-set component order/workstation requirement patterns".

  Note: The Order Board Frame Elements will be wrapped in Grey Duct Tape to distinguish them from the surrounding White Floors and Walls.

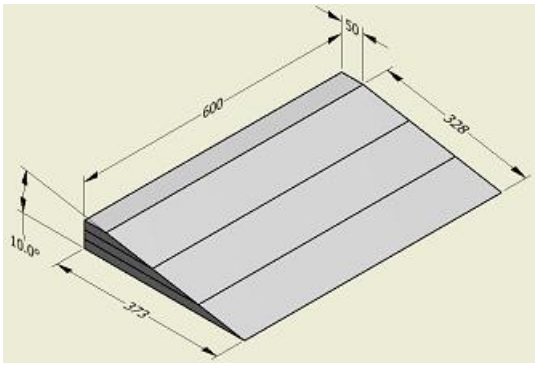


- Able to retrieve the Designated Components from the Parts Department Component Source Bins
- Able to load the Designated Components into the Correct Component Carrier
- Able to take possession of a Loaded Designated Component Carrier
- Able to maintain possession of the Loaded Component Carrier (or carriers) as the robot travels to the Assigned Factory Workstation (or Workstations)

  Note: The Performance Assessment Space Floor generally presents a smooth, hard, white surface. The exception being the presence of Elevated Platforms either providing a 600 mm X 600 mm space in which Robots are expected to be able to manoeuvre or 600 mm X 100 mm Platforms Robots are expected to be capable of travelling over.

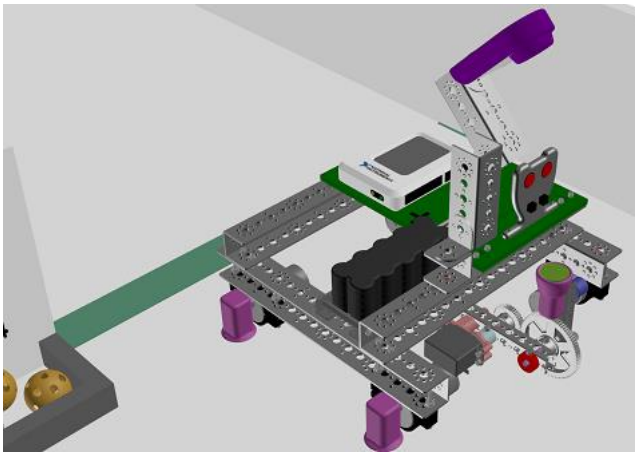


600mm x 600 mm Elevated Platform / Ramp



600 mm x 50 mm Elevated Platform / Ramp

- Able to place the Loaded Component Carrier on the Correct Workstation Stand
- Able to return to the Parts Department
- Turn "OFF" their "Power On Indicator Light"



Note: It is a **Competitor Responsibility to Check/Confirm** that the Court Layout is Correct **BEFORE** the Start of a Marked Test Project Run.

This involves checking that there is a Component Carrier on every Component Stand and Seven Target Objects (Golf Balls) in every Component Bin.

Once a Marked Continuous Test Project Run has started there can be NO intervention made by Competitors or Experts.

	Worldskills Kazan 2019 Mobile Robotics		
	Criteria as Defined in the Technical Description	Mark	Related Evaluation Items / Experiences
A	Work Organization & Management	10.00	Workspace & Time Management / Co-operative Behaviour
B	Communication and Interpersonal skills	10.00	Technician's Journal
C	Design	15.00	**C1** Robot Assembly and Intermittent Task Execution
D	Prototyping	10.00	Robot Inspection
E	Core Programming, Testing & Adjustment	15.00	**C2** Known In Advance Continuous Task Experience
F	Performance Review and Commission	40.00	**C3 & C4** Unknown In Advance Continuous Task Experiences
	Total	100.00	

5 MARKED PERFORMANCE TEST PROJECT EXPERIENCE FORMATS

- There are 2 Marked Performance Test Project Formats.
  - **Continuous Test Project Assessment Experiences:** A Series of Linked Test Project Segments where Assessment marks are not assigned until the end of the entire Test Project attempt and Competitors CANNOT intervene and assist their robot between individual Test Project segments.
  - **Intermittent Assessment Experiences:** A Series of Linked Test Project Segments where Assessment marks are assigned as each individual Test Project segment is completed and Competitors CAN intervene and assist their robot between individual Test Project segments.
  - Competitors MUST be prepared to complete Test Project Experiences in either of the Test Project Formats described above using any of the following Robot Control Methods: Autonomous, Teleoperation with either Direct or No Direct Line of Sight to the Robot.
  - The following examples display how the same set of Test Project sequences would be conducted and evaluated in each of the Test Project Experience Formats.
  - **Sample Test Project Sequence:** Load the Correct Pattern of Components into the Correct Component Carrier

    Example: Workstation 3 Component Carrier (Out of 6 available CC's) is expecting 1 Orange Whiffle Ball and 1 Red Standard Golf Ball

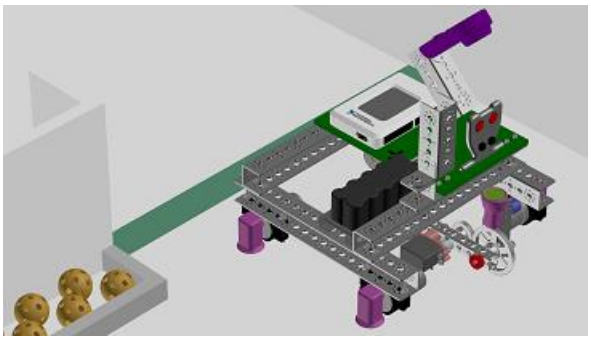
    Deliver the Correct Component Carrier to the Correct Workstation

    Return to the Parts Department

    Turn "OFF" the "Power ON Indicator Light" (To indicate the Robot is aware it has completed the Test Project).

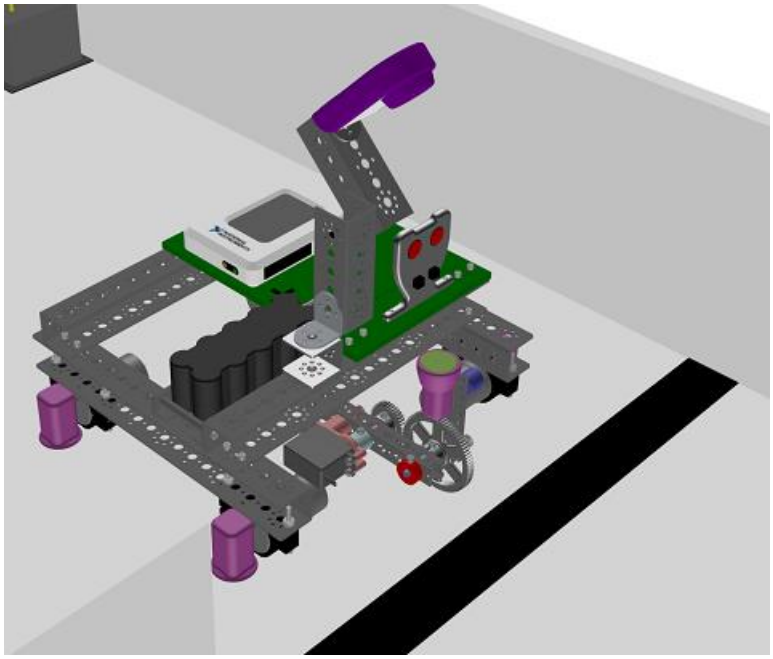
6 CONTINUOUS TEST PROJECT ASSESSMENT EXPERIENCE EXAMPLE

- The Test Project Run starts with the robot positioned inside the Parts Department with the centre of the robot aligned with the mid-point of the Parts Department Entry Passageway
- The Robot Loads 1 Yellow Standard Golf Ball and 1 Orange Whiffle Ball into the CC at WS 3.
  Note: This load is in the correct CC but is only partially correct and will be awarded only partial marks for this sequence when the Assessment is made at the end of the evaluated Test Project run.
- The Robot Delivers CC 3 to Workstation 3
  Note: Marks for a correct CC delivery will be awarded given marks have already been deducted for the incorrect load.
- The Robot returns to the Parts Department.
  Note: Mark is based on the robot being 100% past the Parts Department Entry Passageway Tape Line
- The Robot turns OFF its "Power ON Indicator Light"
  Note: Mark is awarded based on the robot displaying that it is aware the Test Project has been completed.



- No Time Marks awarded due to the CC loading error.

7 TIME MARKS



- Time Marks based on the amount of time taken to complete a Marked Test Project run will only be applied in the following circumstances:
- The Test Project completed by ALL Teams has the same set of Test Project segment circumstances.
  Note: Both of the following samples would qualify for the awarding of time marks.
- The complete components order would be known at the start of the competition day and would not change. This reflects a factory situation where a robot delivers the same components to the same workstations in a repeated pattern day after day.

  Note: In this situation it would be a Competitor decision to organize the order of the CC's are delivered.

Example:

- Team One's delivery order is: CC1, CC5, CC4, CC3, CC2, and CC6
- Team Two's delivery order is: CC3, CC6, CC4, CC5, CC1, and CC2
- The complete set of component orders a robot must manage would be known at the start of the day and would not change at any time during the day. However, the order in which the component carriers MUST be delivered would NOT be either known to or set in advance by the competitors. This reflects a factory situation where the robot would be "On Call" to service a known set of Workstations on an "As Needed Basis".
- **Note:** In this situation the robot is expected to Read Workstation Barcode's displayed on the "Parts Department Order Screen" to determine which CC it should load and deliver First, Second, Third etc.

Example:

- Team One's random delivery order is: CC4, CC1, CC3, and CC2
- Team Two's random delivery order is: CC2, CC1, CC4, and CC3

Note: Time marks are justified given when all robots manage an identical set of Components and CC's. The order in which they handle the CC's does not impact the reality that all the robots must travel the same distance, handle the same set of components and CCs

- Time Marks will be awarded ONLY to robots that have completed 100% of the Test Project being evaluated in less than 601 seconds (10 minutes) or 361 seconds (6 minutes).
- Time Marks will be calculated based on the CIS "Percent Score Comparison" calculation utility using the following formula:

Mark = [1 – {(Team's Time – Fastest Team's Time) / (Maximum Time – Fastest Team's Time)}] * max Mark

Autonomous Continuous Task Time Mark Calculation SAMPLE • The Maximum Time Mark for a Single Evaluated Task Run is 0.75 Marks • Teams that Fail to Complete the Entire Task Run being Evaluated will be Assigned a Task Completion Time of 600 Seconds for Mark Calculation Purposes			
	Task Completion Time in Total Number of Seconds	Autonomous Continuous Task Time Mark Calculation Formula: Time Mark = (1 - ((Team Time – Fastest Team Time) / (Maximum Time – Fastest Team Time))) * maxMark	Time Marks Awarded
Team A	490 Sec.	(1 - ((490 - 405) / (600 - 405))) * 0.75 = (1 – (85 / 195) * 0.75 = (1 – 0.44) * 0.75 = 0.56 * 0.75	0.42 Marks
Team B	535 Sec.	(1 - ((535 - 405) / (600 - 405))) * 0.75 = (1 – (130 / 195) * 0.75 = (1 – 0.65) * 0.75 = 0.35 * 0.75	0.26 Marks
Team C	600 Sec.	(1 - ((600 - 405) / (600 - 405))) * 0.75 = (1 – (195 / 195) * 0.75 = (1 – 1) * 0.75 = 0.0 * 0.75	0.0 Marks
Team D	405 Sec.	(1 - ((405 - 405) / (600 - 405))) * 0.75 = (1 – (0 / 195) * 0.75 = (1 – 0.0) * 0.75 = 1 * 0.75	0.75 Marks
Team E	585 Sec.	(1 - ((585 - 405)/(600 - 405))) * 0.75 = (1 – (180 / 195) * 0.75 = (1 – 0.92) * 0.75 = 0.08 * 0.75	0.06 Marks

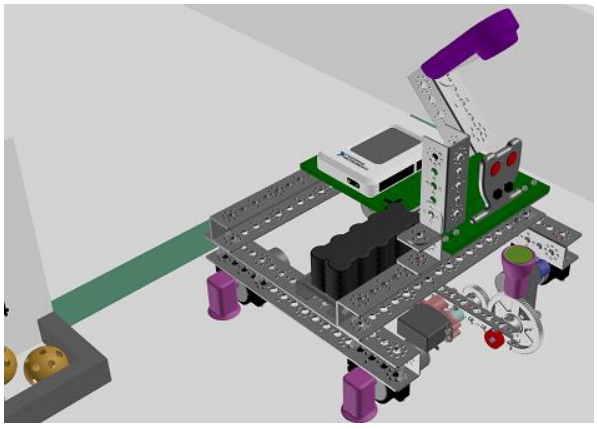
Teleoperation Continuous Task Time Mark Calculation SAMPLE • The Maximum Time Mark for a Single Evaluated Task Run is 0.75 Marks • Teams that Fail to Complete the Entire Task Run being Evaluated will be Assigned a Task Completion Time of 360 Seconds for Mark Calculation Purposes			
	Task Completion Time in Total Number of Seconds	Autonomous Continuous Task Time Mark Calculation Formula: Time Mark = (1 - ((Team Time – Fastest Team Time) / (Maximum Time – Fastest Team Time))) * maxMark	Time Marks Awarded
Team A	240 Sec.	(1 - ((240 - 220) / (360 - 220))) * 0.75 = (1 – (20 / 140) * 0.75 = (1 – 0.14) * 0.75 = 0.86 * 0.75	0.65 Marks
Team B	290 Sec.	(1 - ((290 - 220) / (360 - 220))) * 0.75 = (1 – (70 / 140) * 0.75 = (1 – 0.5) * 0.75 = 0.5 * 0.75	0.38 Marks
Team C	220 Sec.	(1 - ((220 - 220) / (360 - 220))) * 0.75 = (1 – (0 / 140) * 0.75 = (1 – 0) * 0.75 = 1.0 * 0.75	0.75 Marks
Team D	310 Sec.	(1 - ((310 - 220) / (360 - 220))) * 0.75 = (1 – (90 / 140) * 0.75 = (1 – 0.64) * 0.75 = 0.36 * 0.75	0.27 Marks
Team E	360 Sec.	(1 - ((360 - 220)/(360 - 220))) * 0.75 = (1 – (140 / 140) * 0.75 = (1 – 1) * 0.75 = 0.0 * 0.75	0.0 Marks

8 INTERMITTENT TEST PROJECT ASSESSMENT EXPERIENCE SAMPLE

- Competitors will participate in their THREE Competition Day One Intermittent Test Project Assessment Experiences on the following basis:
  - These Assessment Experiences will NOT be scheduled by the Expert Jury Panel
  - These Assessment Experiences will take place at times set on a "By Competitor Request" with the provision that ALL Competitors MUST request their Three Intermittent Test Project Assessment Experiences BEFORE the end of the Official Competition Day One Time Block.
  - If the Official Competition Day One Time Block has ended and Competitors have not yet had their requested Intermittent Test Project Assessment Experiences they will place their robot on their Transportation Trolley and wait in the General Meeting Area. They will not be allowed to continue working on their robot while they wait their turn for their Intermittent Test Project Assessment Experiences.
- Intermittent Test Project Assessment Experiences will be conducted in all the following conditions:
  - Component Carrier Load Patterns will Always be KNOWN in Advance
  - Autonomous Control when the Workstation Service Order is KNOWN in Advance.
  - Autonomous Control when the Workstation Service Order is UNKNOWN in Advance.
  - **Note:** Competitors are expected to program a "Pause" between Autonomous Performance Segments to enable Individual Performance Segments to be marked and to allow Competitors to intervene when their Robot Fails to complete a Performance Segment correctly to ensure their Robot has an opportunity to attempt the next Individual Performance Segment
  - **Example:** IF a Robot stopped in front of the wrong component source bin then a Competitor would be allowed to enter the court and move their robot to a position in front of the correct component source bin to enable the robot to have an opportunity to complete the next stage (take possession of the correct ball).
  - Teleoperation Control when the Workstation Service Order is KNOWN in Advance.
  - Teleoperation Control when the Workstation Service Order is UNKNOWN in Advance.
- Marks will be awarded for each individual Intermittent performance segment on a YES/NO basis at the end of each performance segment. If a Robot "Fails to Complete an individual Performance Segment" it will immediately be awarded ZERO Marks for that individual Performance Segment.

Intermittent Test Project Performance Sample:

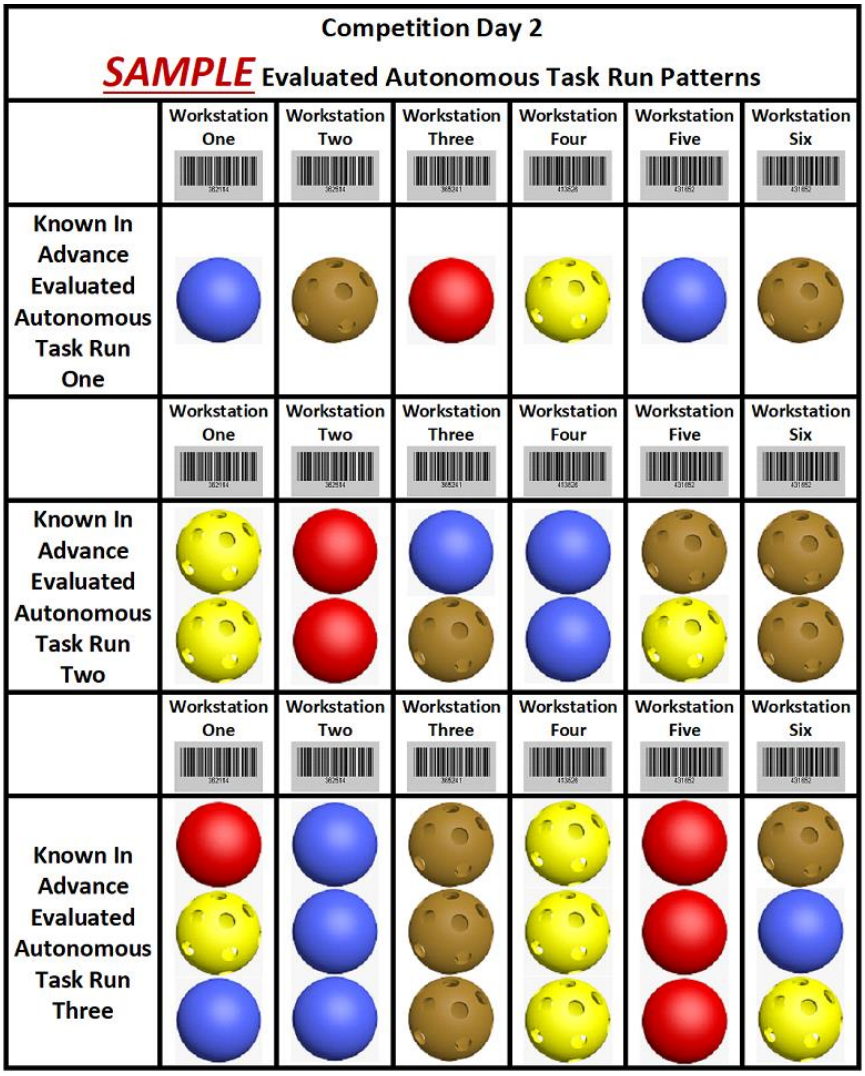
- Place the Robot in a Common to ALL Teams Starting Position which is Centred on the Parts Department Entry with the Robot 100% inside the Parts Department (Past the Entry Way Tape Line)
- Move to a position in front of the Yellow Standard Golf Ball Bin
- Take possession of 1 Yellow Standard Golf Ball
- Move to a position in front of CC3Load 1 Yellow Standard Golf Ball into CC3's holding column
- Move to a position in front of the Orange Whiffle Golf Ball Bin
- Take possession of 1 Orange Whiffle Golf Ball



- Move to a position in front of CC3Load 1 Orange Whiffle Golf Ball into CC3's holding column
- Take possession of CC3
- Move into the factory to a position in front of WS3
- Place CC3 onto WS3
- Move back to the Robot's Starting Position inside the Parts Department
- Turn OFF an Indicator Light on the Robot to confirm the Robot is aware the Test Project has been completed

9 30% CHANGE ELEMENTS TO PROJECT

- WorldSkills requires 30% of the Test Project be "unknown in advance by the Competitors".
- The various physical features of the Performance Environment and Target Objects determine the Performance Capabilities Competitors need to integrate into their design solutions.
- The 30% change will not involve the introduction of new Performance Environment Physical Features requiring the Competitors to integrate completely new performance capabilities into their robot solutions.
- The Mobile Robotics 30% Change Element will involve:
  - A different Performance Environment "Factory" Layout will be used EACH Competition Day.
  - The position of Component Bins, Component Carrier Stands and Workstations **WILL NOT Change** during an individual competition day.
  - On each of Competition Days 2, 3 and 4 Robots will be required to service SIX Workstations.
  - Robots will have THREE Evaluated Test Project Runs on EACH of Competition Days 2, 3 and 4.
- The number of "Truck Components" (Golf Balls) a Robot must manage **WILL BE DIFFERENT** in each of the three Evaluated Test Project Runs per day.



10 ROBOT CONTROL FORMATS

- **Autonomous Control Mode:**
  - The Robot Control Program has been downloaded to the robot
  - NO active interaction between the competitor's Robot and Lap Top is allowed during an Evaluated Test Project Experience Execution
  - The Test Project Execution is initiated by either pressing the Enter Key on the competitor's Lap Top, or, a Designated Button on the Robot
  - Once the Test Project Execution has started the competitor's Lap Top screen needs to be folded down

- **No Direct Line of Sight Teleoperation Control Mode:**
  - Both Competitors on a Team will be sitting side by side at a court side table with their Backs to the court space
  - Competitor's laptops will be open and Competitors will be able to see their laptop screen
  - Competitors will have access to view a camera image displayed on a monitor, provided by the competition positioned on their court side table. The image sent to this monitor will be from an On the Robot Camera that is functioning Independent of the MyRIO/Labview control system.

FPV2 Camera

USB Ethernet Hub

Note: No Direct Line of Sight Teleoperation reflects the real workplace where a Remote Robot Operator manages a Robot and its' Object Management System with the Robot in a location where the operator cannot see the robot directly.

Note: No Direct Line of Sight Teleoperation is the **PRIMARY** Teleoperation Control Method and will be used unless Competition Space Independent Camera Signal Issues Develop.

- Direct Line of Sight Teleoperation Control Mode:
  - Both Competitors on a Team will be sitting side by side at a court side table facing the court space
  - Competitor's laptops will be open and Competitors will be able to see their laptop screen
  - Teleoperation by a Remote Operator who has Direct Line of Sight Access to the Robot and Court.

Note: Direct Line of Sight is the Secondary Teleoperation Control Method and will be used **ONLY IF** Competition Space Independent Camera Signal Issues Develop.

11 OVERALL ASSESSMENT PATTERN

- All competitor Assessment experiences will be conducted incompliance with Worldskills Computer Information Systems (CIS) Guidelines
- All marked experiences over the Four Competition Days will collectively total 100 Marks
- NO Individual Marked Aspect will have a value greater than 2 Marks
- Time taken to complete an assigned Test Project **WILL be an Assessment** factor when the Performance Expectations in the evaluated experience are the same for ALL Competitors.
- The Overall Marks Pattern is based directly on section 2.2 Worldskills Standards Specification. The essential details defining the categories listed below can be found on pages 6 to 10 of the WSC2019_TD23_EN.pdf.

  - Work organization and management: Value 10 Marks
  - Communication and interpersonal skills: Value 10 Marks
  - Design: Value 15 Marks
  - Prototyping: Value 10 Marks
  - Programming, testing and adjustment: Value 15 Marks
  - Performance Review and Commissioning: Value 40 Marks

  - Design, Programming, testing and adjustment, Performance Review and Commissioning represent a combined total of 70 Marks. These Assessment experiences will involve "Measurement Marking" based directly on the observation of Competitor Managed Robot Performance.

  - Work organization and management represents a total of 10 Marks and will be evaluated based on a system like the "Yellow / Red Cards" used in Soccer. Assessment is ongoing all day and conducted by a team of 3 Experts.

    - **Adherence to schedules:** Total of 3.0 marks based on 0.75 Marks per Competition day
      - 0 Penalty Cards = 0.75 Marks awarded (100%)
      - 1 Penalty Card = 0.56 Marks awarded (75%)
      - 2 Penalty Cards = 0.38 Marks awarded (50%)
      - 3 Penalty Cards = 0.19 Marks awarded (25%)
      - 4 Penalty Cards = 0.0 Marks awarded (0%)
    - **Co-operative Behaviour** with your Compatriot Competitor, Opponent Competitors and the Experts: Total of 2.0 Marks based on 0.5 Marks per Competition Day
      - 0 Penalty Cards = 0.5 Marks awarded (100%)
      - 1 Penalty Card = 0.375 Marks awarded (75%)
      - 2 Penalty Cards = 0.25 Marks awarded (50%)
      - 3 Penalty Cards = 0.125 Marks awarded (25%)
      - 4 Penalty Cards = 0.0 Marks awarded (0%)
    - **Work Space Organization and Management:** Total of 4.0 based on 1.0 Marks per Competition Day
      - 0 Penalty Cards = 1.0 Marks awarded (100%)
      - 1 Penalty Card = 0.75 Marks awarded (75%)
      - 2 Penalty Cards = 0.5 Marks awarded (50%)
      - 3 Penalty Cards = 0.25 Marks awarded (25%)
      - 4 Penalty Cards = 0.0 Marks awarded (0%)

- **Robot Assembly** Completed on Time (Competition Day 1 Only) = 1.0 Mark awarded on a Complete / Incomplete Basis

- **Communication and interpersonal skills** represent a total of 10 Marks encompassing two areas, the Mobile Robotics Competitor's Engineering Journal and their 'Pitch Presentation' made to a panel of 3 Experts.
- **Judgement Assessment** involves a Panel of 3 Experts each assigning an Assessment value between 0 and 3. Then the CIS uses the average of these values to calculate the mark that will be assigned to the Competitor.

  Example:
  Expert 1 assigns a value of 1, Expert 2 assigns a value of 2 and Expert 3 assigns a value of 2.
  The CIS calculation is 5/9 X 1.25 = 0.694 Marks Awarded

- Competitors are required to maintain a Mobile Robotics Engineering Technician's Journal during their competition preparation activities.

- The **Mobile Robotics Engineering Technician's Journal** will serve the following purposes:
  - Provide an insight into the competitor's thinking throughout their Mobile Robot / Test Project Specific Solutions Development across the full spectrum of content areas associated with the development of Mobile Robot / Test Project Specific Solutions.
  - Highlight the Competitors thinking relative to their robot design, program file structure, overall Test Project strategy and Team Organization.
  - Serve as an 'In the Competition Space Competitor Resource' available to the Competitors to consult while at their workbench and during their Expert Jury Panel Presentation Experiences.

- The **Mobile Robotics Competitor's Engineering Journal** is expected to include the following sections:
  - Engineering Journal Frame / Structural Section = 1.25 Marks
  - Engineering Journal Wiring Section = 1.25 Marks
  - Engineering Journal Mobility Management Section = 1.25 Marks
  - Engineering Journal Object Management Section = 1.25 Marks

- The **Engineering Journal Frame / Structural Section** Assessment Criteria:
  - Judgement Rating of 0 = Incoherent content organization, lacking in detail and containing a poor quality of drawings / diagrams. The foundation strategy on which the Frame / Structures are based is NOT evident in the Journal content
  - Judgement Rating of 1 = Coherent content organization, adequate in detail and containing a reasonable quality of drawings / diagrams. The foundation strategy on which the Frame / Structures are based is somewhat apparent in the Journal content
  - Judgement Rating of 2 = Very Coherent content organization, more than adequate in detail and containing a good quality of drawings / diagrams. The foundation strategy on which the Frame / Structures are based is clear in the Journal content
  - Judgement Rating of 3 = Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of drawings / diagrams. The foundation strategy on which the Frame / Structures are based is exceptionally evident in the Journal content

- **Engineering Journal Wiring Section** Assessment Criteria:
  - Judgement Rating of 0 = Incoherent content organization, lacking in detail and containing a poor quality of diagrams / schematics. Adherence with Industry Wiring Standards is NOT evident in the Journal content.
  - Judgement Rating of 1 = Coherent content organization, adequate in detail and containing a reasonable quality of diagrams / schematics. Adherence with Industry Wiring Standards is reasonably apparent in the Journal content.
  - Judgement Rating of 2 = Very Coherent content organization, more than adequate in detail and containing a good quality of diagrams / schematics. Adherence with Industry Wiring Standards is very evident in the Journal content
  - Judgement Rating of 3 = Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of diagrams / schematics. Adherence with Industry Wiring Standards is exceptionally evident in the Journal content.
- The **Engineering Journal Mobility Management** Section Assessment Criteria:
  - Judgement Rating of 0 = Incoherent content organization, lacking in detail and containing a poor quality of drawings / diagrams. The foundation strategy and functional elements on which the Mobility Management System is based are NOT evident in the Journal content
  - Judgement Rating of 1 = Coherent content organization, adequate in detail and containing a reasonable quality of drawings / diagrams. The foundation strategy and functional elements on which the Mobility Management System is based are reasonably evident in the Journal content
  - Judgement Rating of 2 = Very Coherent content organization, more than adequate in detail and containing a good quality of drawings / diagrams. The foundation strategy and functional elements on which the Mobility Management System is based are more than adequately evident in the Journal content
  - Judgement Rating of 3 = Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of drawings / diagrams. The foundation strategy and functional elements on which the Mobility Management System is based are exceptionally evident in the Journal content
- The **Engineering Journal Object Management** Section Assessment Criteria:
  - Judgement Rating of 0 = Incoherent content organization, lacking in detail and containing a poor quality of drawings / diagrams. The foundation strategy and functional elements on which the Object Management System is based are NOT evident in the Journal content
  - Judgement Rating of 1 = Coherent content organization, adequate in detail and containing a reasonable quality of drawings / diagrams. The foundation strategy and functional elements on which the Object Management System is based are reasonably evident in the Journal content
  - Judgement Rating of 2 = Very Coherent content organization, more than adequate in detail and containing a good quality of drawings / diagrams. The foundation strategy and functional elements on which the Object Management System is based are more than adequately evident in the Journal content
  - Judgement Rating of 3 = Exceptionally Coherent content organization, Superior in detail and containing an excellent quality of drawings / diagrams. The foundation strategy and functional elements on which the Object Management System is based are exceptionally evident in the Journal content

- **Competitors will make a presentation** "Pitch to the Client" represented by a panel of 3 Experts. Total Value 5 Marks
  - During the presentation both competitors talk and explain some parts of the presentations. Value 1 Mark
  - From the competitors' own words what was the problem presented? What are the main challenges. Value 1 Mark
  - How did they solve the problem? Innovative ideas. Value 1 Mark
  - During the project what costs did you have? Value 1 Mark
  - Graph with the evolution of the project and the main landmarks. Value 1 Mark
- **Prototyping** represents a total Value of 10 Marks and is based on an inspection of the Competitor's Assembled Robot by a Panel of 3 Experts with the focus being on the following areas / items.
- **Memory Management:** Competitors will prepare their robot to complete a 'Surprise Sequence of Robot Actions' that will be presented to the competitors in the competition space. The CIS "Percent Score Comparison" calculation utility will use the Memory Usage Readout for Teams that complete the entire sequence of Robot Actions to award the marks. Total Value of 0.8 Marks

  Note: Competitors can expect the 'Surprise Sequence of Robot Actions' will involve only Core Performance Expectations such as: Read a Barcode, Move to a Specified Component Bin, Take Possession of a Ball, Move to a Specified Component Carrier Stand, Load a Ball into a Component Carrier, Take Possession of a Component Carrier, Travel carrying a Component Carrier and Deliver a Component Carrier Onto a Workstation.
- **Base Robot – Structural Elements:** Frame Assembly meets Industry Standards for fit and alignment of components Examination of the Robot Frame's Structural Integrity (fit between connected components, accuracy of component alignment angles, sizes etc.) Value 0.7 Mark
  - Judgement Rating of 0 = Overall Robot Frame is poorly organized. Multiple structural element connections are loose and allow movement when a fixed positional relationship between structural elements is required. An excessive number of structural elements are used. The robot base is an unstable platform presenting a poor degree of support to the Object Management System.
  - Judgement Rating of 1 = Overall Robot Frame is reasonably well organized. A minimal number of structural element connections are loose and allow movement when a fixed positional relationship between structural elements is required. A reasonable number of structural elements are used. The robot base is a moderately stable platform presenting a reasonable degree of support to the Object Management System.
  - Judgement Rating of 2 = Overall Robot Frame is very well organized. No structural element connections are loose and allow movement when a fixed positional relationship between structural elements is required. An effective number of structural elements are used. The robot base is a very stable platform presenting an effective degree of support to the Object Management System.
  - Judgement Rating of 3 = Overall Robot Frame is exceptionally well organized. No structural element connections are loose and allow movement when a fixed positional relationship between structural elements is required. A very efficient number of structural elements are used. The robot base is an exceptionally stable platform presenting a very effective degree of support to the Object Management System.

- **Wiring installation** meets Industry Standards for secure / safe installation Examination of the Robot's Wiring (secure wire placement, efficient wire organization, quality of connections, protection from Abrasion) Value 0.7 Marks
    - Judgement Rating of 0 = Wire placement is poorly organized. Multiple wires are loose and tangled. An excessive amount of wire is used. No wiring labels present. Connections are loose. Excessive amounts of wire is exposed at connections. Wires are positioned where they are at risk of abrasion damage due to component movement.
    - Judgement Rating of 1 = Wire placement is reasonably organized. Minimal wires are loose and tangled. Amount of wire used is reasonable. Majority of Wires are labelled. Connections are reasonably secure. A reasonable amount of wire is exposed at connections. Wires are positioned where they are minimally at risk of abrasion damage due to component movement.
    - Judgement Rating of 2 = Wire placement is very well organized. No wires are loose and tangled. Amount of wire used is efficient. Majority of Wires are labelled. Connections are secure. An appropriate amount of wire is exposed at connections. Wires are positioned where they are Minimally at risk of abrasion damage due to component movement.
    - Judgement Rating of 3 = Wire placement is exceptionally well organized. No wires are loose and tangled. Amount of wire used is very efficient. All Wires are labelled. All connections are secure. A minimal amount of wire is exposed at connections. Wires are positioned where they are Not at risk of abrasion damage due to component movement.
- **Drive System Installation** - The fixation of the motors (DC, servos and others), connection between motors and wheels or Hubs Value 0.7 Marks
    - Judgement Rating of 0 = Overall robot Mechanical is poorly fastened / tensioned. Motors and supports are poorly fastened. Belts and chains are poorly tensioned. Gear and Hubs are poorly adjusted.
    - Judgement Rating of 1 = Overall robot Mechanical is reasonably well fastened / tensioned. Motors and supports are reasonably well fastened. Belts and chains are reasonably well tensioned. Gear and Hubs are reasonably well adjusted.
    - Judgement Rating of 2 = Overall robot Mechanical is very well fastened / tensioned. Motors and supports are very well fastened. Belts and chains are very well tensioned. Gear and Hubs are very well adjusted.
    - Judgement Rating of 3 = Overall robot Mechanical is exceptionally fastened / tensioned. Motors and supports are exceptionally fastened. Belts and chains are exceptionally tensioned. Gear and Hubs are exceptionally adjusted.
- **Object Management System Structural Elements** - Object Management System Frame Assembly meets Industry Standards for fit and alignment of components. Examination of the Object Management System Frame's Structural Integrity (fit between connected components, accuracy of component alignment angles, sizes etc.) Value 0.7 Marks
    - Judgement Rating of 0 = Overall OMS Frame is poorly connected
    - Judgement Rating of 1 = Overall OMS Frame is reasonably well connected
    - Judgement Rating of 2 = Overall OMS Frame is very well connected
    - Judgement Rating of 3 = Overall OMS Frame is exceptionally well connected

- **Object Management System Wiring** installation meets Industry Standards for secure / safe installation Examination of the Robot's Wiring (secure wire placement, efficient wire organization, quality of connections, protection from Abrasion)
    - Judgement Rating of 0 = Overall OMS Wire placement is poorly organized.
    - Judgement Rating of 1 = Overall OMS Wire placement is reasonably organized.
    - Judgement Rating of 2 = Overall OMS Wire placement is very well organized.
    - Judgement Rating of 3 = Overall OMS Wire placement is exceptionally well organized.
- **Object Management System Mechanical Parts** - The fixation of the motors, connection between motors and related gears, chains, pulleys etc. Value 0.7 Marks
    - Judgement Rating of 0 = Overall OMS Mechanical is poorly fastened / tensioned
    - Judgement Rating of 1 = Overall OMS Mechanical is reasonably well fastened / tensioned
    - Judgement Rating of 2 = Overall OMS Mechanical is very well fastened / tensioned
    - Judgement Rating of 3 = Overall OMS Mechanical is exceptionally well fastened / tensioned

12 ADDITIONAL COMPONENTS ROLE IN ASSESSMENT

- The Overall Competitor Experience is based on reflecting the relationship between a Service Provider (The Competitor Team) and an End User Client (JSC KAMAZ).
- The core budget is the 2019 Worldskills Kazan Mobile Robotics Collection. The Client's expectation is the project will "Come in ON Budget".
- Staying "On Budget" means that a team uses only the provided performance related components and does not use any additional performance related components.
    - The Core Robot Frame / Structure must be built using the supplied channels as the primary elements.
    - The supplied electronics **MUST** be used.
    - The supplied Teleoperation Controller **MUST** be used
    - The system **MUST** be designed to use the MyRIO as the main or only processing unit
    - Programming **MUST** be accomplished in Labview
    - Teams **CANNOT** use any hydraulic or barometric pressure
    - Teams **MUST** use the provided battery

- 5 Marks in the 'Prototyping Aspect' will be determined by the number and type of additional components competitors have used when designing / assembling their robots. These marks will be assigned during the 'Marked Robot Inspection Experience'.
- Prototype Points will be assigned based on the type and number of additional components used and these point values will be entered into the Competition Information System (CIS) and used to calculate the related Prototype Marks Assigned to Teams. The CIS calculation will be as follows:
    - ZERO Additional Components Points = 100% of the available Prototype Category Marks being awarded to the Competitor Team
    - ONE Additional Component Point = 75% of the available Prototype Category Marks being awarded to the Competitor Team
    - TWO Additional Components Points = 50% of the available Prototype Category Marks being awarded to the Competitor Team
    - THREE Additional Components Points = 25% of the available Prototype Category Marks being awarded to the Competitor Team
    - FOUR Additional Components Points = 0% of the available Prototype Marks being awarded to the Competitor Team

Prototype Additional Component Marking Categories/Values

- **Sensors: Total Value 1.25 Marks**
    - Infrared / optical / ultrasonic – 1 point / each additional part
    - Gyroscope / magnetometer – 2 points / each additional part
    - Encoder – 2 points/each additional part
- **Motors: Total Value 1.25 Marks**
    - Servomotor same specification as those in the Studica MR Collection – 1 point / each additional part
    - DC motor with or without gearbox – 2 points / each additional part
    - Step motor - 2 points / each additional part
- **Electronics: Total Value 1.25 Marks**
    - Battery – 1 point/ each additional part
    - Microcontroller and board computers (Arduino / PIC / Raspberry / etc) – 2 points each additional part
    - Motor drive / sensor drive – 2 points each additional part
- **Mechanical: Total Value 1.25 Marks**
    - Industrial gripper / arm or Gripper Arm Combination – 4 points / each additional part
    - Linear actuator - 1 point/ each additional part
    - Competitors **CANNOT** add components as direct replacement / upgrades to the provided components. Example: The Four provided Encoder Motors must be used before adding additional encoder motors.
    - Competitors **MUST** use their Mobile Robotics Engineering Technician's Journal / Presentation to provide the rationale on which the decision to add **EACH** additional component was made.
    - All the parts for the robot **MUST** be disassembled and in their initial state (not pre-built) at the end of Familiarization Day (C-2). For example, a motor cannot be put into its' mounting bracket until assembly time begins.
    - The following list represents the type of Components / Elements / Parts that can be added to a Robot that will NOT be counted as additional components with respect to marking.
        - Channel and Tubing, Extrusions / Beams, Gussets, Linkages, Tank Tread, Plates and Brackets, Clamping Mounts, Standoffs and Spacers, Wheels / Axels / Wheel Hubs, Mounting Hardware, Belting and Pulleys, Linear Slide Systems, Fasteners, Gears / Sprockets / Chain

13 COMPETITION SCHEDULE

C-2	**Familiarization Day** • Competitors unpack their tools and robot components • Competitors examine their tools and robot components to confirm they have not been damaged during shipping to the competition site • NO Robot or component assembly takes place on C-2 • Competitors hand in to the Expert Jury Panel a printed copy and a PDF file of the English Text version of their Mobile Robotics Technician's Journal
C1	**Competition Day One** • Competitors have the Full Competition Day to Build / Assemble their Competition Robot • Competitors have Shared Access to their Assigned Performance Assessment Spaces (Parts Department / Factory Floor) on an Unscheduled Basis in the AM session. • Competitors will complete an unscheduled Intermittent Test Project Assessment Experience • Competitors will complete their Intermittent Test Project Assessment Experience on a by Competitor Request Schedule Basis with the restriction that ALL Teams MUST complete these Assessment Experiences by the End of C1 • The Appendix at the end of this document presents SIX Different Parts Department / Factory Layouts. The C1 Layout will be One of the Six Layouts in the appendix. This Layout will be in place on Familiarization Day (C-2).

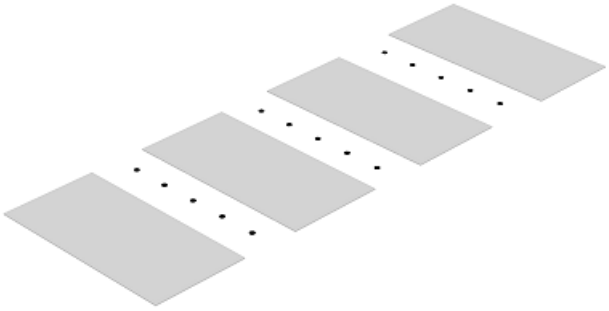
C2	**Competition Day Two**
	• Competitors continue Maintaining / Preparing their Competition Robot
	• Competitors have Shared Access to their Assigned Performance Assessment Spaces (Courts) on a Scheduled Basis during the AM Robot Preparation Basis.
	• Competitors will complete a **Continuous Test Project Assessment Experience** on a scheduled basis possibly including both AM and PM experiences. This schedule will be set by the Experts.
	• The **Continuous Test Project Assessment Experience** will take the form of a 'Completely Known In Advance Test Project'. This mirrors the repetitive type of real-world work assignment (the same work to be completed day after day) often completed by robots.
	  • The exact pattern of Component Loads, Component Carriers and Workstations will be presented during the AM Competitor Information Session and will not change all day.
	  • The Court Layout used will be One of the SIX layouts presented in the appendix.
	  • Time will be an Assessment factor in C2's Evaluated Test Project.

C3	**Competition Day Three** • Competitors continue Maintaining / Preparing their Competition Robot • Competitors have Shared Access to their Assigned Performance Assessment Spaces (Courts) on a Scheduled Basis during the AM Robot Preparation Basis. • Competitors will complete a **Continuous Test Project Assessment Experience** on a scheduled basis possibly including both AM and PM evaluated experiences. This schedule will be set by the Experts. • The **Continuous Test Project Assessment Experience** will be an **Autonomous Experience** and take the form of a "Completely Known In Advance Test Project". This mirrors the type of real-world work assignment where a Robot 'Knows' the Specific Workstations it is responsible to serve BUT does not know the order it must serve these

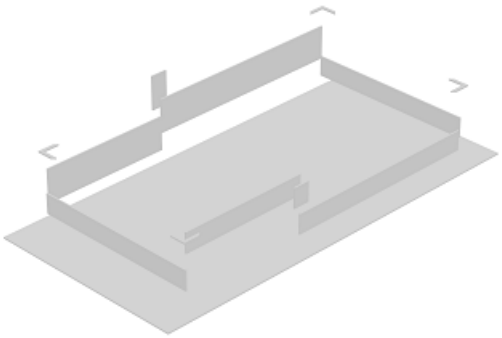
	workstations. This is the equivalent to a real- world robot working in an "On Call Situation". • The exact pattern of Component Loads, Component Carriers and Workstations will be presented during the AM Competitor Information Session and will not change all day. • Robots will be expected to view the "Order Board" to determine which Component Load / Component Carrier to deal with First, Second etc. • The Court Layout used will be One of the SIX layouts presented in the appendix. • **Time will be an Assessment factor in C3's Evaluated Test Project**
C4	**Competition Day Four** • Competitors continue Maintaining / Preparing their Competition Robot • Competitors have Shared Access to their Assigned Performance Assessment Spaces (Courts) on a Scheduled Basis during the AM Robot Preparation Basis. • Competitors will complete a Continuous Test Project Assessment Experience on a scheduled basis possibly including both AM and PM evaluated experiences. This schedule will be set by the Experts. • The **Continuous Test Project Assessment Experience** will be a **Teleoperation with NO Direct Line of Sight Experience** and take the form of a "Completely Known In Advance Test Project". This mirrors the type of real-world work assignment where a Robot "Has malfunctioned and needs to be managed directly by an Operator in a Control Room who knows the Specific Workstations the Robot is responsible to serve". • It will be an Expert Jury Panel Decision whether the Order Workstations are served during this Test Project Assessment Experience will be: (a) Set based on a Competitor Decision made prior to the start of the Test Project Assessment Experience starting, or, (b) Set based on the Competitor (Robot Operator) viewing (through their monitor displaying the image sent from the on the robot independent camera) the Workstation Barcodes presented one at a time on the Order Board. • The Court Layout used will be One of the SIX layouts presented in the appendix. • **Time will be an Assessment factor in C4's Evaluated Test Project.**

14 CREATING ONE CORE PERFORMANCE ENVIRONMENT (EXCLUSIVE USE COURT)

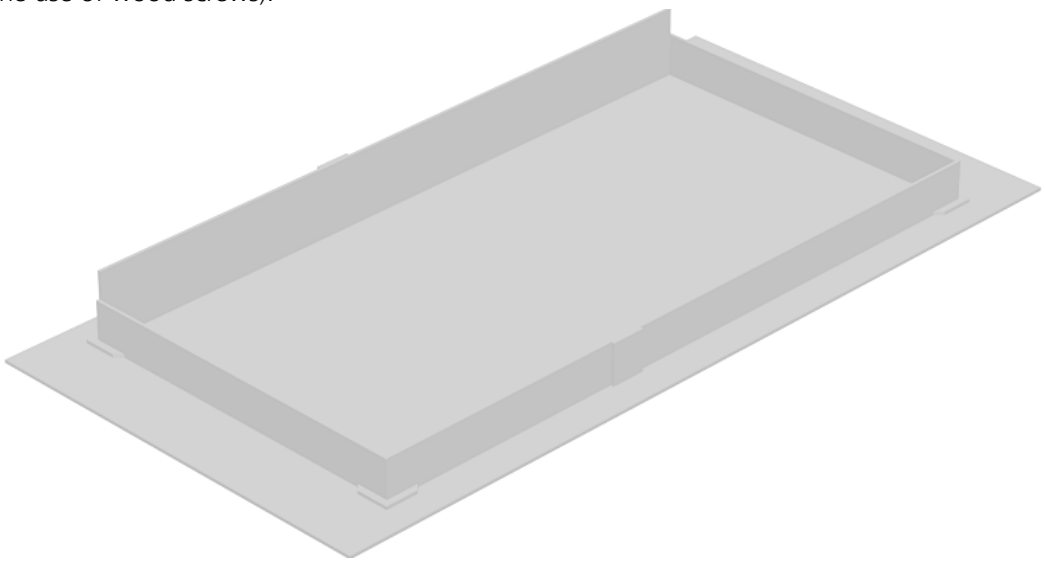
- A Sturdy, Smooth, Hard, White One Team Performance Environment (Court) Floor is created by:
  - Cutting Biscuit Joints along two sides of the centre1220 mm x 2440 mm x 19 mm White MDF Sheets and One side of the End White MDF Sheets
  - Laying the Four MDF Sheets on the floor
  - Inserting the Biscuits
  - Sliding the sheets together



- Following the Cutting Plan presented in this document will create the following Court Pieces:
  - Two End Walls
  - Two Centre Divider Pieces
  - Two Side Wall Pieces
  - Two Wall Plates (For Overlapping the Centre Diver and Side Wall Pieces Seams
  - Pre-drill screw holes at the corners and in the walls where the Wall Lap Plates are positioned.
  - Assemble with "Dome Headed Screws"
  - Screw the Corner Supports to the Floor Sheets



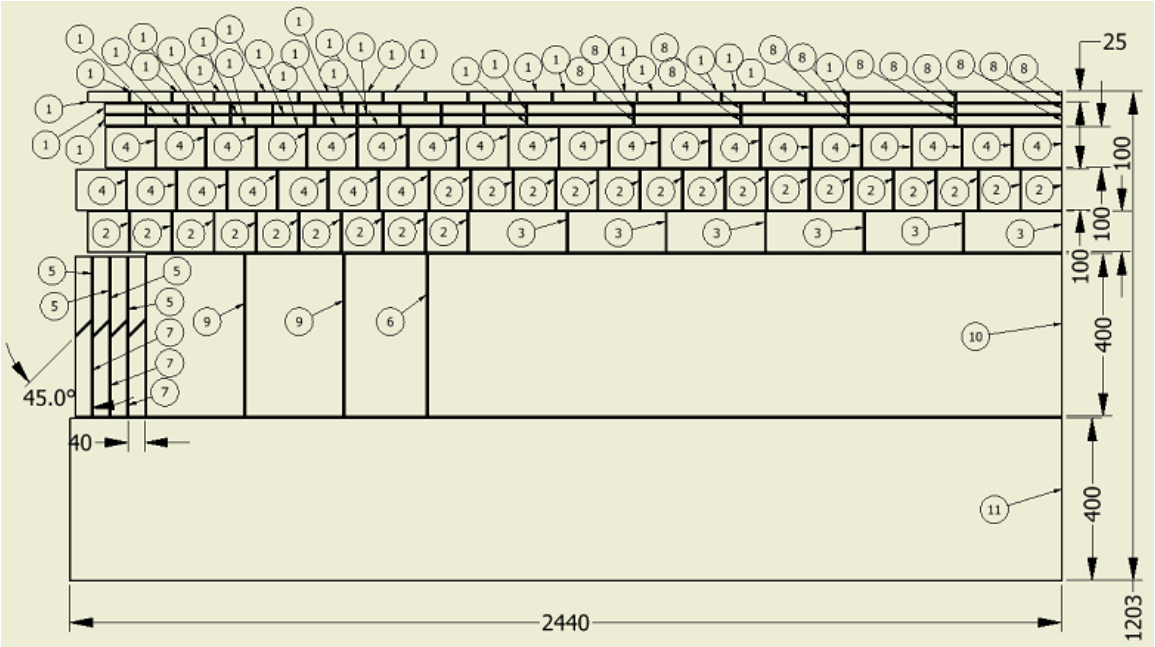
Note:
Internal court layout elements will be connected using White Duct Tape (To avoid damaging the edges of these court elements and enable them to be re-used given Melamine is not very friendly to the use of wood screws).



15 CUTTING PATTERNS FOR ONE EXCLUSIVE USE COURT

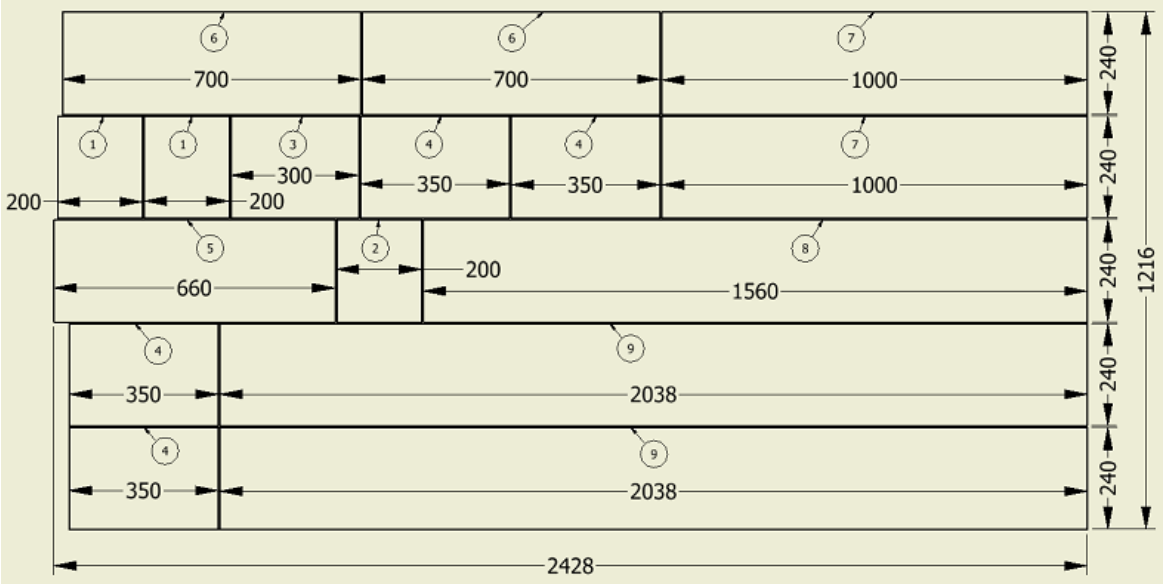
- It takes Nine 1220 mm x 2240 mm x 19 mm Sheets of White MDF to be able to create the complete set of 'Building Blocks' and Floor Panels required to create ALL of the Court Layout Samples presented in this document.
- The intention is to have a useful learning environment that can be used for a long time in schools following the Kazan competition NOT a used one time at the competition or during Kazan only competition preparation experiences and then discarded.

By way of example I can create a very viable reproduction of the following Worldskills Performance Environments using the 2019 Building Blocks Collection. The primary extra item I would need to add would be a set of Billiard Balls and a Bag of Garden Hose Washers.



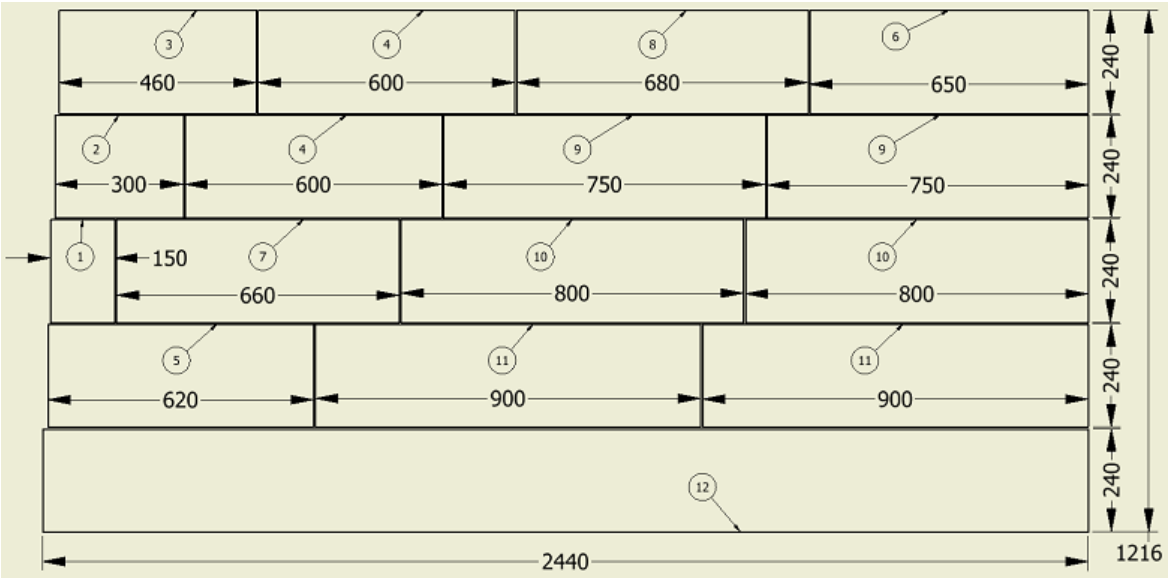
- One Team Performance Environment (Court) Cutting Pattern One

Crt Elements CP 1 PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	38	Bin Wall / Component Carrier Leg	100 by 25 by 19 mm
2	24	Component_Carrier_Plt	100 by 100 mm
3	6	100_Crt_Wall	100 by 240 mm
4	26	WorkStation_Plt	120 by 100 mm
5	4	Corner_Brace_2	195 by 40 mm
6	1	200_Center_CrtWallPlt	200 by 400 mm
7	4	Corner_Brace_1	235 by 40 mm
8	12	260_Bin_Face	260 by 30 mm
9	2	400_Crt_Wall	400 by 240 mm
10	1	1560_Center_Crt_Divider	1560 by 400 mm
11	1	2440_Center_Crt_Divider	2440 by 400 mm



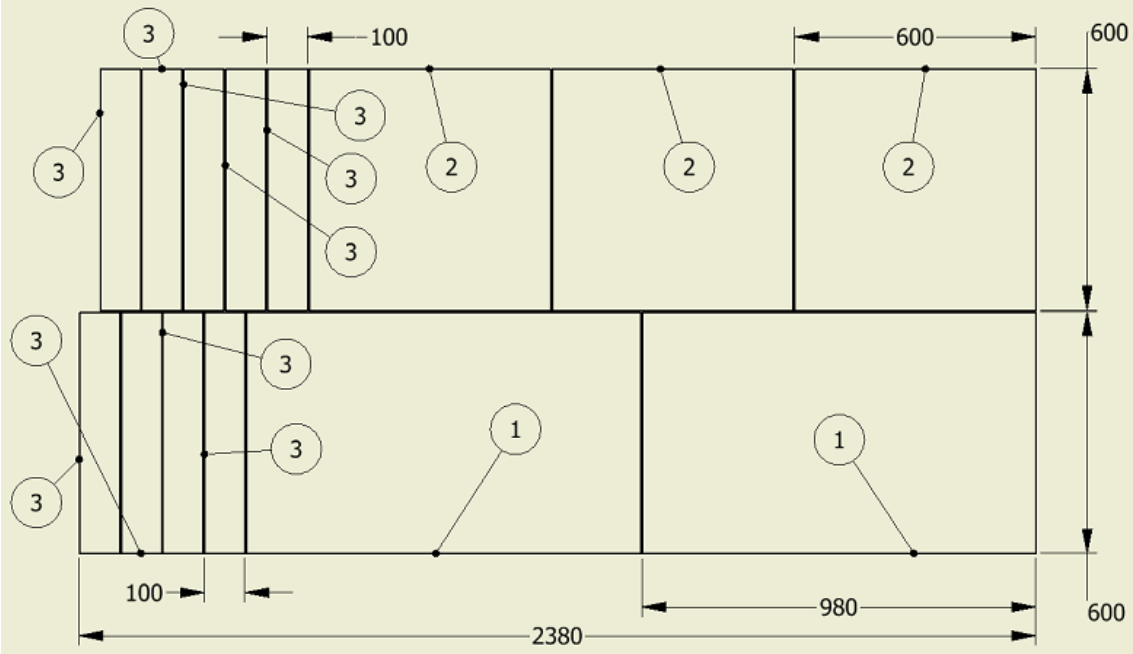
- One Team Performance Environment (Court) Cutting Pattern Two

Court Elements CP 2 Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	200_Crt_Wall	200 by 240 mm
2	1	200_CrtWallPlt	200 by 240 mm
3	1	300_Crt_Wall	300 by 240 mm
4	4	350_Crt_Wall	350 by 240 mm
5	1	660_Crt_Wall	660 by 240 mm
6	2	700_Crt_Wall	700 by 240 mm
7	2	1000_Crt_Wall	1000 by 240 mm
8	1	1560_Crt-SideWall	1560 by 240 mm
9	2	2038_Crt_EndWall	2038 by 240 mm



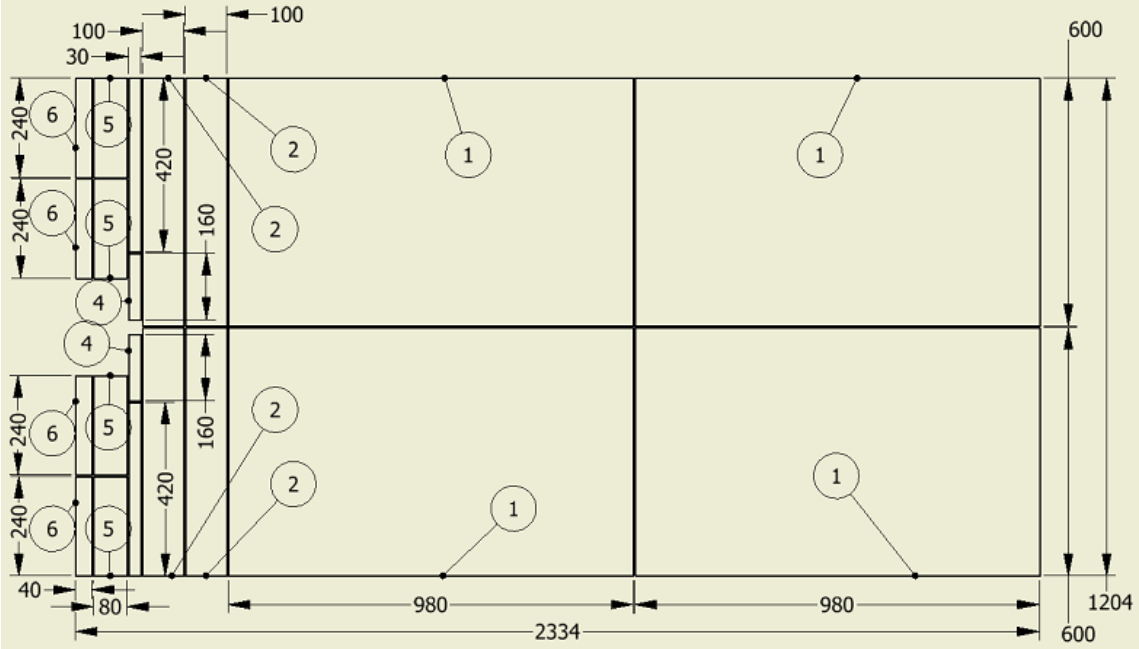
- One Team Performance Environment (Court) Cutting Pattern Three

Court Elements CP 3 Parts List			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	150_Crt_Wall	150 by 240 mm
2	1	300_Crt_Wall	300 by 240 mm
3	1	460_Crt_Wall	460 by 240 mm
4	2	600_Crt_Wall	600 by 240 mm
5	1	620_Crt_Wall	620 by 240 mm
6	1	650_Crt_Wall	650 by 240 mm
7	1	660_Crt_Wall	660 by 240 mm
8	1	680_Crt_Wall	680 by 240 mm
9	2	750_Crt_Wall	750 by 240 mm
10	2	800_Crt_Wall	800 by 240 mm
11	2	900_Crt_Wall	900 by 240 mm
12	1	2440_Crt-SideWall	2440 by 240 mm



- One Team Performance Environment (Court) Cutting Pattern Four

Court Elements CP 4 PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	Ramp_Source_Plate	980 by 600 by 19 mm
2	3	Platform Source Plate	600 by 600 by 19 mm
3	9	Workstation Platform / Floor Plate	600 by 100 by 19 mm



- One Team Performance Environment (Court) Cutting Pattern Five

Court Elements CP 5 PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	Ramp_Source_Plate	980 by 600 by 19 mm
2	4	Workstation Platform / Floor Plate	600 by 100 by 19 mm
3	2	Order Board Frame Top / Bottom	420 by 30 by 19 mm
4	2	Order Board Sides	160 by 30 by 19 mm
5	4	80_Crt_Wall	80 by 240 by 19 mm
6	4	40_Crt_Wall	40 by 240 by 19 mm

16 KAZAN EXCLUSIVE USE PERFORMANCE ENVIRONMENT (COURT) COLLECTION

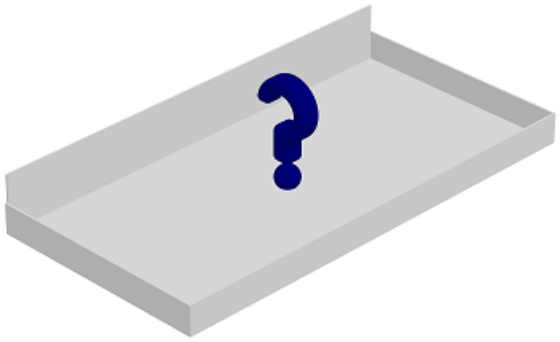
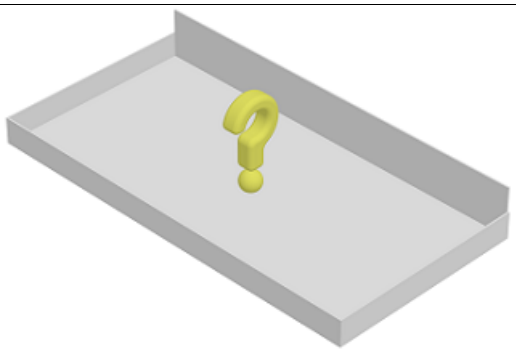
Note:

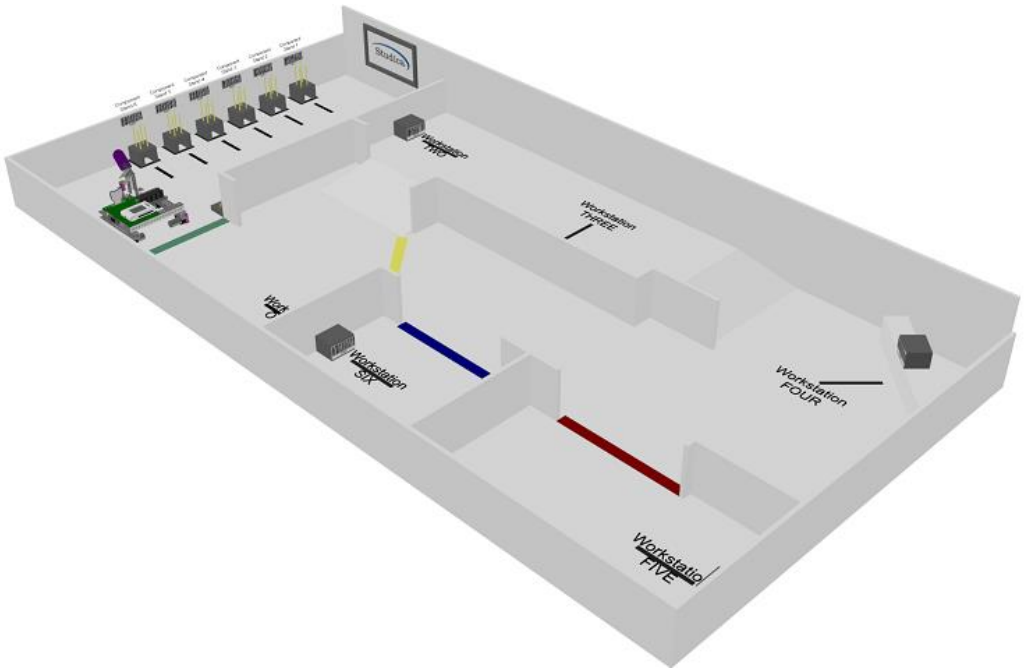
There are **SIX Factory Layouts** presented in detail in this document with each providing Teams with an Exclusive Use Performance Environment.

Two additional Factory Layouts (Numbers Seven and Eight) will be created. These Factory Layouts will have the same range of performance requirements as Factory Layouts 1 to 6. However, the specific Layout Details for Factories 7 and 8 will not be known by the Competitors or Experts in advance.

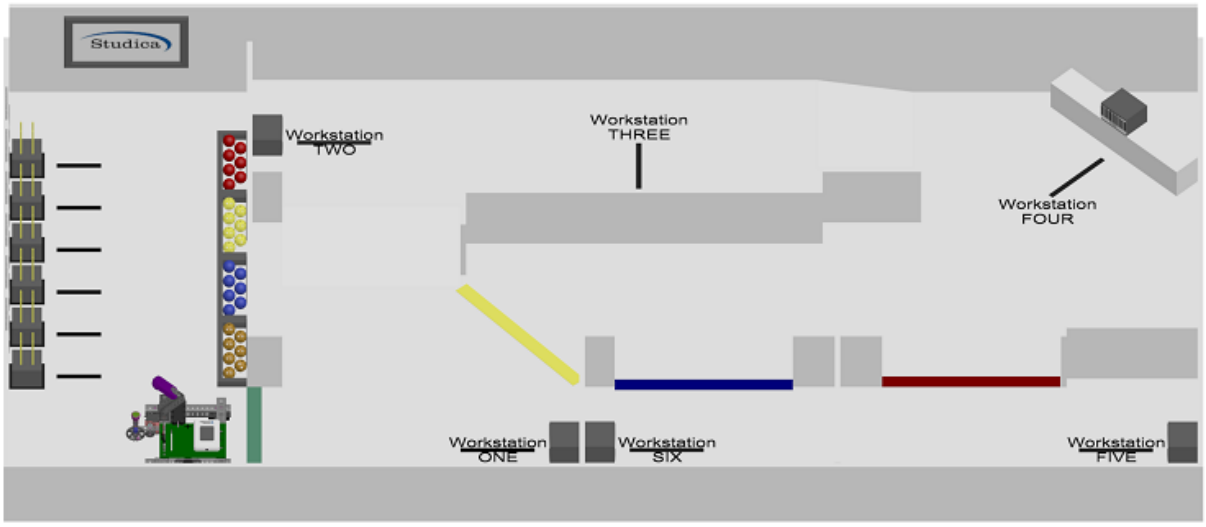
ALL EIGHT Factory Layouts will be available for use on any of the **Four Competition Days** of the Kazan Competition.

However, **One or BOTH of Factory Layouts Seven and Eight will be used in Kazan.**

	
Factory Seven	Factory Eight

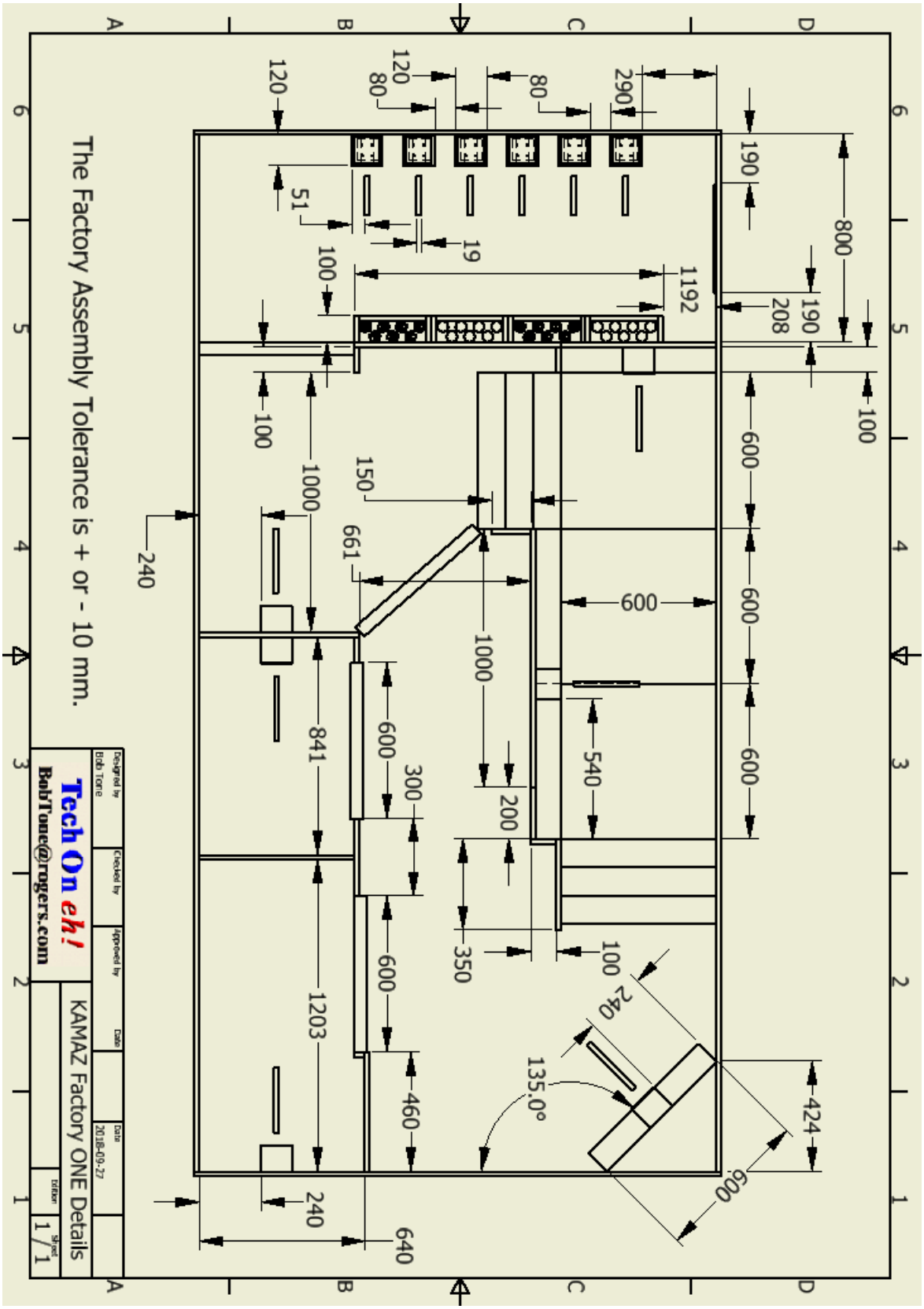


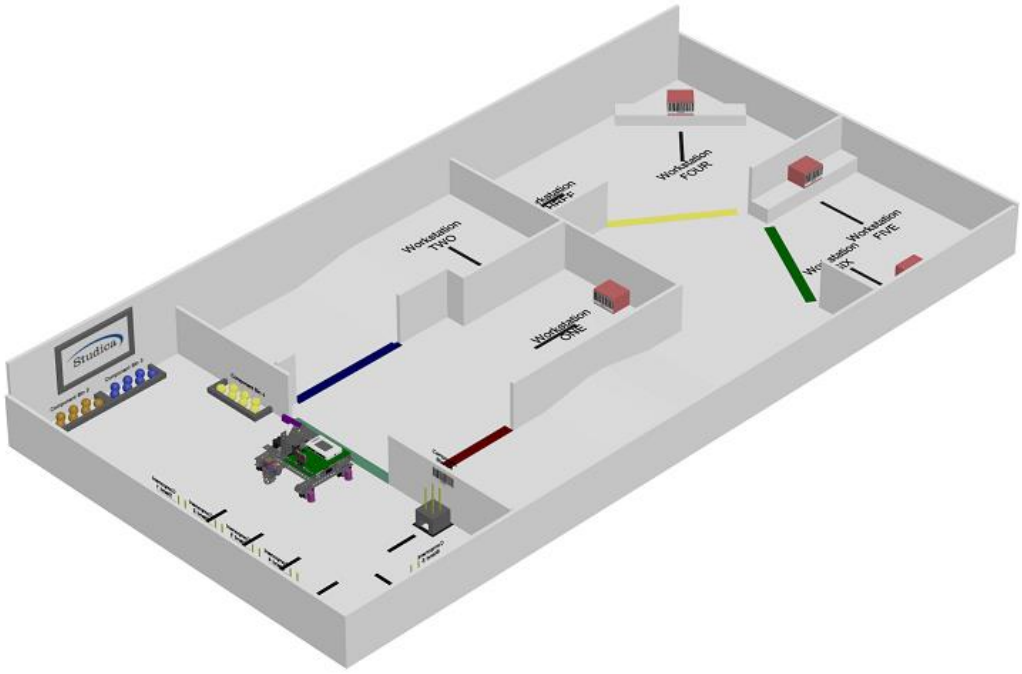
- Kazan "KAMAZ" factory layout one



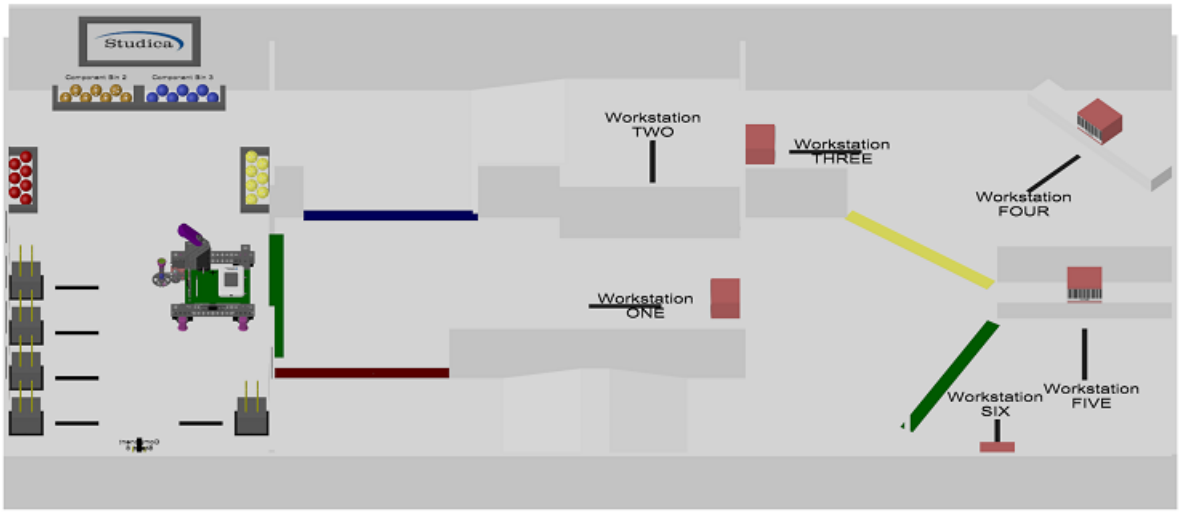
Worldskills Kazan 2019 / KAMAZ Factory ONE Court Elements					
ITEM	QTY	Crt Element	ITEM	QTY	Crt Element
1	1	40 mm Court Wall	13	1	600 by 100 by 114 mm Platform
2	4	100 mm Court Wall	14	3	600 by 100 by 57 mm Platforms
3	1	150 mm Court Wall	15	1	600 by 600 by 57 mm Platform
4	1	200 mm Court Wall	16	1	Order Display
5	1	300 mm Court Wall	17	6	Workstations
6	1	350 mm Court Wall	18	6	Component Carriers
7	1	460 mm Court Wall	19	6	Component Carrier Stands
8	2	600 mm Court Wall	21	1	Bin with 7 Orange Wiffle Balls
9	1	620 mm Court Wall	22	1	Bin with 7 Yellow Wiffle Balls
10	1	800 mm Court Wall	23	1	Bin with 7 Blue Standard Balls
11	1	1000 mm Court Wall	24	1	Bin with 7 Red Standard Balls
12	2	600 by 600 Ramps			

- "KAMAZ" Factory Layout ONE Details



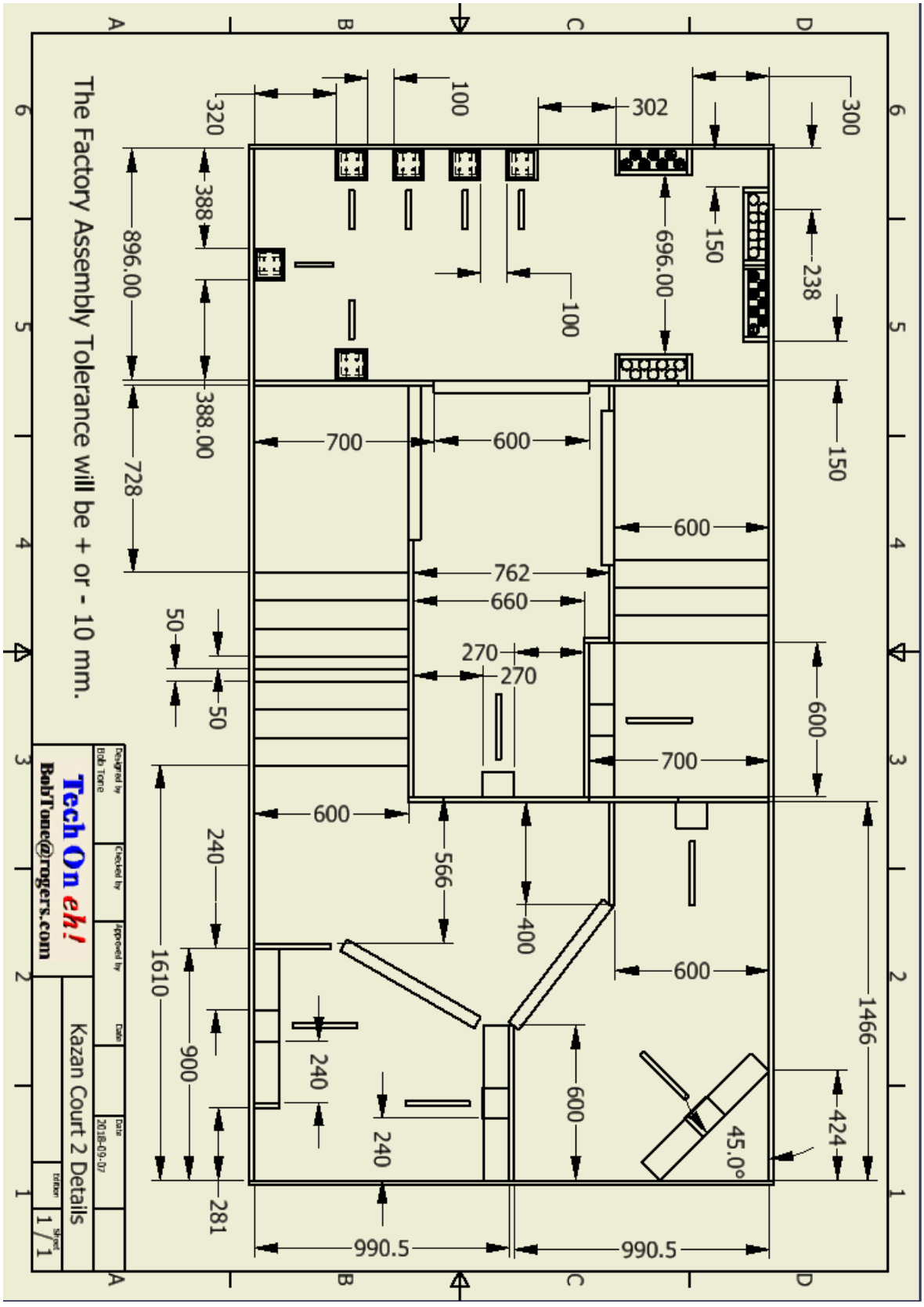


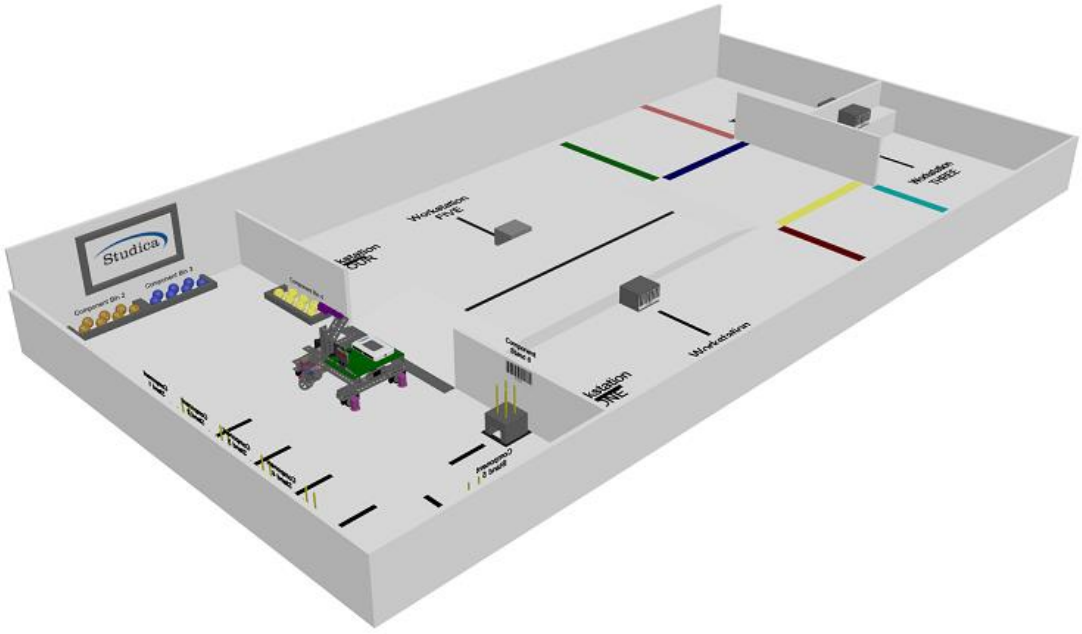
- "KAMAZ" Factory Layout Two



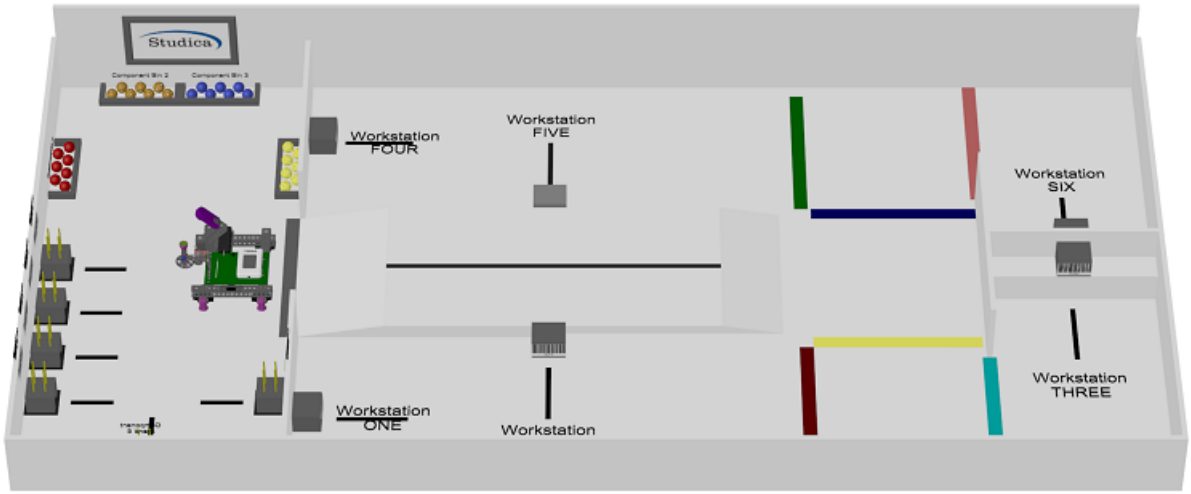
Worldskills Kazan 2019 / KAMAZ Factory TWO Court Elements					
ITEM	QTY	Crt Element	ITEM	QTY	Crt Element
1	3	100 mm Court Wall	11	2	600 by 100 by 57 mm Platform
2	2	300 mm Court Wall	12	1	600 by 100 by 76 mm Platform
3	4	350 mm Court Wall	13	1	600 by 100 by 114 mm Platform
4	1	400 mm Court Wall	14	6	Component Carriers
5	2	600 mm Court Wall	15	6	Component Carrier Stands
6	2	700 mm Court Wall	16	6	Workstations
7	1	1000 mm Court Wall	17	1	Bin with 7 Yellow Wiffle Balls
8	2	600 by 50 Ramps	18	1	Bin with 7 Blue Standard Balls
9	1	600 by 600 Ramp	19	1	Bin with 7 Red Standard Balls
10	1	900 mm Court Wall	20	1	Bin with 7 Red Standard Balls
11	1	1000 mm Court Wall	21	1	Order Display

- "KAMAZ" Factory Layout TWO Details



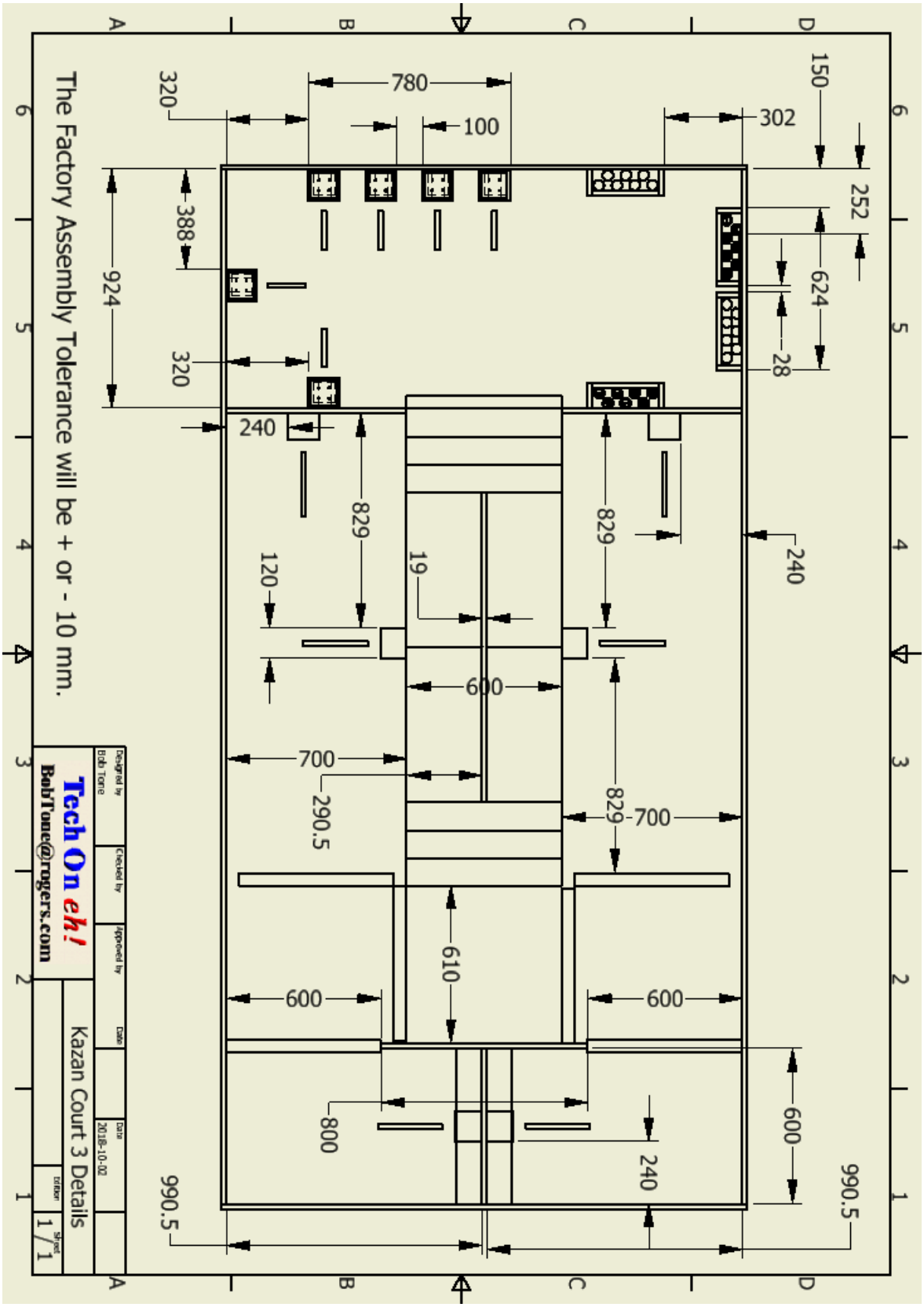


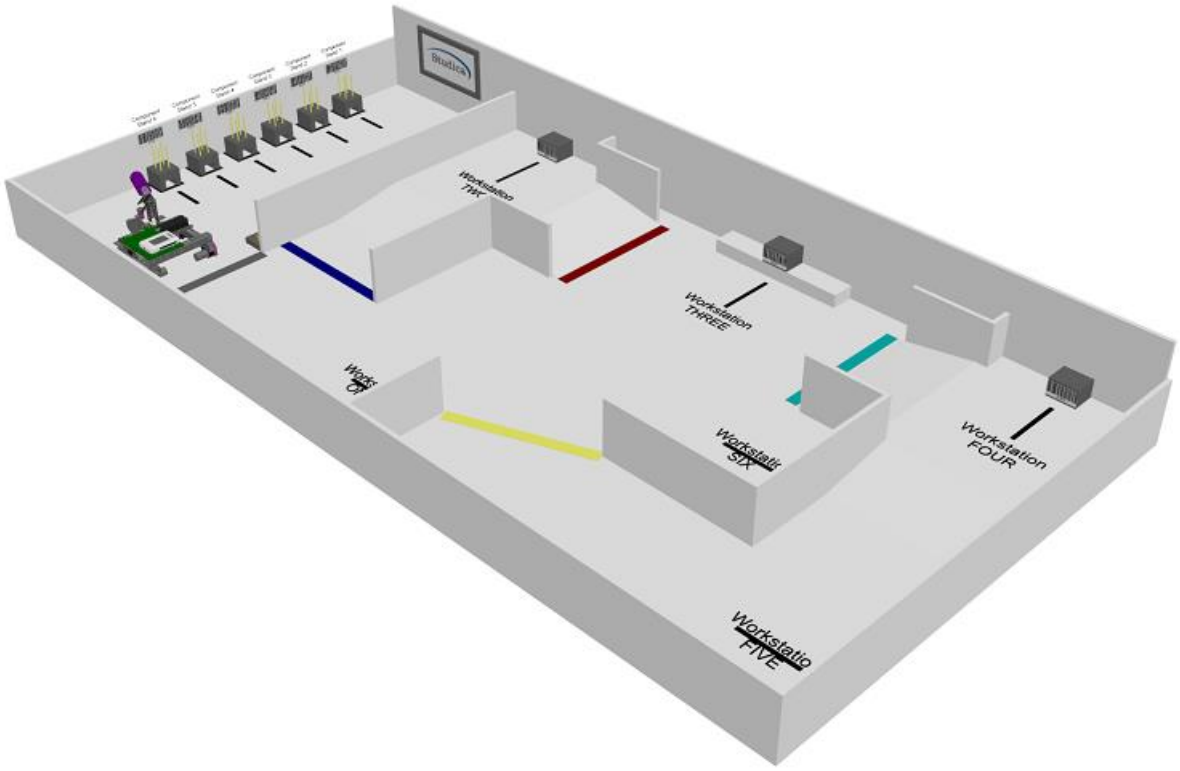
- Kazan "KAMAZ" factory layout THREE



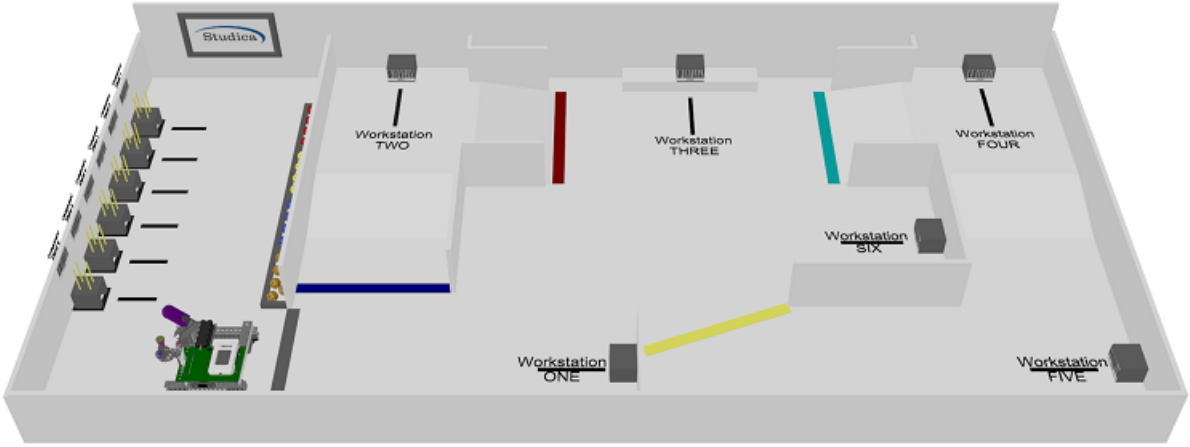
Worldskills Kazan 2019 / KAMAZ Factory THREE Court Elements					
ITEM	QTY	Crt Element	ITEM	QTY	Crt Element
1	1	600 mm Court Wall	8	6	Component Carrier Stands
2	2	700 mm Court Wall	9	6	Workstations
3	1	800 mm Court Wall	10	1	Bin with 7 Orange Wiffle Balls
4	2	600 by 600 Ramps	11	1	Bin with 7 Yellow Wiffle Balls
5	2	600 by 100 by 114 mm Platforms	12	1	Bin with 7 Blue Standard Balls
6	1	Order Display	13	1	Bin with 7 Red Standard Balls
7	6	Component Carriers			

- "KAMAZ" Factory THREE Details



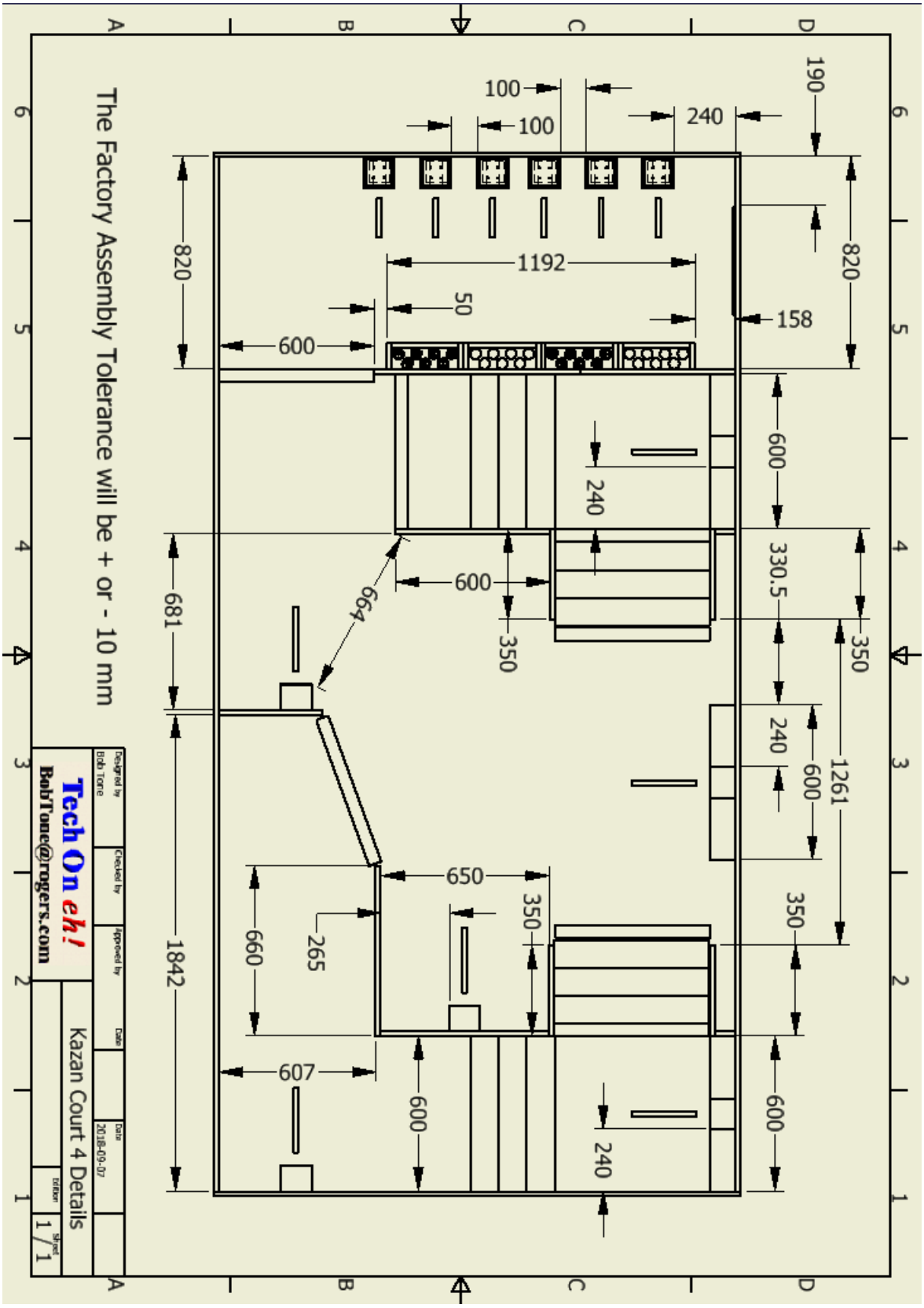


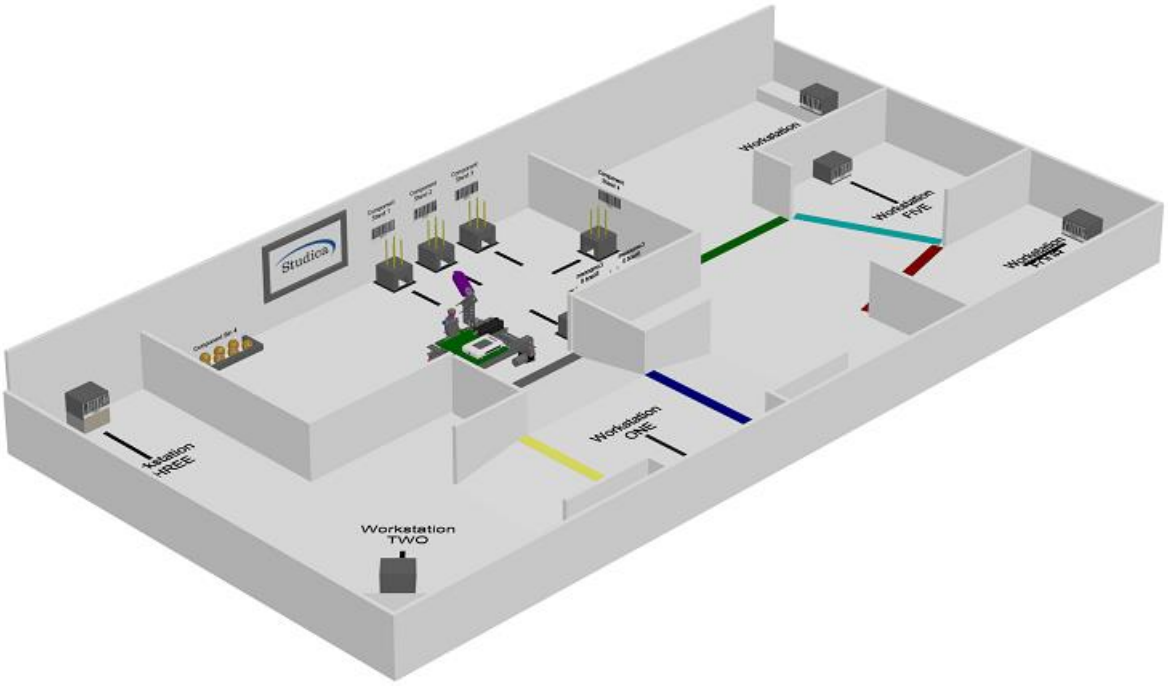
- Kazan "KAMAZ" Factory Layout FOUR



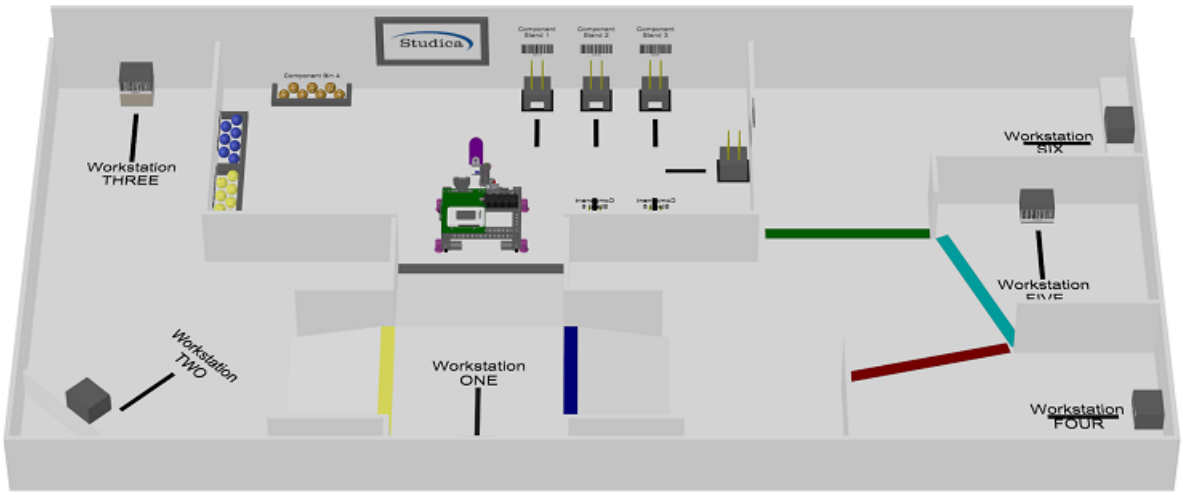
Worldskills Kazan 2019 / KAMAZ Factory FOUR Court Elements					
ITEM	QTY	Crt Element	ITEM	QTY	Crt Element
1	2	80 mm Court Wall	10	2	600 by 50 Ramps
2	4	350 mm Court Wall	11	1	Order Display
3	1	400 mm Court Wall	12	6	Component Carriers
4	2	600 mm Court Wall	13	6	Component Carrier Stands
5	1	650 mm Court Wall	14	6	Workstations
6	2	660 mm Court Wall	15	1	Bin with 7 Orange Wiffle Balls
7	1	800 mm Court Wall	16	1	Bin with 7 Yellow Wiffle Balls
8	3	600 by 100 by 57 mm Platforms	17	1	Bin with 7 Blue Standard Balls
9	2	600 by 600 Ramps	18	1	Bin with 7 Red Standard Balls

- Kazan "KAMAZ" Factory Layout FOUR Details


The Factory Assembly Tolerance will be + or - 10 mm
Tech On eh!
BobTonne@rogers.com
Designed by
Bob Tonne
Checked by
Approved by
Date
Date
2018-09-07
Kazan Court 4 Details
Sheet
1 / 1
100
100
240
190
820
1192
50
158
820
600
600
240
330.5
681
600
664
350
350
240
600
1261
650
350
350
660
265
1842
607
600
600
240

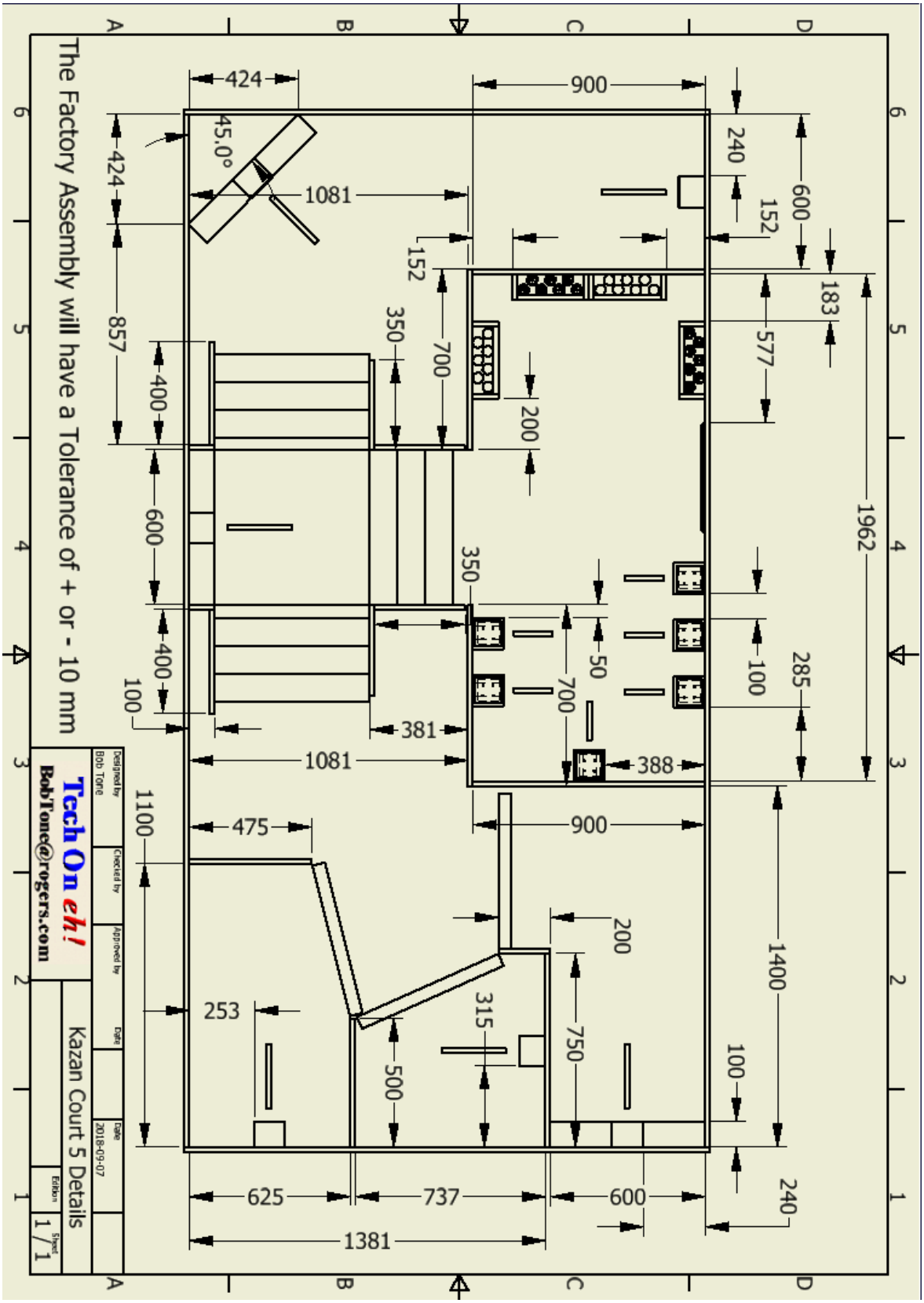


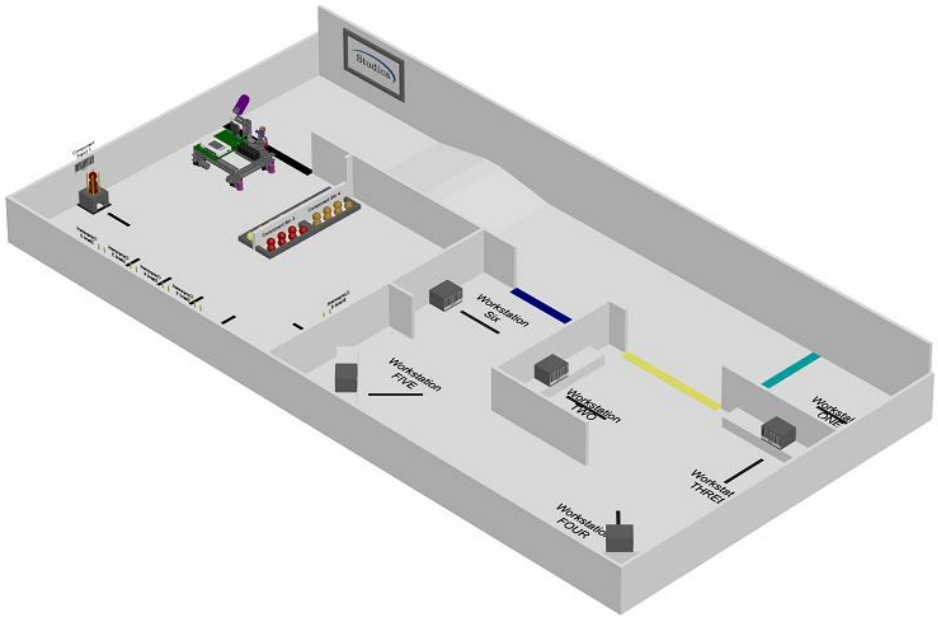
- Kazan "KAMAZ" Factory Layout FIVE



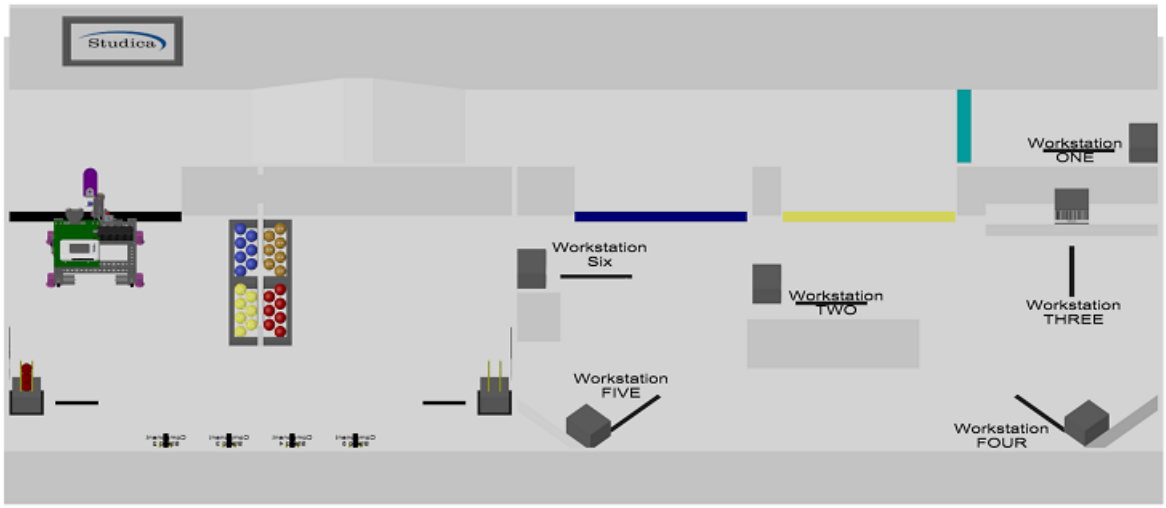
Worldskills Kazan 2019 / KAMAZ Factory FIVE Court Elements					
ITEM	QTY	Crt Element	ITEM	QTY	Crt Element
1	2	100 mm Court Wall	12	1	600 by 600 Ramps
2	1	200 mm Court Wall	13	2	600 by 50 Ramps
3	4	350 mm Court Wall	14	1	Order Display
4	2	400 mm Court Wall	15	6	Component Carriers
5	1	475 mm Court Wall	16	6	Component Carrier Stands
6	1	500 mm Court Wall	17	6	Workstations
7	2	700 mm Court Wall	18	1	Bin with 7 Orange Wiffle Balls
8	1	750 mm Court Wall	19	1	Bin with 7 Yellow Wiffle Balls
9	2	900 mm Court Wall	20	1	Bin with 7 Blue Standard Balls
10	2	600 by 100 by 57 mm Platforms	21	1	Bin with 7 Red Standard Balls
11	1	600 by 100 by 114 mm Platforms			

- Kazan "KAMAZ" Factory Layout FIVE Details





- Kazan 'KAMAZ' Factory Layout SIX



Worldskills Kazan 2019 / KAMAZ Factory SIX Court Elements					
ITEM	QTY	Crt Element	ITEM	QTY	Crt Element
1	1	40 mm Court Wall	12	1	1000 mm Court Wall
2	1	100 mm Court Wall	13	4	600 by 100 by 57 mm Platform
3	1	100 by 600 mm Court Wall	14	2	600 by 50 Ramps
4	1	150 mm Court Wall	15	1	Order Display
5	1	200 mm Court Wall	16	6	Workstations
6	1	350 mm Court Wall	17	6	Component Carriers
7	2	400 mm Court Wall	18	6	Component Carrier Stands
8	1	600 mm Court Wall	19	1	Bin with 7 Orange Wiffle Balls
9	1	700 mm Court Wall	20	1	Bin with 7 Yellow Wiffle Balls
10	1	750 mm Court Wall	21	1	Bin with 7 Blue Standard Balls
11	1	800 mm Court Wall	22	1	Bin with 7 Red Standard Balls

- Kazan 'KAMAZ' Factory Layout SIX Details