The iriss
Space Robotics Competition

TABLE OF CONTENTS:

1 ACRONYMS 3
2 DIDACTIC GOALS 4
3 INTRODUCTION 5
4 TASK OBJECTIVES 6
5 TEAM COMPOSITION 8
6 PARTICIPATION PROCESS 9
6.1 Registration / Letter of Intent 9
6.2 Preliminary Design Review (PDR) 9
6.3 Critical Design Review (CDR) 10
6.3.1 CDR documentation 10
6.3.2 CDR video conference 10
6.4 Finals 11
6.4.1 Flight Acceptance Review and Finals at ESTEC 11
7 DETAILS OF TASKBOARD AND ACTIONS 12
7.1 The Taskboard 12
7.1.1 The surface of the Taskboard 13
7.1.2 Walls of Taskboard 13
7.1.3 The supply vehicle 14
7.1.4 Zvezda, Zarya, Node 1 and Destiny 16
7.1.5 Columbus Module and cargo stowage 17
7.2 Ground Command Centre 18
7.2.1 Loss of signal 19
7.3 Game time 19
7.4 Age categories and prizes 19
8 POINTS SYSTEM AND REFEREE 21
8.1 Points and Penalties 21
8.2 The referee 22
9 ROBOT SPECIFICATION 23
9.1 General notes 23
9.2 Dimensions 23
9.2.1 Stowed configuration 24
9.2.2 Deployed configuration 24
9.3 Energy sources 24
9.4 Other constraints 25
9.4.1 Control mechanism 25
9.4.2 Wireless communications 25
9.4.3 Emergency OFF button 25
9.4.4 Optional Crew/collision avoidance system 25
9.5 Safety 25
9.5.1 Overview 26
9.5.2 LASERS 26
9.5.3 Powerful lights 26
9.5.4 Compressed air systems 26
9.5.5 Lithium-based batteries 26

10 FINALS AT ESA/ESTEC 28
10.1 Date 28
10.2 Dispensation 28
10.3 Schedule 28
10.4 Meeting with astronaut 28
10.5 Press 28
10.6 Talent release forms 28
10.7 Accommodation/travel 29

1 ACRONYMS

CDR	Critical Design Review
ESA	European Space Agency
ESTEC	European Space Research and Technology Centre
FAR	Flight Acceptance Review
GCC	Ground Command Centre
IFC	In-flight call (to the ISS)
ISS	International Space Station
LOI	Letter of Intent
PDR	Preliminary Design Review
STEM	Science Technology Engineering Mathematics

2 DIDACTIC GOALS

The activities described within this document are intended to be inspiring, entertaining, fun and at the same time have didactic goals outlined below.

Participants will:

Ages 11 to 13	Ages 14 to 16	Ages 17 to 19
1. Appreciate the conditions of microgravity environment and the challenges of working in space. 2. Learn about basic programming skills. 3. Learn new vocabulary associated with the space business and industry. 4. Learn how to measure dimensions, design, build and programme a functional robot 5. Learn more about how robots are used in everyday life and robotic gadgets. 6. Learn how to work as a team, problem solving and enhance their curiosity and creativity. 7. Learn how to present ideas and to create a video recording of these ideas.	• 1 to 7 as shown. 8. Learn about interaction and computer programming as applied to robotics. 9. Enhance their knowledge in STEM related subjects. 10. Learn about persistence, curiosity, problem-solving in an inquiry based setting 11. Students will learn how to present their ideas both verbally and visually in a creative way.	• 1 to 11 as shown. 12. Students will learn that there are opportunities of all kinds associated with robotics, from entrepreneurship to software design, engineering to writing, marketing and inventing.

3 INTRODUCTION

The iriss Space Robotics Competition is an educational activity organised by the European Space Agency (ESA) and the Danish government as part of Andreas Mogensen *iriss* mission. This activity addresses students in Europe (ESA Member States only) between the ages of 11 and 19 (split into 3 different categories; 'iriss 1', 'iriss 2' and 'iriss 3'), who are challenged to propose, design and demonstrate - in a competition event - a robot capable of fulfilling a logistic task on a scaled-down mock-up of the ISS.

The competition also attempts to cater for students who may not necessarily excel in engineering know-how and/or robotics, by attributing a proportion of scores to non-technical achievements, such as use of language, communications media and presentation skills.

The activity is structured in the following phases:

1. **Application phase (Letter of Intent)**: Letters of intent from teams must arrive to ESA by 6th February 2015. Required structure and content of the letter is detailed in the Annexe. ESA will communicate by 11h of February 2015 reminders and more information on the next phase Development Phase (PDR).

2. **Development Phase (Preliminary Design Review/PDR)**: The teams will start to prepare their robots. Teams are requested to present the status of their project with a short 5 minute YouTube video (due on 6th March 2015). Requirements on the video are detailed in the Annexe. ESA will announce by email on 10th March which teams are finalists and invited to the next phase (CDR).

3. **Critical Design Review/CDR** : This step will occur in two phases. For the first one, due on the 22nd May 2015, the teams will send the project status with all the technical characteristics of their project. They will receive some comments and points to improve from ESA within 3 weeks. Secondly, September 2015 (tentatively Friday 4th), the teams will have a direct video connection with ESA experts from the Space Research and Technology Centre of ESA (ESA/ESTEC) and partners.

4. **Competition Event (Flight Acceptance Review)**: In December 2015 (tentatively within the first two weeks of December), invited finalist teams will travel to ESA/ESTEC where they will compete against each other to fulfil the tasks set in this document. On the day of the competition, students will have the unique possibility to meet Andreas Mogensen. They will also have the chance to visit some of the facilities in ESTEC.

4 TASK OBJECTIVES

Supply vehicles regularly dock with the International Space Station and replenish it with food, water, experiments, clothes etc. The ISS crew (astronauts and cosmonauts) have very busy schedules. Unpacking the cargo is a lengthy operation that encroach other important activities such as science.

For educational purposes only, the Agency has decided to exploit the imaginative and inspirational potential of robots and space by asking teams of students from schools, groups of friends or independent robotics clubs to design and build remotely controlled robots that can perform a series of tasks depicted below, in a reduced-scale model of the ISS.

- Offload as many items of cargo
- Transport the cargo safely along the ISS to the Columbus Module
- Stow the cargo safely into the Columbus Module
- Avoid colliding with crew on the ISS
- Deal with loss of video signal from the Taskboard

Various technical and tactical solutions are possible to undertake such tasks. Imaginative solutions are sought as an ideal opportunity for challenging young students.

The teams participating to this activity will eventually face each other in a competition event that will assess the performance of the team and their robot.

This document sets the rules and regulations the teams and their robots must comply with. The following chapters address several aspects of the competition.

Some keywords are here quickly introduced:

- The **Taskboard** is a simplified and highly condensed model of the International Space Station. A Taskboard will be used in the final stage of the competition at ESTEC. However each team can build its own copy of the Taskboard to assist the development of the robot. Construction drawings of the Taskboard are provided by ESA. While it is not necessary for teams to build the entire Taskboard for testing their robots, it is recommended that simplified sections are reproduced for testing purposes (shelves, ramp and junctions between modules).

- The **supply vehicle** is a simplified model of a real cargo vehicle. The cargo vehicle is composed of a set of differently sized hollow boxes. ESA will distribute a set of boxes to teams progressing sufficiently far enough into the competition for testing purposes.

- The **robot** is the element that the teams will need to procure/build. The requirements for the robot are detailed in section 9. The operation of the robot will be done *remotely* and *wirelessly* with *no direct vision* of operations. Visualisation of operations will be provided in form of several cameras aboard the Taskboard (thus simulating module video cameras) and any additional remote sensing methods that the teams add to their robot.

5 TEAM COMPOSITION

Teams must include one adult supervisor (Team Leader) who takes responsibility for the team's progress throughout the composition and submission of the documentation within the deadlines indicated by ESA. The purpose of the supervisor is *not* to fill in the documentation on behalf of the students, but to assist in case of difficulties and to keep the team on track.
The supervisor will be the only point of contact between ESA and the team.

The teams shall not comprise of more than 5 students. Therefore the entire team will comprise of 5 students maximum and 1 adult Team Leader.

Any changes in team composition throughout the competition will be indicated to ESA immediately, but the numbers (5+1) shall not be exceeded.

In the eventual travel to ESA/ESTEC for finalists, additional adults will be allowed to accompany the students.

6 PARTICIPATION PROCESS

The application process is designed to be as interactive as possible between the team and the European Space Agency.

6.1 Registration / Letter of Intent

All teams participating in the Letter of Intent stage will be allowed through to the next stage (PDR).

Deadline Date: - 6th February 2015 at 23:59. ESA will acknowledge the receipt of the Letter of Intent by email within 2 working days.

Details:- The letter of intent should be addressed to ISS Education team of ESA Education Office (ISSeducationteam@esa.int). The content of the letter should contain *all* contact details; briefly describe the team and its members (name, date of birth, sex) and the overall strategy which the team may implement to ensure their presence in the finals at ESTEC (team structure, any preliminary robot design ideas if any). The letter of Intent does in no way oblige the team to follow in the process from start to finish.

6.2 Preliminary Design Review (PDR)

6 teams in each age category (iriss 1, 2 and 3) in the PDR will be allowed through to the CDR stage.

Deadline Date:- 6th March 2015 at 23:59

Details:- Submission of the PDR video is the first 'real' phase of the competition. The quality and content of video, presentation, use of language etc. will all count towards advancement to the next phase. This phase therefore tests communication and presentation skills of the students. The video should be submitted in English.
The video shall not be longer than 5 minutes and shall be uploaded to YouTube. The link should be sent to ISSeducationteam@esa.int before 6th March 2015 at 23:59.

The video should include:
-Presentation of the team members
-Presentation of the strategy
-Presentation of capabilities of robot prototype if any (load lift, camera, comms setup)

Please remember that ranking of submitted videos will be determined by the **quality of communication**, and *not* by the strategies or abilities of the rover. ESA wants to test a wide set of skills in the team.

Based on the quality of the video, the selected teams will be given a multiplier constant (see section 8 - 1st place 1.3x, 2nd place 1.2x, 3rd place 1.1x). This factor will be used to multiply the final score during finals in ESTEC.

6.3 Critical Design Review (CDR)

After the PDR three of the 6 teams in each age category (iriss 1, 2 and 3) will be allowed through to the Finals at ESTEC.

6.3.1 CDR documentation

Date:- Critical Design Review documentation should be delivered to ISSeducationteam@esa.int before 22nd May 2015 at 23:59.

Details:- The CDR documentation should be submitted in English and be based on the template provided.
The CDR documentation should also contain information about efforts and milestones achieved in securing funding to cover additional costs of team travel to ESTEC in December 2015.
The emphasis of this documentation should be more on technical aspects of the project. Based on your documentation ESA will give you some pieces of advice to be ready for the next step within 3 weeks of receiving the CDR package.

6.3.2 CDR video conference

Date:- In September 2015, during the iriss mission, the video conferences will be conducted. Dates will be organised with the teams to minimise disruption to school's organisation.

Details:- You will be invited for a review with a panel of experts to discuss your robot. The interview will be conducted in English.
You will be asked anything from technical questions to demonstrating your robot/breadboard model live. Remember that presentation skills, camera work, ability to understand and answer the questions will feature heavily in the experts' recommendation, thus test a wide range of skills. The interviews shall be mostly between the students and the ESA experts. This is to assess the knowledge and know-how of the students, not the teacher/team leader.

The interview shall be conducted using WebEx or Skype. An internet connection and a PC or Mac are sufficient for the video conference. Please be aware that Skype and WebEx require some software (free) installation and administrator rights will be necessary to install these small programmes. A good webcam and microphone are also necessary.

Based on the quality of the video conference, the teams will be given a multiplier constant (see section 8 - 1st place 1.3x, 2nd place 1.2x, 3rd place 1.1x). This factor will be used to multiply the final score during finals in ESTEC.

6.4 Finals

6.4.1 Flight Acceptance Review and Finals at ESTEC

Date:- 2 days in first two weeks of December 2015

Details:- The days shall be divided into several activities, first a flight acceptance review presentation will occur where students will present to ESA experts their robots and declare any changes since the CDR. Visits of the ESTEC facilities. A setup/warmup test/familiarization session will also be arranged. The following day, the actual competition will occur. Andreas Mogensen will also be attending the competition.

7 DETAILS OF TASKBOARD AND ACTIONS

Disclaimer:
While ESA strives to be as accurate as possible while building the playing area, there may be some small discrepancies and deviations from the official dimensions within this document due to manufacturing tolerances. No complaints will be accepted regarding these deviations. If any modification is made to the specifications, they will be made available in a complimentary document and announced to participants registered with the competition. We strongly recommend you check the ESA website appropriate to the competition regularly to avoid any surprises.

7.1 The Taskboard

The Taskboard (figure 1) is a highly condensed version of the International Space Station. The dimensions and details of the playing area, if teams decide to build one, are depicted in the annexe of this document. Because the ATV docks to the aft (rear) of the ISS and the Columbus Module is at the fore (front) of the ISS, many modules have been compressed to reduce the amount of material needed for constructions and time for completion of the tasks.

The CAD file of the Taskboard is freely available upon request to ISSeducationteam@esa.int. The format is the free tool SketchUp available at www.sketchup.com.

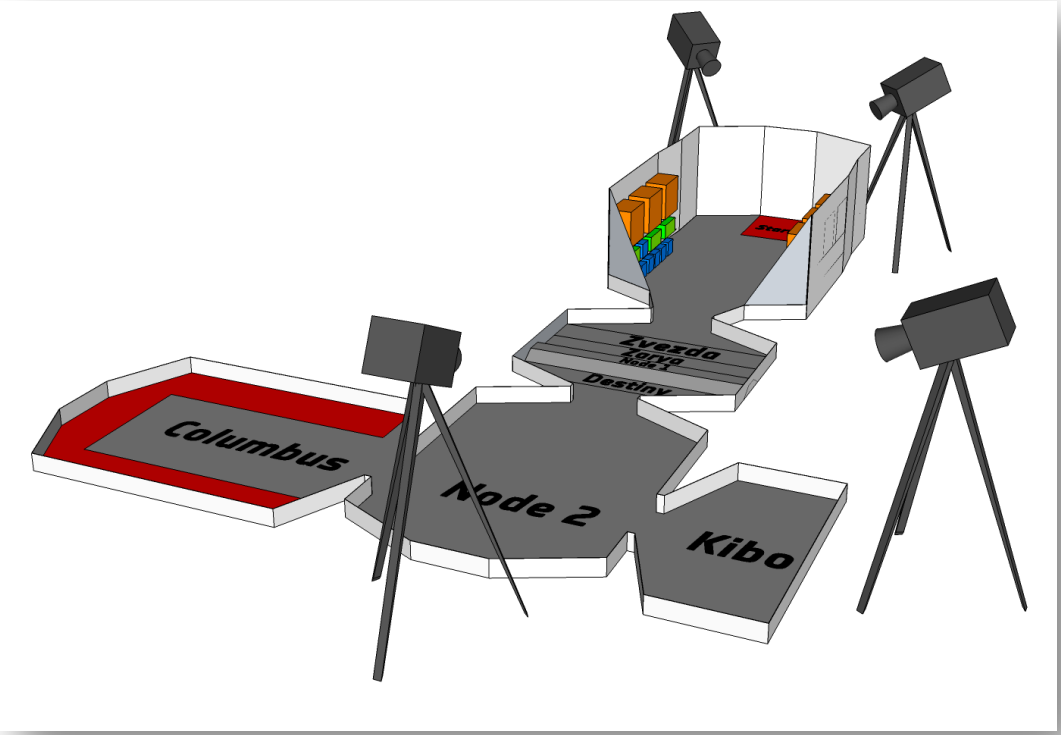

Figure 1: Model of the Taskboard

7.1.1 The surface of the Taskboard

The entire surface of the Taskboard will be constructed from 6mm thick Trespa (http://en.wikipedia.org/wiki/Trespa). The colour of the floor is RAL 9010

The start area of the robot is a stowage location in the cargo vehicle (figure 2). The robot must be entirely contained within the start area (0.5m x 0.4m x 0.7m (height) before the game starts. Refer to CAD file for details.
The colour of the start area and cargo depositing areas in Columbus module is RAL 3002

7.1.2 Walls of Taskboard

The entire upright structure of the Taskboard will be constructed of aluminium hollow rectangle profile 10cm high, 2.5cm wide and 3mm thick. The colour of the walls shall be RAL 9010.

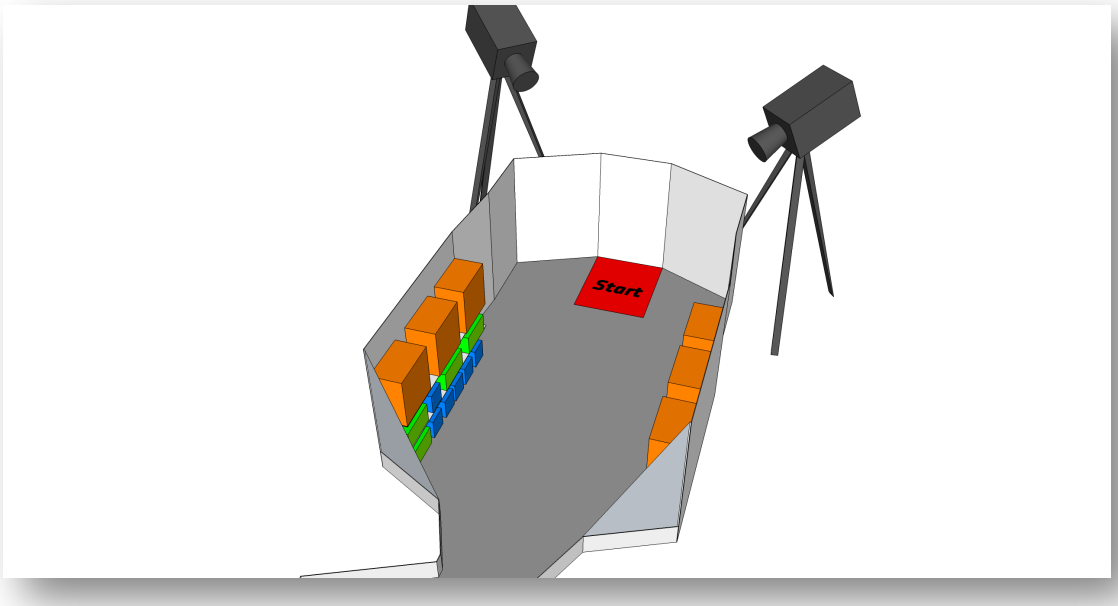

Figure 2: Start area

7.1.3 The supply vehicle

The cargo vehicle is loaded with three different shaped and weighted cargo containers worth different points.

1) Size: 10cmx10cmx10cm, colour: RAL (blue) 5002, mass: 225gr, 10 points
2) Size: 20cmx10cmx10cm, colour: RAL (green) 6018, mass: 375gr, 15 points
3) Size: 25cmx15cmx25cm, colour: RAL (orange) 2008, mass: 1100gr, 30 points

Note for iriss 1 competition: The blue boxes will contain a horizontal strip of crochet section (hooks) Velcro on the face of the cargo across the entire face of the cube bisecting the face presented to the main volume of supply vehicle. The cargo can be dragged on the floor without penalisation for iriss 1 teams.

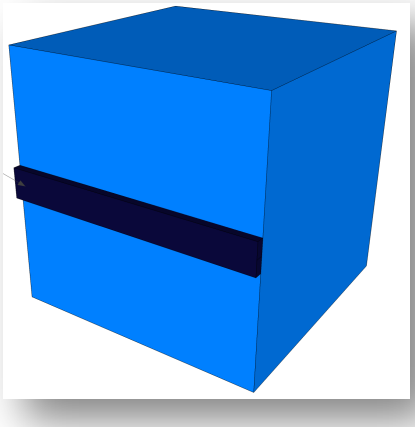

Figure 3: Blue box cargo (with Velcro)

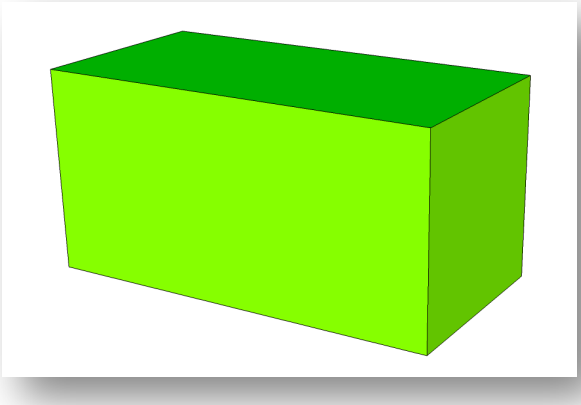

Figure 4: Green box cargo

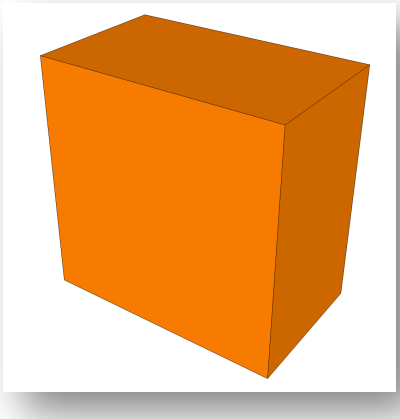

Figure 5: Orange box cargo

The cargo is placed at three different levels within the supply vehicle:

1) Level 1: ground – mostly blue cargo
2) Level 2: 15cm off the ground – mostly green cargo
3) Level 3: 30cm off the ground – all orange cargo

The cargo is loaded exactly as in the figures 6 and 7 below. Refer to CAD file for exact positioning.

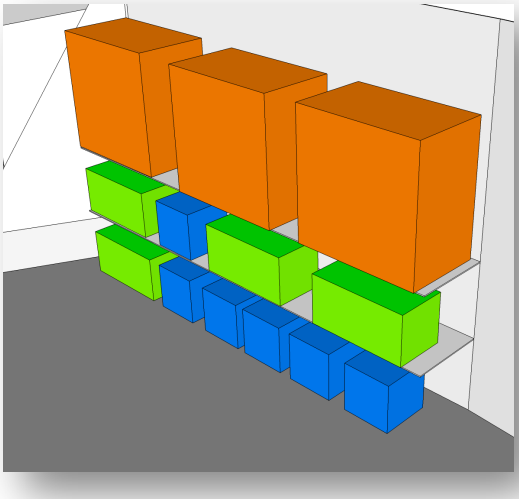

Figure 6: Starboard cargo shelves

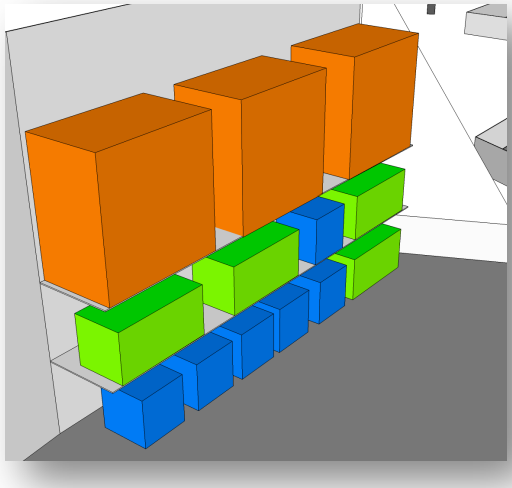

Figure 7: Port cargo shelves

There are no restrictions as to how many cargo items the robots may carry during one trip from supply vehicle to Columbus.

A flat packed unpainted set of cargo boxes will be sent to the teams who request them from ISSeducationteam@esa.int .

7.1.4 Zvezda, Zarya, Node 1 and Destiny

These modules have been reduced in size for practicality purposes.

Node 1 interconnects Russian and US segments and interfaces between the Russian sized hatch and the US/European/Japanese sized hatches. This is represented by an elevated section in the playing field. Angles are approximately 30 degrees and elevation approximately 5 cm with a 10 cm long elevated surface. Refer to CAD file for exact angles.
The ramp will NOT be present for iriss 1 games. Instead the entire section will be flat.

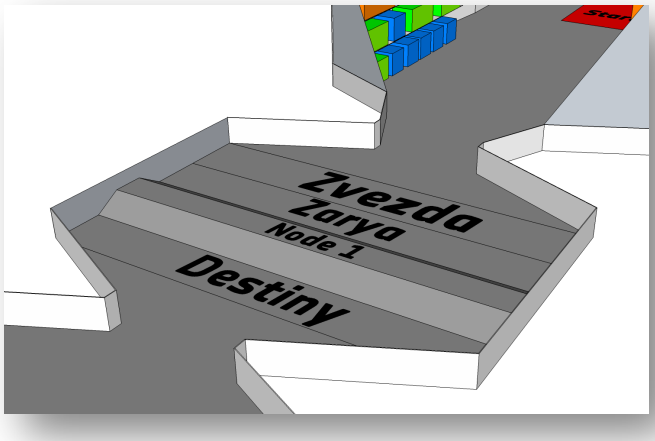

Figure 8: Compressed Russian/American segments

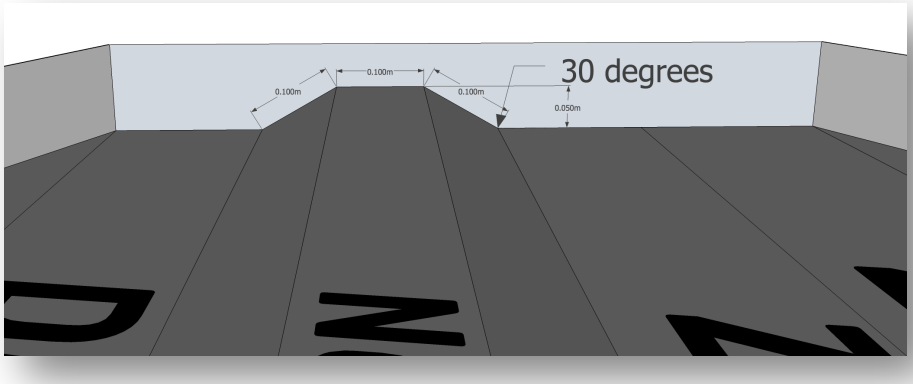

Figure 9: Elevated ramp in Node 1

7.1.5 Columbus Module and cargo stowage

The cargo has to be safely brought to the Columbus module and deposited in the cargo stowage area (RAL 3002). The cargo should be deposited in a controlled fashion rather than thrown into the area. There are no specific pre-determined areas for the boxes; anywhere in the stowage area will be accepted and points awarded by the referee. Partial stowage (cargo partially on red zone) will not be counted as successful. Figure 10 shows the accepted stowage areas in red. Refer to CAD file for measurements.

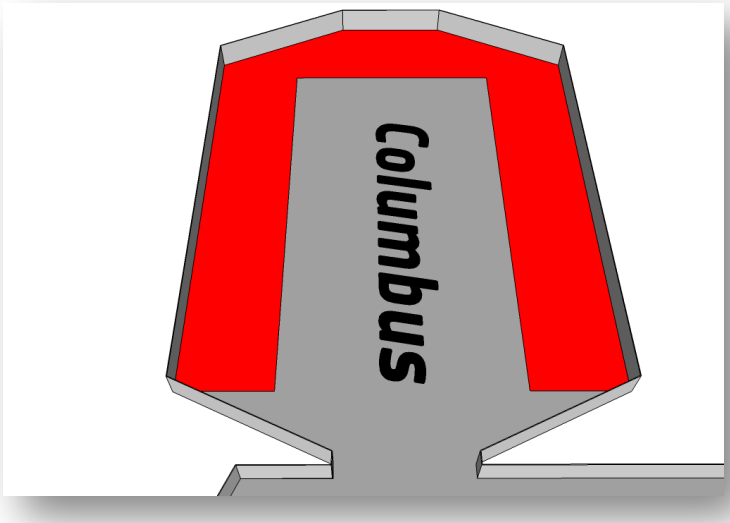

Figure 10: Columbus view Red areas are valid stowage areas

7.2 Ground Command Centre

Commanding of the robots will be done from a 'Ground Command Centre' (GCC). The distance between the command centre and the playing field will be 20<50 meters. Adjust your wireless communications accordingly. The playing field will be shielded from view from the GCC. Therefore, the GCC will not have direct visualisation of the playing field but rather receive relayed video feeds from 4 cameras on board the ISS at specific points as depicted in figure 1. These video feeds should aid teams to perform all operations task from unloading ATV to stowing cargo in Columbus. The height of the cameras is set at (1.5m) and the field of view cannot be changed during the operations and between the operations of different teams. This will be strictly enforced.

Figure 11: Ground Command Centre

Important: The teams are allowed to mount visualisation mechanisms on their robots but these data must be relayed wirelessly to a maximum distance of 50 metres. **The robot-mounted visualisation apparatus (if any) will not be subject to loss of signal** (see section 7.2.1)

7.2.1 Loss of signal

Loss of signal (LOS) is a frequent and easily predictable occurrence on the ISS, where the data are in such a configuration that no video feed is achievable with the ISS. At the beginning of each round, the referee shall announce the specific time at which the LOS will occur in that particular round. The LOS lasts 15 seconds, during which no ISS video will be received (robot mounted cameras will still function however). During LOS, GCC will still be able to move their robot, at their own peril of incurring penalty points.

7.3 Game time

Each game will last 5 minutes. Each team is expected to play at least 3 times. In between games, ±1 minute will be dedicated to exchanging the robot and to replacing the cargo precisely in the supply vehicle. The teams will be given a schedule of when they are expected to be ready with their robot.
Each team will have 20 minutes to make minor modifications to their code/robot/strategy between their games.

7.4 Age categories and prizes

The competition is open to several different age categories:

iriss 1: 11-13 years (no bridge in Node 1 – students allowed to drag boxes using Velcro)
iriss 2: 14-16 years
iriss 3: 17-19 years

The category in which the team will fall will be determined by the average age of the team at the time of submission of the letter of intent.

All participants shall receive a welcome pack from ESA Education.

In addition, each category winner will receive a dedicated competition prize.

8 POINTS SYSTEM AND REFEREE

There shall be one appointed referee who will have the final word on all decisions. Arguing with the referee will not be tolerated. Only the referee will be allowed onto the Taskboard. Teams shall hand their robots to the referee with clear indications on how to handle the hardware so that he/she may place it in the ATV before each game.

8.1 Points and Penalties

The referee shall be responsible for granting points as well as penalties.

Multiplier constants:
-There are two stages at which teams can receive multiplier constants. The PDR video submission and the CDR teleconference. The constants are numbers that will be used to increase the score acquired during the competition in ESTEC.
1st - 1.3
2nd - 1.2
3rd - 1.1

For instance, a team manages to get one 10-point box successfully in Columbus without incurring any penalties in the round. During the process, they also received 1st place in video submission (1.3 constant) and 3rd place in teleconference with ESA (1.1 constant). The teams points will therefore be:-
10+3+1=14 points for that round.
The multiplier constants are only applicable to ONE round, chosen immediately before the round is started. E.g. a team with one multiplier constant (1.1) scores 30 points in round one and decide to apply their multiplier constant to this round (giving them 33 points). In their second round they accumulate 40 points, however they can no longer apply their multiplier constant to this new score.
If a team received two multiplier constants, they can be split over different rounds.

Points:
-Successful and careful relocation of a blue cube fully into the Columbus stowage area = 10 points
-Successful and careful relocation of a green cube fully into the Columbus stowage area = 15 points
-Successful and careful relocation of an orange cube fully into the Columbus stowage area = 30 points

Points will be accumulated in each round (3 rounds total).

Disqualifications from round:
-Toppling over leading to off nominal contact with Taskboard surface

Percentage penalty reductions:
-Disruption of cargo stowage in supply vehicle (knocking off accidentally or dropping) – 10% reduction per cargo knocked over accidentally off that round
-Causing damage to / bumping into the playing area delimitations – 10% off final score off that round
-Swearing and general untoward behaviour for a friendly competition – 50% off final score of that round

Penalties are applied after multipliers have been awarded.

10 point box + 1.2 multiplier – 20% for cargo knocked off = 9.6 points final score for that round.

8.2 The referee

The referee shall have the final decision on point allocation and disqualification.

9 ROBOT SPECIFICATION

9.1 General notes

Teams are free to build robots from **any** kits readily available on the market or amend pre-existing robots to fulfil the tasks assigned. There are *no* restrictions and there are *no* recommendations.

Only one robot may be used per team and may be present in the playing area at any one time. The same robot shall perform in the three rounds.

The route to the playing area includes several steps. Please ensure your robot can be transported easily.

The robots may not cause intentional damage to the playing area. If such behaviour is suspected, the referee will automatically disqualify the team from that round.

The robot must stay in one piece throughout the competition, dropped counter weights are not allowed and will lead to disqualification. Dropping cargo is permitted but penalised.

The robots may not attach themselves to the playing field by any mechanisms whatsoever (e.g. suction).

The robots should not have any vibrating mechanisms or any other mechanism that would cause an illegal move as deemed by the referee. If you have any questions, please contact the organisers of the competition (ISSeducationteam@esa.int).

Please be creative, wonderfully coloured robots or robots with 'personality' affect the mood in a seemingly sterile environment that is a space station.

Sponsors are invited to provide appropriate logos and decorations to the robot so long as these do not interfere with the functionality of the equipment and doesn't exceed the restrictions set in this document.

Teams are strongly encouraged to make visible the mechanism inside the robot(s). This in order to allow the audience and other participants to see how the transport of elements is managed inside the robot.

9.2 Dimensions

There are two configurations which teams must take into account, the stowed configuration and the deployed configuration. The dimensions stated in this

document do not apply to the easily accessible emergency stop button needed on each and every robot.

9.2.1 Stowed configuration

The maximum size for stowed configuration is 0.5m x 0.4m x 0.7m (height). Please note the tight junctions between the modules when deciding on your robot's dimensions.

9.2.2 Deployed configuration

The length and breadth for a deployed configuration are unlimited, but please note the dimensions, surface and geography of the play area are restrictive. The deployed height is limited to 70cm, same as storage height maximum.

9.3 Energy sources

All the energy sources stored in the robot are allowed (batteries (sealed, maximum 13.8V), springs, compressed air, with the exception of energy sources which use gravitational potential and chemical reactions like combustion or pyrotechnic processes which are prohibited for safety reasons. In addition, the use of corrosive products is prohibited and the splash of liquids is not allowed.

If you have doubts about an energy source, please consult the organizing party ahead of time (ISSeducation@esa.int)

Teams have access to the industry (220V 50Hz) standard and can use this to recharge appropriate batteries.

To avoid the risk of fire it is requested to pay special attention to the choice of conductors, depending on the intensity of current passing through them. It is also recommended to protect the wiring with a fuse, wired to the nearest battery.

Robots must be able to play three consecutive games. Note that this includes the time required for the stand by, during which the robot is powered on and waiting to start. Therefore, we strongly recommend that teams bring several sets of batteries, and provide easy access to them in the robot for their replacement, keep permanently a set of batteries fully charged.

9.4 Other constraints

9.4.1 Control mechanism

Each robot must have a control mechanism which will operate during the 5 minutes of the game time. There will be no direct connection to the robot during the game time. All will be done wirelessly.

9.4.2 Wireless communications

It is recommended that wireless communications are encrypted to avoid interference during communications. The choice of wireless communications is left entirely up to the team, but please note that teams must bring all necessary comms equipment with them to the finals (i.e. pre-configured Wi-Fi wireless router in case of Wi-Fi comms). Please note that the GCC and the Taskboard area may be separated by up to 50 meters and that the signal will have to go through several obstacles. Extension cables from the Taskboard to GCC will be allowed to facilitate the comms, however there shall be no cabling allowed into the Taskboard. Wi-Fi routers or Bluetooth emitters can be placed on a table close to the Taskboard.
Teams that are not competing whilst others are requested to turn their communication devices off to avoid interference.

9.4.3 Emergency OFF button

The robots must include an emergency off button, with a diameter of **at least 20 mm** painted in red (for example a safety emergency stop button). It shall be placed on the top of the robot, in a conspicuous position and in a zone that is not dangerous and that is immediately accessible to the referee at any time during the match. The stop button must be actuated by a simple downwards motion (such as a hit with the fist). Pressing the emergency button must result in the immediate shut down of all of the robot's actuators, leaving them limp (not actively braked nor energized).

9.4.4 Optional Crew/collision avoidance system

Teams have the option to equip their robots with an obstacle avoidance system. The system is intended to prevent collisions between the ISS and or the crew. The crew shall be coloured yellow (RAL 1016 – see section **Error! Reference source not found.**)

9.5 Safety

Safety is paramount and will weigh heavily in the selection process for teams to progress in the competition. Please keep this in mind when constructing your hardware.

9.5.1 Overview

All the systems (robot and comms) shall respect existing national and European laws and specifications. Specifically, the systems used shall comply with legal safety regulations and must not endanger the participants or the public both during matches and in pits and backstage.
The robots must not have any protruding or sharp parts that may be able to inflict injury or to be dangerous.
The use of liquid, corrosive, pyrotechnics and of living things is prohibited. As a general rule, any device or system considered as potentially dangerous by the referee will be rejected. It must be removed from the robot prior to competition, or will result in the team's disqualification. Please check with ISSeducationteam@esa.int if there are any doubts.

9.5.2 LASERS

Only considerations based on laser class definition (in the "EN 60825-1:2007, Edition 2 -Safety of laser products– Part 1: Equipment classification and requirements" standard) will be taken in account. Teams using lasers will have to provide the classification notice of the equipment, or the data sheet of the laser component. Not being able to provide such documents will prevent the robot to be approved. Based on the classification, it is allowed to use lasers of Class 1, 1M. All other classes (2, 2M, 3R, 3B and 4) are strictly forbidden.
CAUTION: disassembling or modifying devices using laser sources often leads to a change of class. The laser devices should be used in the state of their marketing (laser device = Source + Electronics + Optical).

9.5.3 Powerful lights

When high intensity light sources are used, be aware that the light intensity can be dangerous for the human eye. Note that some commercially available high power LED devices can exceed this limit. Be responsible! Your machines are performing in front of an uninformed public!

9.5.4 Compressed air systems

Compressed air systems are not allowed in this competition.

9.5.5 Lithium-based batteries

This type of battery is allowed under the following conditions:
• A suitable charger must be shown at FAR
• Li-Ion Batteries are permanently contained in special fireproof bags (either inside the robot or on the stand, even in storage)
A system to detect underloading is also highly recommended
These conditions apply except in the case of Lithium-based batteries used in LEGO Mindstorm/laptop/cell phone, as long as:

- they are not removed from the initial device.
- they are used for the use intended by the manufacturer.

Never tamper with batteries.

10 FINALS AT ESA/ESTEC

10.1 Date

The date depends on the status of the ISS and cannot be predicted at the moment of publication (1st quarter 2015). It is however expected that the finals will occur on two consecutive weekdays in December 2015.

10.2 Dispensation

ESA will send to teams participating in the competition letters requesting special dispensation from normal school working days to attend the finals in ESTEC.

10.3 Schedule

The teams will be provided with setup stations with power on both days. The teams should bring their own tools and necessary equipment for assembly and disassembly of their apparatus.
Assembly, GCC setup and testing will take place on Day 1. Visits of ESA premises will take place on this day.
The competition will take place on Day 2. The schedule of games will be sent in advance to the teams.

10.4 Meeting with astronaut

The students will have a chance to meet and speak with astronaut Andreas Mogensen. The teams can prepare their questions a few weeks beforehand and we will attempt to give every team an opportunity to ask a few questions. Not all students will be able to ask questions due to time restrictions however.

The forms for submitting questions will be sent out to the finalist teams.

10.5 Press

Press (local to the team or national) is encouraged to follow the teams that make it to ESTEC. A detailed list of press that follow the teams shall be provided to ISSeducationteam@esa.int 2 weeks before the event. The press will then be put in contact with the ESA Corporate Communication Office.

10.6 Talent release forms

Photos and video products will result from this event. Therefore, each and every student travelling to ESTEC will need to have a form signed by parent or guardian allowing ESA to use footage of their child to be used on ESA website and/or for promotional purposes. The children may also be asked to participate in interviews with press. The forms will be sent to finalist teams.

10.7 Accommodation/travel

While ESA is not responsible for lodging and international/local travel, we can provide upon request (ISSeducationteam@esa.int) a list of affordable hostels in the area and information on international and public transportation within the Netherlands. Local transport to and from ESTEC and Leiden will be arranged by ESA on the day of the competition.