Engineering Ethics and the Ubiquity of Undergraduate Defense Funding: A Conflict of Interest

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Undergraduate engineering programs have long been bound to the United States defense industry, and this industry has long been reliant upon these universities to produce engineers capable of developing new militaristic technologies. There is perhaps no field of engineering as affected by this relationship as aerospace engineering—a field which perpetually turns out engineers to design and herald the newest hypersonic technology the United States relies upon. Simply put, the United States is what can only be described as an "Aerospace Nation," best articulated by Geis and Garretson (2015). This is principally the result of the broader preceding historical context–specifically of the second World War and the Cold War—which must be investigated to understand how this war machine arose. Furthermore, the Department of Defense (DoD) and numerous private military contractors (PMC) have encroached upon these undergraduate engineering programs through the means of career fairs and recruitment events, which are justified through direct contributions made from these bodies to the schools themselves. These organizations have continued to exploit the aforementioned relationship between engineering programs and the defense industry, a relationship which is mutually beneficial to these parties, but also ultimately morally compromising.

In addition to this transmuting dynamic, engineering ethics have changed to reflect our growing awareness of the social impact of engineering. These universities have made considerable changes to their programs to allow space for engineering ethics, specifically through the requirements outlined by the Accreditation Board for Engineering and Technology (ABET) for an undergraduate degree in engineering (Benderly, 2016; Volkwein, 2007). These two forces seem to be in direct opposition; engineering universities require students to undertake

coursework in ethics and the social responsibility of engineering, and yet continue to allow the DoD and private defense contractors to attend career events by means of donations or funded research labs. This developing conflict of interest has not gone unnoticed by student bodies—in fact, many engineering students have criticized this explicitly, though to little avail (Miller, 2024; Bohl, 2022; Ellin, 2019). Importantly, these careers are also extremely popular for aerospace engineers. The job stability, salaries, and unprecedented research being done are hard to turn down in favor of a less financially secure profession. Defense careers comprise such a large portion of the available job market for aerospace engineers that it can be difficult to find a profession completely independent from the monolithic industry of defense.

Naturally, the question broached is this: how can undergraduate engineering programs continue to promote careers in the defense industry while both receiving funding from these same bodies and teaching the importance of engineering ethics? I posit that this simultaneity is inherently disingenuous to the engineering ethics required by ABET and that the appeal of these careers is misaligned with the student values expressed by opposition to the presence of these defense contractors. The DoD and excess of PMCs are uniquely well funded and therefore are prescribed the capital to influence the position of universities on this issue.

Background, Significance, and Motivation

The historical context surrounding World War Two is vital to fully understanding this issue. The United States emerged from the second World War with the world's most advanced commercial infrastructural and as a leading aerospace nation, as noted in "An Aerospace Nation" (Geis & Garretson, 2015). The industry necessitated by the war effort had created a new foundation upon which the US economy now rested, and that economy had to be maintained.

The paper “Trends in World Military Expenditure” (Silva et al., 2021) indicates that the US military budget remained consistent despite the varying global trends which, of course, parallel the scope of large-scale international conflict. This not only presents the defense industry as a reliable and safe career path, but also perpetuates the constant cycle of weapon development the United States undertakes to remain at the forefront of defense technology. In addition to this, the paper also indicates that in 2018, the US accounted for more than one third of all defense spending in the world. It is clear that the US economy’s reliance upon the military-industrial complex has, in fact, created an industry which must perpetuate itself. This perversion of the war effort, driven also by the growing presence of private military contractors, has distorted the stake this industry holds in the United States economy—and therefore also in the careers available to prospective aerospace engineers. The growing presence of these contractors is outlined in Brian Warren’s article “Reining in the ‘Third Path’” (2023)—and it is these contractors specifically, such as Raytheon, Lockheed Martin, General Dynamics, and Northrop Grumman, who have specifically faced backlash from students for their presence at university job and career fairs.

During recruitment events attended by these private military contractors, student bodies across the US have not quietly accepted their presence. In fact, students have only become more vocal as the recent resurgence of the Israel-Palestine conflict has escalated tensions in the Middle East (Roscoe, 2023; Chen, 2024). Most recently, students protested the presence of Lockheed Martin—a widely known aerospace defense company—at an engineering career fair for students of the California Polytechnic State Institute; as described in an article by Wu et al. (2024), the protesters wielded signs informing students that the private contractor sold fighter jets to Israel. This case particularly outlines the direct impact these companies have on international conflict. Student upheaval is, however, not limited to this recent issue. In 2022, students at the University

of Connecticut also protested 'Lockheed Martin Day'–an entire day dedicated to the recruitment of students for the contractor–after the world's largest weapons manufacturer sold the precision-guided munition to Saudi Arabia used in an airstrike which resulted in the death of 40 children (Oliver, 2022). Student objections have expanded to target many military contractors besides only Lockheed Martin; University of Massachusetts students protested against Raytheon at an engineering career fair, according to an article by Caitlin Reardon (2022). The Progressive Student Alliance also expressed their grievances with Raytheon–specifically for the sale of weapons to states known to have committed war crimes–in March of 2023 (Mailly & Aldrich, 2023). Northrop Grumman was the subject of a protest as recently as February of 2024 in Waynesboro, also for their perpetuation of the genocide in Gaza (Stuart, 2024). BAE Systems, Caterpillar, and General Dynamics were all protested at an engineering career fair at the University of Wisconsin-Madison (Panzer, Patra, 2024). All of these cases are to say that the students of these institutions hold not only the contractors, but also their own universities to a higher moral standard. By perpetuating their relationship with such entities, universities inherently endorse their actions, even if they are not directly responsible. By permitting military contractors to have tables at their recruiting events, these universities are at the mercy of the often unethical decisions made by the contractors. Colleges across the US seem to be unwilling to acknowledge the dissent of their students if it means forfeiting the research funding they have come to rely on.

The Department of Defense announced that it would be awarding $161 million to 281 researchers at 120 institutions in 2024 as part of its Defense University Research Instrumentation Program (DURIP) (U.S. Department of Defense, 2023). The influence of this capital cannot be understated, and as such the defense industry deepens its roots in the undergraduate engineering

education system. For many students, research is a practical means of acquiring workplace readiness skills before seeking internships, and for many of these students, defense research is the easiest place to turn due to this excessive funding. Here at the University of Virginia, the Air Force Office of Scientific Research awarded funding as part of DURIP for research involving the study of hypersonic and propulsion environments (U.S. Department of Defense, 2023). In a 2014 article by Austin Wright (2014), defense lobbyist and Raytheon representative Michael Herson stated, "In the defense space, it's been our experience that it's a lot of the engineering schools that lobby." This explicit confirmation of these practices clearly indicates how invested these schools are in maintaining this aforementioned relationship. He goes on to state "It raises their stature to be able to say they're doing this kind of work for the Department of Defense." These universities are not only reliant upon the direct funding provided by the defense industry, but also upon the image and reputation associated with the work they are able to perform. Of course, only an industry as well funded as the United States defense market has the capital to allow for this kind of research.

Penn State, for example, spent $180,000 on defense lobbying during 2014 (Wright, 2014). However, the university also brought in $187 million in 2013 through grants and contracts; most of this money was allocated to the university's associated Applied Research Laboratory. The defense funding extends beyond these few programs: the DoD also awarded $47 million in grants through its National Defense Education Program (NDEP) in 2023 for projects geared to research areas such as biotechnology (OUSD(R&E), 2021). Furthermore, this funding is not limited to the deep pockets of federal funding. Lockheed Martin, for example, awarded a $150,000 research grant to Rickard Ewetz at the University of Central Florida for a one-year project (Department of ECE, 2022). The company has donated $5 million across more than a

dozen universities for research projects related to hypersonic capabilities (Lockheed Martin Corporation, 2022). These cases serve to outline how symbiotic the relationship between undergraduate education and the defense industry has become. The reliance developed here is not just one of capital, but of reputation—of the image these contractors hold. Because of this, these colleges are reliant upon the defense industry to award these grants and other funding. The DoD and private contractors also rely on the schools to turn out engineers who will pursue defense careers, but the relationship is imbalanced; there are more than 600 ABET-accredited programs as of 2020 (ABET, 2020) capable of producing intelligent and work-ready engineers. These contractors have the freedom to choose where their capitol, influence, and most importantly their reputation, are best allocated.

The final factor necessary to understanding the scope of this issue is the code of ethics prescribed to engineers by ABET and by the National Society of Professional Engineers (NSPE). ABET's fundamental principles state that the engineer should "uphold the integrity, honor, and dignity of the engineering profession by being honest and impartial, and serving with fidelity the public, their employers, and clients" (ABET, 2020). The fundamental canons include that the engineer must act in professional matters as a faithful agent and avoid conflicts of interest. The broached topics clearly indicate that, at the very least, these universities cannot truly act as impartial agents in fields concerning the defense industry. It is established that these two bodies are deeply entwined with one another, and therefore this principle is inherently violated. It is also not reasonable that any undergraduate program receiving funding from the DoD can avoid conflicts of interest when presented both with contractors who want to attend recruiting events and students who morally oppose their presence. The NSPE goes as far as to state "Engineers shall not be influenced in their professional duties by conflicting interests" (NSPE, 2019). Of

course, these universities are clearly influenced by conflicting interests: the voices of their students and their primary sources of funding. These students often rely on the resources provided by their university—whether that be career fairs, resume workshops, or outreach programs—to find full time employment after graduation. The ethics prescribed by ABET and NSPE are principally used to teach eager engineering students how to perform their duties. The hypocrisy of these undergraduate programs outlined here not only invalidates the codes they aim to teach, but also dangerously compromises the ethics of their emerging engineers by setting such a precedent.

Methodology, Literature Review, and Discussion

To further analyze this posited conflict of interest, the analytical framework of virtue ethics must first be cohesively established. Not only does this framework render the onus of these programs, government bodies, and student groups clear, but it also dictates the ramifications violating these morals may have on the other groups. The social-technical problem created by decades of this relationship necessitates a framework oriented towards the social implications of this misconduct. In "A Virtue Ethics Approach To Engineering Ethics," William Jordan (2006) broaches the separation students feel from their ABET-required ethical coursework. He claims that these ethics are "too theoretical" and that students make decisions "without regard to official codes of conduct." This argument is not unique to Jordan's paper; in "Training responsible engineers," Frigo et al. (2021) posit ways to integrate phronesis into engineering ethics education to bridge this gap. This integration is demonstrated as plainly necessary in the paper, as technical knowledge seems to exist as entirely separate from even the case studies used in engineering ethics coursework. In "A Virtue Ethics Approach," Jordan goes

on to present the classic virtues and vices, and how these apply to a case study of student cheating on exams. The implication of this ethical framework on engineering education is overt in both arguments. What is less obvious, however, is the implications the adaptation of this framework has on the bodies which aim to teach them.

The ethical framework should similarly apply to the undergraduate programs which have integrated engineering ethics into their course requirements. Just as these schools have unintentionally sundered their technical requirements from their ethics coursework for their students, they too have separated their own moral responsibilities from the presented conflict of interest regarding private military contractors. Virtue ethics allows for the formation of a radically important idea: the notion of a morally responsible and impartial undergraduate engineering program. This notion necessarily resolves this morally compromising stance and would also allow students the choice of involvement with these private contractors. After all, many students are enticed by the career stability of these entities. However, because of the encroaching presence of the DoD and these PMCs in undergraduate education, students are no longer able to reasonably escape their ubiquity.

The program most emblematic of the omnipresence of defense funding in these schools is the aforementioned Defense University Research Instrumentation Program (DURIP). The DoD itself articulates its own presence best. In "DOD Awards $161 Million to Universities to Purchase Equipment Supporting Defense-Relevant Research" (U.S. Department of Defense, 2023), Dr. Bindu Nair (2023) comments "DURIP awards build vital research infrastructure… of our academic institutions." Whether "our" refers to the larger United States or the Department of Defense itself remains to be seen. The article includes a list of the 281 universities which received funding, as well as a synopsis of the research the colleges perform. Dr. Nair goes on to

state that the program "underpins the enduring scientific excellence of our universities." This underpinning alludes to the relationship of dependency these schools have developed in their relationship with the DoD. As previously articulated by Michael Herson (2014) in "Universities chase defense dollars" (Wright, 2014), this research "raises their stature." In the same article, Bob Cook—who led the Institute for Manufacturing and Sustainment Technologies at Penn State—is quoted in urging the navy to "take advantage of us [Penn State's Applied Research Lab]" (2014). This dynamic is not merely one of fiscal reliance; it is one of reputation, of image—of "stature." Once again, this is simply congruent with capital available to the Department of Defense—capital which cannot be matched even by the PMCs. In the article, Maria Zuber—the MIT Vice president for Research—comments that "no professor has to take money from the DoD" and that students "certainly don't have to" work on "defense-related issues" (2014). In light of the DoD's boasting that their funding necessarily underpins all university scientific excellence, these comments are difficult to take at face value. In fact, it seems that involvement with the defense industry is the most straightforward route to successful undergraduate research. Here at the University of Virginia, professors who conduct research for DURIP average a salary 27% higher than the median professor pay (The Cavalier Daily, 2023). Of course, this sample size is not nearly large enough to draw any conclusive evidence—let alone posit any sort of causation—but it serves to demonstrate an important point: conducting defense research is a reliable way to ensure job security, even in academia.

The DoD itself is deeply intertwined with private security contractors, and these contractors have followed the DoD's example in their relationship with undergraduate engineering education. In "Lockheed Martin Announces STEM Scholarships," Andy Szal (2023) outlines the extent of the security contractor's scholarships: $10,000 to 100 recipients studying

STEM at a 4-year university. This funding—much like the DoD's grants awarded to professors—rewards those who are willing to overlook the encroaching presence of the security monolith. Similarly, in "Northrop Grumman Foundation Grant to AAU Undergraduate STEM Education Initiative Will Support Campus Reforms" (Association of American Universities, 2016), the contractor goes as far as to "encourage… universities to use teaching practices proven to be effective in engaging students in STEM education." With this five-year, $1 million grant the PMC has directly affected how students learn engineering across these 60 universities. Maria Zuber's previous comment, that students "certainly don't have to" work on "defense-related issues," (Wright, 2014) rings especially incongruous in the context of this article. Perhaps the most egregious case of a PMC's overreach is the 2000 University-Industry Partnership between the University of Texas at El Paso and defense giant Raytheon. In "University-Industry Partnerships for ABET EC 2000 Preparation: A Case Study," Swift et al. (2000) relate how the PMC helped develop course criteria in preparation for the new ABET accreditation system. This case study is particularly unique given the engineering ethics requirements heralded by this exact ABET criteria. Much like how Northrop Grumman's grant shaped how technical engineering was taught, this partnership allowed Raytheon to prepare UTEP's engineers for the issues the giant typically encounters in their contracts. Swift et al. go on to state that the "joint effort" would "strengthen the relationship, significantly benefitting Raytheon" (Swift et al., 2000). This dynamic was effectively a corporatization of UTEP for Raytheon's direct benefit. Swift et al. argue that this partnership in fact emphasized ABET requirements, specifically the criteria's focus on outcomes, dialog with constituents, and quality control—all which happen to also be important to Raytheon's mission.

However, the case study makes no mention of the engineering ethics requirements outlined by ABET; it seems this set of criteria is entirely set aside. The paper comments "Although ultimately the burden of responsibility for accreditation falls to the academic institution, industrial partners are also stakeholders in that most want to hire students from accredited programs" (Swift et al., 2000) and yet fails to realize the imbalance of this dynamic; if universities are indeed bound to ABET accreditation standards and also bound to corporate bodies and the DoD for funding, then it is only the college which has its freedom restricted. These PMCs are free to hire from any accredited institution. In their partnership, Raytheon conducted mock ABET visits and organized retreats to develop ABET-specific education objectives. These objectives, while aimed at adhering to the new criteria, were informed by Raytheon's own "facilitators experienced in Quality issues" (Swift et al., 2000). In fact, Raytheon used this opportunity to develop "a comprehensive approach to providing their strategic university partners the added support to have them adequately and effectively prepared." As such, the precedent was set. The irony of this case study is particularly stark when armed with the context of the ABET-required engineering ethics this sort of relationship inherently violates.

Student dissent has wholly acknowledged this long-standing relationship between ostensibly independent undergraduate engineering programs and the military industrial complex. This is best exemplified by student protest opposing "Lockheed Martin Day," an event hosted by the PMC across universities to recruit engineering students. According to an article by Daniela Doncel (2018), students at the University of Connecticut protested Lockheed Martin Day in 2018 when one of the contractor's bombs was used in the killing of 40 children in Yemen. The contractor went as far as to land an S76 helicopter and a Black Hawk on campus—and allowed

pre-selected students to take a ride over the university. Students held signs that read "Lockheed Interns wanted: must be ok with dead kids, proficient at Microsoft excel" (Doncel, 2018). Almost exactly four years later, University of Connecticut students awoke again to another military helicopter in their front yards (The Daily Campus, 2022). Lockheed Martin Day continued at the University of Connecticut, as well as their sponsored career events for Raytheon and Sikorsky—the former promising $1.47 million to engineering professors for their defense research. The endurance of this relationship in spite of the atrocity permitted by the contractor demonstrates the inability for such engineering programs to acknowledge the voices of their students.

Students at the University of Connecticut recognized the conflict of interest inherent to this parasitic relationship. In "Reject the war industry at UConn" (The Daily Campus, 2022), students broached the irony of requiring classes such as "Philosophy and Social Ethics" for engineering students while accepting millions in funding from contractors including Lockheed Martin. Published in the school's independent newspaper "The Daily Campus," the editorial board goes on to comment: "UConn has also forced an ethical dilemma onto the student body…students in the School of Engineering… are left deciding between potential high-paying opportunities contributing directly to war and humane work connected to far less supporting resources" (2022). The transparency of this dependence upon the military industrial complex only emphasizes how bereft fields unrelated to defense are of proper funding. The incentives to participate in the war effort are hard to overlook. The paper makes the potent argument that "whatever students take away from these [engineering ethics] courses must remain inside the classroom, as … students are later met with… opportunities working directly for the U.S. military" (2022). This observation is clearly in line with the separation engineering students feel

from their ethics coursework as previously mentioned in "A Virtue Ethics Approach To Engineering Ethics" (Jordan, 2006). The ethical dilemma articulated here is not unique to the University of Connecticut. Just as engineering ethics courses across the US fail to have a lasting impact outside the classroom, these universities also fail in applying the principles they teach to their relationship with such contractors. In fact, this inability to apply such ethics communicates to students that these concerns are unimportant—a relic of the ABET program with no bearing on contemporary engineering conduct. In doing so, undergraduate engineering programs have diminished the value of their own required coursework.

ABET-accredited universities cannot expect their engineering students to retain their ethical coursework outside of the classroom if they themselves set the example that operating with this extreme conflict of interest is permissible—and in fact encouraged. Engineering programs boost their stature by drinking from this ostensibly infinite pool of defense dollars, but in doing so, they also diminish their moral reputation and compromise the ethics of their own prospective engineers.

Conclusion

There is no doubt that the long-standing relationship between the defense industry and undergraduate engineering universities benefits both parties fiscally; schools accept millions in funding and receive feedback on their course requirements, while these security contractors are able to indirectly train the students they will go on to hire. However, as this dynamic has evolved since the rise of our "Aerospace Nation" (Geis, Garretson, 2015) such as during Raytheon's dictating of UTEP's technical requirements in 2000, these PMCs have overstepped. The two entities have become wholly inseparable. In this transfiguration, these colleges have immolated

their autonomy; even as weapons from companies like Lockheed Martin and Raytheon continuously violate international human rights, universities like UTEP cannot sever their involvement with these bodies—they have become too reliant. Even as students like those at UConn ululate the deaths of those who smothered under the rubble of Lockheed Martin's bombs, these schools choose not to forgo their millions in research funding. Ironically, the engineering ethics courses these schools require create a natural framework through which to observe this dire conflict of interest. Virtue ethics makes apparent the abstraction this course material suffers from—and it is clear now that these educational bodies have faltered to the same separation of morality and action. In their pursuit of defense funding, undergraduate universities have both stripped engineering students of the practical freedom to learn outside the war machine and surrendered themselves entirely to the private security contractors their annual budgets rely upon. There is no easy solution. The image of the morally responsible and impartial engineering university previously broached is far from this reality, and yet it is not unobtainable. The strongest voice in this conflict is that of the students—even if these colleges have so far refused to acknowledge their concerns. So, it is left to the students to express their discontent louder—louder than the millions which pour in from DURIP, from Lockheed Martin's STEM Scholarship program, from NDEP, from Raytheon's ELC scholarship program, from the Northrop Grumman Foundation Grant, and from every other program which heralds this conflict of interest.

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