Engineering Undergraduates and the Moral Compass: How to Empower Students to Pursue Careers in line with their Ethical Code

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Mehki Rippey

Spring 2025

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

Advisor

Rider W. Foley, Department of Engineering and Society

Introduction

The emergence of new technologies, such as quantum computing, has bolstered America's investment towards the defense industry. Investment in quantum-powered encryption and quantum sensors, which utilize "the properties of quantum mechanics in combination with light and other atomic properties to provide high resolutions measurements of variations in the properties of an object," has become a top priority for long term defense planning (Myers, 2024). During 2023, the Department of Defense requested more than 700 million dollars for quantum computing-related funding, with a considerable amount of this funding sent directly to defense contractors (2022). The top five government contractors (Lockheed, Raytheon, General Dynamics, Boeing, and Northrop Grumman) were awarded over $150 million in contracts during the same year (2023b). Lockheed received half of this amount individually, outweighing "the entire budget of the State Department and the Agency for International Development combined" (Hartung & Freeman, 2023). It has been proven through financial investment that quantum computing and blockchain are vital for national security, and much of this investment is sent directly to defense contractors for their assistance on new implementations.

To support this continual increase in government investment, defense contractors have pursued partnership opportunities with engineering schools throughout the country. These partnerships present themselves as mutually beneficial for both parties. Defense contractors establish strong career pipelines, connecting themselves to a constant stream of new talent, while universities can use these financial investments to strengthen their research opportunities and attract new students with the promise of relevant, hands-on experience in the classroom. For example, Arizona State University erected a 28,000 square foot Raytheon facility within their Innovation Center, opening in Fall of 2023 (2023a). Further, the University of Southern

California (USC) partnered with Lockheed Martin to build the Quantum Computing Center (QCC) in 2011, designed to "advance fundamental experimental and theoretical knowledge" of quantum technological applications. (Knapp, 2011). Outside of physical buildings, defense contractors maintain their visibility within engineering schools through research grants, endowed chairpersons, and official partnerships.

Due to these university-corporate partnerships, defense contractors are omnipresent during the engineering undergraduate experience. While the defense industry is made extremely visible to engineering students, little guidance is provided on navigating the ethical implications of defense work. Defense contractors are sustained by the perpetuity of war and international conflict. Jonathan Turley, Public Interest Law Professor at George Washington University, argues that while "perpetual war constitutes perpetual losses for families, and ever expanding budgets, it also represents perpetual profits for a new and larger complex of business and government interests" (Turley, 2014). Although engineering students studying at ABET-accredited institutions are required to evaluate the global, economic, societal, and environmental consequences of their work, current engineering curriculums do not successfully prepare students to make informed and ethical decisions related to career pursuits (ABET, 2025). Building on prior research, I will craft a framework engineering students can use to make ethical, value-driven career decisions. With this new framework, I hope to empower students to look past the falsely unilateral path toward defense and create their own career pathways that validate their moral code.

Case Context

These corporate-university relationships are part of the military industrial complex (MIC), a broader classification of institutions, groups, or individuals contributing to the development of weapons and technology for the military, which have had an unwavering presence in the engineering student experience (Turley, 2014). This identifying term was popularized by former President Dwight D. Eisenhower during his 1961 Farewell Address, where the political leader urged the nation to "guard against the acquisition of unwarranted influence, whether sough or unsought" (Eisenhower, 2016). Eisenhower's chilling warning failed to prevent the increasing influence of the MIC on government spending. Due to a federal decrease in investments for higher education, college institutions have relied on financial support from private corporations (Olivier, 2022b). Tight partnerships between universities and defense contractors quickly usher students into a position where values must be affirmed, reinforced, or compromised when selecting career paths. Synthesized by Indigo Olivier in their one-year report on Lockheed's omnipresence on college campuses, "Decades of state disinvestment in public higher education have converged with a growing emphasis on sponsored research, and in an era of ballooning student debt, the billions in annual defense spending prop up university budgets and subsidize student educations" (Olivier, 2022b). Due to a decline in government funding, universities are forced to rely on corporate investments, with the defense industry holding a firm grip on available capital.

Outside of financial investments, dedicated student pipelines have been created to recruit talent into the MIC, coming to fruition through career fairs, mentorship, internship/early career programs, and recruiting events. Lockheed Martin, for example, has personally established relationships with over one hundred universities. Since 2022, fifteen universities established day-long recruitment events called Lockheed Martin Day (LMD), featuring technological demonstrations of Lockheed aircraft and technologies, flashy university donations, and direct connections between students and recruiters. During LMD 2020 at the University of New Haven, Lockheed landed a Sikorsky S-76 helicopter on the school's central quad, while simultaneously contributing $100,000 to a mentorship program sponsored by the corporation. At a University of Connecticut LMD in 2018, Lockheed landed similar aircrafts on campus to promote "TED-style talks, flight simulations, technology demos and on-the-spot interviews" (Olivier, 2022a).

For engineering students throughout the county, interactions with the defense industry are daily occurrences. The ubiquitousness of the weapons industry communicates that the MIC is the only viable career pathway, and students are stressing how hopeless they feel about their future as an engineering professional. Engineering students are stuck in limbo, balancing the moral qualms of contributing to the MIC and the immense financial opportunities presented by the defense industry. One University of West Florida electrical engineering graduate proclaimed that "[w]hen it comes to engineering, we do have a responsibility…I don't really feel like I need to be putting my gifts to make more bombs." Other students feel the weight of engineering things "that are going to kill people," but their moral dissent often evaporates when receiving their compensation package (Olivier, 2022b).

ABET, the main accreditation board for science, computing, and engineering programs, has required engineering ethics education since a criteria reform effort was launched in the 1990s. With the implementation of this new standard, engineering graduates were required to understand their "professional and ethical responsibility" (Riley, 2021). The most recent revision of this ethics requirement expects engineering students to "recognize ethical and professional responsibilities in engineering situations" and to make informed decisions on the societal impacts of their work (ABET, 2025). However, attempts to implement engineering ethics education (EEE) into engineering coursework have left both students and instructors dissatisfied.

Science, Technology, and Society (STS) research has highlighted individual shortcomings with EEE, such as instructors struggling to "make sense of the variety of theoretical frameworks, learning goals, teaching activities, and assessment methods," further exacerbated by engineering instructors' "low familiarity with ethics and their access to institutional support" (Martin et al., 2021, p. 60). Compounding this issue is a lack of faculty buy-in and weight given to ethics in a holistic engineering program. From a student perspective, discussions in engineering ethics courses produce varied responses. Although nearly all engineering students can recognize the ethical implications of personal decisions in relation to a client, personal interpretations of this knowledge vary substantially. Through EEE, some students begin to see the broader consequences of engineering work, while others willingly chose to ignore the societal implications of cases discussed in EEE courses under the belief that ethics was not relevant to their engineering education (Lim et al., 2021). Grant programs established by university departments have sought out to aid in the development of sufficiently ethical engineers. In 2024, UVA Engineering established the Engineering Character Strength Initiative (ECSI). Programs created by the initiative are supported by a $900,000 grant from Wake Forest University's Program for Leadership and Character to develop strong character within its student population (Klobuchar, 2024).

STS Theory

In 2014, University of Michigan sociologist Erin Cech published a groundbreaking paper discussing the culture of disengagement created by engineering schools. Cech uses the culture of disengagement to describe how engineering students and professionals "conceptualize their responsibility to the public…and how engineers produce, conceptualize, talk about, and evaluate their work" (Cech, 2014). For example, when engineers conceptualize how their design solution attends to the problem definition, disengagement influences the societal needs considered by engineers, particularly the causes they believe the engineering team does not need to value. In the study, Cech sets out to evaluate student investment in four public welfare beliefs: professional/ethical responsibilities, understanding of technological consequences, the importance of understanding how people use technology, and the importance of improving society (for example, promoting racial equity and helping those in need). Interviews were conducted with students from four engineering schools during their first year of education, near degree completion, and after graduation. Students were interviewed from four different universities: two that featured traditional engineering programs (Massachusetts Institute of Technology and University of Massachusetts at Amherst), and two that utilized a more integrated approach to EEE (Franklin Olin College of Engineering and Smith College).

Synthesizing survey results, Cech concludes that engineering students generally viewed public welfare as an unimportant aspect of their professional identity, and their engagement with these ethical implications decline throughout their time at university (Cech, 2014). Even further, there was little variety in results based on individual engineering programs, and personal investment in public welfare did not increase for students once they were in the workforce. Cech cites three major reasons for the culture of disengagement: depoliticization, technical/social dualism, and meritocracy. Depoliticization, the belief that engineering work should be removed from possible political and social implications, is derived from the assumption that considering ethical consequences would dilute true engineering innovation (Cech, 2013). Technical/social dualism stresses how engineers separate the technical and social impacts of their work, leading to a devaluation of social implications. Lastly, meritocracy, which is the belief that "social advancement structures are fair and just" encourages engineers to believe that "those who do not succeed lack…hard work and dedication and thus deserve their disadvantaged status" (Cech, 2014). All three of these ideologies come together to create a culture of disengagement that deems ethics as out of scope for engineers.

Although much EEE has focused on teaching moral rules and principles, an emerging subgroup of psychologists have pushed for ethics education methods built from virtue ethics. Rather than prioritizing the consequences of actions or duties and responsibilities, virtue ethics emphasize moral character as the desired driving force for decision making (Hursthouse & Pettigrove, 2023). Most ethics education pedagogy is framed around moral rules, emphasizing rigid moral principles that should be upheld. Moral rules education is governed by fundamental principles of deontology, and ethical theory that states "actions are good or bad according to a clear set of rules" (ethics, 2016). Due to the type of public-facing work engineers complete, moral rules education struggles to hold strong in real-world applications, where engineering professionals struggle to make morally sound judgements due to perceived conflicts and career costs (Han, 2015). On the other hand, framing EEE around virtue ethics allows students to internalize moral virtue through model-based teaching. Even further, with this teaching method, engineering undergraduates are empowered to "discuss which and to what degree virtues are exercised by exemplars, and what is the underlying reason why the exemplars made such a decision in a dilemmatic situation in the field" (Han, 2015). Virtue ethics education has the power to motivate students to trust their own moral character when faced with tough decisions, rather than depending on moral rules built off absolute truths.

Research Questions and Methods

To synthesize this ethical complication of the engineering student experience, I asked, how can higher education help engineering students create their own ethical framework that can drive their career pursuits? Rather than focusing purely on the negative implications of the MIC on the engineering student experience, I developed practical methods to empower students to define their personal values and apply them to career decisions. The research aimed to provide engineering students with an opportunity to align career decisions with their personal sense of morality.

I have developed a student workshop based on my work within ECSI. Framing the workshop session is a sorting activity designed to provide both qualitative and quantitative results for analysis. Students were provided with nine cards, each labeled with varied, pre-selected virtues and were asked to rank these virtues from least to most personally significant to their identity as an engineer. During the session introduction, dictionary definitions were provided for each virtue listed on the cards. Students were then asked to use their mobile device to digitally submit their ranking, along with a short voice memo describing how they ranked each virtue. Point values were assigned to each ranking to quantitatively determine the relative importance of each virtue. Virtues ranked first were given nine points, creating a continual scale, ending with the lowest ranked virtue receiving one point. Nine virtues were selected in total: prudence, authenticity, discipline, responsibility, empathy, bravery, curiosity, open-mindedness, and passion. This group of virtues were selected from the Virtues and Vices Index developed by Crossan et al., which categorizes an extensive list of virtues into eleven dimensions. Complementary virtues are added to describe the result of virtue held in excess or deficiency. The virtues of prudence, authenticity, discipline, and responsibility were selected to embody the deontology framework. These four virtues are grounded by the dimensions of judgement, justice, and accountability, emphasizing the importance of adherence to solidified rules, structures, and standards. In contrast, the five virtues of empathy, bravery, curiosity, open-mindedness, and passion, were selected to epitomize moral virtue. The five virtues embodying virtue ethics were selected from the dimensions of courage, drive, collaboration, and humanity.

After students have completed this activity, participants engaged in small group discussions (about five individuals per group) to compare their virtue ranking results with the group. After small group conversations, students were encouraged to share details from their small discussions with the larger group. Next, a large group discussion, motivating students to think critically about their virtues ranking and their overall experiences with EEE at UVA. The large group discussion questions utilized in the workshop are listed below:

1. What should the role of engineers be in a modern society?
2. What values would you associate with ethical engineering? Same with unethical engineering?
3. What life experiences do you believe helped you develop your core values?
4. How do you feel like your core values have changed/shifted while pursuing an engineering degree?
5. Once you have graduated from school, how prepared do you feel to make ethical decisions at work?

While facilitating the hour-long workshop, STS professor and Advisor Rider Foley aided in the collection of speaker notes used for analysis. Submitted audio files, along with workshop discussion notes, were reviewed to collect themes in opinions expressed by the student participants.

Results

Overall, engineering students are guided by the goal to create artifacts that help people but are constrained by a microethical view of their work, along with apprehension towards more courageous workplace decisions. Responsibility was firmly seen as the most valuable virtue. Student responses also demonstrated a firm understanding of the individual responsibility to the greater good of the public. Further, students demonstrated their investment in more virtuous traits, such as curiosity and open-mindedness, as important to their role as an engineer. These two results illustrate a strong commitment to microethics, which are ethical concerns that "pertain to one's responsibilities as an individual practitioner" (Schiff et al., 2021). However, participant responses revealed a strong apprehension towards embracing bravery as a core virtue. Multiple students viewed bravery as a non-essential value to daily work, highlighting a depoliticized view of engineering work and a weaker understanding of macroethical issues, "pertaining to the broader social responsibilities of the profession" (Schiff et al., 2021). To develop engineering students equipped to make more virtuous career decisions, EEE must continue to emphasize bravery as a vital and necessary value for engineering ethically.

Based on the ranking system derived earlier, responsibility is clearly seen as the most important virtue to students' identity as engineers. Multiple students described responsibility as the grounding principle of their work, with one student expressing that "being legally responsible to the set of laws and society, as well as morally responsible, is probably the most important thing an engineer can do." Students also made broader conclusions about how responsible engineering is needed with such public facing work. In their submission, another student explained how “as an engineer, I believe that it’s important to…maintain moral, legal, and mental accountability for the work that you do, especially because it affects so many people.” Reasonings given by participants demonstrate an extremely strong adherence to deontological values, firmly reinforced in engineering coursework and ethical codes upheld by professional organizations. Multiple students mentioned the need to “follow guidelines that are set forth by the industry,” with one student specifically stating that “following any principles or rules is good and ensures for a good engineer.” The embrace of moral virtues, such as open-mindedness and curiosity, demonstrate the value engineering students give to welcoming different perspectives and personal investment into their work. A few participants discussed how the best engineering work comes from a pursuit of curiosity, with one student proclaiming that “as an engineer, you’re supposed to create things, and you can’t do that without caring about what you’re creating.” Another student added that “if I am not passionate in what I’m doing, I think my quality of work is not as good because I do not have that continued curiosity and investment.”

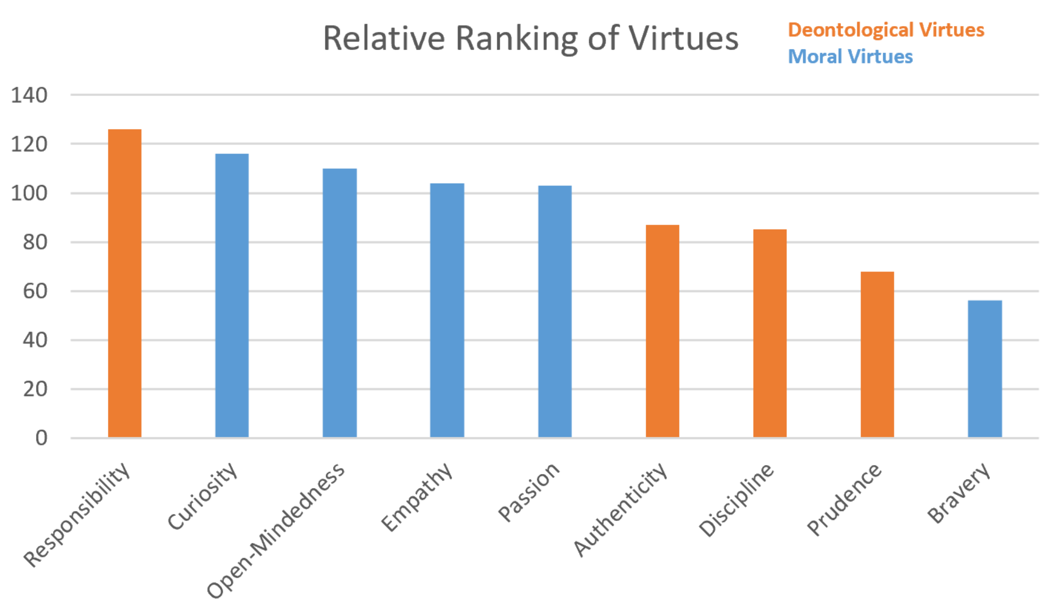

Figure 1. Relative ranking of virtues, labeled according to the virtue category described above.

However, much of the discussion was centered around what aspects of work should and should not be considered by engineers. The students often framed this conversation on which virtues were important and which ones were non-essential. This was seen through the consensus that bravery is a non-essential virtue to engineering professionals. Students expressed their resistance towards bravery in a multitude of ways. Some students mentioned fear and difficulty as their justification, with one student explaining that "it can be hard to have bravery at times so I think it's easier to give yourself some grace and choose to be brave when you can." Another student described how they wouldn't consider bravery as a "trait [they] associate with [themselves] as an engineer" since they do not wish to put themselves in spaces of fear or danger with their work. Others explained how they saw bravery as a virtue they only had to utilize in certain situations, therefore making it less essential than others.

Many of these perspectives on which virtues were non-essential stem from the underlying belief that engineers do not have much autonomy in their work. Responses demonstrated that individualism is not seen as an important aspect of being an engineering professional. A student explained that they ranked empathy, prudence, and discipline as the bottom three because they did not think "other people's personal lives affect them as an engineer." Another participant placed authenticity as their least important virtue because their personal belief on the best design does not necessarily drive engineering developments. One student made a connection between rigid power structures and a lack of autonomy at work, stating that they did not view prudence as important since "most of the time you are regulated to doing what other people say to do." In both small and large group discussions, participants made the belief clear that engineers have very little self-governance due to rules and precedents set in place by leaders, government officials, and customs.

Discussion

Student responses broadly mirror the findings produced by similar research projects completed in the field. Particularly, students' weaker understanding of the marcoethical impact of their work. The work of Schiff et al. illuminated how engineering students compartmentalize microlevel and macrolevel concerns into separate categories, often directing less focus to macroethical concerns. This is seen directly in how participants generally argued that governing bodies (such as an employer or government officials) manage the societal impacts of their work (Schiff et al., 2021). Cech's culture of disengagement is also represented in student responses, particularly through an overall student opinion that it is not worth the effort to challenge the lack of autonomy possessed by professional engineers. Interestingly, responsibility was often seen by the participants as a moral virtue, rather than the deontological categorization prescribed to the value in previous literature. Students made a clear connection between responsibility and the macrolevel impacts of engineering work on society. However, discussion about other moral virtues demonstrated a weaker consideration of macroethical issues. As discussed, the primary conversation topics on autonomy and adhering to established institutions demonstrated a more microlevel understanding of engineering ethics. This dichotomy between how students connected specific moral virtues to a macrolevel view of their work highlights how students can identify the importance of virtuous values but are hesitant to apply these virtues to their career with a macroethical lens.

A major limitation on the findings presented above is the small number of student participants. Students were not selected at random to participate in the workshop, and the students represented in the study skewed towards the upperclassmen classification. Further, I was simultaneously enrolled in the STS 4600 course with about half of the participants, and I was familiar with a few others outside of the class. My familiarity with many of the student engineers may have influenced their reasoning and conversation points, due to their knowledge of the goals of my research project.

If I were to repeat this research with larger aspirations, I would dedicate much of my energy towards producing a larger and more randomized selection of student participants. With a larger pool of students, I could further investigate different student categorizations and analyze their impacts on responses. Building from a larger group of participants, along with collecting demographical information through survey responses, I could investigate how attributes such as sex, class year, or socioeconomic status affect the prioritization of certain virtues. Consistent with previous research, female-identifying students tended to prioritize the more virtuous values, such as empathy and open-mindedness (Cech, 2014). One student mentioned a very poignant argument: acting on virtues is a privilege due to the increased efforts employees from disadvantaged groups put into obtaining, maintaining, and succeeding in their roles (Walker, 2019; Wilson & Darity Jr., 2022). With further research, I would love to use a more intersectional view on this work, tailoring strategies for students based on their personal communities.

This research project presented an interesting opportunity for me to reflect on my own identity as an engineer. More specifically, how it has and continues to shift as I plan towards matriculating out of UVA. Especially within the mechanical engineering field, it is incredibly important to make design decisions that advance the wellbeing of all people. On an individual level, I firmly relate to the culture of disengagement that has entrapped numerous engineering students throughout the country. This project has reaffirmed my belief that as engineering students, we have the desire to buck these societal and economic pressures to do unethical work; students just need the tools to act on that conviction.

Conclusion

Based on research results, students empirically viewed responsibility nearly twice as important as bravery. To prepare engineering students to make virtuous and ethical career decisions, we must encourage them to be brave in the workplace. Engineers are constantly put in difficult situations, wedged between the economic and social impacts of their work. Before even securing a position, new graduates must quickly decide how much they are willing to compromise between financial security, economic stability, and the ethical consequences of the project. To inject bravery into EEE, I encourage educators to utilize case studies, specifically recent and culturally relevant examples, to allow students to practice decision making skills in real time. As structural engineer Jon Schmidt proclaims, the goal “is not so much better engineering decisions, but rather better engineering decision-makers; that is, better engineers” (Schmidt, 2014). A holistic embrace of virtue ethics throughout the engineering undergraduate curriculum will empower students to take full ownership of their engineering career.

Appendix

Figure 2. Virtue Flash Cards used in the workshop.

Dimension	Deficient Vice	Virtue	Excess Vice
Accountability	Unaccepting Negligent Irresponsible Deflects	Accepts Consequences Conscientious Responsible Takes Ownership	Burdened Obsessive Controlling Can't delegate
Courage	Cowardice Unassured Hesitant Fragile Yielding	Brave Confident Determined Resilient Tenacious	Reckless Arrogant Bull-headed Overly-compensating Stubborn
Transcendence	Unthankful Unimaginative Short-sighted Uninspired Pessimistic Directionless	Appreciative Creative Future-Oriented Inspired Optimistic Purposive	Awe-struck Untethered Missing the present Over-stimulated Delusional Fixated
Drive	Waits for direction Apathetic Aimless Mediocrity Lethargic	Demonstrates Initiative Passionate Results-Oriented Strives for Excellence Vigorous	Dictatorial Fanatical Tunnel-vision Strives for perfection Forceful
Collaboration	Confrontational Self-centered Inflexible Disconnected Narrow-minded	Collegial Cooperative Flexible Interconnected Open-Minded	People-pleaser Conflict-avoider Compliant Boundaryless Abstract
Humanity	Uncaring Oblivious to others Unrelatable Vindictive Aloof	Compassionate Considerate Empathetic Forgiving Magnanimous	Overly concerned Overly-accommodating Overwhelmed by feelings Exploitable Over-bearing
Humility	Fixed mindset Disinterested Ungrateful Braggard Unreflective Disrespectful Unaware Protective	Continuous Learner Curious Grateful Modest Reflective Respectful Self-aware Vulnerable	Lacking focus Transfixed Feeling insignificant Self-effacing Ruminating Fawning Self-conscious Over-exposed
Integrity	Fake Untruthful Inconsistent Unprincipled Manipulative	Authentic Candid Consistent Principled Transparent	Uncompromising Belligerent Rigid Dogmatic Indiscriminate
Temperance	Anxious Agitated Impatient Inattentive Rash	Calm Composed Patient Prudent Self-Controlled	Indifferent Detached Overly accepting Overly cautious Overly-regulating
Justice	Inequitable Biased Unfair Disproportionate Narrow concerns	Equitable Even-Handed Fair Proportionate Socially Responsible	No exceptions No differences "One size fits all" Micromanage proportion Paralyzed by complexity
Judgment	Stagnant Lacking logic Simplistic Lazy thinking Indecisive Lacking instinct Ignorant Unrealistic Oblivious	Adaptable Analytical Cognitively Complex Critical Thinker Decisive Intuitive Insightful Pragmatic Situationally Aware	Overly malleable Over-analyzing Complicating Overly critical Impulsive Lacking reason Cunning Overly practical Over valuing situations

Figure 3. List of Virtues and Vices (Furlong et al., 2023).

References

ABET. (2025). Criteria for Accrediting Engineering Programs, 2025—2026. *ABET*. https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2025-2026/

Alexander, L., & Moore, M. (2021). Deontological Ethics. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2021). Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/win2021/entries/ethics-deontological/

Andrea Hicks & Wissam Kontar. (2024). The Role of Disasters and Infrastructure Failures in Engineering Education with Analysis through Machine Learning. *Journal of Civil Engineering Education*, *150*(4). https://doi.org/10.1061/JCEECD.EIENG-2021

Cech, E. A. (2013). The (Mis)Framing of Social Justice: Why Ideologies of Depoliticization and Meritocracy Hinder Engineers' Ability to Think About Social Injustices. In J. Lucena (Ed.), *Engineering Education for Social Justice: Critical Explorations and Opportunities* (pp. 67–84). Springer Netherlands. https://doi.org/10.1007/978-94-007-6350-0_4

Cech, E. A. (2014). Culture of Disengagement in Engineering Education? *Science, Technology, & Human Values*, *39*(1), 42–72.

Center for Quantum Information Science and Technology – Ming Hsieh Department of Electrical Engineering. (2025). Center for Quantum Information Science and Technology. https://sites.usc.edu/cqist/

Department of Defense (DOD) | Spending Profile | USAspending. (n.d.). Retrieved November 5, 2024, from https://usaspending.gov/agency/department-of-defense

Eisenhower, D. (2016, October 20). January 17, 1961: Farewell Address | Miller Center. https://millercenter.org/the-presidency/presidential-speeches/january-17-1961-farewell-address

ethics, T. E. C. (2016, February 17). Ethics Explainer: What is Deontology? THE ETHICS CENTRE. https://ethics.org.au/ethics-explainer-deontology/

Furlong, B., Crossan, C., Crossan, M., Hamdulay, F., Linkletter, K. E., & Milani, K. Y. (2023). *Character Leadership as a Competitive Advantage*. *36*(12).

FY 2023 Defense Investment in Quantum Information Science—GovWin IQ. (n.d.). Retrieved November 8, 2024, from https://iq.govwin.com/neo/marketAnalysis/view/FY-2023-Defense-Investment-in-Quantum-Information-Science/6864?researchTypeId=1&researchMarket=

Han, H. (2015). Virtue Ethics, Positive Psychology, and a New Model of Science and Engineering Ethics Education. *Science and Engineering Ethics*, *21*(2), 441–460. https://doi.org/10.1007/s11948-014-9539-7

Hartung, W. D., & Freeman, B. (2023, May 9). *The Military Industrial Complex Is More Powerful Than Ever*. https://www.thenation.com/?post_type=article&p=444641

Hursthouse, R., & Pettigrove, G. (2023). Virtue Ethics. In E. N. Zalta & U. Nodelman (Eds.), *The Stanford Encyclopedia of Philosophy* (Fall 2023). Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/fall2023/entries/ethics-virtue/

IBM and Raytheon Technologies to Collaborate on Artificial Intelligence, Cryptography and Quantum Technologies. (n.d.). IBM Newsroom. Retrieved October 16, 2024, from https://newsroom.ibm.com/2021-10-11-IBM-and-Raytheon-Technologies-to-Collaborate-on-Artificial-Intelligence,-Cryptography-and-Quantum-Technologies

Inside Lockheed Martin's Sweeping Recruitment on College Campuses. (2022, August 11). In These Times. https://inthesetimes.com/article/lockheed-martin-recruiting-military-industrial-complex-student-debt

Klobuchar, S. (2024, August 8). *UVA Engineering Receives $900,000 Grant to Create Character-Building Initiative | University of Virginia School of Engineering and Applied Science*. https://engineering.virginia.edu/news-events/news/uva-engineering-receives-900000-grant-create-character-building-initiative

Knapp, A. (2011, October 31). *Lockheed Martin Installs Quantum Computer*. Forbes. https://www.forbes.com/sites/alexknapp/2011/10/31/lockheed-martin-installs-quantum-computer/

LaPatin, M., Barrens, S., Poleacovschi, C., Vaziri, B., Spearing, L., Padgett-Walsh, K., Feinstein, S., Rutherford, C., Nguyen, L., & Faust, K. M. (2023). Engineering in a Crisis: Observing Students' Perceptions of Macroethical Responsibilities during Pandemics and Natural Disasters.

Lim, J. H., Hunt, B. D., Findlater, N., Tkacik, P. T., & Dahlberg, J. L. (2021). "In Our Own Little World": Invisibility of the Social and Ethical Dimension of Engineering Among Undergraduate Students. *Science and Engineering Ethics*, *27*(6), 74. https://doi.org/10.1007/s11948-021-00355-0

Journal of Civil Engineering Education, *149*(4). https://doi.org/10.1061/JCEECD.EIENG-1909

Martin, D. A., Conlon, E., & Bowe, B. (2021). A Multi-level Review of Engineering Ethics Education: Towards a Socio-technical Orientation of Engineering Education for Ethics. Science and Engineering Ethics, 27(5), 60. https://doi.org/10.1007/s11948-021-00333-6

Myers, J. (2023, December 29). *Quantum Sensing's Revolutionary Potential for Cancer Treatment, Navigation, and Precision Measurement*. The Quantum Record. https://thequantumrecord.com/quantum-computing/quantum-sensing-revolutionary-potential/

Myers, J. (2024, July 14). *Quantum Technologies Advance Military Capabilities, Raising Ethical Concerns*. The Quantum Record. https://thequantumrecord.com/philosophy-of-technology/quantum-technologies-advance-military-capabilities-raising-ethical-concerns/

Olivier, I. (2022, August 18). US universities are pipelines to the defense industry. What does that say about our morals? *The Guardian*. https://www.theguardian.com/commentisfree/2022/aug/18/us-universities-are-pipelines-to-the-defense-industry-what-does-that-say-about-our-morals

Pfaff, W. (2010). Manufacturing Insecurity: How Militarism Endangers America. *Foreign Affairs*, *89*(6), 133–140.

Quantum Computing Center. (n.d.). Retrieved October 16, 2024, from https://www.isi.edu/centers-qcc/

Raytheon to open engineering design hub at ASU's SkySong location | ASU News. (n.d.). Retrieved October 16, 2024, from https://news.asu.edu/20230728-arizona-impact-raytheon-opening-engineering-design-hub-asu-skysong

Riley, D. (2021, February 24). *What we assess for accreditation and what we teach need not be completely aligned – SEFI*. https://www.sefi.be/2021/02/24/what-we-assess-for-accreditation-and-what-we-teach-need-not-be-completely-aligned/

Schiff, D. S., Logevall, E., Borenstein, J., Newstetter, W., Potts, C., & Zegura, E. (2021). Linking Personal and Professional Social Responsibility Development to Microethics and Macroethics: Observations from Early Undergraduate Education. *Journal of Engineering Education*, *110*(1), 70–91. https://doi.org/10.1002/jee.20371

Schmidt, J. A. (2014). Changing the Paradigm for Engineering Ethics. *Science and Engineering Ethics*, *20*(4), 985–1010. https://doi.org/10.1007/s11948-013-9491-y

Stone, M. (2022, February 16). EXCLUSIVE Biden to seek more than $770 billion in 2023 defense budget, sources say. *Reuters*. https://www.reuters.com/world/us/exclusive-biden-seek-more-than-770-billion-2023-defense-budget-sources-say-2022-02-16/

Susan V. Henry. (2024). Understanding Engineering Students' Ethical Decisions: Machiavellianism, Ultimatum Bargaining Choices, Student Experience, and Implications for Engineering Education. In *ProQuest LLC* (ProQuest LLC. 789 East Eisenhower Parkway, P.O. Box 1346, Ann Arbor, MI 48106. Tel: 800-521-0600; Web site: http://www.proquest.com/en-US/products/dissertations/individuals.shtml).

Turley, J. (n.d.). *Big money behind war: The military-industrial complex*. Al Jazeera. Retrieved November 7, 2024, from https://www.aljazeera.com/opinions/2014/1/11/big-money-behind-war-the-military-industrial-complex

Walker, C. (2019, December 5). African Americans Face Systematic Obstacles to Getting Good Jobs. *Center for American Progress*. https://www.americanprogress.org/article/african-americans-face-systematic-obstacles-getting-good-jobs/

Wilson, V., & Darity Jr., W. (2022, March 25). *Understanding black-white disparities in labor market outcomes requires models that account for persistent discrimination and unequal bargaining power*. Economic Policy Institute. https://www.epi.org/unequalpower/publications/understanding-black-white-disparities-in-labor-market-outcomes/