2021+1 ENGINEERING GAMES

RETOUR AUX SOURCES JEUX DE GÉNIE XXXI

MACHINE HANDBOOK

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MACHINE HANDBOOK

2021+1 Quebec Engineering Games : Retour aux sources Robotic Machine Handbook Polytechnique Montréal



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A huge thank you to the partners involved in the Engineering Games 2021+1 Machine Challenge. Without you, it would simply be impossible to complete this project.

Official partner of the Machine competition:



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Dear participants,

It is truly an honour for our entire Olympus NDT Canada team to be a part in this new edition of the 2021 Engineering Games. The past year has shown us a need to rethink the way we live and work. The pandemic has brought about its share of challenges that now mark the new era we are entering, and our needs are constantly changing. Now, more than ever, the world needs smart, creative, and passionate people like you to meet these challenges.

These profound changes have pushed many individuals and companies to go back to basics. That is what you will find in this new edition of the games. However, this does not mean revisiting the past, but rather a return to the fundamentals of success and innovation: mutual assistance, perseverance, intellectual rigor, and agility. These are what you will need to take on the challenge of The Machine, which is a good representation of the future challenges you will face in your careers.

It is hard to imagine a more exciting challenge than this Machine competition. At Olympus, we are fortunate to be able to work every day on the design and development of all kinds of amazing robots and machines that help make people's lives safer and more fulfilling. I hope you find as much pleasure in this competition as we do in our work. I look forward to seeing your beautiful machines in action!

On behalf of the entire Olympus NDT Canada team, good luck to all of you!

Patrick Huot, ing. Executive Director of Research & Development Olympus NDT Canada

Table of contents

Machine 2021+1 Challenge: Collecting and Transporting Resources in the Engineering Games Village	7
1. The Elements of the Challenge	8
1.1. Mat	8
1.2. The Resources	9
1.2.1. Natural Resources: Tree, Cereal and Water	9
1.2.2. Processed Resources: Flour, Plank, Toilet Paper, Beer and Bread	9
1.2.3. Resource Transformations	10
1.3. Forest	11
1.4. Field	11
1.5. Lake	12
1.6. Mill	12
1.7. Sawmill	13
1.8. Brewery	13
1.9. Bakery	13
1.10. Houses	14
1.11. Park	14
1.12. Starting Area	15
1.13. Market	15
1.14. The Stock Exchange	16
1.15. Initial Placement of Resources	17
2. The Robotic Solution	18
2.1. Size and Weight Restrictions	18
2.2. Communications Restrictions	18
2.3. Safety Restrictions	18
3. Public Demonstration	19
3.1. Before the Attempt	19
3.2. During the Attempt	19
3.2.1. Dimensions	19
3.2.2. Replace the Robot	19
3.2.3 Leaving the Course	19
3.2.4. Interaction with Buildings: Exchanging Resources	20
3.2.4.1. Interaction with the Mill	20
3.2.4.2. Interaction with the Sawmill	21
3.2.4.3. Interaction with the Brewery	22
3.2.4.Interaction with the Bakery	23
3.2.5. Interaction with the Market: Selling Resources	24

3.2.6 Resources Leaving the Course	24
3.2.7. Replacing Water Bottles in the Lake	24
3.2.8. Interaction with the Stock Exchange: Knowing the Price of the Resources	25
3.2.8.1. Connecting to the Stock Exchange	25
3.2.8.2. Making a Request	25
3.3. At the End of the Attempt	26
3.3.1. Resident Disturbance Penalty	26
3.3.2 Deforestation Penalty	27
3.4. Driving Team	28
3.4.1. Positioning of the Team During the Attempt	28
3.5. Allowed Time	29
3.6. Restrictions	29
4. Scoring of the Demonstration	30
4.1. Breakdown of the Score	30
4.2. Resources Sold	31
4.3. Replacing the Robot	31
4.4. End of Attempt Penalties	32
5. Competition Deliverables	33
5.1. Scoring Scale	33
5.2. Progress Report	34
5.2.1. Presentation of the Robotic Solution	34
5.2.2. Presentation of the Planned Strategy and Expected Results	35
5.2.3. Risk Management Process	35
5.2.4. Structure and Clarity of the Report	35
5.2.5. Bonus: CAD of the Robotic Solution	35
5.3. Presentation Video	36
5.4. Presentation to the Judges	37
5.5. Demonstration to the Public	37
6. Logistics	38
6.1. Machine Periods	38
6.2. Competition Day	38
7. External Documents	39
Appendix A: Elements Provided	40
Appendix B: Organizing Committee	41

Machine 2021+1 Challenge: Collecting and Transporting Resources in the Engineering Games Village

The 2021+1 Engineering Games Organizing Committee needs your help! With the recent disruptions in the manufacturing and transportation industries, it is becoming increasingly difficult to secure the resources needed to host the Games. The Organizing Committee is calling on all Machine teams to help solve this difficult logistical problem.

The participants will have to produce a robotic solution to collect and transport the necessary resources in the Engineering Games village. This solution will need to harvest natural resources, transport them and process them. The Organizing Committee will reward teams for bringing the resources collected to the market, where they can be used for the organization of the Games, to the delight of the delegates. The Organizing Committee also asks the teams to minimize the disturbance to the residents of the village.

Specifically, the robotic solution must be able to :

- 1. Harvest natural resources placed on the course;
- 2. Exchange natural resources for processed resources;
- 3. Transport natural and processed resources to the market in order to sell them;
- 4. Optionally, connect to a wireless stock exchange system to find out the prices at which resources can be sold;

7

5. Avoid moving houses in the village.



1. The Elements of the Challenge

Figure 1: Machine 2021+1 Challenge Course

1.1. Mat

The play surface is a 10' x 10' vinyl mat. The other play elements are placed on this mat.



Figure 2: Play mat

1.2. The Resources

Your robotic solution must be able to manipulate resources. Some resources, called "natural", are present on the course at the beginning of the attempt. The other resources, called "processed", can be obtained in various places by exchanging other resources.

1.2.1. Natural Resources: Tree, Cereal and Water

Natural resources are resources present in the village at the beginning of the official attempt. These resources can be harvested by the robotic solution. There are 3 types of natural resources:

- The tree, represented by wooden dowels 1" in diameter and 3" in length;
- The cereal, represented by small boxes of *Kellogg's Fun Pac* cereal;
- The water, represented by 500mL *Eska* water bottles.



Figure 3: Natural resources

1.2.2. Processed Resources: Flour, Plank, Toilet Paper, Beer and Bread

Processed resources are resources that are not present in the village at the beginning of the official attempt. These resources can be obtained by exchanging other resources at certain locations in the village. There are 5 types of processed resources:

- The flour, represented by sandbags, is obtained by exchanging a cereal;
- The plank, represented by 1" x 3" x ¹/₂" pieces of plywood, is obtained by trading a tree;
- Toilet paper, represented by an actual toilet paper roll, is obtained by swapping a tree and a water bottle. The toilet paper rolls used are Cashmere, 2-ply, regular rolls;
- The beer, represented by a (full) 7up 355mL can, can be obtained by transforming a water bottle and a cereal;
- Bread, represented by real slices of bread, can be obtained by transforming a bottle of water and a flour. The bread slices are slices of Ultra Moelleux White POM bread, excluding the ends.



Figure 4: Processed resources

1.2.3. Resource Transformations

Here is a summary of possible resource transformations:



Figure 5: Summary of possible transformations

1.3. Forest

The forest is an area approximately 60" x 25" that contains trees ready to be harvested. At the beginning of the attempt, a total of 30 trees are placed on the forest circles.



Figure 6: Forest

1.4. Field

The field is an area approximately 60" x 36" that contains cereals ready to be harvested. At the beginning of the attempt, a total of 25 boxes of cereal are placed on top of the cereal images in the field.



Figure 7: Field

1.5. Lake

The lake is an area approximately 38" x 25" that contains water ready to be harvested. At the beginning of the attempt, a total of 5 bottles of water are placed in the lake. These bottles are placed on the darker circles in the lake.



Figure 8: Lake

1.6. Mill

The mill is a 30" x 24" building that is used to transform cereals into flour.



Figure 9: Mill

1.7. Sawmill

The sawmill is a 24" x 8" building that is used to transform trees into planks AND trees and water into toilet paper.



Figure 10: Sawmill

1.8. Brewery

The brewery is a 32" x 26" building that is used to transform water and cereal into beer.



Figure 11: Brewery

1.9. Bakery

The bakery is a 26" x 20" building that is used to transform water and flour into bread.

Figure 12: Bakery

1.10. Houses

There are a total of eight 14" x 9.5" houses in the village. These houses are made of cardboard and are not attached to the course. Under each of the houses are red marks, delimiting a 12.5" x 8" area. These marks are used to determine if a house has been moved by a robotic solution: a red mark visible at the end of the attempt indicates that the house is no longer in its original location.

Please note that images can be placed on the houses during the official attempt.



Figure 13: House

1.11. Park

A park is located in the center of the village. This park contains 10 trees, which must not be moved. If any trees are not standing in their respective circles at the end of the attempt, penalties will apply.



Figure 14: Park

1.12. Starting Area

The starting area, located near the market and the mill, is a 24" x 18" space delimited by dotted lines on the mat.



Figure 15: Starting area

1.13. Market

The market is a place to sell harvested and processed resources.



Figure 16: Market

1.14. The Stock Exchange

Throughout the attempt, the prices at which resources can be sold vary depending on previous sales. The stock exchange allows the robotic solution to obtain the current prices of the resources. Specifically, the stock exchange is a Raspberry Pi available through a Wifi access point. The way to connect to the stock exchange is detailed in section <u>3.2.8. Interaction with the Stock Exchange: Know the Price of the Resources</u>.

Note: The stock exchange provided to Machine teams is a Raspberry Pi that creates its own Wi-Fi access point. The stock exchange during the official attempt will be a Raspberry Pi available through a Wifi network created by a real router.

1.15. Initial Placement of Resources

- 30 trees in the forest
- 10 trees in the park
- 25 boxes of cereal in the field
- 5 bottles of water in the lake



Figure 17: Initial disposition of resources

2. The Robotic Solution

2.1. Size and Weight Restrictions

The robotic solution must be contained within the 24" x 18" starting area at the beginning of the attempt. There are no height or weight restrictions.

2.2. Communications Restrictions

The team shall provide a control system that will allow for remote (wireless) control of the robotic solution. This control system is not part of the robotic solution volume, and must meet the following restrictions:

- It is battery powered;
- It does not have a screen.

For the purposes of the competition, we will define a control system containing more than 50 pixels as non-compliant. A pixel is an element whose brightness or color can change independently of other pixels.

The control system has no size or weight restrictions, can be composed of multiple distinct parts, and can communicate directly with the stock exchange.

2.3. Safety Restrictions

The robotic solution must not pose a safety risk to participants, judges or the public. For this reason, explosives, thermal machines and flying devices are not allowed. The Organizing Committee reserves the right to refuse any Machine deemed dangerous, even if it does not include any element specifically mentioned above.

3. Public Demonstration

3.1. Before the Attempt

At the beginning of the attempt, the robotic solution must be completely contained within the 24" x 18" starting area without any outside assistance.

The maximum size will be verified with a box. Once the size of the robotic solution is verified, the box will be removed. When removing the box, the robotic solution must remain within the 24" x 18" space. The attempt will then begin.

3.2. During the Attempt

3.2.1. Dimensions

During the attempt, the dimensions of the robotic solution are not constrained. It is also allowed for the robotic solution to split into several parts.

3.2.2. Replace the Robot

At any time, it is possible for a team to move the entire robotic solution in order to relocate it in the starting area, incurring a penalty. It is then subject to the same dimensional constraints as at the beginning of the attempt: the dimensions must be checked again with the box. Any resource that is moved by repositioning the robot is removed from the course for the remainder of the attempt. For the duration of the operation, the time continues. The team also has the right to repair or modify the robot solution before returning it to the starting area. To do so, they may use only manual tools (no electric tools). Also, no components may be added to or removed from the robotic solution.

3.2.3. Leaving the Course

During the attempt, the robotic solution may extend beyond the perimeter of the village but not touch the ground. If the robotic solution touches the ground, the team must replace the robotic solution as defined above, incurring the same penalty.

3.2.4. Interaction with Buildings: Exchanging Resources

When the resources needed for an exchange are placed in the appropriate building and the robotic solution no longer touches these resources, the Organizing Committee gives the team the processed resource. A participant can then place the resource in the appropriate unloading area. The resource must be placed on the play mat, without coming into contact with any other resource, any building or the robotic solution.

3.2.4.1. Interaction with the Mill



Figure 18: Possible transformation at the mill

To obtain a flour, the robotic solution must deposit a cereal into the mill through the opening at the front. A member of the Machine team can then deposit flour on the flour unloading area (marked as *Zone de déchargement de farine* on the play mat).



Figure 19: Flour unloading area, located behind the mill



3.2.4.2. Interaction with the Sawmill

Figure 20: Possible transformations at the sawmill

To get a plank, the robotic solution must drop a tree into the sawmill through the opening at the front. A member of the Machine team can then drop a plank on the plank unloading area (marked as *Zone de déchargement de planches* on the play mat).

To get a roll of toilet paper, the robotic solution must drop a tree and a bottle of water into the sawmill through the opening in the front. A member of the Machine team will then be able to drop a roll of toilet paper on the paper unloading area (marked as *Zone de déchargement de papier* on the play mat).



Figure 21: Unloading areas for planks and paper, located next to the sawmill



3.2.4.3. Interaction with the Brewery



To get a beer, the robotic solution must drop a cereal and a bottle of water into the brewery through the opening on its roof. A member of the Machine team will then be able to deposit a beer on the beer unloading area (marked as *Zone de déchargement de bière* on the play mat), located in the alley between the brewery and the sawmill.



Figure 23: Beer unloading area, located between the brewery and the sawmill



3.2.4.4. Interaction with the Bakery

Figure 24: Possible transformation at the bakery

To get a slice of bread, the robotic solution must drop a flour and a bottle of water into the bakery through the opening on its roof. A member of the Machine team can then drop a slice of bread on the bread unloading area (marked as *Zone de déchargement de pain* on the play mat).



Figure 25: Bread unloading area, located behind the bakery

3.2.5. Interaction with the Market: Selling Resources

All resources can be sold at the market. To make a sale, the robotic solution must deposit the resources on the market, then a team member must press a button near the path. The resources are then sold at the current market price. The Organizing Committee then removes the resources placed in the market. The market will thus be unavailable to the robotic solution for a few seconds.

For a resource to be counted, its full weight must be supported by the market at the time of sale. Stacked resources can therefore be sold, since their weight is indirectly supported by the market.

At the time of sale, any resource whose weight is partially supported by the floor or play mat will be removed and not counted. Any resource touching the robotic solution or being supported by a resource touching the robotic solution will also be removed and not counted. Finally, any significantly damaged resource will be removed and not counted.

3.2.6. Resources Leaving the Course

Any resource that falls to the ground outside the course is considered "dead". It is removed from the game and can no longer be used.

3.2.7. Replacing Water Bottles in the Lake

When there are less than 5 water bottles on the course, the team can place some back in the lake, on the dark blue circles. A water bottle is considered off the course if it has been sold, traded for another resource or dropped on the ground off the course.

When placing the bottle, the participant may not move any other game object or touch the robotic solution.

3.2.8. Interaction with the Stock Exchange: Knowing the Price of the Resources

3.2.8.1. Connecting to the Stock Exchange

To connect to the stock exchange, the robotic solution must connect to the following wifi network:

- SSID: machine_bourse
- Password: Will be sent to VPs-Machine directly

It can then send TCP requests to the stock exchange:

- IP address: 192.168.0.10
- Port: 8000

3.2.8.2. Making a Request

The possible requests are:

GetTime:<university>

- <university> is the name of the university making the request
- Returns the number of seconds since the start of the attempt, in text form.

GetStock:<university>

- <university> is the name of the university making the request
- Returns: <pending sale>:<tree price>:<cereal price>:<water price>:<flour price>:<plank price>:<toilet paper price>:<beer price>:<bread price>
 - <pending sale> is "1" if a sale is pending confirmation by the Organizing Committee, which means that prices have not yet been updated. "0" otherwise.
 - Resource prices are accurate to 4 decimal places, and do not contain a dollar sign.

The university names accepted by the stock exchange are:

Concordia	ETS	Mcgill	UQAR
Drummondville	ITR	Sherbrooke	UQAT
EPM	Laval	UQAC	UQOttawa

Exemples:

"GetTime:Concordia" \rightarrow "145"

"GetStock:ITR" \rightarrow "0:1.0000:1.5000:2.0000:3.0000:3.0000:5.0000:6.0000:7.0000"

The names of the commands "GetTime" and "GetStock" are also accepted in French: "ObtenirTemps" and "ObtenirBourse". The commands and university names are case insensitive.

The behavior of resource prices during a sale is described in section <u>4.2. Resources sold</u>.

3.3. At the End of the Attempt

3.3.1. Resident Disturbance Penalty

At the end of the attempt, a house is considered displaced if it does not cover the 4 red marks located inside a house positioning rectangle or if it is not standing. Each house considered out of place will result in a loss of points.



Figure 26: On the left, a correctly placed house. On the right, a displaced house.

3.3.2. Deforestation Penalty

At the end of the attempt, a tree is considered cut if it is not standing or it is not touching the tree image on the course. The tree image includes both the circle of the trunk and the 4 roots.

Each tree cut in the park will result in a loss of points.

If more than 20 trees are cut in the forest, each excess tree will result in a loss of points. For example, if 23 trees are cut, 3 of them will be counted for the penalty.



Figure 27: On the left, a correctly placed tree. On the right, a tree considered cut.

3.4. Driving Team

The driving team is composed of a maximum of 4 members:

- Up to 2 pilots. They are the only ones who can manipulate the control system.
- Up to 2 resource managers. These are the only ones who can manipulate the resources.

3.4.1. Positioning of the Team During the Attempt

During the event, the driving team can position themselves in two zones:

- 1) The driving area on the left and at the back of the course
- 2) The restricted area on the right side of the course

The whole team can move freely within the driving zone. However, only one team member at a time may be in the restricted area. The team member must be crouched in the restricted area to avoid obstructing the judges' view.

It is forbidden for team members to position themselves in front of the course in order to avoid obstructing the view of the public and the audiovisual technical team.



Figure 28: Positioning of the team during the attempt

3.5. Allowed Time

Each team is given 10 minutes to demonstrate the capabilities of their robotic solution. The time does not stop if the team returns the robot to the starting area. At the end of the allotted time, the robotic solution must stop moving.

3.6. Restrictions

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

The robotic solution must not damage or soil the course or game elements. Failure to do so will result in a loss of points as a penalty depending on the severity and nature of the breakage. Measures up to and including disqualification may be taken. Given the fragile nature of bread slices and toilet paper, breakage of these two resources will be tolerated.

A member of the Machine Team may only come into contact with the robotic solution before the attempt or to replace it to the starting area. Failure to comply with this rule will result in a loss of points as a penalty depending on the severity and nature of the contact. Measures up to and including disqualification may be taken.

When a Machine team member places a resource on the course, they may not move other resources or game elements already on the course. Failure to comply with this rule will result in a loss of points as a penalty depending on the severity and nature of the contact. Measures up to and including disqualification may be taken.

The wifi network provided by the stock exchange may not be used to communicate between the control system and the robotic solution, between different parts of the robotic solution or between different parts of the control system. Failure to comply with this rule will result in disqualification.

The robotic solution and the control system can only connect to the exchange through the public API. The use of the dashboard is reserved for the Organizing Committee. Failure to comply with this rule will result in disqualification.

The robotic solution and control system may not use another university's name to connect to the stock exchange. Failure to comply with this rule will result in disqualification.

4. Scoring of the Demonstration

4.1. Breakdown of the Score

The score for the public demonstration is calculated from the resource sales made at the market. However, displaced houses, uprooted trees in the park, excessive cutting of trees in the forest, and replacements of the robotic solution will result in penalties.

The preliminary score of a team is calculated as follows:

X = Total price of resources sold * Penalty factor

X: Preliminary score of the team, which will be weighted

Total price of resources sold: Sum of all resource sales to the market

Penalty factor: Factor penalizing certain actions of the robotic solution, which takes a value between 0.4 and 1.0.

The total score of the demonstration is calculated as follows:

$$Total = \frac{X_{team}}{X_{best team}} * 60$$

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

4.2. Resources Sold

Each resource sold at the market is sold at a specific price, which varies throughout the attempt.

- At the beginning of the attempt, all resources can be sold at their nominal price
- When a resource is sold, its price then drops by 40%.
- When the current price of a resource is lower than the nominal price, it goes up by a certain amount every second.

Resource	Nominal price	Fluctuation per sale	Fluctuation per second
Tree	1.00\$	-40% of the current price	+0.0010\$/s up to the nominal price
Cereal	1.50\$	-40% of the current price	+0.0015\$/s up to the nominal price
Water	2.00\$	-40% of the current price	+0.0020\$/s up to the nominal price
Flour	3.00\$	-40% of the current price	+0.0030\$/s up to the nominal price
Plank	3.00\$	-40% of the current price	+0.0030\$/s up to the nominal price
Toilet paper	5.00\$	-40% of the current price	+0.0050\$/s up to the nominal price
Beer	6.00\$	-40% of the current price	+0.0060\$/s up to the nominal price
Bread	7.00\$	-40% of the current price	+0.0070\$/s up to the nominal price

Table 1	:	Resource	price	variations
		1,0000100	price	variationo

When several resources of the same type are sold at the same time, the price is calculated again between each resource. Thus, a sale of 2 trees, when the tree is worth 1.00\$, will give 1.60\$: 1.00\$ for the first tree, and 0.60\$ for the second tree. The current price of a tree will then be 0.36\$.

We invite participants to experiment with the stock exchange in order to fully understand its behavior.

4.3. Replacing the Robot

Replacing the robotic solution instantly drops all market prices by 20%. This drop does not affect the prices of previous sales.

4.4. End of Attempt Penalties

The penalty factor, recorded at the end of the attempt, is calculated as follows:

Penalty factor = $1 - (N_{houses} * 0.05) - (N_{trees park} * 0.01) - (N_{trees forest} * 0.01)$

 N_{houses} : Number of houses displaced $N_{trees \ park}$: Number of trees uprooted in the park $N_{trees \ forest}$: Number of excess trees if more than 20 trees have been cut down in the forest

With all the houses displaced, all the trees uprooted in the park, and all the trees cut down in the forest, this brings the penalty factor to a minimum value of 0.4.

5. Competition Deliverables

Here are the important dates to remember for the competition.



5.1. Scoring Scale

The scoring scale for the 2021+1 Engineering Games Robotics Machine is shown below.

Deliverables	Score (%)
Progress report	10
Video presentation	5
Presentation to judges	25
Public demonstration	60
Total	100

5.2. Progress Report

The progress report should be a concise document to inform the Organizing Committee on the progress of the robotic solution and the strategies being considered. We want to see your engineering process!

This report should contain a maximum of 12 pages, including the title page and table of contents, if applicable. This constraint excludes appendices, but these should not be necessary to understand the report.

Evaluation criteria	Score
Presentation of the robotic solution	2
Presentation of the planned strategy and expected results	4
Risk management process	4
Structure and clarity of the report	Up to -1
BONUS: CAD of the robotic solution	1
Total	10

Table 3 : Progress Report Evaluation

5.2.1. Presentation of the Robotic Solution

Your report should present the current status of your robotic solution. It should also briefly present the additions and improvements you plan to make to your solution.

The following elements will allow you to present your solution comprehensively:

- Sketch or rendering of the solution
- Presentation of the movement system
- Presentation of the resource collection, transport and deposit systems
- Presentation of the control system
- Presentation of any other systems that give your solution a competitive advantage

5.2.2. Presentation of the Planned Strategy and Expected Results

Your report should outline the strategy you plan to use for your official attempt.

- Resource Prioritization
- Presentation of the order in which the resources will be processed and sold
- Presentation of the expected score

5.2.3. Risk Management Process

A solution to a complex problem does not come without risks! You will need to identify the risks that threaten the performance of your robotic solution and develop a plan to manage these risks:

- Identification of the risks
- Identification of the probability and impact of the risks
- Identification of mitigation plans: what are you doing to prevent the risk from occurring?
- Identification of contingency plans: what do you do if the risk occurs anyway?

5.2.4. Structure and Clarity of the Report

Up to 1 point may be deducted if the structure and clarity of the report are unsatisfactory.

5.2.5. Bonus: CAD of the Robotic Solution

A bonus of up to 1 point will be awarded to teams providing a CAD of their robotic solution. This can be complete or partial. It should not be necessary to understand the report and cannot raise the total score of the progress report above 10 points.

5.3. Presentation Video

The Machine video will be shown to the audience prior to each team's on-stage demonstration and should be between 3 and 4 minutes in length. The purpose of the video is to entertain the audience while informing them about the university, the team members and their design and manufacturing process.

This video can be produced in either French or English. Any video deemed unsuitable by the Organizing Committee will not be presented and will be given a score of 0/5.

Evaluation criteria	Score
Introduction of the team and its university	1
Presentation of the Machine and its operation	1
Vulgarization of content and accuracy of information	1
Originality and concordance with the theme	1
Video quality	1
Total	5

Table 4 : Evaluation of the video presentation

The presentation video must be submitted in MP4 format on January 3, 2022, before the end of the first work period of the Machine. A video submitted late will automatically lose 50% of the points. A video not submitted by the end of the Machine period beginning January 5 will be given a score of 0/5 and will not be presented.

5.4. Presentation to the Judges

You will be asked to present your solution to a panel of judges. Your presentation should last a maximum of 8 minutes and will be followed by a 5-minute question period. This will take place on the day of the competition, just before the public demonstration.

Evaluation criteria	Score
Introduction of the team and its university	1
Presentation of the Machine and its operation	8
Design critique	4
Presentation of the strategy and expected results	6
Realism of the large-scale solution	2
Structure of the presentation and professionalism of the team	1
Question period	3
Total	25

Table 5 : Evaluation of the video in front of judges

5.5. Demonstration to the Public

The score for the public demonstration will be calculated as defined in section <u>4. Scoring of the</u> <u>demonstration</u>.

6. Logistics

6.1. Machine Periods

During the 2021+1 Engineering Games, Machine teams will have the opportunity to participate in three work periods. The official competition course will be made available to teams and the schedule for trial periods on the course will be determined during the first Machine period. You are strongly encouraged to bring all or part of your course. It will then be made available to all teams.

During the Machine periods, you will not be allowed to start your stock exchange. You will be able to connect to the official course stock exchange, which will be available at all times to all teams.

At any given time, only 4 members per team will be allowed to be present at the Machine's work areas. However, teams will be able to swap members as they see fit.

The team is responsible for bringing the necessary tools to work on their robotic solution during the Machine periods.

6.2. Competition Day

The day of the competition will be divided into two parts:

- 1) Presentations to the judges (morning);
- 2) Demonstrations to the public (afternoon).

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

For the public demonstration, the team will have 5 minutes to prepare their robotic solution and place it in the starting area. The next 10 minutes will be used for the execution of the attempt. If the team is not ready after 5 minutes, they can continue to prepare their robotic solution without incurring a penalty. However, the 10 minute attempt time will begin.

The running order will be determined randomly in the morning, independently of the running order of the presentations to the judges.

7. External Documents

On the <u>2021+1 Engineering Games website</u>, you will be able to download the following:

- 1) The Machine Handbook;
- 2) The course construction specifications;
- 3) The documentation of the stock exchange;
- 4) The cut list for making the course;
- 5) The CAD of the course;
- 6) The image of the stock exchange (the disk image of the Raspberry Pi);
- 7) The PDF of the play mat.

The Organizing Committee reserves the right to modify these documents at any time and will notify you of any changes. In case of discrepancy between the French and English versions of these documents, the French version will prevail.

Appendix A: Elements Provided

(1x) Play mat

- (8x) Cardboard house, to fold
- (5x) Sandbags
- (1x) Stock exchange (1 Raspberry Pi with case, SD card, power supply and button)

Appendix B: Organizing Committee

If you have any questions or comments about the challenge, you can reach the Machine team at the following address :

Pierrick Arsenault - Vice President, Robotic Machine Alex Frappier Lachapelle - Assistant, Robotic Machine Alexandre Francoeur - Assistant, Robotic Machine Alexandre Mongrain - Assistant, Robotic Machine Ben Fevereiro - Assistant, Robotic Machine machine@jeuxdegenie.qc.ca

If you have any questions or comments that are not related to the Machine Challenge, do not hesitate to contact the various members of the organization at the following addresses :

Camille Lalancette - President

presidence@jeuxdegenie.qc.ca

Catherine Dumas - Vice President, Sponsorships

partenariats@jeuxdegenie.qc.ca

Happy Machine season to all participants!