Welcome to the 2021 Ethics in Engineering Case Competition!

This Case Competition Guide contains information that will help you prepare for the competition, including the Case, Agenda, Judging Criteria for all rounds and more.

Please contact Nafeeza Rahaman with any questions.

WE LOOK FORWARD TO SEEING YOU FEBRUARY 23-25!

Contents

Welcome

Welcome to the 4th Annual Ethics in Engineering Case Competition.

Lockheed Martin is proud to hold this competition to support our business ethics awareness in our colleges and universities, contributing to the ethical development of our future workforce and strengthening our academic partnerships.

To keep everyone safe this year, we are holding our competition over Zoom instead of an in-person event at one of our Lockheed Martin facilities.

We have updated the format of the 2021 competition. Teams will now be competing against one another in the tournament rounds.

This three-day event will take place in the afternoons of Tuesday through Thursday, February 23-25, 2021.

The qualifying rounds on Day 1 will seed the brackets for the tournament. The tournament rounds begin on Day 2 and the semi-finals and the finals occur on Day 3. The semi-finals and finals will be open to the public on Thursday, February 25.

Student Teams will receive a schedule for Day 1 in advance of the competition. The tournament brackets will be posted before competition begins on Day 2.

We have a full schedule of speakers as well as an opportunity for students to ask Lockheed Martin engineers and recruiters any questions they may have, so please try to be present for those activities for the full-value experience.

The rest of this competition packet provides details on the event and the new format, instructions, scoring rubrics, and tips for success. Be sure to thoroughly read the competition packet to get a clear understanding of expectations.

For more information on previous years' cases, visit the Academic Outreach Page.

We look forward to seeing you February 23rd.

Agenda

(times are US EST)

Please see the Competition event site for the most updated schedule.

Day 1 (Tuesday – February 23rd)	
4:00pm	• **Welcome** by David Gebler, Blair Marks, and Leo Mackay
4:30pm	• **Icebreaker** - Faculty Advisors included
5:05pm	• Teams will be digitally escorted to their breakout rooms for **Qualifying Round 1- 90-second "elevator pitch"** • Teams that are not presenting will be allowed to take a break and prepare for Qualifying Round 2
5:30pm	• **Break**
5:45pm	• Teams will be digitally escorted to their breakout rooms for **Qualifying Round 2 – 15-minute Overview** • Teams will tune in 15 minutes before their specific time slot.
7:45pm	• Day 1 Review and Expectations for Day 2

Day 2 (Wednesday – February 24th)	
4:00pm	• **Welcome Back** by David Gebler • Brackets announced
4:05pm	• Teams will be digitally escorted to their breakout rooms for **Tournament Round 1** • Teams that are not presenting will be allowed to take a break and/or discuss their performance on Tournament Round 1. Teams will need to be sure they are in the main room 15 minutes before their time slot.
5:45pm	• **Keynote Speaker with Q&A** Robie Samanta Roy, Lockheed Martin VP of Technology & Government Relations, "Ethical Dilemmas in a High-Tech World"
6:30pm	• Winners Announced • **Break**
6:45pm	• Teams will be digitally escorted to their breakout rooms for **Tournament Round 2** • Teams that are not presenting will be allowed to take a break and/or discuss their performance on Tournament Round 2. Teams will need to be sure they are in the main room 15 minutes before their time slot.
8:10pm	• **Winners Announced**
8:15pm	• Teams will be digitally escorted to their breakout rooms for **Tournament Round 3** • Teams that are not presenting will be allowed to take a break and/or discuss their performance on Tournament Round 3, but return by 7:50pm for the Overview of the Day
8:52pm	• **Day 2 Overview** Go Over Final Day Finalists announced

Day 3 (Thursday – February 25th)	
4:00pm	• **Welcome Back** by David Gebler and Blair Marks. The Final Day will be public.
4:10pm	• Each finalist team will be digitally escorted to their own breakout rooms while the **Semi-Finals – Final Four** will take place in the main room.
4:15pm	• Teams will be digitally escorted from their breakout rooms to the **Semi-Finals** and will return to their breakout room after they have presented.
5:10pm	• Moderators Leave for Final Scoring
5:15pm	• All teams re-join main room • **Lockheed Martin/Engineering/Recruiting Q&A Panel** •
6:15pm	• **Break** • Finalists announced • Preparation time for Finalists
6:30pm	• **Final Round:** The two remaining finalist teams compete. For non-finalist teams, open to all participants to view.
7:10pm	• **Discussion** with Lockheed Martin Engineers and Ethics Reps on how they would solve the case
7:55pm	Awards Ceremony hosted by Blair Marks • Presentation of the competition winners, and a celebration of all the teams' hard work. • Program Wrap Up

2021 Ethics in Engineering Case

Gupta Advanced Materials Corporation's breakthroughs in advanced materials has made GAMCO an industry leader. GAMCO's founder, Dr. Amar Gupta, holds several patents for materials that can withstand extreme temperatures and have high structural performance. As a result, GAMCO has become a leading supplier of advanced materials for the rapidly growing hypersonic industry.

Dr. Laura Radcliffe leads 2Strong Engineering (2SE), an additive manufacturing company that has been at the leading edge of building and integrating additive structures. 2SE's designs have been critical in maintaining the integrity of advanced materials, while providing a light and strong product. With their proprietary and patented machines and processes, 2SE is a world leader in printing advanced materials. 2SE's printing capabilities coupled with GAMCO's advanced materials have caught the attention of many aerospace and defense (A&D) companies. Radcliffe and Gupta have been close friends since graduate school and have worked together to disrupt the advanced materials and additive industry beyond military use.

With increasing competitive challenges in the defense industry, Skyward Hypersonic Optimization Technologies (SHOT), a leading A&D company, recently entered the commercial aircraft industry to diversify its operations. SHOT's hypersonic missile defense capabilities have provided the government with cutting-edge solutions, albeit very expensive for the government to continue to fund. Other companies have been effectively designing hypersonic missile defense systems at a fraction of the cost, but their solutions have not met full performance requirements to offset SHOT's competitive advantage.

One of the barriers to entry in the emerging commercial hypersonic market is the need for a longer life expectancy of a hypersonic aircraft compared to missiles. As a result, SHOT must invest more research & development (R&D) funds than initially anticipated. The schedule continues to get more and more condensed, as the R&D funding will soon run out, putting the company in a difficult position.

One of the most critical components of a hypersonic aircraft is its Aircraft Body Shielding (ABS). SHOT subcontracted the ABS development to 2SE based on its exceptional previous program performance with low-life expectancy hypersonic applications. In the contract SHOT required 2SE to partner with GAMCO to integrate their advanced materials with 2SE's cutting-edge manufacturing. The contract called for the production of two units, one for ground testing and the other for flight testing.

2SE started official qualification testing of the ABS. The qualification test plan, approved by SHOT, documented that the ABS will be tested under extreme thermal temperatures, and once complete, will be moved to the vibe chamber to perform rigorous vibration testing. Although sequential testing is standard, Fernando, a new PhD material scientist at 2SE, felt that the standard testing protocol may not be fully representative of the combined temperature and vibration environment the aircraft may face in actual flight. Fernando decided to conduct an ad hoc and unfunded combined thermal and vibration analysis on the ABS. Fernando's analysis identified a potential risk in the combined environment. He theorized that the advanced materials from GAMCO were a hazard to use on the ABS. Fernando quickly communicated this risk to Vincent, the Chief Engineer. Vincent was surprised with Fernando's findings as the 2SE environmental test team recently completed successful thermal testing and then successful vibration testing. Although Fernando's analysis was outside the scope of the contract, Vincent initiated a

Root Cause and Corrective Action (RCCA) investigation to determine why the team is seeing discrepancies between the environmental qualification test and Fernando's combined analysis results.

During the RCCA, the 2SE team identified improper heat treatment of the additive part or the raw material as likely causes of the variations in expected values. Radcliffe quickly contacted Gupta to get his company involved in the RCCA process. Gupta was quite frustrated as he thought that 2SE was wasting time looking for trouble since the required test met the specifications, and the project schedule was already constrained as it was. GAMCO shared that they printed a test coupon with the new material on their additive equipment which showed positive test results. Gupta felt that he had to cooperate since 2SE was possibly finger pointing at GAMCO.

At the same time Brianna, a GAMCO ceramic engineer working on the project, analyzed data from previous thermal and vibration tests utilizing 2SE's additive processes with GAMCO materials. She saw that the tests had been at the edge of the outer ranges deemed acceptable, but she was unable to determine if GAMCO had been running tests with the most current passing 2SE data.

Given the pressure of the situation, Brianna didn't express her concerns to her engineering manager as she felt the results were likely still acceptable and she didn't want to bring undue attention to the issue without fully knowing if she was correct. When her leadership pressed for her opinion, she said that everything appeared to be within the specification and the analysis from 2SE was overly conservative.

After being briefed by his engineering leadership, Gupta felt confident that the ceramic advanced materials that his company produces met the advertised specification. He and his material scientists believe the issue identified by Fernando resides with 2SE's new additive manufacturing process and their lack of knowledge of the new material.

2SE's leadership, including Dr. Radcliffe, however, believe GAMCO does not fully understand all the properties of the new material in extreme environments and how the material properties change during the additive manufacturing process. Radcliffe is a highly analytical, risk-averse leader, but she is confident that the problem does not reside within 2SE. She questions how thoroughly GAMCO looked into the issue.

In an attempt to figure out the problem, Radcliffe suggests that they run another round of temperature and vibration testing on the second unit. Like the first test, the ABS used in the testing cannot be delivered to SHOT because the test is deemed destructive and may compromise the integrity of the part, making it not flight worthy. Gupta reminds Radcliffe that they only have one ABS manufactured for delivery so far and the contract states they only need to test one ABS which already successfully passed testing. While GAMCO and 2SE were performing the RCCA, SHOT contacted Radcliffe to relay the customer's request to accelerate the demonstration of the aircraft to verify readiness for future funding. SHOT provided Radcliffe with an aggressive new timeline that put 2SE's ABS on the critical path. 2SE would need to accelerate their schedule to meet the demonstration timeline. Radcliffe told SHOT that they had run into a potential technical risk with the ABS and could not meet the new timeline. SHOT informed Radcliffe that 2SE must deliver on the requested schedule date or SHOT would look for an alternate supplier for future efforts as their delay could significantly impact the hypersonic commercial aircraft program (H-CAP). This would result in SHOT not securing the follow-on funding for H-CAP. As

2SE's largest customer, this could be a major financial setback for the company and would have a significant impact on GAMCO's business as well.

Radcliffe immediately contacted Gupta with the news. Gupta felt that Radcliffe was caving under pressure and was not looking hard enough for ways to meet the new deadline. Gupta requested more information on the customer demonstration to better understand the requirements for the ABS. Radcliffe shared with Gupta that the H-CAP would not reach hypersonic speeds but would be tested at supersonic speeds and highlighted that the aircraft would be manned for this demonstration.

Gupta and Radcliffe agreed to re-perform Fernando's data analysis on the ABS with the anticipated supersonic constraints for the customer demonstration. Fernando, the material scientist who discovered the potential discrepancy, analyzed the ABS which performed within the specification, but found that it was on the upper edge of the control limit. Fernando highlighted to Radcliffe that even though it was within the defined specification range, other environmental factors could impact the part's performance, and he could not say with certainty that it was safe to fly. Fernando said that if in the demonstration the pilot reached higher speeds than provided by SHOT, then the ABS may experience technical issues and could result in a hard failure.

Radcliffe was not comfortable taking any risk with a manned flight. Even though the ABS showed positive results during lower temperature analysis and passed qualification, she was concerned with the potential failure which could impact the pilot's safety. Gupta, on the other hand, felt he was more adept than Radcliffe in taking informed risks. He was confident with the results in the lower speed requirement, they had met the customer's specs and followed the process. He further reinforced that if they did not meet SHOT's schedule, then both companies would likely incur layoffs and potentially go out of business due to the strategic relationships they have with SHOT.

Gupta and Radcliffe brought their teams back together to come up with a solution. At the end of an inconclusive meeting Gupta turned to the engineers of both companies. "Did the tests meet the customer's requirements? Yes. Is the ABS perfect? No. Can any of you prove to me that it is unsafe for the demonstration to proceed?" There was no response from any of the engineers in the room. Gupta then turned to Radcliffe and said, "See, what did I tell you?"

SHOT's senior program and engineering team have called 2SE and GAMCO's leaders to an emergency meeting to get to the heart of the issue and to determine how the demonstration can go forward.

In the tournament rounds your team will be assigned to play the role of either the 2SE team or the GAMCO team at this critical meeting with SHOT's leadership (which will be the role the judges will play in the competition rounds).

Notes on the Case

This Case will be used for all rounds of the competition.

The situation described in the case is hypothetical and intentionally ambiguous, so there is not one correct solution. Teams can leverage whatever resources they wish (professors, colleagues, internet, scientific journals, etc.) to prepare their recommendations, with one exception: teams are not permitted to contact current Lockheed Martin employees for guidance.

Teams can assume that GAMCO, 2SE and SHOT's core values and code of conduct are very similar to those of Lockheed Martin.

Any questions about the case can be directed to Nafeeza Rahaman, who will determine with the case competition planning committee whether and how to respond to the question. *If* a response is provided, it will be posted to the FAQs tab of the event website, and all participants will be notified via email that new information about the case is available.

Competition Guidelines

Qualifications

A team is comprised of two undergraduate students, along with a faculty advisor. Each of the registered schools may register guests from their school (i.e., additional faculty advisor, graduate student, additional students, etc.), but only the two registered student competitors may present throughout the competition. As the case will address an engineering issue, we recommend that at least one of the students be studying engineering.

Students who have interned at Lockheed Martin may participate but students who have participated in a previous Lockheed Martin case competition may not.

Students of all nationalities are welcome.

Mandatory Dry Run

In order to participate in the competition, each team must participate in a 15-minute dry run during the week of February 15th. In the session, the student competitors may present their Qualifying Round 1 90 second "elevator pitch" and elements of their Round 2 presentation to a member of the Lockheed Martin event team to ensure the students are comfortable with the Zoom environment and are prepared for the event. Faculty advisors may also join the session.

Nafeeza Rahaman, the event coordinator, will work with each team's faculty advisor to find a suitable time for the dry run.

All teams must complete a dry run session in order to compete in the competition.

Zoom Meeting Rooms

Qualifying Rounds 1 and 2, and the first day of tournament rounds will take place in four (4) dedicated zoom meeting rooms. In each room will be a moderator and three judges. Typically, only the two student competitors, official judges, moderator, zoom support and faculty advisors (from the team's school) will be in the room during a team's presentation. Other teams assigned to that room will wait in a separate room until they are called by the moderator to present.

All participants will be able to watch teams compete in the Semi-Final and Final Rounds, except the other finalists, who will wait in a separate room until they are called.

Students may present in the same room or virtually.

Zoom Recording

This event will be recorded. We will be taking screenshots to be used in Public Relations and external marketing. By signing up, you are agreeing to be recorded. If you have any concerns, reach out to Nafeeza Rahaman.

Time Limits

A moderator in each room will ensure each team stays within the time parameters for that round and will say "stop" when time is up. Judges will be instructed to disregard anything said by the team after this point.

Score Calculation

Each judge in the room will assign a score, from 1 (worst) to 5 (best) to each team for each of the criteria for that round after they have heard all competitors for the round (See Judging Criteria below). The criteria will be weighted equally, and the judges' scores will be totaled to determine the team's score for each round.

Dress Code

Even though it's virtual, the dress code for this event is business casual (or military attire for cadets).

Roles and Responsibilities

Student Competitors

Students are ambassadors of the organizations they represent, and they are expected to treat everyone with respect and comply with the letter and the spirit of all competition guidelines.

For the qualification rounds, competitors will demonstrate their understanding of the overall case.

For tournament rounds, competitors will be randomly assigned the role of GAMCO or 2SE.

Faculty Advisors

- Faculty advisors should support and encourage the students as they prepare for the competition.
- Faculty advisors may suggest resources for students to use in their research, provide feedback on the students' ideas, proofread their presentation deck or talking points, and/or listen to the students practice their presentations.
- Faculty advisors may help students think through their ideas to determine whether they are reasonable and defensible, but should not provide students with what they believe to be "the correct answers" or put together the presentation for them.
- During the competition, the role of the faculty advisor will be to provide moral support and encouragement, as well as feedback that will help the students learn from their experience. Faculty advisors may sit in only on their school's presentations, and not in any other's.

Judges

Judges are required to disclose any potential conflicts of interest. Every effort will be made to avoid assigning judges to teams with which they could be reasonably believed to have a personal or professional relationship. Judges will evaluate teams' performances using the *Judging Criteria* defined in this document.

Moderators

The Lockheed Martin moderator in each room will be responsible for timing each presentation and saying "stop" when time has elapsed, for ensuring that judges complete their scoring forms correctly, for escorting teams in and out of the room, and for relaying any issues or questions to the conference organizers. Moderators will not judge the competition and will serve as a facilitator/host.

Zoom Support

Zoom support will be present in each room to help organize with breakout rooms, when necessary.

Competition Format

The qualifying rounds will be held on Day 1. Scores from the two qualifying rounds will seed the brackets for the tournament. Each team will be randomly placed into one of four divisions.

We understand schedules and time zones will vary throughout the competitors so you will receive a schedule of your timeslot for Day 1 later in advance of the competition. On Day 1, teams must log in 15 minutes before their time slots. Because Day 1 will determine seeding, teams will receive their schedules for Day 2 and 3 the night before or on the day of.

The tournament rounds begin on Day 2 in the team's pre-designated division and we will have a Keynote Speaker. The tournament rounds are single elimination head-to-head competitions.

The semi-finals and the finals which will also be in the tournament format will be held on Day 3. We will have an opportunity for students to ask Lockheed Martin engineers and recruiters any questions they may have. Then we will finish off the competition by presenting a Lockheed Martin-based suggestion to the case and will announce the winner.

Rounds

Qualifying Round 1

Room assignments and order of presentation for Round 1 are based on a random drawing.

Each team will define the engineering, ethical and business dilemmas of the case and present their solution in a 90-second "elevator pitch."

Teams may not use any notes or visual aids.

Judges will not ask questions during this round.

Qualifying Round 2

Order of presentation for Round 2 will be based on a random drawing.

In Qualifying Round 2 each team will have 15 minutes to identify and address the ethical, engineering, and business issues of the case.

Teams may use up to five (5) slides or visual screens in their presentation.

Teams will share their presentation via Zoom. During the team's time slot, a team member or faculty advisor may drive the slides by clicking on the green "Share Screen" button.

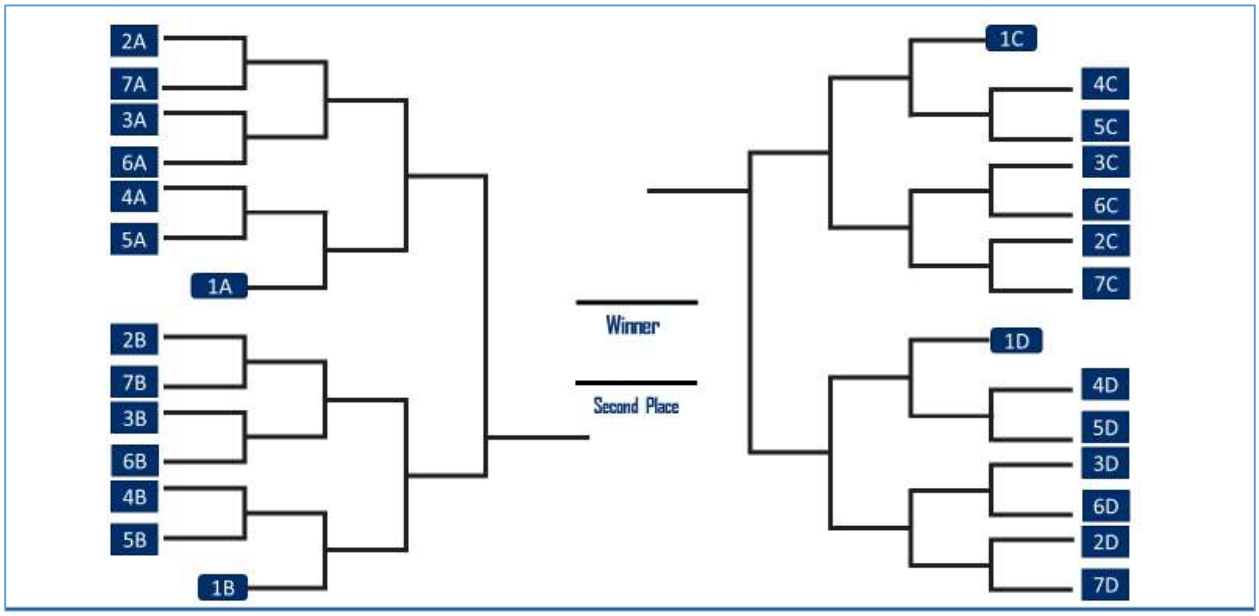
There will be a 10-minute Q&A period after the presentation, during which judges may ask teams to explain, clarify or defend specific aspects of their arguments or overall presentation.

Tournament Seeding

The total of each team's points from Qualifying Rounds 1 and 2 will determine only the team's seed for Round 1 of the Tournament and will not be used in determining finalists for subsequent rounds.

On Day 2, the 28 teams will be provided with room assignments for Round 1. The assignments will be seeded based on the aggregate scores from Qualifying Rounds 1 and 2. For Round 1 there will be four rooms based on random assignment. Competitors for Day 2 and the tournament rounds are based on seeding.

Bracket for Tournament Rounds starting Day 2.



Neither individual team scores nor their ranking will be revealed. The teams will only be told their room assignment.

The tournament bracket will be continuously updated and available for viewing throughout the competition.

Tournament Rounds and Finals

The tournament rounds and regionals will all take place in the team's respective division.

The format for the tournament rounds is the formal meeting with GAMCO, 2SE and SHOT as outlined in the case.

For the tournament rounds, competitors will be randomly assigned the role of GAMCO or 2SE at the beginning of the round.

There will be no slides for the tournament rounds.

Each round is 25 minutes:

- Each team will have 5 minutes to present their assigned company's recommendations to the judges who will be playing the role of SHOT's leadership team
- The teams will engage in an eight-minute discussion with one another to work towards a resolution.
- After hearing all perspectives, each team will then present a 1-minute closing argument.
- There will be a 5-minute Q&A period after the presentation, during which judges may ask teams to explain, clarify or defend specific aspects of their arguments or overall presentation.

The student teams will return to the breakout room while the judges confer. Scores will be based on Judging Criteria to choose a winner to proceed to the next round.

The judges will bring both teams back into the room to announce the winner of the round.

The winning team will view the tournament board to see the time for the next round.

Judging Criteria and Scoring

In each round, each judge will assign a score from 1 (worst) to 5 (best) for each of the criteria below. General guidelines for the scores are as follows:

1 point	Did not achieve any of the objectives; totally incoherent and/or unprofessional
2 points	Achieved, or partially achieved, some of the objectives but missed key elements
3 points	Achieved most of the objectives but left room for improvement
4 points	Achieved all of the objectives with no apparent shortcomings
5 points	Significantly exceeded expectations; went above and beyond defined objectives

Judges may complete their scoring after each school's presentation or after the final presentation. However, the judges will not confer with one another until their score sheets are submitted via Microsoft Forms.

Qualifying Round 1 (total of 20 points possible)

Four criteria

Content

1. Did the team identify and clearly explain the engineering, ethical and business dilemmas of the case?
2. Did the team clearly summarize their recommended solution and high-level rationale?

Communication

3. Did the team present their ideas in a coherent, engaging and professional fashion?
4. Did the team make adequate use of the allotted time without exceeding the time limit?

Qualifying Round 2 (total of 35 points possible)

Seven criteria

Conceptual Foundation

1. Did the team demonstrate an understanding of the ethical aspects of the case?
2. Did the team consider the competing interests of multiple internal and external stakeholder groups?

Content

3. Did the team identify and clearly explain the engineering, ethical and business dilemmas of the case?

Communication

4. Did the team present their ideas in a coherent, engaging and professional fashion?
5. Did the team make adequate use of the allotted time without exceeding the time limit?
6. Did the students present as a cohesive team?

7. Did the team respond clearly and thoughtfully to the judges' questions?

Tournament Rounds (Total of 60 points possible)

Twelve criteria

Conceptual Foundation

1. Did the team demonstrate an understanding of the technical/engineering aspects of the case?
2. Did the team demonstrate an understanding of the business/financial aspects of the case?
3. Did the team demonstrate an understanding of the ethical aspects of the case?
4. Did the team consider the competing interests of multiple internal and external stakeholder groups?

Content

5. Did the team identify and clearly explain the engineering, ethical and business dilemmas of the case?
6. Did the team present recommendations that were logical/defensible (i.e. adequately supported by facts, figures and rationale)?
7. Did the team come to an effective solution?
8. Did the team respond clearly and thoughtfully to the judges' questions?

Communication

9. Did the team present their ideas in a coherent, engaging and professional fashion?
10. Did the students present as a cohesive team?
11. Did the team respect their opponent?
12. Did the team make adequate use of the allotted time without exceeding the time limit?

Note: The competition organizers reserve the right to adjust or clarify the judging criteria. We don't expect many changes, but if you see something that is confusing or incorrect, please let us know so we can discuss a modification. All participants will be notified of any changes ASAP.

Prizes

The winners will be announced at the Program End Thursday afternoon.

Each student competitor on teams in the final rounds will receive an Amazon gift card:

- 1st Place: $650
- 2nd Place: $350
- Semi-Finalists (4 teams): $100

Winners who are U.S. citizens or resident aliens will be required to complete a W-9 Form so that Lockheed Martin can send them IRS Form 1099-MISC in January 2021. Winners who are foreign nationals will be required to complete a W-8BEN Form.

Contact Information

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Participating Schools