Citadel Takes 2nd Place at National Ethics Competition

written by faculty of The Citadel's School of Engineering

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Earlier this semester, a team of students representing The Citadel finished in 2nd place at the annual Ethics-in-Engineering Case Competition hosted by The Lockheed Martin Corporation. Robert Perrecone (Foxtrot Company) and Daniel Rathbun (Regimental Staff), both graduating seniors majoring in Electrical Engineering, traveled to Bethesda, MD for the 2-day competition (February 27th-28th). Our cadets defeated 5 teams in head-to-head single-elimination matches; they were bested only once -- in the final round -- by Rice University.

The event was held at Lockheed Martin's Center for Leadership Excellence (CLE), a 300,000-square-foot conference center and lodging facility located next to Lockheed's corporate headquarters just 5 miles northwest of Washington DC. Most competition rounds were held in the CLE's 18 conference rooms. The semifinal matches took place in two of the facility's eight large training rooms, and the final round occurred in the CLE's auditorium.

A total of 72 teams competed: 60 schools which brought 1 team (including The Citadel) and 6 schools which brought 2 teams. Notable institutions joining The Citadel at this event were The U.S. Naval Academy, The Georgia Institute of Technology, The U.S. Coast Guard Academy, The Pennsylvania State University, The U.S. Air Force Academy, The University of Notre Dame, and The U.S. Military Academy at West Point.

Daniel R. Rathbun, Robert C. Perrecone, and Dr. Gregory J. Mazzaro,
of The Citadel's Department of Electrical & Computer Engineering

Atrium at the Lockheed Martin Center for Leadership Excellence
(photo provided by The Lockheed Martin Corporation)

The format of the competition was a role-play of a business meeting held between two engineering companies -- contractors working together to develop a satellite-based asteroid-detection platform for the National Aeronautics and Space Administration. According to the imagined scenario, the two companies have met twice beforehand. This role-play simulates their third meeting, which takes place just 10 days before the companies must decide whether or not they will launch their joint satellite. Models developed by one contractor indicate that the current design falls just short of specifications; scientists from this company are confident that their design will meet specifications before it is scheduled to launch. Even without meeting all specs, the satellite would provide detection and tracking capabilities which could avert a catastrophic loss of human life. Redesign would delay the satellite's launch by two years, during which there would be no detection. A whistle-blower working for one of the contractors insists that the detection estimates provided for the current design are invalid because they do not account for a certain environmental effect that will likely produce false-positive detections after the satellite is operational. Amidst this thorny scenario, the contractors must agree on a course-of-action to take within the next 10 days.

For the competition, the goals of each team were to (a) clearly identify the technical and ethical dilemmas evident in their situation, (b) suggest realistic technical, ethical, and programmatic solutions, and (c) agree upon concrete steps that both companies would take to address the situation. More nuanced than a traditional debate, success in this give-and-take format requires that a team advocate for novel solutions while being conciliatory towards ideas presented by the other team.

Each match was attended by the two competitors from each team, each team's faculty advisor, a moderator, and three judges. Not until the semifinal round could additional spectators view the matches. All moderators and judges were Lockheed Martin employees -- engineers, former engineers, and officers from Lockheed's Corporate Ethics division -- some of which flew into Bethesda from Lockheed offices scattered throughout the United States.

To score each round, the judges evaluated the students on their analysis of the case, how well their solution(s) met stakeholder needs, their persuasiveness, and how respectfully and reflectively they engaged in their discussions. The students were allowed to refer to hand-written notes; no electronic devices were permitted. Each round started with a coin toss. The winner of the toss decided which contractor to role-play; the loser of the toss decided which team would deliver its opening statement first. Each team was allotted 5 minutes to make a statement without interruption, then the teams held an open discussion for 15 minutes. Afterwards, for 5 minutes, the judges were permitted to ask questions of one or both teams.

On the morning of Tuesday the 27th, all schools participated in the Preliminary Round. Particular teams matched against each other were selected at random. These opening matches were scored by judges and used to seed the 1st round of the single-elimination brackets for the remainder of the competition. In the Prelim, The Citadel faced The University of Connecticut. Our cadets scored well and earned the #2 seed -- high enough to earn a bye for the 1st elimination round. Later that same day, in the 2nd elimination round, The Citadel faced Alabama A&M University. Our cadets suggested a clever solution to eliminate the false positives highlighted by the whistle-blower: training the asteroid-recognition algorithm on-board the satellite with artificial (software-injected, statistically-Gaussian) electronic noise. Alabama A&M could not offer a comparable technical solution, and The Citadel easily won this match. Our cadets would need to wait until the following morning to compete again.

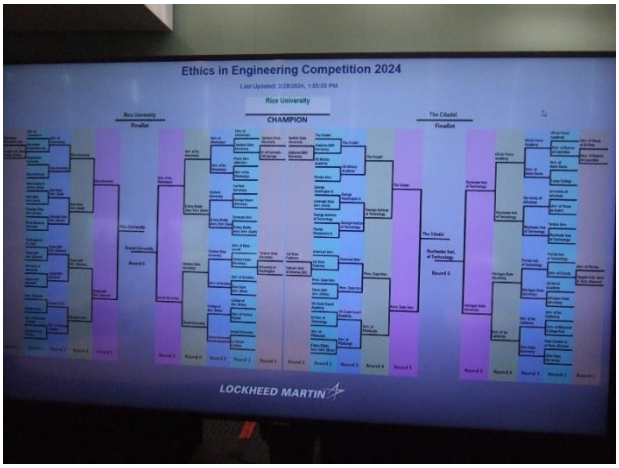
Participants at the competition: (left) U.S.M.A. at West Point; (right) U.S. Air Force Academy.
(photos provided by The Lockheed Martin Corporation)

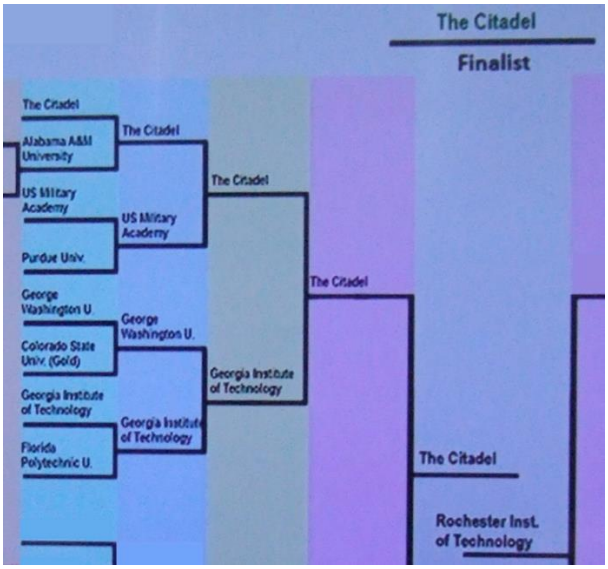
Virtual-reality simulators available to use between elimination-round matches.
(photos provided by The Lockheed Martin Corporation)

Between rounds, in the large training rooms next to the CLE's central atrium, students tried out Lockheed's virtual-reality simulators: a Lunar Rover, a piloting & targeting system for the AH-64 Apache helicopter, F-35 cockpit controls, and a futuristic city circa 2050. Exhibits manned by Lockheed employees allowed students to learn more about the company's work, culture, programs, and commitments to ethics & sustainability. Every hour, from 9am until 5pm Tuesday, Lockheed employees offered workshops: Resume Writing, Networking Skills, Interview Tips, and Transitioning from College to Work. Included in the registration fee for the competition were fully-catered lunches and dinners on Tuesday and Wednesday. Teams eliminated from the competition on Tuesday were given the opportunity to attend one of three tours on Wednesday, via buses chartered by Lockheed: the LM Global Vision Center in Arlington VA, the LM Security Intelligence Center in Rockville MD, or the Udvar-Hazy Air and Space Museum in Chantilly VA.

The single-elimination rounds resumed on the morning of Wednesday the 28th. Only 10 minutes before the 3rd round began, a twist of the role-play scenario was provided by Lockheed: it was discovered that one of the contractors had been using code from an open-source repository to quicken the pace of its software development; doing so may have jeopardized its claims to intellectual property. In either their opening statement or follow-on discussion, the teams would need to assess the impact of this discovery on stakeholders and address the ethical implications.

In the 3rd round, The Citadel faced The U. S. Military Academy at West Point. Our cadets' opening statement was well-rehearsed; it concisely summarized the contractors' situation and conveyed a clear understanding of the tradeoffs involved in achieving a technical and ethical solution simultaneously. At this match, the Citadel team suggested the implementation of Field Programmable Gate Arrays to reconfigure the hardware on the satellite to improve detection accuracy and ultimately meet NASA's specifications. Our Citadel cadets dispatched the West Point cadets and moved on to face The Georgia Institute of Technology in the 4th round.





Single-elimination brackets: (left) overall; (right) matches won by The Citadel.

Georgia Tech attempted a unique strategy, role-playing as the whistleblower and the company's chief scientist, but since no tension was evident between the two characters (as was clearly established in the case description), this unorthodox tactic seemed to confuse the judges. Our team held to its original game-plan: steady, assertive, technically solid. Once again, The Citadel came out on top.

Before the 5th round, a second twist was added to the case: The program managers for the two contractors were college roommates, and these friends -- between each formal meeting, unbeknownst to their companies -- had been coaching each other on the information that they reported to the customer. In this 5th round, The Citadel faced The Pennsylvania State University.

The Penn State team argued in favor of awarding compensation to the authors of the open-source software. Our cadets noted that authors who submit material to open-source repositories understand that they will generally not be compensated; in particular, they forfeit their rights to patenting their code. The Penn State students presented sensible ways to address the case's ethical issues, while our Citadel students presented reasonable solutions to the technical problems. This match was close. Ultimately, the judges decided in favor of The Citadel.

For the 6th round, the semifinal round, spectators were allowed to watch the matches. Teams which had been eliminated in earlier rounds and judges from those matches crowded into one of the (capacity-50) training rooms to watch The Citadel face The Rochester Institute of Technology. Down the hall, in another crowded room, Rice University faced Drexel University.

The team from RIT discussed how their emerging satellite design would integrate with NASA's existing celestial-monitoring projects. Our Citadel students re-focused the discussion on the satellite itself -- in particular, how offloading computations to graphics processing units would mitigate the additional power required to implement their detection-improvement scheme. Our

cadets appeared to take the upper hand when they suggested that an external Ethics Review Board be established to investigate the relationship between the contractors' program managers and evaluate the effects of their collusion on the progress of the satellite's design. The Citadel again prevailed; they would face Rice in the 7th and final round.

Before the final round, one more twist was added: Electronic components used in the current version of the satellite's circuitry were selected from a line of compromised chips; some of the components might be counterfeit. This last match took place on stage in the CLE's (nearly-full) 250-seat amphitheater. Despite the tension of the moment, despite being under the stage lights and watched by a couple-hundred other students & advisors & Lockheed employees, Perrecone and Rathbun remained calm, cool, and collected.

The young man and young lady from Rice University were confident in their opening statement, but they grew nervous when our cadets insisted that Rice's technical solution would not achieve an acceptable asteroid-detection rate. Our cadets acknowledged the possibility of system failure caused by malfunction due to counterfeit parts, but they argued that the present amount of risk did not preclude launching their satellite. Rice established momentum after they proposed forming an Ethics Review Board made up of representatives from both companies; this suggestion appeared to tip the match in their favor. We congratulate Rice University's Eric Breyer (junior, computer science), and Cassandra Wagoner (senior, mechanical engineering) on an excellent match and a well-deserved championship.

"Our favorite parts of the competition were seeing the diversity of ideas that teams presented and using the knowledge that our professors had given us to come up with solutions on-the-spot," remarked Perrecone. Rathbun summed up the cadets' overall sentiment: "We're honored to represent The Citadel. Ethics are deeply ingrained in our curriculum. We're grateful for the support of The Citadel's Department of Electrical & Computer Engineering and to our coach Dr. Mazzaro."

Final round of the competition: stage at the front of the 250-seat amphitheater.
(photo provided by The Lockheed Martin Corporation)

On this trip, the cadets were accompanied by Dr. Gregory Mazzaro, an Associate Professor in the Department of Electrical & Computer Engineering -- Perrecone and Rathbun's teacher for *Electric Circuit Analysis* in their sophomore year, *Electromagnetic Fields* in their junior year, and *Antennas & Propagation* in their senior year. "Monday morning, we're driving up to Bethesda and I'm thinking, 'I hope we'll have a good story to tell after we get back'. Wednesday afternoon, I'm watching our students on stage, one win away from a national championship, and I'm thinking, 'Yeah; this'll do; haha.' I'm thankful to Lockheed for providing this opportunity to our students, to The Citadel for participating, and to Perrecone and Rathbun for representing us."

Dr. Mark McKinney, chair of the Department of Electrical & Computer Engineering and the students' teacher for *Electronics* in their junior year, added "I am incredibly proud of Cadets Perrecone and Rathbun. Immersion in a program where honor, integrity, and personal responsibility are baked into everything we do gives our students a deep understanding of the complex ethical and moral dilemmas faced by engineers. Perrecone and Rathbun epitomize the best of The Citadel." Dr. Andrew Williams, Dean of the School of Engineering, appreciates the positive influence of his professors: "Our electrical and computer engineering cadets' outstanding performance in this national ethics competition is a testament to our faculty, who role-model and incorporate principled leadership as they teach our students."

Lockheed Martin has held the Ethics-in-Engineering Case Competition every year since 2018. The inaugural competition was held at Lockheed's Aeronautics unit in Ft. Worth, TX. The Citadel was invited to participate along with the five other senior military colleges and five military academies. This first year, our school was represented by veteran ECE students Gabriel Ramos and Justin Sligh. They were accompanied by Dr. John Peeples, a professor who recently retired from our Department of Electrical & Computer Engineering. Before the two-day competition, Lockheed provided a tour of the F-35 production line and delivered an in-depth briefing about the Aeronautics facility. A month ahead of the competition, the student teams were presented with a narrative description of a scenario developed jointly by Lockheed Martin and the University of Illinois: an intelligent wireless communications system provided to first responders to terrorist attacks in large public venues (e.g. London or New York City). The ethical dilemma revolved around health concerns raised by testing of the communications-headgear which occurred during the company's product rollout. The competition opened with an "elevator-pitch" round, a 90-second analysis of the case without visuals. In the main round, each team presented its recommendations in 20 minutes followed by a 5-minute question-and-answer session with judges. In the final round, the three top-ranked teams presented for 25 minutes with intermittent questioning.

In 2019, the competition was moved to the Center for Leadership Excellence in Bethesda. By 2020, the number of institutions participating in the event had grown to over two dozen. In 2021 and 2022, due to the COVID-19 pandemic, the event was held virtually. In 2023, the competition returned to its present in-person format in Bethesda and the number of teams ballooned to almost 70. The Citadel has participated every year since the inception of the competition and we intend to return in 2025.