MACHINE COMPETITION HANDBOOKM

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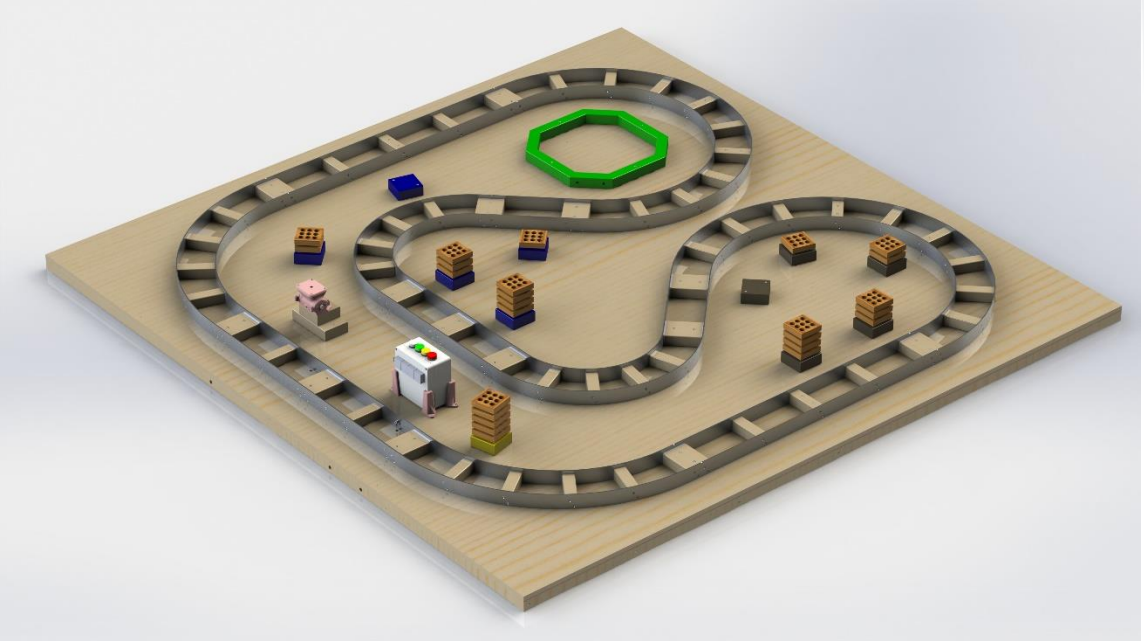
Mission JDG2020

TOP SECRET

RHEINMETALL DEFENCE

Quebec Engineering Games
Mission JDG 2020: Change the world
Machine competition handbook
École de Technologie Supérieure



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A HUGE thanks to all partners involved in the 2020 Engineering Games Machine challenge. Without you, it would inconceivable to successfully carry out this ambitious project.

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Le 7 novembre 2019

RHEINMETALL DEFENCE

À tous les participants et participantes,

Encore une fois cette année, l'équipe de Rheinmetall Canada est extrêmement fière de participer aux Jeux de génie du Québec. Et nous aimerions bien que ce partenariat devienne une tradition puisque cet événement prépare très bien la relève à la réalité qui l'attend sur le marché du travail.

Selon nous, au cœur du travail des ingénieurs.es, il y a la volonté de se dépasser, de pousser la technologie plus loin et de relever des défis techniques en équipe – du moins, c'est le cas chez Rheinmetall Canada. Et c'est exactement ce que vous vivez en participant à cette compétition amicale.

La *Mission JDG2020*, cette année, vous pousse à mettre votre ingéniosité au service d'un monde meilleur. Nous espérons que la volonté de changer les choses, thématique de cette compétition, vous permettra de donner le meilleur de vous-même durant cette épreuve, mais aussi tout au long de votre carrière.

De la part de toute l'équipe Rheinmetall Canada, merci aux organisateurs.trices, aux partenaires et bonne chance à toutes les délégations!

Roger Bolduc, ing.

Directeur principal, Ingénierie
Rheinmetall Canada inc.

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2020 Machine Challenge:
Urban agriculture on electrified rails

In the past, land had to be cleared with a plow and oxen. Nowadays, engineering has made it possible to develop motorization, fertilizers, and pesticides to ensure better land productivity. Unfortunately, land on the surface of the earth can no longer support that kind of culture.

Such farming has contributed to water pollution, made the air unbreathable and increased climatic variations. Also, this sector of activity, which requires huge quantities of water, is vulnerable to diseases and insects as well as being at the mercy of bad weather. In Quebec, the number of farms is constantly decreasing. Increasingly harsh winters, spring floods, and critical periods of drought are problematic for the region's inhabitants, who must then resort to technological alternatives to feed themselves.

Inspired by a company in London[1], the Bureau of Engineering and Planning of Competitions Organized as Multidisciplinary (BEPCOM) believes that a viable solution to this problem is to develop urban agriculture through hydroponics: the cultivation of plants in a soil-free environment. This type of controlled indoor cultivation has countless advantages to offer.

The BEPCOM's Machine department therefore wishes to develop a technology that will allow the installation of new ultra-sophisticated industrial plantations. To take advantage of the creativity and knowledge of the next generation of engineers, the organization is launching an open competition to member universities of the Quebec Confederation for Engineering Student Outreach (QCESO).

Driven by the desire to get involved in the development of young scientific minds, the NPO PMI-Montréal provides its mentoring resources in project management to all teams to optimize their chances of success for this challenge.

Thanks to their technical knowledge and partnerships, the participants will have to produce a complete solution that can be operated by the BEPCOM in the environment designed by the organization's Machine Department. The team producing the best result on a small scale will then be given the opportunity to coordinate BEPCOM's semi-automated agricultural development project across the province of Quebec.

[1] *Where it all started...!*

1. Challenge overview

Hydroponics is a process that allows plants to be grown in an inert substrate. This way, nutrients are supplied to plants by water circulation in growing stations. The process consists of 4 main steps that the robotic solution will have to recreate.

First, seeds taken from a distributor must be laid on a substrate tray. Then, they are placed in the dark to optimize sprouting. After a few days, the sprouts can now be moved to illuminated hydroponics stations to optimize their growth. Finally, the mature plants are harvested and placed in a packaging area for shipment to various retailers.

Participants will be required to produce a small-scale prototype to promote their concept of robotization of a hydroponic process. BEPCOM provides the following scaled-down model, which represents a facility with electrified rails and its different areas of production.

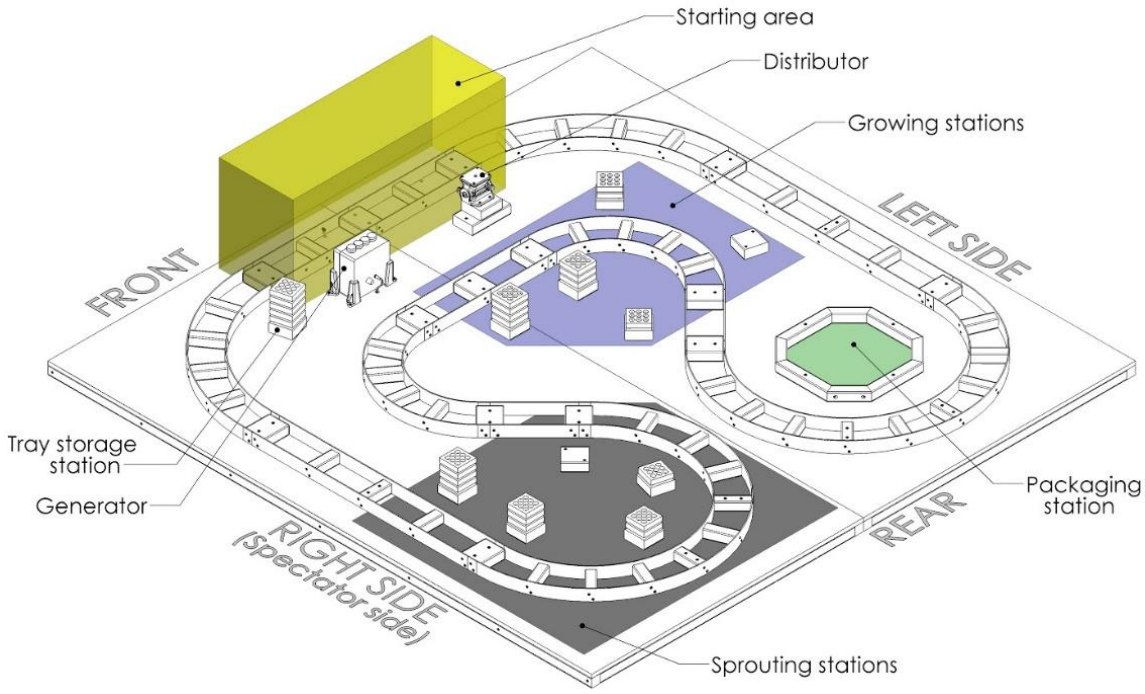

Figure 1: 2020 Machine challenge course

In concrete terms, the robotic solution must be able to:

1) Move around using electrified rails as its main energy source;
2) Remove steel marbles from a manual dispenser;
3) Store marbles inside drilled square MDF trays;
4) Transport trays and place them at the proper location according to their contents;
5) Remove glass marbles from trays and place them in the appropriate area;
6) Replicate a sequence by pressing the buttons on a generator.

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2. Challenge components

This section includes all the information related to the course and the definition of its different components. Each section contains:

1) *A contextualization written in italic;*
2) The physical characteristics of a component;
3) Its behavior and possible interactions with the element.

2.1. Rails

The robotic solution will have to be powered by the facility's electrified rails. Of course, the power supply has protections that limit the current to prevent any damage to the equipment.

2.1.1. The aluminum bars

The rail consists of two aluminum bars of 2"x1/8", separated by 4-3/4" for a total width of 5". Each bar was drilled and milled to embed the screw heads to leave the outer side of the rail uniform.

To ensure electrical continuity throughout the course, the rail sections are linked with each other with aluminum continuity segments. These segments are 1-1/2" high, 1/8" wide and 3-1/2" long.

On the entire course, there is a minimum clearance of 4" on both sides of the rails. Therefore, the challenge components are reachable at about this distance.

The rails can be used as a mechanical support for the robotic solution. However, the aluminum bars must not be damaged under any circumstances. Damaging the rails will result in penalties.

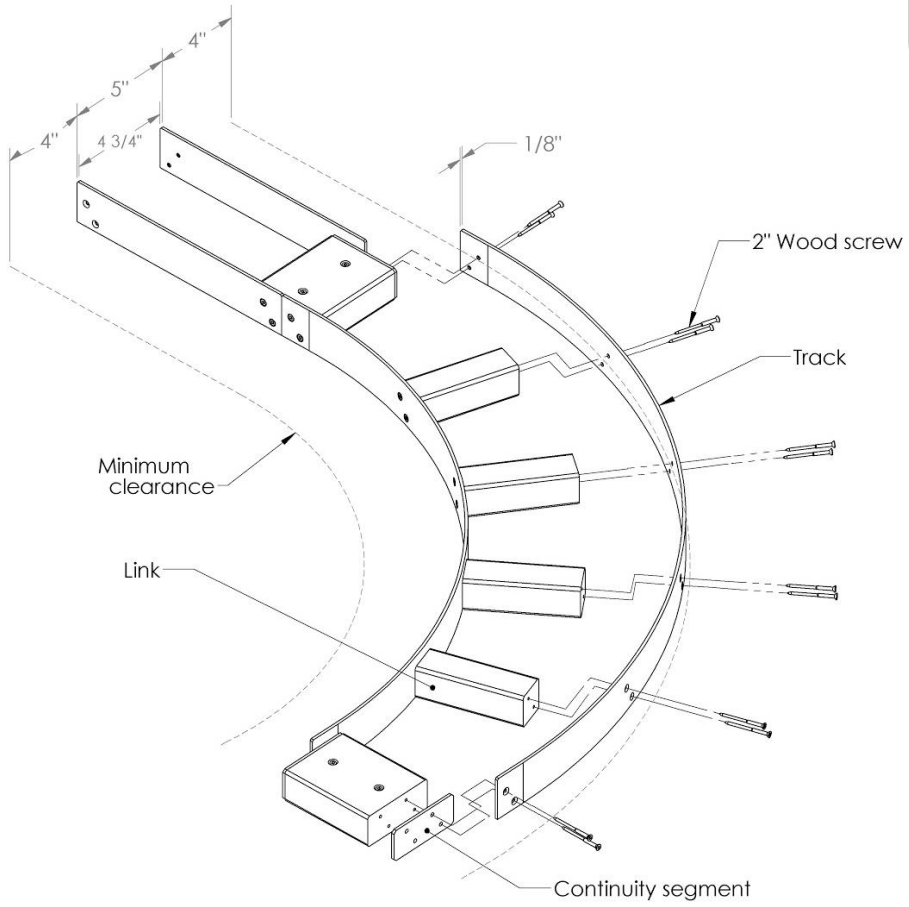

Figure 2: Rail composition

2.1.2. Rail electrification

The rails **must** be used as the power supply for the robotic solution. They will be powered by a 115V / 18V transformer whose primary winding is connected to the 120Vac domestic power supply and it's secondary is protected by a 10A circuit breaker before feeding the rails. Causing the circuit-breaker to trip due to excessive power consumption will result in penalties.

2.2. Marble modules

2.2.1. The marbles

The logistics surrounding the crop production in the facility means that the robotic solution has to handle 3 types of resources represented by marbles:

1) Seeds of plants;
2) Sprouted seeds;
3) Mature plants ready to harvest.

Three types of marbles must be placed at different locations along the course:

1) 1/4" diameter steel marbles (seeds);
2) 3/8" diameter steel marbles (sprouts);
3) 1/2" diameter glass marbles (plants).

To lighten the text, each resource will be named by their representation in the challenge by respectively "seeds", "sprouts" or "plants".

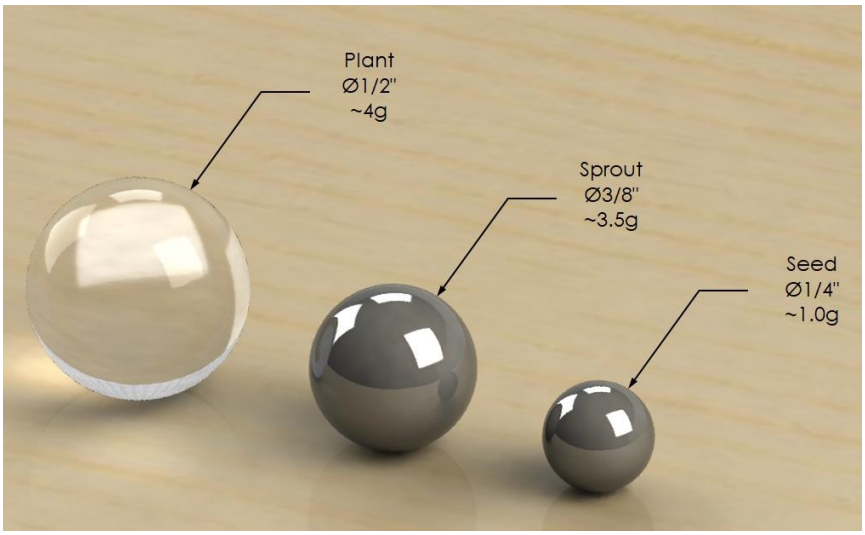

Figure 2: Resources

2.2.2. The trays

Substrate trays allow plants to develop themselves. They contain fibers in which the roots can grow, allowing nutrients to be sent to the plants by hydroponics.

The trays are used as containers for the marbles. They consist of two squares made of medium density fiberboards (MDF). A first square of 3-1/4" x 3-1/4" x 3/4" has 9 holes of 11/16" diameter. A second 2-1/2" x 2-1/2" x 1/4" square glued under the first one allows to block the holes at the bottom.

Since they are all identical, each tray can be used for any resource. However, each marble space can only store one marble at a time, which means that the maximum capacity of a tray is 9 marbles. Therefore, only one ball per hole will be counted in the score. Damaging a tray during handling will result in penalties.

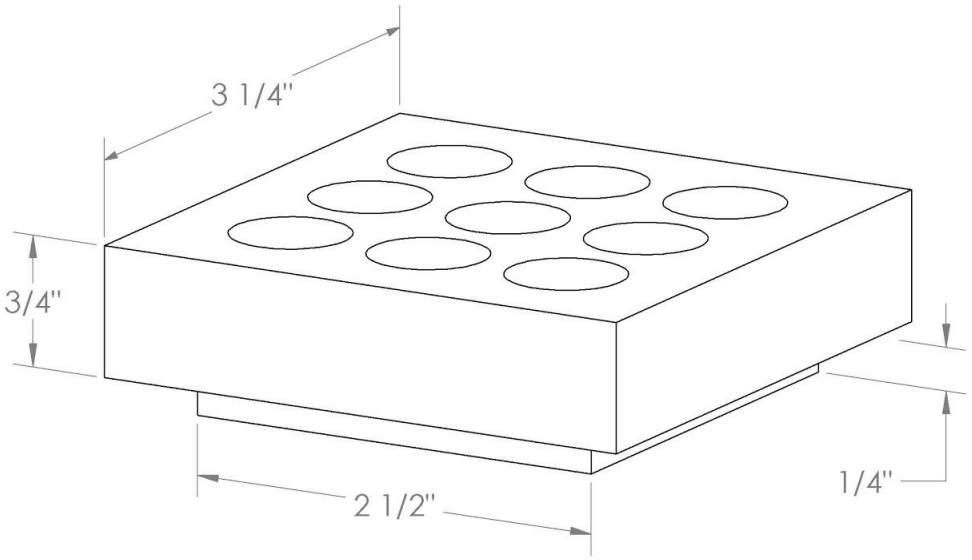

Figure 3: Transport tray

2.2.3. The dispenser

Initially, seeds must be extracted from a dispenser to be placed in an empty tray. This represents the process of planting seeds. To avoid waste, the dispenser only releases one seed at a time.

Operating the dispenser at the front of the field is the only method of obtaining seeds. The latter consists of a covered container, a horizontal distribution cylinder, and a chute. Through this chute, the seeds will be released to be collected. Initially, the tank contains about 200 marbles of seeds ready to be extracted and put into empty trays. On the official course, this dispenser is printed with red-colored PLA.

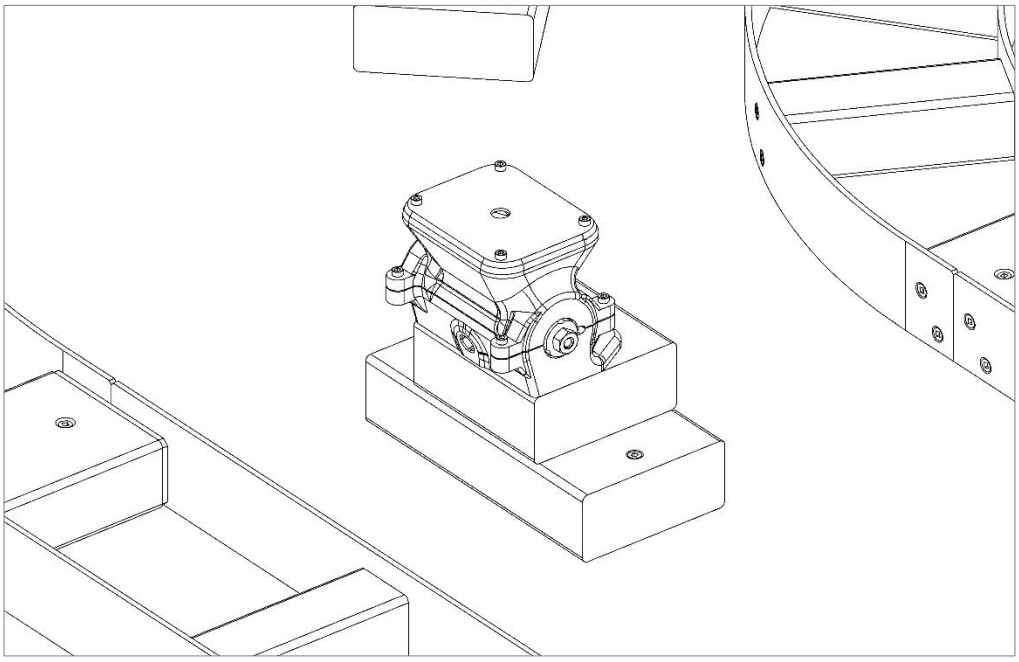

Figure 4: Dispenser position

The seeds can be extracted by operating the distribution cylinder. When it rotates, a marble enters one of the three individual marble holes and then finds itself in the chute. The cylinder has grooves on its outer surface to shake the marbles thus avoiding them to jam together.

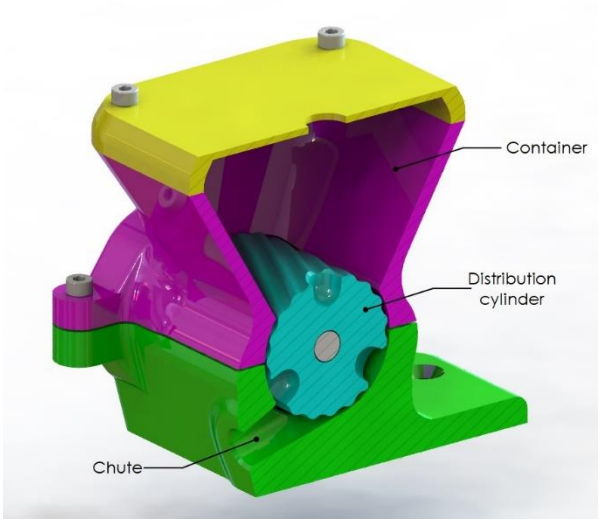

Figure 5: Inside the dispenser

The distribution cylinder has hexagonal heads which on each side of the dispenser. These heads can be used as an attachment point to enable the clockwise or counterclockwise rotation of the distribution cylinder. Damaging to the dispenser during handling will result in penalties.

Figure 6: Handling the dispenser

2.3. Stations

To produce food, the facility must guide the vegetation through several stages of development: planting, sprouting, development (growth), harvesting and packaging. Sprouting, growth, and packaging take place in specific sections of the facility. Planting, transport, and harvesting are carried out directly by the robotic solution.

Stations are receptacles for the trays. To score points, the marbles must be strategically placed throughout the course on specific stations by the robotic solution. A marble placed in the wrong type of station will not be counted, and only one marble per hole will be counted. The score will only be counted at the end of the attempt. A tray positioned outside a sprouting, growth or storage station at this time will result in penalties.

2.3.1. Sprouting stations

The darkness and humidity levels in this environment trick the seeds into believing that they are underground. This station offers optimal conditions for seed sprouting.

The 5 sprouting stations are located in the right-rear part of the field and each consist of a 3-1/2" x 3-1/2" x 1-1/2" wooden block painted in black.

This type of station is used to receive the trays containing the seeds taken from the dispenser to score points. Any other type of resource in this type of station will not be counted in the score. Each station has a maximum capacity of 4 trays.

Initially, some stations are occupied by trays filled with sprouts ready to be moved according to the following configuration:

- 1a station: 4 full trays;
- 1b station: 3 full trays;
- 1c station: 2 full trays;
- 1d station: 1 full tray;
- 1e station: No tray.

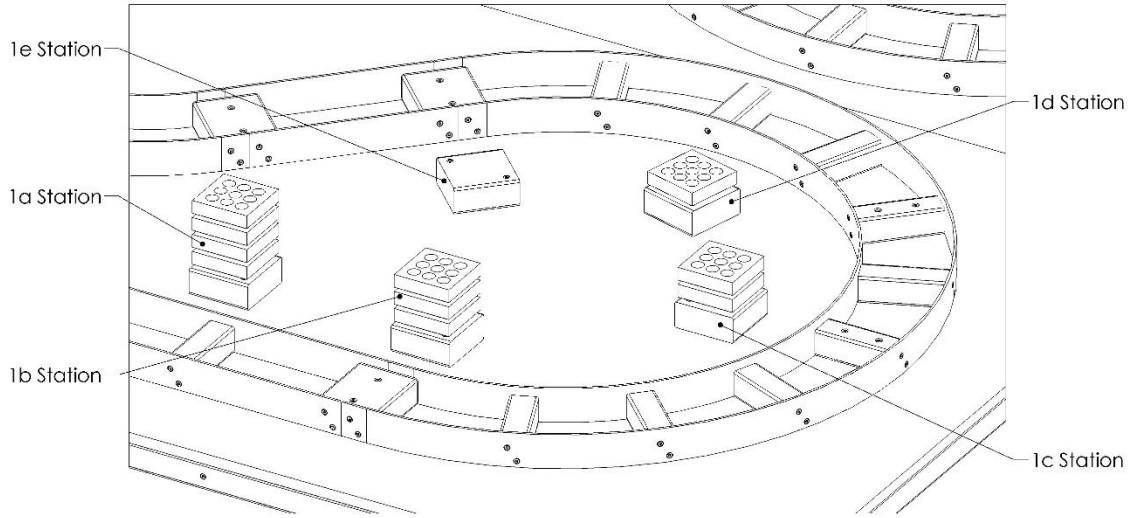

Figure 7: Sprouting stations and their contents

2.3.2. Growing stations

This station provides the nutrients necessary for the development of sprouts thanks to hydroponics, thus eliminating the need to water them. Controlling the environment, such as its brightness and humidity level, leads to the production of a high-quality product.

The 5 growing stations are located in the central part of the field and each consist of a 3-1/2" x 3-1/2" x 1-1/2" wooden block painted in blue.

This type of station is used to receive trays containing the sprouts from the sprouting stations to score points. Any other type of resource in this type of station will not be counted in the score. The stations also have a maximum capacity of 4 trays.

Initially, some stations are occupied by trays filled with plants ready to be harvested then packed according to the following configuration:

- 2a station: 4 full trays;
- 2b station: 3 full trays;
- 2c station: 2 full trays;
- 2d station: 1 full tray;
- 2e station: No tray.

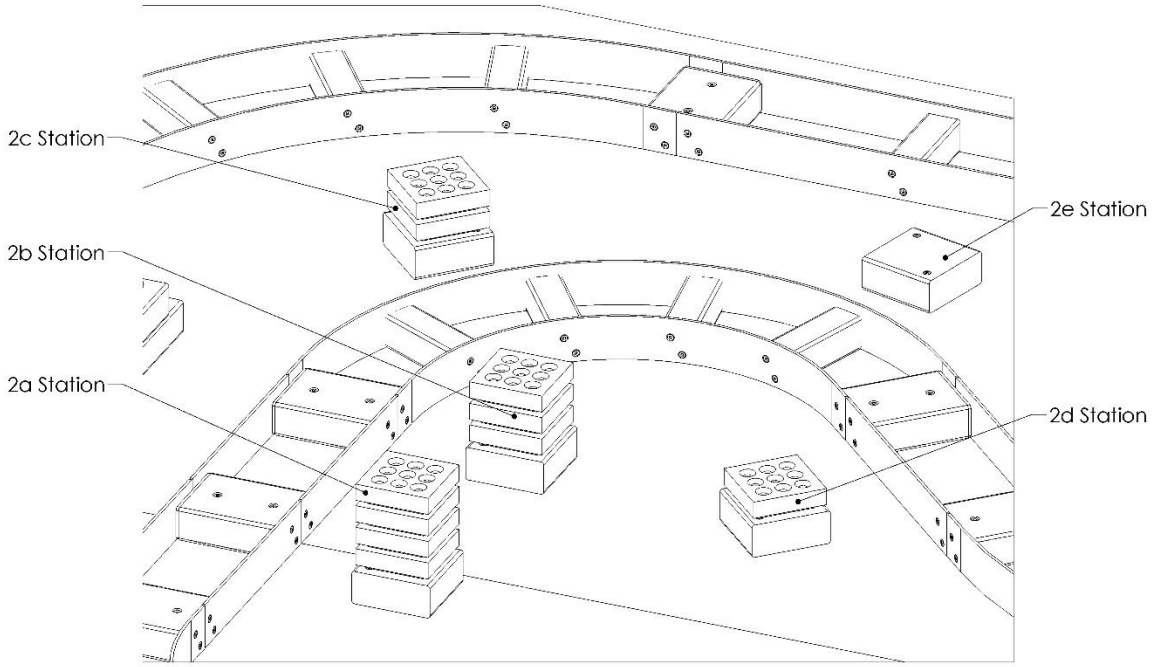

Figure 8: Growing stations and their contents

2.3.3. Packaging stations

Once placed in this station, the plants are automatically packed in different formats and labeled with the BEPCOM brand to be sent to the various retailers near the facility.

The packaging station is used to receive plants from the growing stations and is located in the rear left part of the field. The station is octagon-shaped and made out of 2"x2" pieces of wood painted in green. The packaging station has no height limit and is initially empty.

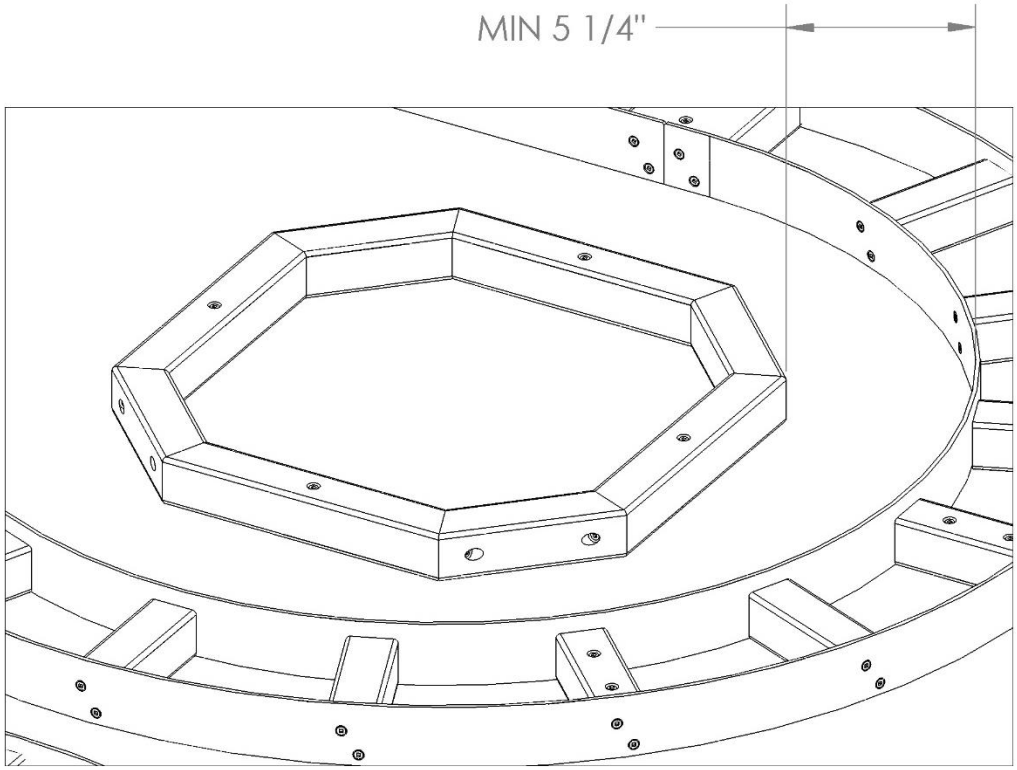

Figure 9: Packaging station

2.3.4. Tray storage station

A section of the facility is dedicated to the storage of empty replacement trays. The ceiling is surprisingly high in this area....

This station is located at the front of the sprouting stations is a 3-1/2" x 3-1/2" x 1-1/2" wooden block painted in yellow. The purpose of this station is to allow the storage of unused trays. There is no maximum number of trays for this station. Initially, this station contains 5 empty trays.

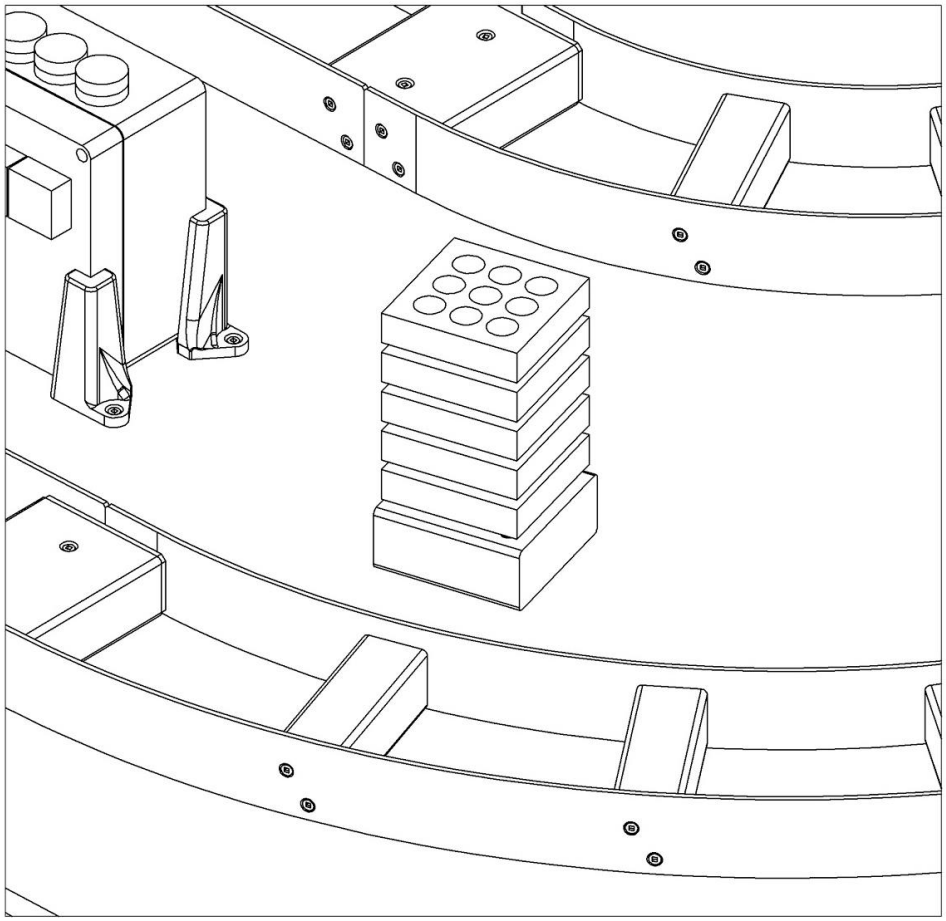

Figure 10: Tray storage station

2.4. Initial arrangement of marbles and trays

At the beginning of the attempt, all the components and resources are on the 8'x8' platform that forms the course. The following figure summarizes the initial position of all the marbles and trays of the challenge.

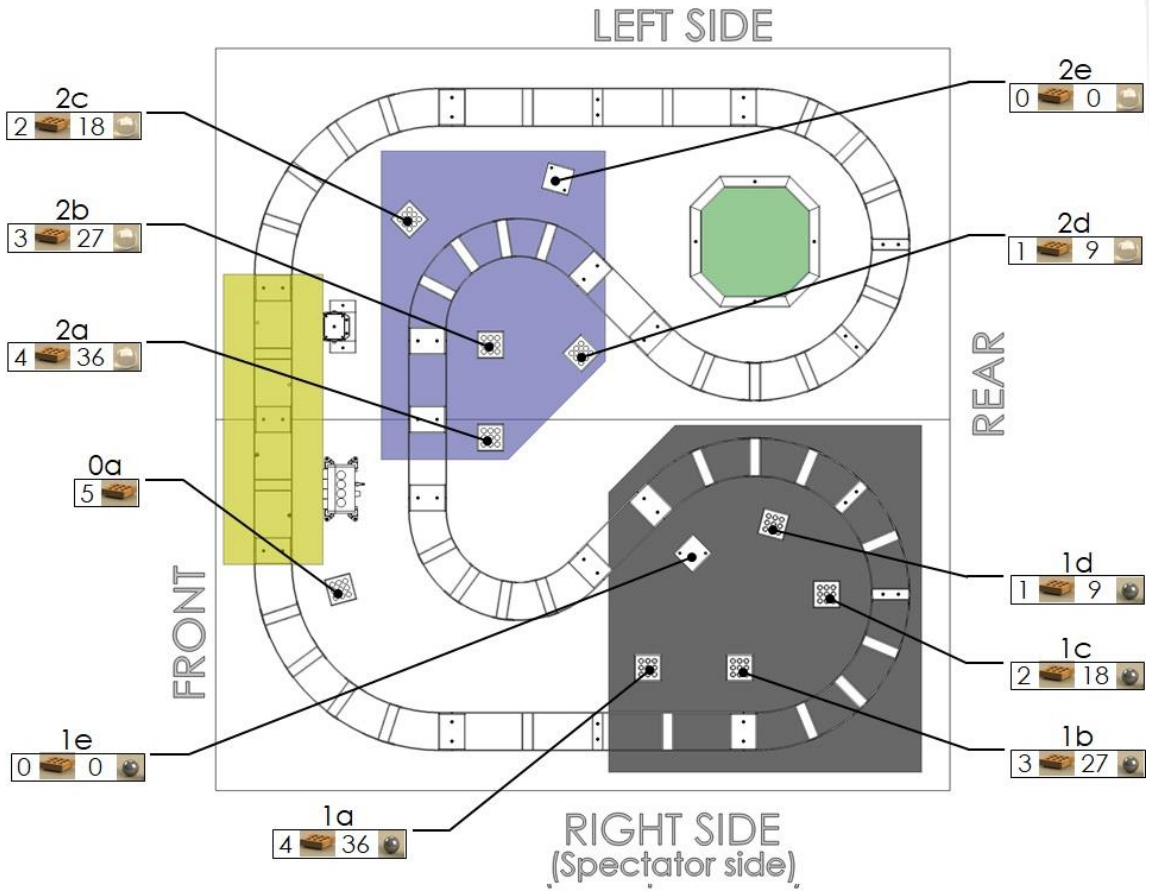

Figure 11: Arrangement of marbles and trays on the course

2.5. Machine starting area

The starting area, located in the front center of the course, is a 12" x 37-1/2" space delimited by the outer side of lines formed with adhesive tape. As a visual reference, the 37-1/2" length is the distance between the outer side of the 2"x4" connecting rail No.1 to rail No.2 on each side of the field.[2]

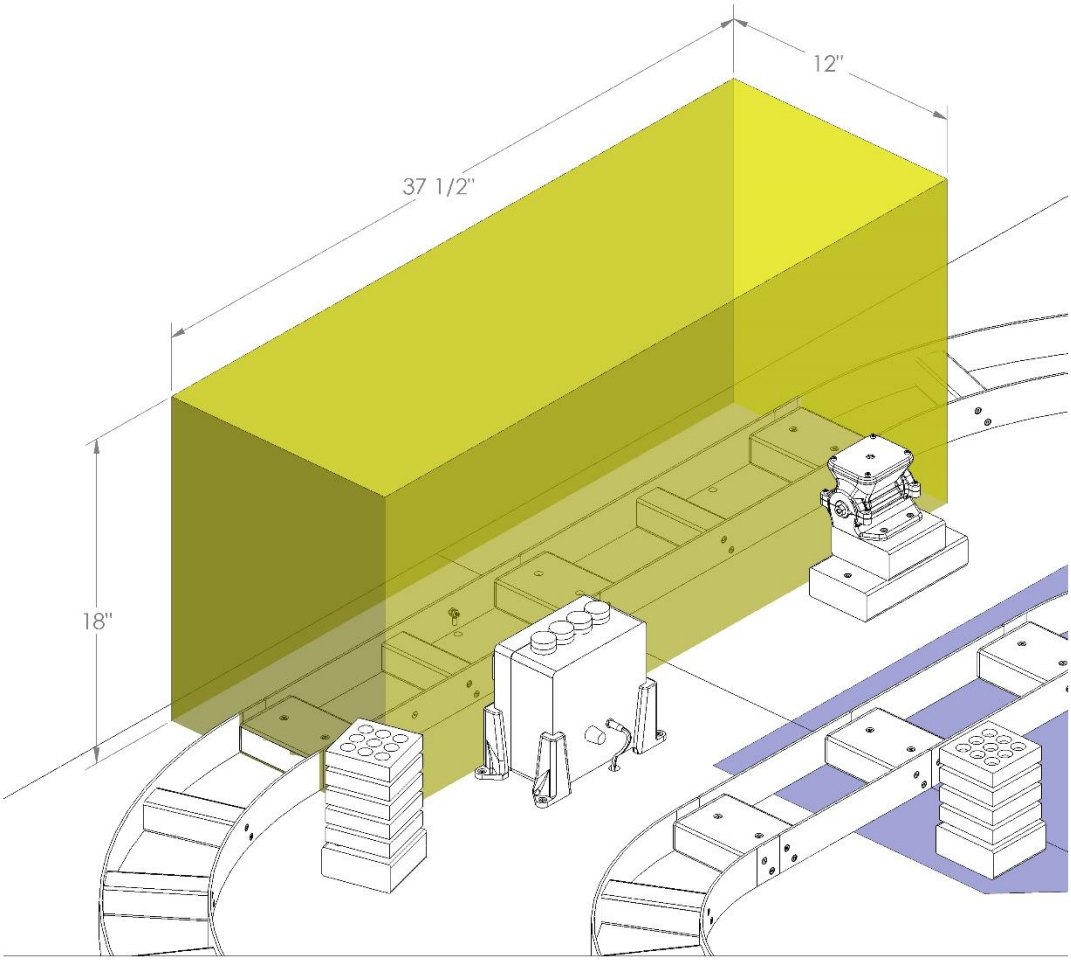

Figure 12: Starting area

[2]The rails' naming is illustrated in the Construction Specification Handbook

2.6. The generator, a component that adds time

BEPCOM wishes to use its new hydrogen generator model to power the rails. Therefore, the developed solution must be able to take action if any maintenance is needed. To do so, an interface on this highly sophisticated generator can be used to solve any problems! At least, almost all of them...

The generator dictates the time during which the robotics solution can score points. This game element is located at the front of the course.

On the back, a connector for the AC/DC adapter and a fuse holder are used to power the generator. At the front, a display with 4 matrices of 8x8 LEDs displays the remaining attempt time in minutes and seconds in the [M:SS] format. Contact between any of these components and the robotic solution will result in penalties.

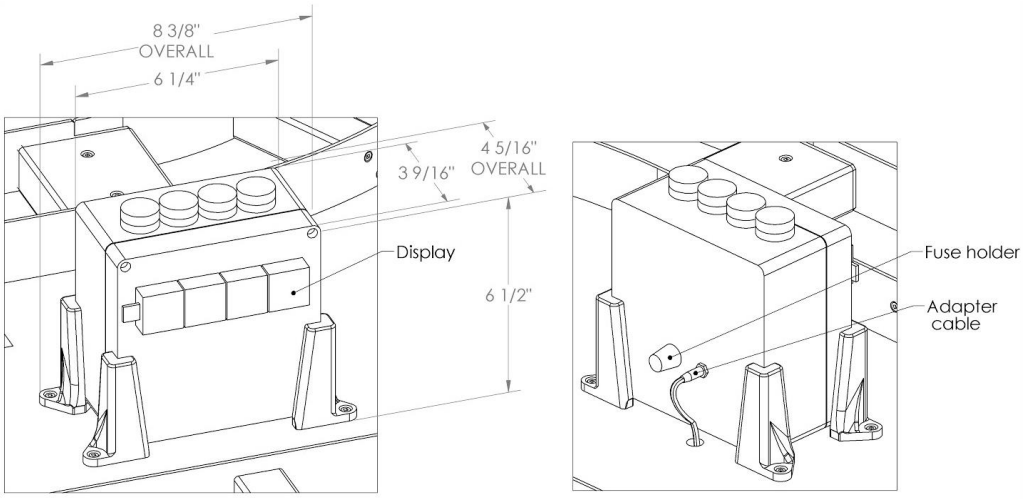

Figure 13: Front and rear sides of the generator

The top of the generator has 4 illuminated momentary push buttons. The latter are white, green, yellow and red respectively. At different times during the attempt, the generator will experience problems that require the attention of the machine crew. When a problem occurs, the generator lights its buttons in a specific order.

To fix a problem, the robotic solution must reproduce the sequence by pressing the buttons in that same order. This rectifies the problem and allows the machine crew to extend the time allocated to the attempt. Damaging the buttons or the case during handling will result in penalties.

2.6.1. Operating modes

2.6.1.1. Before the attempt

The generator checks the proper operation of the buttons. When the adapter is plugged in, the display of the following sequence confirms that the lights are up and running:

white → green → yellow → red → red → yellow → green → white.

Then, the game element waits for each button to be pressed in the following order to start the countdown of the time allocated to the attempt:

white → green → yellow → red.

Only then will a team member have to press the buttons to complete the sequence, marking the start of the attempt. This is to confirm proper operation of each of the generator's components before the beginning of the demonstration.

2.6.1.2. During the attempt

The generator will be affected by three problems which can be resolved to obtain additional time and points. The timing regarding the problems will be detailed in section 3.4.2 - additional time with the generator.

The time display mode indicates the generator's status.

- **The time is displayed without flashing:** The generator operates normally and simply indicates the time remaining before the next problem. After the third problem has been resolved, it displays the remaining attempt time instead.
- **The time flashes slowly:** The generator is having problems. A sequence of buttons is randomly lit and must be reproduced. The displayed time indicates the time remaining to solve the problem.
    - If the sequence is properly reproduced, the generator returns to normal.
    - If there are any errors when trying to reproduce the sequence, the generator flashes all its buttons simultaneously. A new random sequence is then displayed for a new attempt.
    - If the sequence is not reproduced in time, the generator encounters a critical problem.
- **The time flashes quickly:** The generator is experiencing critical problems. There is less than 1 minute left to the attempt.

3. Public demonstration

3.1. Before the attempt

At the beginning of the attempt, the robotic solution must be completely contained within the 12" x 18" x 37-1/2" space bordered by the outer side of the adhesive tape lines of the starting area, without any external assistance.

3.2. During the attempt

3.2.1. Dimensions

During the attempt, the dimensions of the robotic solution are not restricted. The robotic solution is also allowed to split into separate parts.

3.2.2. Repositioning the robot

At any time, a team can move the entire robotic solution only to reposition it in the starting area, resulting in a penalty. It is then subjected to the same dimensional restrictions than at the beginning of the attempt. Any trays or marbles moved during repositioning are removed from the course for the remaining time of the attempt. Meanwhile, the countdown continues and any interaction with the distributor or generator will result in penalties.

The team also has the right to repair or modify the robotic solution before replacing it in the starting area. To do so, only manual (non-electric) tools can be used. Also, no component can be added or removed from the robotic solution.

3.2.3. Exiting the course

During the attempt, the robotic solution may leave the perimeter of the course but cannot touch the ground. Following any contact with the ground, the team will have the opportunity to either conclude its attempt to score points or reposition the robotic solution as defined above, resulting in the same penalty.

3.3. Driving team

The driving team is composed of 4 members. No action is reserved for a particular member. Therefore, all members can perform each of the authorized actions.

3.3.1. Team positioning during the attempt

During the attempt, the driving team can stand in two areas:

1) The driving area on the front and left sides of the course;
2) The restricted access area at the back of the course.

The entire team can move freely within the driving area. However, only one team member at a time may enter the restricted area. The latter must be crouched down to avoid obstructing the judge's view.

It is forbidden for team members to position themselves to the right of the course to avoid obstructing the public's and the audiovisual technical team's view.

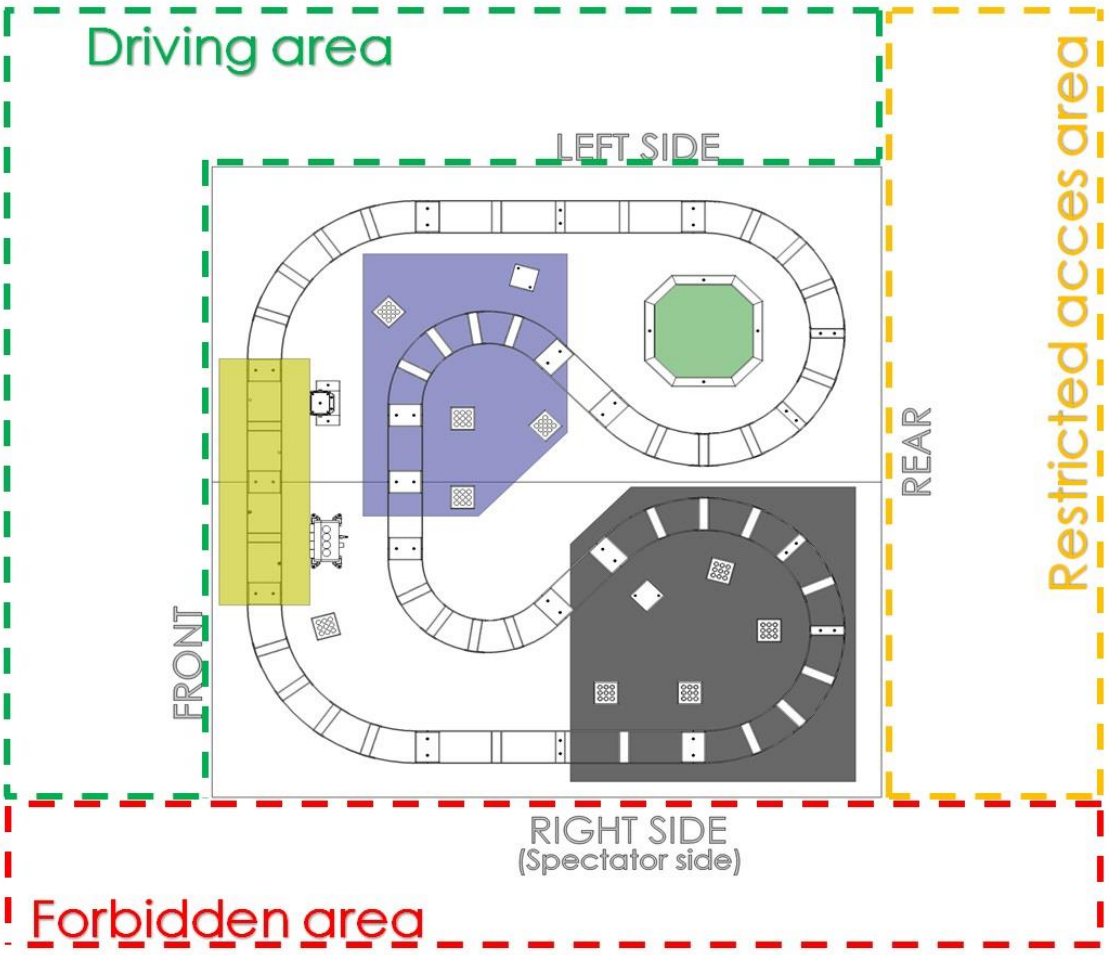

Figure 14: Layout of the areas surrounding the course

It will be tolerated that the members of the driving team lean over the course. However, in the event of contact with the course or the robotic solution that has an impact on the progress of the attempt, the attempt will be terminated, and the points thus performed will be removed.

3.4. Allowed time

3.4.1. Initial time

Initially, the allowed time for the attempt is 7 minutes. As explained in section 2.6 – The generator, a component that adds time, the robotic solution must be able to interact with the generator to extend the time allocated to the challenge.

3.4.2. Additional time with the generator

Three problems will be presented and must be resolved to obtain additional time. The following table shows the evolution of attempt time according to the result of the interaction with the generator.

Table 1: Time allocated by the generator [M:SS]

Problem	Problem presentation	If the problem is not solved	If the problem is solved
1	[5:00, 6:00]	The attempt ends at 7:00	The attempt continues and the 2nd problem will be presented.
2	[8:00, 9:00]	The attempt ends at 10:00	The attempt continues and the 2nd problem will be presented.
3	[10:00, 11:00]	The attempt ends at 12:00	The attempt ends at 13:00

3.4.3. At the end of the attempt

At the end of the attempt, the rail supply is cut off. The score is then calculated after any moving object has stopped or 5 seconds after the end of the attempt, whichever occurs first.

3.5. Restrictions

Below is a list of the more general restrictions and consequences associated with the actions of the robotic solution.

The robotic solution must not damage or dirty the course or challenge components. Failure to comply with this rule will result in a loss of points as a penalty depending on the severity and nature of the damages. Measures up to and including disqualification may be taken.

Contact with the generator's power supply wire, fuse holder or LED arrays will be tolerated if deemed unintentional and having no impact on the proper operation of the generator. Repeated contact, intentional contact or contact affecting the proper operation of the generator will result in the end of the attempt.

While the team is returning its robotic solution to the starting area, any interaction with the dispenser or generator will result in the end of the attempt.

Causing the circuit-breaker to open due to excessive current consumption will result in the end of the attempt.

4. The robotic solution

4.1. Dimension and weight restrictions

As mentioned in section 3. Public Demonstration, the robotic solution must be fully contained inside the starting area. There is no weight restriction for the solution.

4.2. Communication restrictions

The operator interface has already been chosen and purchased by BEPCOM. They chose a USB controller that allows integration with a multitude of platforms, from Raspberry Pi to Odroid to BeagleBone. It can even be integrated with Arduino technology!

4.2.1. Mandatory controller

To communicate with the robotic solution, the pilot(s) will have to use the controller provided, a Logitech F710, which cannot be modified. The controller receiver (dongle) is part of the maximum initial volume of the robotic solution while the controller is not part of this volume.

The provided controller is the only authorized component allowed for establishing communications from the team members to the robotic solution.

4.3. Electrical restrictions

4.3.1. No batteries

The robotic solution must be powered only by the rails and cannot contain batteries. However, other devices such as capacitors are accepted to overcome a momentary loss of contact with the rail. The organizing committee is entitled to refuse any energy accumulators rendering the solution self-sufficient.

4.3.2. Current limit

As stated in section 2.1.2. Rail electrification, the maximum current allowed is 10A according to the characteristics of the supplied circuit-breaker.

4.4. Safety restrictions

The robotic solution must not pose any risk to the safety of the participants, judges or the public. Therefore, explosives, thermal machines, and flying devices are not allowed. The organizing committee retains the right to refuse any machine deemed dangerous, even if it does not contain any element specifically mentioned above.

5. Demonstration score

5.1. Score distribution

The score for the public demonstration is calculated from the number of harvested marbles and generator activations. On the other hand, poorly arranged trays and the repositioning of the robotic solution both generate penalties. The score is only calculated at the end of the attempt.

Table 2: Demonstration score

Harvested marbles	45 points
Generator activations	15 points
Total	**60 points**

Table 3: Demonstration penalties

Robot repositioning	-2.5 points / repositioning
Misplaced trays	-1 point / tray Up to a maximum of 8 points

5.2. Harvested marbles

The preliminary score assigned to the marbles is calculated as follows:

$$X = (N_{seeds} + N_{sprouts} + N_{plants}) * F.C.$$

Where,

X : Preliminary score of the team, which will be rescaled.

N_{seeds} : Number of seeds in the sprouting stations.

$N_{Sprouts}$: Number of sprouts in the growing stations.

N_{plants} : Number of plants in the packaging station.

$F.C.$: Correction factor, which is based on the following values:

- C.F. = 1: If at least one marble has been moved on its station.
- C.F. = 2: If at least one marble of two types have been moved to their respective stations.
- C.F. = 3: If at least one marble of each type have been moved to their respective stations.

The total of 45 points for the harvested marbles is then calculated as follows:

$$Total = \frac{X_{team}}{X_{best\ team}} * 45$$

With,

X_{team}: Preliminary team score

$X_{best\ team}$: Highest preliminary score of all teams

To accelerate the counting of points and reduce the possibility of human error, the number of marbles will be counted by measuring their weight.

Marbles placed in a tray that touches the robotic solution and any other marbles indirectly supported by the latter at the end of the attempt will not be counted.

Reminder

- Only one marble per board hole will be counted;
- The sprouting and growth stations have a maximum capacity of 4 trays.

5.3. Generator activation

Each activation of the generator, in addition to increasing the time available for the attempt, gives 5 points for a total of 15 points.

5.4. Repositioning the robot

Repositioning the robot back in the starting area as defined in section 3.2.2. Repositioning the robot results in a penalty of 2.5 points on the final score of the demonstration. This penalty cannot reduce the total score of the demonstration below 0.

5.5. Misplaced trays

At the end of the attempt, the trays must be placed in a sprouting station, a growing station or the storage station. They must not be in contact with the robotic solution. The maximum capacity of the sprouting or growing stations is 4 and any additional tray will be considered as misplaced.

Each tray that does not meet these criteria will incur a penalty of 1 point, up to a maximum of 8 points on the final score of the demonstration. When the robotic solution is placed back in the starting area, the trays removed from the course doing so are also considered as misplaced. This penalty cannot reduce the total score of the demonstration below 0.

6. Competition deliverables

Here are the important days regarding the competition.

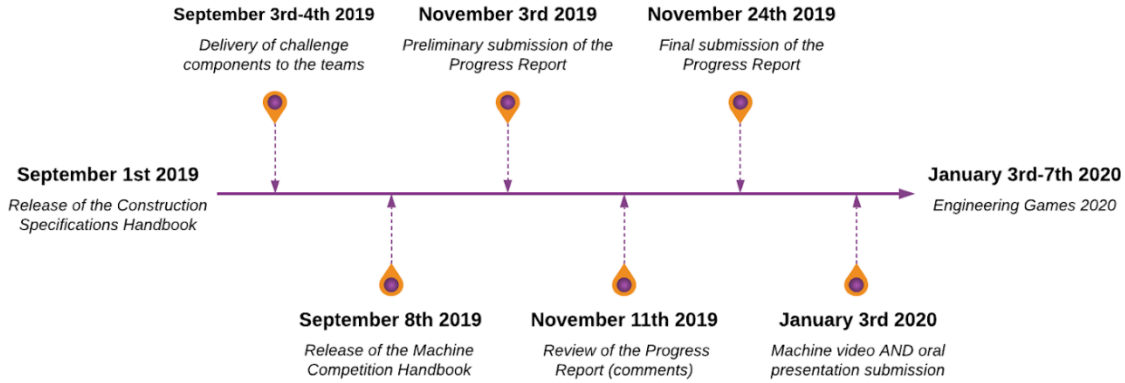

Figure 15: Important dates of the Machine competition

6.1. Scoring scale

The 2020 Engineering Games Robotic Machine scoring scale is presented below.

Table 4: Deliverable weighting

Deliverable	weighting [%]
Progress report	10
Video presentation	5
Judges' presentation	25
Public demonstration	60
Total	100

6.2. Progress report (10%)

The progress report should be a concise document intended to inform the BEPCOM on the design of the robotic solution and the team's strategies.

This report must contain a maximum of 12 pages, including the title page. This constraint excludes annexes, but they must not be necessary to the understanding of the report.

Table 5: Progress report scorecard

Evaluation criteria	Score
Sketches or rendering of the robotic solution	1
Presentation of the energy supply system and transport system	2
Transporting method for the marbles and trays	2
Strategy used to solve the generator problems	1,5
Presentation of the planned strategy and expected results	1,5
Risk mitigation plan	1
Structure and clarity of the report	1
BONUS: Robotic solution's CADs	*1*
Total	10

The 1 point bonus is given to teams that provide a complete CAD of their robotic solution. The report must be understandable without needing to refer to the CADs and the bonus cannot raise the total score for this progress report over 10 points.

6.3. Presentation video (5%)

The machine video will be aired in front of the audience before each team's demonstration on stage and should last between 3 and 4 minutes. Its purpose is to entertain spectators while informing them about the university, the team members and their design and manufacturing process.

This video can be made in French or English. Any video deemed unsuitable by the organizing committee will not be presented and will be awarded a score of 0/5.

Table 6: Presentation video scorecard

Evaluation criteria	Score
Introduction of the team and its university	1
Presentation of the machine and its operation	1
Vulgarisation of content and accuracy of information	1
Originality and concordance with the theme	1
Quality of the video	1
Total	5

The presentation video must be submitted in MP4 format on January 3, 2020, before the end of the first Machine work session. A late video will automatically lose 50% of the points. A video not submitted at the end of the machine work session starting on January 5 will be given a score of 0/5 and will not be presented.

6.4. Judges' presentation (25%)

You will have to present your solution before a committee of judges. Your presentation must last a maximum of 8 minutes and will be followed by a 5-minute Q&A session. This will take place on the day of the competition, just to the public demonstration.

Table 7: Judges' presentation scorecard

Evaluation criteria	Score
Introduction of the team and its university	1
Presentation of the machine and its operation	8
Design criticism	4
Presentation of the planned strategy and expected results	6
Realism of the solution on a large scale	2
Presentation structure and team professionalism	1
Q&A Session	3
Total	25

6.5. Public demonstration (60%)

The score of the public demonstration will be calculated as defined in section 5. Demonstration score.

7. Logistics

7.1. Machine work sessions

During the 2020 Engineering Games, Machine teams will have the opportunity to take part in three work sessions. The official competition course will be made available to the teams and a schedule of trial periods will be determined during the first Machine work session. You are strongly encouraged to bring your course, whole or in part. It will then be made available to all teams.

At all times, only 4 members per team will be allowed to be present at the Machine's work areas. However, teams will be allowed to exchange members as they see fit.

The team is responsible for providing the necessary tools to work on their robotic solution during Machine work sessions. The team is also responsible for bringing the Logitech controller, rail power system, and other challenge components provided by the organizing committee.

7.2. Competition day

The competition day will be divided in two:

1) Presentations to the judges (morning);
2) Public demonstrations (afternoon).

A screen will be provided for the presentation to the judges. A standard HDMI cable will be made available to the speakers, but teams will have to provide their laptop and other cables if necessary. The order of performance will be decided randomly that morning.

For the public demonstration, the team will have a minimum of 5 minutes to prepare their robotic solution and place it in the starting area. Meanwhile, the rails will be powered and the team will be allowed to operate their robot inside the starting area. The next 7 to 13 minutes will be used to perform the attempt. The order of appearance will be determined randomly that morning, independently of the order of presentation to the judges.

8. External documents

On the 2020 Engineering games website, you can download the following:

1) The construction specifications handbook;
2) The machine competition handbook.

All CADs and additional documents related to the challenge are available here.

The generator code is also available on Github here.

The organizing committee is entitled to modify these documents at any time and will notify you of any changes. In the event of any disagreement between the French and English versions of these documents, the French version prevails.

Annex A: Provided materials

(2x) Rails No.1 to No.7 of the course

(1x) White drilling template for the 2"x2" links

(1x) Blue drilling template for the 2"x2" links

(1x) White drilling template for the 2"x4" links

(1x) Blue drilling template for the 2"x4" links

(1x) Rail power supply box

(1x) Rail supply wire with hardware

(180x) 1/4" steel marbles

(120x) 3/8" steel marbles

(120x) 1/2" glass marbles

(1x) Seed dispenser

(1x) Generator

(1x) Adapter 115 Vac / 5 Vac, 2A

(4x) Generator holder (white, green, yellow, red)

(4x) N.F contact of the generator buttons (to re-use the buttons)

(1x) Logitech F710 controller and receiver

Annex B: Organizing committee

For any questions or comments regarding the challenge, do not hesitate to contact the Machine team at the following address:

Gabriel Lévesque - Vice-Président, Machine robotique
Alexandre Mongrain - Adjoint, Machine robotique
Pierrick Arsenault - Adjoint, Machine robotique
Ben Fevereiro - Adjoint, Machine robotique
machine@jeuxdegenie.qc.ca

For any questions or comments not related to the Machine Challenge, do not hesitate to contact the various members of the organization at the following addresses:

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The organizing committee of the 2020 Engineering Games thanks you for the time and effort you will put into building a robotic machine that is at the best of your skills during the four months preceding the event.

We also take this opportunity to wish you every success in meeting this challenge. We simply UNBELIEVABLY look forward to seeing the outcome of your work! Don't forget to enjoy the experience, have fun and remember that the process is more important than the result!