Internal Competition Rules Manual

Note: This document is subject to minor changes throughout the competition, mostly clarifications, which should not affect your design choices and game strategy in general. Whenever this document is updated, we will provide a new version number and make an announcement.

Change Log

V1.1

1. *Added soldering challenge supportive figures*
2. *Updated the soldering challenge assessment method*
3. *Updated Battle Lab flexible configuration*
4. *Clarified that the Battle Lab's surface that interacts with the box is smoothened by a sticker*
5. *Clarified on additional material usage*
6. *Clarified that only TB47/TB47D TB48/TB48D DJI Battery provided can be used as the power source*

7. *Clarified that the computation platform (laptop for example) for the Engineer is not counted towards the dimension of the Robot*

0. Table of Content

1. Administration

1.1 Timeline

Please note that the following timelines are subject to change due to, for example, discovery of CoVid-19 cases among the frequent attendees but generally we won't change the timeline too frequently, you can construct your plans based on the current presented timeline. Also, whenever an event time changes, we will make an announcement and publish a new version of the Rule Manual.

Event	Date	Remark
End of Tutorial	Nov.4	The last assignment deadline
Game Rule preview Release	Nov, 7	Only minor changes afterwards
Ice-breaking/welcoming session & all official materials release	Nov.11	Session Venue: LT-K
Weekly Progress Checking	Nov 19th , 26th Dec 3rd	Dec: Must have at least one movable robot
Final Review	Dec 17th	

Field Testing Day	Dec 19th	Venue: Hall 7 Multi-purposes Room
Competition Day	Dec 20th	Venue: Hall 7 Multi-purposes Room

1.2 Schedule

Field Testing Day Day1	Dec 19	Place: Hall 7 Multi-purposes Room
Competition Day Day2	Dec 20	Detail: TBA

1.3 Lab regulations & department-wise rules

For more details of our administrative regulations, please refer to the following file:

https://docs.google.com/document/d/1k0woLMVRLAAU_4szfLn8N3-D-YYx5jUe25vDkKStcTs/edit?usp=share_link

You must read relevant information carefully, when violated, we might disqualify you or even report you to the school for bad behaviors.

2. Overview

2.1 Background

You may have played some games like *Overwatch* or *Call of Duty* where one of the gameplays is that both teams need to **capture some given objectives/sites**. Here in this competition, your main objective is to compete for the five sites by operating the robots made by you.

2.2 Core-Play

In this match, you need to operate a ***Carrier***(a manual robot) to deploy your ***Soldiers***(black/white blocks) or ***Generals***(blue blocks) to the five ***sites***(an area enclosed by AL tubes). ***Soldiers*** are collected from the ***barracks*** via the ***Carrier***, and the more ***Soldiers*** you deploy, the more ***Soldiers*** are spawned at the ***barracks***. ***Generals***, on the other hand, need to be obtained by both sides' ***Engineer*** (a fully autonomous robot) at the ***Battle lab***(a chimney-liked tube filled with Generals and Bombs). **1 General = 3 Soldier*s***.

In each match, we will have a black team and a white team competing with each other. For every site, the team with more deployed Soldiers in it captures it. You will receive a large amount of points by capturing each site at the end of the competition.

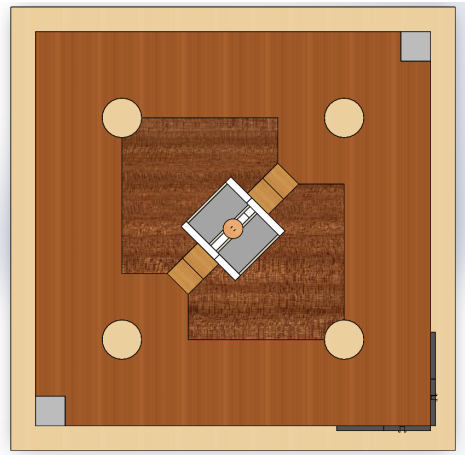
At the end of the match, **the team with the most points wins**. Although we have bonus policies for some additional objectives, the main source of points is still capturing sites.

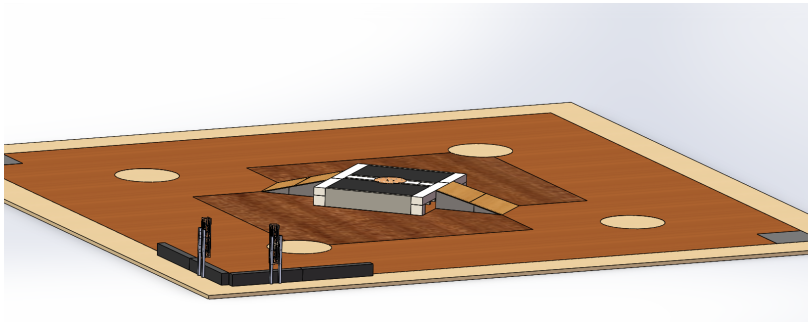
2.3 Objectives

- Machining and manufacturing of basic parts
- Understand how the program drives each component

- Understand how to power and signal the various components
- Initial understanding of robotics execution, sensing and decision making

3. Game Field



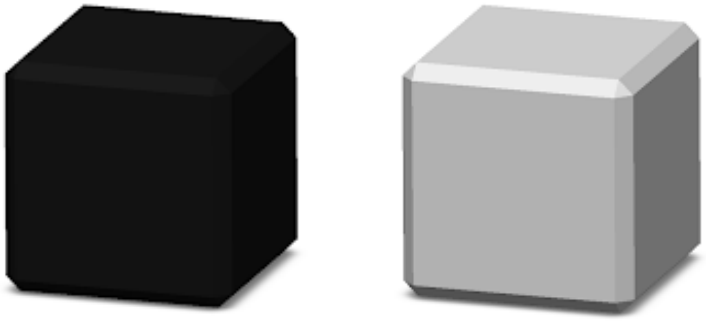


Field size: 8m * 8m

3.1 Field props

There are three types of transportable props on the field. The size and weight of these three props are the same.

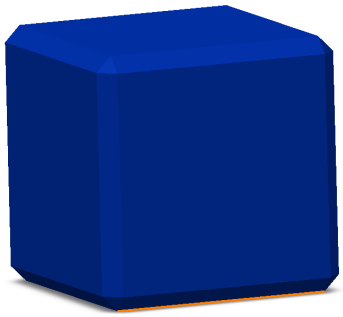
3.1.1 Soldier



A small 3D-printed box in **white / black** (same as the team color). It can be obtained at each team's barrack. A Soldier is considered to be successfully deployed if it had stood still(not moving or rolling) in a site for more than a second.

- *Size: 80*80*80mm (+-1mm)*

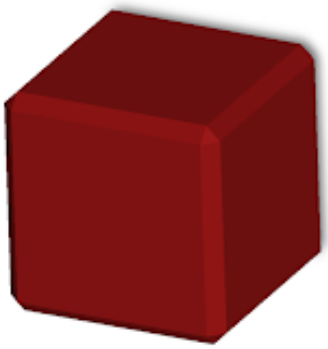
3.1.2 General



A small 3D-printed box in **blue**. It can be obtained at the battle lab. On two specific timings(when remaining time is 3min or 1min) Generals will generate and the battle lab and the Engineer bots on both sides will be powered on to separate Generals from the Bombs. Some Generals have **QRcode** on them while some don't. The QRcode tells whether the box is a General or a Bomb. The program code for extracting this info from the QRcodes will be provided. A General is considered to be successfully deployed if it had stood still(not moving or rolling) in a site for more than a second.

- *Size: 80*80*80mm (+-1mm)*

3.1.3 Bomb



A small 3D-printed box in **red**. When General are generated, they will be filled into the battle lab together with Bombs in random order. **Taking a Bomb out leads to point deduction**. Like Generals, a part of the Bombs have **QRcode** on them while others do not.

- *Size: 80*80*80mm (+-1mm)*

3.2 Site

There are five sites in the field. Site 1~4 are on flat ground and enclosed by AL tubes (Aluminum Tubes), while site 0 is on the highland located at the center of the map. Each team occupies the site **by putting more Soldiers or Generals into it**. One General is equal to three Soldiers, on the basis of which the team with more Soldiers occupies the area. If the number of Soldiers is equal, then neither of the teams occupies the site.

In addition, a successfully deployed Soldier or General is **not able to be used to occupy another position**. Even if a Soldier or General fails to stay in the Site at the end of the game for various reasons, it will still be considered a successful deployment.

3.3 Starting Point

A 15 degree ramp facing the barrack where the Carrier robot **needs to be stationary on this ramp before the start**. Moreover, upon the Game ends, bonus points will be given to teams who manage to drive their Carrier Robots on to the ramp and be stationary.

3.4 Barracks

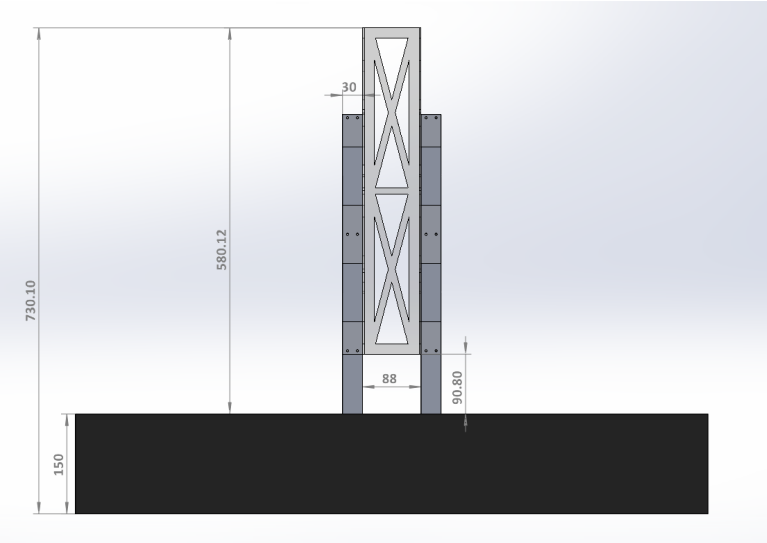
The barracks is the place to get ***Soldiers***, it is an area ON THE GROUND that has up to **5 Soldiers**. The 5 Soldiers will be available at the beginning of the match.

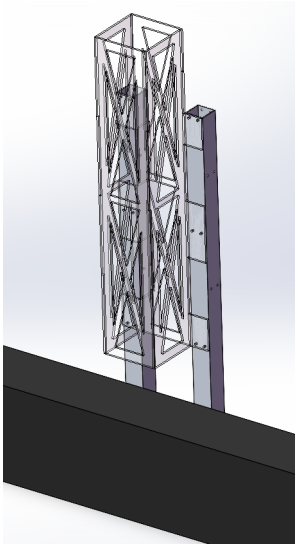
3.5 Battle Lab

The Battle Lab is a raised platform with a fixed chimney-like tube (made of Acrylic board). The tube will be filled with Generals and Bombs in random order and random quantity. The Engineers with separate Generals from Bombs, Generals shall be pushed into the field for the Carrier to retrieve and use for site occupation while Bombs shall be swiped out of the field. A Bomb falling into the field will be marked as score deduction for that team.

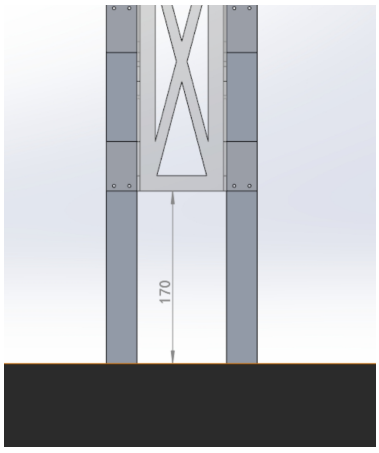
The Engineers should be placed on the platform. Engineers can simply push the generals onto the battle lab restricted area while bombs shall be pushed in the opposite direction to make it drop out of the competition area.

Note: You need to make sure when the Engineers is re-powered up, it can function properly.

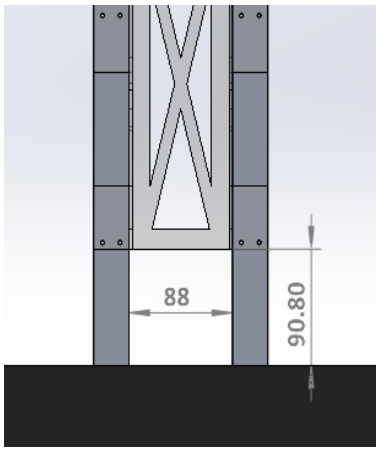




There are two flexible configurations of the Battle Lab chimney, shown below:



Config 1 (newly added in V1.1)



Config2 (same as in V1.0)

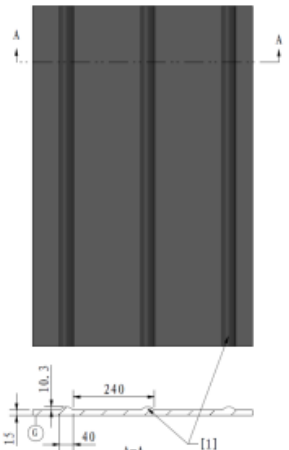
You can specify either one of the configurations depending on your strategy and design of Engineer. Please notify the TAs prior to the games which one you will be needing during the game.

Moreover, you might worry about the friction of the surface of the Battle Lab that might make it hard to push the box. We can ensure the surface friction is low as we stick a smooth sticker onto the surface, the exact friction parameters are not measured but you can come to the lab and feel it yourself.

3.6 Walls and Bumpy Road

Walls are 1cm high aluminum tube, surrounding each site, both teams are not allowed to step on it.

Bumpy Roads are



3.7 Restricted Area

There are 3 kinds of restricted areas which Carrier cannot enter.

3.7.1 Barracks Restricted Area

The area in front of each teams' barrack is a restricted area of the other team's Carrier.

3.7.2 Site Restricted Area

The site is a restricted area for both teams' Carriers.

3.7.3 battle lab Restricted Area

The Area in front of each team's battle lab is a restricted area of the other team's Carrier.

The restricted area will be marked using colored tapes in the actual field, so you will have visual guidance when operating the Carrier Robot.

4. Game Policy

The team with more scores wins. All additions and deductions are listed below.

Note, every score gain and deduction will be shown to all participants immediately once taking effect, there will be a scoreboard updated real-time during the game.

4.1 Score Acquisition

Event	Stage	Points
Carrier Staying on the Ramp	Before the Game	+10
Deploy a Soldier	During the Game	+5
Deploy a General	During the Game	+10
Occupying Site O for 1 minute	During the Game	+20
Stay on the ramp	Ending of the Game	+15
Occupy One Site	Ending of the Game	+80

- When the Carrier is not able to stand still on the ramp, the starting point of the Carrier will be reset to be on the HighWay (flat region).
- As stated above “Deploy a General / Soldier” refers to when a team puts a General / Soldier into a site and the box stays stationary for 1 second, timed by the referees.
- The interval of occupying site 0 refers to the time starting at the time when a General / Soldier is successfully deployed by a team such that the Soldiers of the team in the site outnumbers that of the opponent.
- “Climb over the Ramp" is only considered achieved when the Carrier climbs up the Ramp and the entire body of the Carrier leaves no contact with the Ramp after reaching the High Ground.
- There will be a “site occupation status board” shown to all participants during the game, which shows both which team occupies a site and the number of Soldiers each team has in the site. Although you could theoretically judge the occupation status from the actual number of boxes inside the site, this would not always hold true as we count an increase in the number of Soldiers once deployed, even if that box eventually goes out from the site, the number will not decrease. So you are recommended to check the “site occupation status board“ when you need to check the number of Soldiers you and your opponent have in the site.

4.2 Score Deduction

Event	Stage	Points
Carrier Not Staying on the Ramp	Before the Game	-20
Technical Pause (At most 3min)	Before the Game	-10/min
Carrier Stepping over the Wall	During the Game	-3

Engineer Taking out a Bomb	During the Game	-30
Carrier Going Out of the Field	During the Game	-30
Deliberate striking or blocking the opponent	During the Game	-20
Deliberate moving the other team's Soldier/General in Site	During the Game	-30
Team Member Stepping into the Field	During the Game	-100
Carrier Going into the Restricted Area	During the Game	-30

- A deduction of points if your robot cannot stand still on the Ramp indicates that in this case you will have a 20 points difference between you and the opponent even before the game starts. Thus we strongly recommend to tune-up your PID parameters so that the robot can stay on the Ramp.stop
- Regarding the point of "Team Member Stepping into the Field", here is an additional note: Each team should assign a member who will be responsible for entering the field and stop and move out an out-of-control robot during the game. The name of that person should be told to the group TAs before the game day. In addition, the entrance of that person is only allowed when the main referee raises a signal. Lastly, if that person does things other than stopping the robot and moving it out of field, e.g. deliberately blocking the opponent's robot operation, then the main referee will subjectively deduce the team's point by 50 marks.

5. Technical Requirement

5.1 General Requirement

All robots must meet all the following General technical specifications:

5.1.1 Pneumatic Devices

- Any robots using gas-powered mechanisms must NOT exceed a gas pressure higher than 0.6 MPa in any part of the robot.
- The gas used must NOT be flammable.
- The pressure regulators must be installed on or at the container's main outlet valve.
- The compressed gas container must be adequately protected from rollovers, impacts, and stress which will result in mechanical faults.
- All pneumatic tubes, valves, and compressed gas containers must be concealed and installed away from the outer surface of the robot. No part of the pneumatic system should contact the ground at any time.
- All compressed gas containers must be mounted onto the frame of any robot in a safe manner. There must be at least two fixed points for mounting of the compressed gas container, or at least 1/5 of the compressed gas container’s length must be fixed to the frame.
- All compressed gas containers must be insulated from potential heat sources.
- All pneumatic tubes, valves, and components must be qualified to withstand pressure in the compressed gas container.

5.1.2 Power Supply

- All robots must use a TB47/TB47D, TB48/TB48D battery as a power supply, no other power sources are allowed (like usual AA battery or 18650 battery)
- The Maximum Normal Operating Voltage is 24V
- For the main power supply wire, XT60-M port is a must
- All wires must cover by insulator such as heat sink tube
- Every solder joint of wire must be covered by heat sink tube
- Every XT30 & XT60 wires need to use at least AWG16 Wire
- Every wire should not be movable, expect for movable mechanism

5.1.3 Additional materials other than those provided

You may consider using materials that we don't provide to you, fSuperCapor example, special screws, special springs, etc. For these cases, you can send your design to your TAs (MECH) for review, if proved fine, then our TAs will be providing you the specified materials.

However, NO ADDITIONAL ELECTRONICALLY CONTROLLED ACTUATORS are allowed. Your choice of actuators is limited to 6 DJI motors, 2 servo motors, and extra pneumatic devices if allowed.

5.2 Carrier

5.2.1 Dimensional & Weight

- Initial Dimension Limit: 600mm * 600mm * 500mm
- Maximum Extension Dimension Limit: 800mm * 800mm * 650mm
- Weight Limit: 20kg

5.3 Engineer

5.3.1 Dimensional & Weight

- Initial Dimension Limit: 500mm * 500mm * 650mm
- Maximum Extension Dimension Limit: 800mm * 800mm * 750mm
    - Note, the size of the laptop/PC used for CV tasks & the USB extension are NOT COUNTED towards the dimension, so you can ignore them
- Weight Limit: 15kg

6. Game Process

6.1 Inspection and checking

1. Size of the Carrier Robots and Engineer robots will be verified through frames made up of aluminum tubes, and their internal sizes are 600*600*500mm 500*500*650mm with +5mm error. The robots will pass the checking-in if no parts exceed the frame.
2. Maximum extension will be verified by measuring the furthest vertical distance stretched from the frame/sheet. (via measuring tape)
3. Weight will be verified via electrical balance in the lab. Its precision is up to 2 d.p. (in other words, 0.01kg, you should leave tolerance for this)

6.2 Three-min preparation & wiring challenge

Before each game starts, there is a 3-minute preparation and wiring challenge time, two things executed in parallel.

6.2.1 Personnel entering the field

During this time, only **up to 6 members**, including people doing robot preparation and wiring challenge, can enter the field after the referee's signal. Teams should confirm the group of people that are going to be involved into these 3-minute processes prior to the game starts, and should provide a name list to the TAs of the group.

We recommend **5 people for robot preparation** (among whom, 2 members for each robot with 1 additional coordinator), and the remaining **1 person being responsible for the wiring challenge**, if the group decided to take the challenge.

6.2.2 Preparation time

One of the things you should do during the 3-minute time is set up your robot in the field, making sure they are functioning as expected.

You can design a set of **routines** for setting up your robots, for example for the Carrier Robot:

1. Enter the field, carrying the Carrier Robot + a Soldier box for testing
2. Put the Carrier near the starting point
3. Power on the Carrier
4. Perform basic chassis maneuvers, making sure it can move as controlled
5. Perform box gripping, if implemented, making sure it can take Soldiers/Generals
6. Perform other functionalities, if any.
7. Debug if any of the above goes wrong
8. After making sure the core functionalities are working correctly, put the Carrier to the designated starting point, i.e. the ramp, and make sure it stays still and powered on.
9. Leave the field before 3-minutes time ends

Note: you will be provided with 1 Soldier, 1 General with QRcode, 1 General without QRcode, 1 Bomb with QRcode, and 1 Bomb without QRcode for testing your Engineer/Carrier Robot, use them wisely to test out your robot functionalities.

6.2.3 Wiring challenge

The wiring challenge is an OPTIONAL task that each team can choose to do or not to do. In the wiring challenge, each group needs to solder a **SINGLE** broken power wire shown below.

The criterion for PASSING this challenge are three

1. When using a multimeter to measure, the two sides should connect electrically.
2. The fixed wire should not be able to be broken when pulled from two sides, this is assessed by connecting the wire to a 15kg weight, and each team is required to have a representative to lift the weight connected by the soldered wire by 20cm at least.

3. The re-soldered part must be protected by heat shrink tubes. Any exposed conductive part of the wire around the fixing point will cause failure of the challenge.

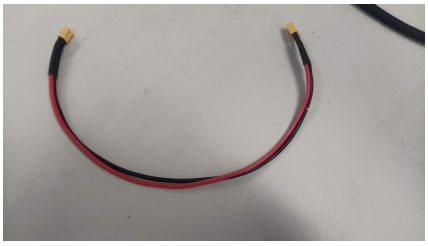
If you choose to do this challenge and successfully pass, you will gain additional game points after the game ends, the specific amount of points is documented in the Game Policy section.

Note: we will provide a portable soldering station, a heat shrink tube, a lighter (used to shrink the tube) and a wire cutter for performing the wiring challenge. You must use the soldering stations we provide and are not allowed to your own stations.

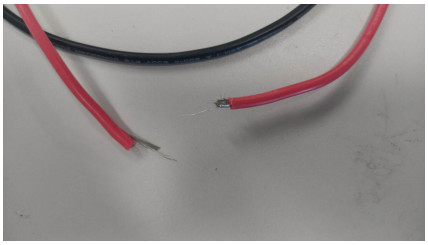
You are also prohibited to use:

- Clamping stand / Wire holder

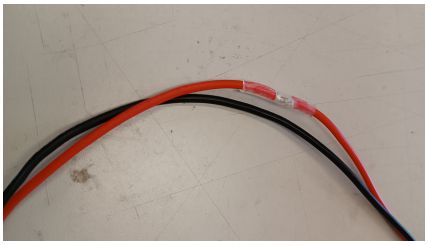
Original wire



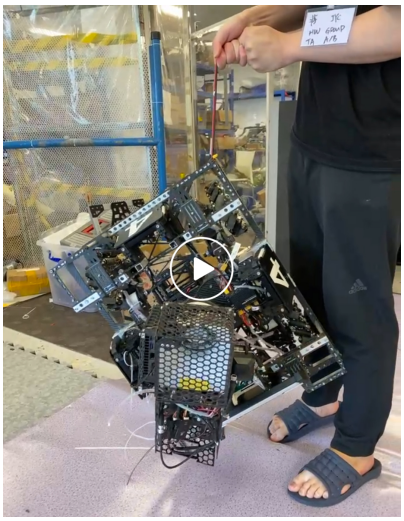
Broken wire (which you will get prior to the challenge)



Recovered wire



A well-soldered wire should be able to hold at least a 15 kg of weights, as shown below



6.3 In game

The game process is 5 minutes, measured starting from the 3-minute pre-match session ends.

6.3.3 Engineer power-on and Battle Lab refill

Please note that the Engineer Robot is not powered-on throughout the match time. The Engineer Robot will be powered on during the 3-minute preparation period, after the match starts, we perform the following:

- **0:00** Game starts
- **0:40** The referee power-off the Engineer Robots of both team simultaneously
- **0:40 - 0:55** The referee refill the Battle Lab of each team by up to 2 random boxes (could be Generals or Bombs), note that the type of boxes and order filled into each team's Battle Lab will be the same though. If the Battle Lab of a team has less than 2 empty slots, then the referee simply fills up until it is full.
- **1:00** The referee power-on the Engineer Robots of both team simultaneously
- **1:40** The referee power-off the Engineer Robots of both team simultaneously
- **1:40 - 1:55** The referee refill the Battle Lab of each team by up to 2 random boxes (could be Generals or Bombs), note that the type of boxes and order filled into each team's Battle Lab will

be the same though. If the Battle Lab of a team has less than 2 empty slots, then the referee simply fills up until it is full.

- **2:00** The referee power-on the Engineer Robots of both team simultaneously
- **2:40** The referee power-off the Engineer Robots of both team simultaneously
- **2:40 - 2:55** The referee refill the Battle Lab of each team by up to 2 random boxes (could be Generals or Bombs), note that the type of boxes and order filled into each team's Battle Lab will be the same though. If the Battle Lab of a team has less than 2 empty slots, then the referee simply fills up until it is full.
- **3:00** The referee power-on the Engineer Robots of both team simultaneously
- **3:40** The referee power-off the Engineer Robots of both team simultaneously
- **3:40 - 3:55** The referee refill the Battle Lab of each team by up to 2 random boxes (could be Generals or Bombs), note that the type of boxes and order filled into each team's Battle Lab will be the same though. If the Battle Lab of a team has less than 2 empty slots, then the referee simply fills up until it is full.
- **4:00** The referee power-on the Engineer Robots of both team simultaneously
- **5:00** Game ends

6.4 Post game

6.4.1 Arguing Process

Should you have any objections to any of the referee's objective decisions, you could initiate an arguing process **AFTER MATCH ENDS**. We have recordings for all of the matches that could be referred to. However, you get only one chance to request a re-evaluation, if the referees decide to keep the original decision, then the game result will not be changed.

On the other hand, depending on the situation, the following events could happen:

1. Score recalculation, for example, in case a score deducting behavior is unspotted then revealed
2. Re-match, for example, when a mis-judgment potentially alters the game process, like a miscount of Soldiers that leads to student teams making wrong decisions.

3. Winner changing, for example, when a serious misconduct was unrecognized for the original winning team but revealed after the argument. Then in that case the winner will be reassigned to the other team.

7. Appendix

7.1 Referee Settings

Each team will have a referee who keeps track of all points deducted and added during the game via a tablet, and is also responsible for placing Soldiers in barracks. There will also be a **main referee** who will record all Site occupations and update the records. A **host** will be responsible for announcing the start and results of the game, as well as monitoring the referee's work by viewing recorded video.

END of Document