21 Kallang Avenue #02-171
Singapore 339412

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1. General Information

1.1. Introduction

The Global Navigation Satellite System (GNSS) Innovation Quest (GIQ) is an annual nation-wide engineering competition co-organised by SLA and Space Faculty for students in Singapore. Using knowledge about advanced satellite technologies, students build up interdisciplinary engineering skills by developing solutions that can improve lives of fellow Singaporeans. GIQ caters to students of varying levels through its two differentiated categories, with a unifying theme of "Precise Positioning for Public Good".

Teams reach their problem statement by one of two routes. They may propose their own, grounded in a need they have identified and evidenced themselves, or they may take up one of the industry-proposed problem statements released by the organisers at the GIQ Bootcamp. The industry-proposed statements are drawn from live operational needs in a variety of sectors that can leverage geomatics technology, so a team taking this route works to a brief that a organisation genuinely wants solved, with the context and constraints that come with it. Neither route is scored more generously than the other: the judging rubric carries separate descriptors for industry-proposed and self-proposed problems, so each is assessed on the terms appropriate to it.

Teams are scored against a weighted rubric across four areas. Engineering (55%) covers problem definition, GNSS/SiReNT understanding, innovation, technical feasibility, and cost estimation. Communication (20%) includes the report, slides, and live demonstration with Q&A. Sustained engagement (15%) tracks GIQ Bootcamp and progress check-in attendance, while judges' discretion accounts for the final 10%.

- The **Starter Category** (recommended for up to university first year) is for younger participants of all educational backgrounds to level up their engineering skills and broaden their understanding of GNSS technologies by experiencing the engineering design process from concept to prototype. The students will gain a head start in tech the field of Science, Technology, Arts and Mathematics. The participants should ideate a prototype that leverages

SLA's high-precision GNSS (SiReNT) to benefit the public. The team should make a mock-up of the device, but it does not need to be fully functional.

- The **Advanced Category** (recommended for poly / JC year 2 onwards) is catered towards past participants of GIQ or students with more engineering experience to showcase their ideas and get recognised for their advanced level skills, build their portfolio and gain industry connections. Participants should develop a functional prototype that leverages SLA's high-precision GNSS (SiReNT) to benefit the public or demonstrate a strong commercial potential.

1.2. Background

GNSS are satellite systems that provide global coverage for Positioning, Navigation and Tracking (PNT) purpose. Examples of GNSS are Global Positioning System (GPS), GLONASS, Galileo and BeiDou. While these systems can provide positioning accuracy of about 3-5m in ideal conditions, the performance drops in less ideal conditions and 3-5m positioning error is not sufficient for applications where decimeter or even centimeter-level accuracy is required.

The Singapore Land Authority (SLA) is a statutory board under the Ministry of Law. SLA optimises land resources for the economic and social development of Singapore. High precision location information is critical to SLA's work as different government agencies need to work together based on an identical reference map to ensure there each plot of land, road, underground piping and tunnel are placed correctly for proper functioning of our country.

SiReNT is an SLA initiative developed to enable high precision PNT with differential GNSS technology in real time or through post processing of recorded data. SiReNT is developed with multiple technologies which improves accuracy and reliability for positioning and navigation applications in Singapore. The network consists of 10 GNSS reference stations across Singapore, operating 24/7 to provide PNT data with different level of accuracy and timeliness as needed.

1.3. Focus Areas

The overall focus for GIQ is to:

- Hone participants' engineering skills, learn about cutting-edge technology, and gain valuable insight into the geomatics industry
- Understand the importance of high precision geospatial information and GNSS technology, fostering new and innovative ideas for future projects
- Develop participants' teamwork, design, problem-solving, and critical thinking skills

2. Guidelines

a. Team Members (recommended team size)
    i. Starter (2 to 3 members) & Advanced (2 to 5 members)
b. External Team Support
    i. Teams are allowed to seek the guidance and support of coaches/mentors
    ii. The support can be from the team's academic institute or externally
c. Each team may only participate in one of the GIQ categories per annual season
d. Students may only register themselves in one team per season
e. Coaches and mentors may be registered to work with multiple teams at once
    i. A coach from an institution may choose to register himself/herself as coach for multiple teams coming from within or even outside of the institution
    ii. Coaches are encouraged to not share information between teams to facilitate fair play
f. Members of any team that has won the Top Prize in either category during a previous season will be restricted from participation in the Starter Category.
    i. Starter Category team members must not include any previous season winners

3. Teams

3.1. Fair Play

Teams should be fair and respectful towards other participates, coaches, judges and organisers.

3.2. Behavior

Teams are expected to demonstrate honest and integrity in their work. Teams should be fair and respectful towards other participates, coaches, judges and organisers any discrepancies in the rules or scoring should be handled in a **respectful** manner.

3.3. Help

Coaches & Mentors may aid teams in matters such as procurement, acquisition, or fabrication of hardware, software, components etc. Coaches, Mentors, and external support may support the teams by providing design feedback & review, but they should not be doing the entire project for the teams.

3.4. Spirit

Teams should have experimentation and learning as the ultimate goal.

It is not whether you win or lose, but how much you learn that counts.

3.5. Violations

Teams that violate the code of conduct may be disqualified from the tournament. It is also possible to disqualify only single person from further participation in the tournament. In less severe cases of violations of the code of conduct, a team will be given a warning. In severe or repeated cases of violations of the code of conduct a team may be disqualified immediately without a warning.

4. Safety

4.1. Construction

All sharp protrusion or object from the project must be tapped up or removed

Project must have all its active components such as gears properly protected and covered with resistant materials or hard plastic

Electrical components should be covered with non-conductive materials or electrical tape.

5. Quest

This edition of the GNSS Innovation Quest is project-based with no pre-determined platform or application.

Teams will either come up with their own problem statement & solution, or develop a solution to tackle one of the problem statements provided by the organizers at the bootcamp.

5.1. Objective

Starter category: Develop a mock-up prototype that exploits high-precision GNSS (SiReNT by SLA) that would benefit the public. The prototype doesn't have to be fully functional.

Advanced category: Develop a functional prototype that exploits high-precision GNSS (SiReNT by SLA) that would bring benefit to the public or have a high commercial potential.

5.2. Deliverables

Report

Starter category: Students will be required to submit a project report (not exceeding 20 pages) detailing their project and its use-case scenarios. The report should include:

a. Problem statement and analysis of the current situation
b. An introductory section with background research on GNSS technology

c. Key concepts of the design and its innovative elements
d. Technical details and feasibility study of their design
e. Estimated cost of their product
f. How the product addresses the problem statement and societal impact of their product

Advanced category: Students will be required to submit a project report (not exceeding 40 pages) detailing their project and its use-case scenarios. The report should include:

a. Problem statement and analysis of the current situation
b. An introductory section with background research on GNSS technology
c. Key concepts of the design and its innovative elements
d. Technical details of their design and challenges overcame
e. Potential improvements for their design
f. Estimated development cost and sale cost of their product
g. How the product addresses the problem statement and societal impact and/or commercial potential of their product

Participants can additionally be expected to note down their individual contributions in building the prototype.

Presentation Slide

Teams will have to submit for a slideshow presentation with pictures and a video demonstrating their prototype. Starter category teams should keep the presentation duration to 10mins, and advanced category teams should keep the presentation duration to 20mins, including a live demonstration of their functional prototypes.

5.3. Evaluation

The assessment categories and breakdown of weightages for each category are as follow:

S/N	Category	Weight	Descriptor (Industry provided problem)	Descriptor (Self-proposed problem)
1	GIQ Bootcamp Attendance	10%	Based on team member attendance and active participation	
2	Regular Check-ins	5%	Follow the schedule to provide updates on project progress after the Bootcamp	
3	Report Clarity, Content & Format	5%	Logical structure, grammar, adherence to page limits, quality of figures/tables	
4	Slide Clarity, Content & Format	5%	Visual clarity, concise messaging, effective use of graphics, professional design	
5	Problem Statement & Societal / Commercial Significance	10%	Based on quality and depth of validation and extrapolation of solution	Based on gap evidence for a GNSS-based solution and impact analysis
6	Understanding of GNSS & Application of SiReNT Technology	10%	Depth of theoretical understanding of GNSS and related technology and practical application of correction services	
7	Innovativeness	10%	Novelty of the engineering solutions	Uniqueness of the problem framing
8	Technical Feasibility & Elegance of the Solutions	20%	Based on identification of design constraints, feasibility and suitability of design, and user considerations	Scaled according to the proposed problem and selected focus of the design
9	Cost Estimate	5%	Realism, breakdown clarity, and justifications for major cost drivers	
10	Presentation, Q&A and Demonstration	10%	Delivery, timing, clarity of speech, and ability to defend their work under judge questioning	

11	Judges' Discretionary Bonus	10%	

6. Regulations & Material Restrictions

1.1. Projects can be made using commercial platforms as a base, Commercial Off the Shelf Components (COTS), designed and fabricated from scratch, or any combination of the above.

1.2. There is no restriction to both hardware and software used for the solution, however grading will be based on parts selection, and how properly components are utilized.

1.3. Teams are allowed to reach out to sponsors for components.

7. GIQ Bootcamp

Participants in both GIQ Starter Category and GIQ Advanced Category will be provided with free entry for a bootcamp. Participation in this bootcamp accounts for 10% of the final score and serves to elevate the teams' skills and provide them with support in producing working prototypes.

During this bootcamp, teams will have the chance to receive live feedback and assistance from experts in the field. This includes introductions and demonstrations to the technologies used in the GIQ, a hands-on guided integration workshop for participants, practical exercises to apply GNSS technology in mapping robots, and more.

More details on the bootcamp will be released at a later date.