Justice in Acopian

Kyle Blumenthal- Lafayette Class 2021, Engineering Studies Major

Contact: blumentk@lafayette.edu

Benny Molina Oliva- Lafayette Class 2021, Engineering Studies Major

Contact: molinaob@lafayette.edu

Report Completed: December 3, 2020

Intro

The next change in socio technical education will be taking in account social and environmental justice. This is an alteration that Lafayette must enact in order to follow the trend. Engineering has evolved immensely over the course of history. In the world we live in today, bias in technology leaves negative effects on underprivileged people. Engineering and technology must adjust to be the best for all people on this planet. The triple bottom line being people, planet, and profit, all are currently in need of more emphasis. People represent the relation to the impacts of an organization on the stakeholders involved including employees, customers, and others. Planet is defined as the impacts of an organization or entity on the natural environment in relation to its carbon footprint and so on. Lastly, profit is the impact of an organization or entity on the local, national, and global economy including employment, innovation, taxes, and more (Forbes, 2019). All three of these need to be evaluated in our current climate to improve technology for all. Negative results of technology are holding back from prosperity of people and the prosperity of the planet. An evaluation of the triple bottom line in today's world comes down to an analysis and need for change in social and environmental contexts. Without change in these core areas, engineering and technology will never reach its full potential. At Lafayette, in Acopian and the Engineering Studies major specifically, these areas of focus need to be included in the curriculum in some manner. Without them, Lafayette will be behind the trend in engineering education. Engineering Studies at Lafayette was created as a socio-technical major in response to criticism of advancements in engineers back engineering back in 1970. Adding social and environmental justice to the existing curriculum is a shift in engineering that must be tackled head on.

Engineering Studies, formerly known as AB Engineering, was originally described that "Lafayette can profit from its combination of arts, sciences, and engineering programs" (*The Lafayette*, 1970 p.6)**.** Over fifty years later, a similar description of Engineering Studies is denoted by all of its beneficiaries. In the 60s and 70s, there was an expressed need for more humanitarian engineering within the industry and society. With schools such as UCLA, Harvey Mudd, MIT, and Caltech, leading the charge of humanitarian engineering and with the goal to "impart technical skill with moral content," Lafayette was not far behind when implementing their own science and technology studies major (Engineers for Change, 2016, p.170). Now, there is a transition in how we as students, scholars, and everyone alike, should assess engineering and technology. There is always the question of "Is vs. Ought" that is posed to analyze whether a technology that is fully operational and could easily be put into society, should actually be put to use. With new innovation being made available in such great frequency, there are new negative effects that question these said advancements. These questions must be asked by the Lafayette community, and that can be evaluated in the Engineering Studies curriculum.

We propose an overhaul and revamping of the Engineering Studies curriculum. The major must integrate everything that it presents to us in a cohesive way, and it must present to us the most significant issues in technology. Our Engineering Studies vision for the future can be presented in the form of a cake. There are three layers to the cake as listed from the base to the top: environmental justice, social justice, and economic justice. All must be put to the forefront of our curriculum. Starting off with environmental justice as the base. Second comes social justice, which is a focus on racial justice. And lastly, there is economic justice. Each one, if not successfully targeted can cause a ripple effect on the next layer, and all are so important for the core of the Engineering Studies curriculum and its success. Sometimes, these layers of economic,

Figure 1: The EGRS Cake. Our EGRS Vision.

social, and environmental justice can seem more like icing than the cake itself. With aspects of what the curriculum poses not acting as a core principle of the major, the set up of the program as a whole must be reevaluated. The Lafayette website states that "The Engineering Studies Program brings together the four divisions of campus-engineering, humanities, science, social sciences- for a truly liberal arts education" (Program-Engineering Studies, 2020). Even though this is consistent with what the major originally set out to be as referenced in *The Lafayette* article from 1970, the execution must be updated to encompass not only new issues, but conflicts that are new in the space of technology.

These conflicts of environmental justice, social justice, and economic justice have always been recognized, but not in the sense of the world of engineering and technology. With the boom of social media, the development of algorithms, and other advancements, these issues of justice have been brought to the world's attention. In our report, We will present an evaluation of the social context, political context, economic context, and the implementation of a new curriculum. For social context, there will be a focus on society and how race and environment are key players in engineering. For political context, we will assess policy and how the addition of social and environmental justice are seen in engineering and education. We will also analyze the economic context, and how the resources are allocated within Lafayette College. There will also be

information on how a lack of diversity disallows the industry from reaching its full potential. Lastly, we will speak on the implementation of how our findings should enhance the major to encompass more of how it is presented.

With this report, we will look to the newly created Hanson Center of Inclusive STEM at Lafayette. They set out to "tackle the lack of inclusion within the scientific disciplines, a common trend throughout United States universities" (*The Lafayette,* 2019*).* The Hanson Center came into existence from a $5 million gift from Daniel and Heidi Hanson of the 1991 class in 2017. Allison Byerly, Lafayette College's current President mentioned, "[Heidi Hanson] was interested in making a substantial gift that would help us with recruiting underrepresented students and she's been supportive of some of those efforts in the past" (Lafayette Student News, 2019). With our goal of making the major more racially and environmentally aware, we believe our report to the Hanson Center will be groundwork to help improve Acopian and Lafayette Engineering. We also intend it to give justice to all students, no matter what their background may be. With any change in the schools system, there are certainly many factors involved, one being funding of programs. Additional funding is a necessity for the expansion of inclusive STEM, and only time will tell if the investment from the Hanson's to Lafayette College will be the answer to the issues presented.

Although there is no current solution, there are several ways that social and environmental justice can be incorporated in engineering in the classroom. Several ideas including cross listed courses, adding courses, adding a professor, and more have been contemplated by current professors involved in the EGRS (Engineering Studies) program. The current Engineering Studies program at Lafayette has a core set of courses that gives knowledge to students and allows them to evaluate issues on a socio technical level. With the change in

socio technical conflicts today in the world around us, there must be a change in the curriculum of the program. In order for an adequate solution to be successfully implemented, an evaluation of several contexts have been done and are explained in this report. From information gathered within the Lafayette community and beyond, there will be an expression of the desired future path of the Engineering Studies major and Acopian of how justice can be incorporated into the curriculum. With social and environmental justice being the main priorities for implementation, they will both be the basis of this report.

Social Context

First, a brief history on the matter must be iterated to provide background and context. Engineering has progressed an incredible amount, especially since the mid twentieth century. The consequences of an engineering militaristic mindset caught up with the engineering profession, exposing the lack of understanding engineers had with the experts of humanities and the wants and needs of society. For some critics, engineers had opened the technological pandora's box and could not control what they had created. This turning point began when the United States government dropped the two atomic bombs on Nagasaki and Hiroshima, which shocked the world. Many people were frightened for their lives for decades as they saw the harsh effects from those bombings on Japan. During the same time, society was seeing technology's negative impacts on the soil, ecosystems and people as shown in Rachel Carson's *Silent Spring,* published in 1962. At this point, engineers were seen as puppets for the government and corporations, doing their will and not serving the people (Kirkman, 2017). The heroes of yesteryear were now viewed as the masters who could not control their creations; this left society to handle the consequences of each innovation. Today, our society has seen how technology is tracking us and slowly peeling away our senses of privacy. Engineers remain in the situation they were sixty years ago, still feeling the pressures of society demanding that engineers consider how technology may affect them and our environment.

Figure 2: MIT Protests 1967-72

MIT students protested militaristic engineering education in the classroom (Science and Revolution, 2018)

Although engineers were trying to become more humanistic individuals, many education programs have been aware of these shortcomings over the past decades and attempted to produce more humanistic engineers. This movement began during the sixties as engineering students sought to take their own education, trying to take initiative and go into a profession that truly aided society. At MIT, students protested "MIT's development of both nuclear weapons and weapons used in the Vietnam war" (Science and Revolution, 2018). Students would protest to ensure their curriculum fit society's expectations, which led to an overhaul towards how some view engineering. Schools like Caltech, Harvey Mudd, MIT, and UCLA became the leaders of this movement, introducing programs that attempted to connect engineers towards society. Lafayette College followed the previously mentioned emerging leaders of this movement as well, introducing their A.B. Engineering program in 1970 (*The Lafayette, 1970)*. Lafayette College intended to create a revolutionary program that combined their liberal arts with engineering. The current Lafayette Engineering Studies program's website claims, "This distinctive bachelor of arts in engineering could be considered the ultimate liberal arts degree because it requires students to delve more deeply into each of the four divisions on campus (engineering, humanities, science, and social sciences) than any other degree offered at Lafayette College." (2020). They want to ensure that more engineering leaders produce technologies that follow the interdisciplinary mindset. Lafayette College and other universities are aware of the effects that deterministic engineering has caused in society, but their words must be acted upon.

Many of these programs have not met the high expectations they started with. Matthew Wisnoiski, a professor in the Science, Technology, and Society department at Virginia Tech states in his book, *Engineers For Change,* "Universities and technical institutes were left with STS programs, minor increases in humanities curricula, and brochures with an aura of human

values" (2012, p. 185). These courses tout how programs are creating leaders who are empathetic members of society, yet we still see these engineers fall into the same mistakes that their predecessors made. Lafayette College is one of the programs that fit this shoe, but they seek to ensure that they are constantly updating the program. The program altered its name to Engineering Studies to reflect one that would not need to change as it can fit any time in history. This change seems to be more icing on the cake rather than making a concrete difference to the discipline. The program is truly trying to change and fit their vision better, but there are some fundamental issues in place. Engineering Studies majors often go towards the route of project management, a very technical but people-driven profession. This is certainly a great profession to enter after graduation, but it does not portray the goals of the major's program. This becomes an issue when reviewing the goals of the program, because if most Engineering Studies majors become project managers, is the original reason for the program still held to the same expectations today?

While there has been great progress in socio-technical engineering, there is always more upgrading and updating to be made. Several schools that have been mentioned from the likes of Caltech, MIT, Harvey Mudd, and others were some of the first schools to implement socio technical majors and courses to their engineering programs. They saw the need for a different approach to what is now known as humanitarian engineering. The most recent round of reformation within the socio technical curriculum country wide is the addition of engineering courses that incorporate social justice and environmental justice or sustainability.

The emergence of social and environmental justice to the curriculum in engineering has come into the shape in college programs over the last several years. With more research on the subject in recent times, it seems imminent that this will be added to more programs across the

nation. Between 2005 and 2016 there were several grants given to researchers ranging from $25,361 to $404,813 from the NSF (National Science Foundation) (Engineering Justice, 2018, p. 168). This represents the expansion in national interest of the study of social justice in engineering. More recently, schools have ventured into adding social justice into the curriculum of their engineering programs.

One school that has taken a step towards the future is the Colorado School of Mines. A student of the school states, "Engineering and Social Justice taught me that engineering is so much more than technical work. I believe a combination of social work and technical work makes the best engineers" (Engineering Justice, 2018, p. 210). With students recognizing the benefits of this and being in a world filled with racial turmoil, courses like these are essential for the future of engineering education. Humanitarian engineering literally means the advancement of technology to help improve human welfare. With engineering focused on the human, all people must be taken into consideration, not just privileged communities. As shown in Figure 3 below, there is a bridge pictured that serves its function as a bridge, but it has some stipulations to tack on to it.

Figure 3: Racist Bridge Designed by Robert Moses

Busses could not pass beneath these bridges, which was a main form of transportation for black communities. Example of political and racial effects of engineering and tech (Engineering Justice, 2018, p.54).

As shown in Figure 3 above, there is an example of how engineering and technology can be purposely racist. In this example, the inability for bus traffic to pass through on the main road exposes poor populations, oftentimes Black Americans and other minorities, from traveling freely. Even though this example has been largely suggested to have been engineered for this reason, there are certainly many technologies that do not take into account the needs of minority populations (Engineering Justice, 2018, p.54). With more knowledge on social justice, there is certainly opportunity to minimize these issues to arise in the first place. An account for the

environment and sustainability must also be recognized for the success of engineering in the past and the future.

When speaking about environmental justice, one can learn from the triple bottom line, which incorporates people, planet, and profit as previously mentioned. While views and opinions on each differ among the entire population, a shift of goals in engineering and tech can heavily impact the planet portion of the triple bottom line. As mentioned in *Engineering Justice*, "The anti-war movement, environmental activism, and other counter-cultural activities in the 1960s and 1970s produced interesting curricular experiments in engineering education with increased presence of HSS (Humanities/Social Sciences)" (2018, p.161). With movements and change in culture, engineering, and more change occurring in the world and the United States specifically, environmental activism came on the scene as a criticism of engineering and technology.

While civilizations have shown to have cared for their local environment, this is not always the case. In recent history, examples of sacrificing the welfare of the environment for other reasons such as economic prosperity or to fulfill basic human needs are very prominent. As mentioned in *Engineering and Sustainable Community Development*, "The Green Revolution: Beginning in 1945 in Mexico and then expanding to other highly populated countries like India, this revolution refers to the transformation of agriculture by means of high yield crops brought by artificial fertilizers, pesticides, and intensive irrigation" (2010, p.23). When referencing each portion of the triple bottom line, this example improves life for people and I can infer that it led to increased revenue and profit; on the contrary, it certainly does not help alleviate the effects on the environment for the local community.

An example that seems to be known by many people within the engineering community is how nuclear power plants are commonly placed within low income and densely populated

minority areas. As mentioned in the Stanford report named *Environmental Injustice: Racism Behind Nuclear Energy*, "Minority groups are more likely to live proximal to NPP(Nuclear Power Plants) thus increasing their exposure and risk of radioactive health related problems...More policies also need to be put in place to protect minority and low income communities who face uncertainty in the event of emergency evacuations" (2018). This is one example of many instances of engineering and technology having social and environmental injustice implications packed to the brim. With this narrative and others, a base of knowledge is lacking in the engineering field of education on this matter. Lafayette currently does not have classes required for engineering and EGRS majors that would help them learn the implications of social and environmental justice in engineering.

Lafayette's Engineering Studies curriculum must teach its students to learn how to solve complex problems by evaluating the aftereffects on each: planet, people, and profit. At Lafayette, there are courses available in the Environmental Studies program for all students to take. Unfortunately, it is not required for an Engineering Studies major, or the other Engineering disciplines to take a course specifically in the EVST (Environmental Studies) department. This brings upon the question of should engineers have to take courses on environmentalism? For engineering to be successful in future production and manufacturing and management of the world, the effects of a technological advancement on the environment must be recognized and minimized of its degradation. An argument as referenced in Wisnioski's *Engineers for Change* of "is vs. ought" is described as to "impart technical skill with moral content" (Wisnioski, 2012, p.170). The notion of encompassing moral content, the environment as well as all people are to be listened to and contextualized to reach the highest potential success of technology.

In its current state, we believe engineering and technology is considered to be socially unjust and environmentally unconscious. The technologies that were developed by engineers in the 20th Century have led to significant environmental problems, such as climate change and increased CO_2 emissions. However, that is only the tip of the societal iceberg; climate change is not only harming wildlife and environmental systems, it's harming people as well. These dangerous technologies are mostly affecting people of color and minority communities. The highest risks for cancer and other health conditions are in underprivileged, minority communities while majority white communities see less of a risk in general. The oppression of minorities and effects of climate change work hand and hand to brew a recipe for a vicious cycle of deafening the most vulnerable. The technologies that these engineers created were not designed with these potential outcomes in mind. We hope and believe that no engineer wants to create a racist technology nor is intending to, but it is an outcome of implicit bias. Implicit or unconscious bias in this context is when we make decisions or act in a way that shows their stereotypes towards different racial groups. Ruha Benjamin is a professor in Princeton University who focuses on the relationship between race, technology, and justice. In Ruha Benjamin's *Race After Technology*, she states, "Racist robots, as I invoke them here, represent a much broader process: social bias embedded in technical artifacts, the allure of objectivity without public accountability" (2019, p. 53). Students need to learn that technology is biased and they need to hold these biases accountable as they will affect people negatively. At this moment, our country and society has come to a crucial tipping point. With the Black Lives Matter movement emerging in a time where implicit and explicit biases are being recognized, change must be made in the world, and that does not stop in the social injustices expressed in technologies. Engineers must realize the

truth in implicit bias and start communicating with their community in order to understand how they can make unbiased and unproblematic technologies.

Technology can be racist and it certainly affects targeted groups, but there are some engineers who deny this. Some engineers determine technology as a neutral force but that is simply not the case. (Benjamin, 2019, p.51). Technology has biased creators who are unaware and may not be willing to accept their role in society. They have a sense of technological determinism, which is a mindset that technology is the only thing that changes society and it is the focus of all that we do. However, we can disprove this idea by mentioning an AI Beauty algorithm, which was also described in Benjamin's *Race After Technology*. This algorithm was designed to simulate a beauty context and when the results were given, the creators were disappointed. The algorithm chose lighter skinned individuals and only picked one person with dark skin. Some may ask why this was the case, but those who are in these communities have an idea of why this happened. The creators programmed this bot to reflect their beauty standards, which is based on society's standards that are clearly biased to give favor towards those with lighter skin.

Why don't engineers develop a socially-aware and environmentally-based mentality throughout their college experiences? It is easier said than done, especially when there is an ideological battle between engineers. Since the 1960s, there have been two main sides to this argument; technological determinism versus a mindful and interdisciplinary approach to engineering and society. In the 60s, some engineers who would like there to be less humanities in engineering as it "can be taught elsewhere" and "we need to make sure we get our students certified and ready for the workforce". We see this mindset at Lafayette College, within students and the engineering program itself. Due to Engineering Studies' focus on the critique and

evaluation of engineering's role in society, other engineering majors may not see it as "real" engineering. Engineering Studies majors have casually been coined as "pretend-gineers" and it is evident that the program has less core engineering technical courses than a Mechanical Engineer, Civil Engineer, and so on. On the contrary, to load up on technical courses is not even the intention of the major. The Engineering Studies major features a math and science heavy foundation and other engineering majors also take these classes as well in the beginning of their college careers. Then courses that are woven into the humanities like the capstone course Engineering, Engineering and Society, are very much writing and reading focused. Lafayette is not the only place where this type of mentality takes place. Professor Donna Riley is an Engineering Professor who focuses on engineering and social justice at Purdue University. Professor Donna Riley points out an interesting experience of resistance when she was trying to apply environmental justice concepts in her class. She recalls, "Just before Thanksgiving, a student frustrated with an essay assignment held up her essay and exclaimed, 'This isn't thermodynamics!' and then held up a problem set: 'THIS is thermodynamics!'" (Pushing Boundaries of Mass and Energy, 2015, p. 10). This shouldn't be surprising as students grow up in a traditional school environment, where every concept is treated as its own. Trying to teach students to think about the interconnectedness of engineering and the world around them when they have spent so much time learning the opposite can be quite the challenge. Students will resist this mindset and continue to stick to the more comfortable problem sets. Society is an ongoing problem that requires constant interventions and failures, but allows learning lessons. A traditional problem set is easier to figure out; it starts and ends somewhere, unlike societal problems.

One possible issue that can arise in conversations about social and environmental justice in the classroom is if the teacher or professor is ill prepared to speak on such a topic. Since the addition of engineering justice courses are quite new in universities and colleges in the United States, many might not be comfortable instructing on the matter. *Engineering Justice* states, "We need to acknowledge that some engineering faculty can struggle with the term social justice" (2018, p. 14). Assuming many engineering professors did not take courses in social justice when they were studying shows a difficulty in adding this to the curriculum. Although this is an obstacle, there must be a starting point and a shift in curriculum across the nation.

The socio technical engineer was introduced in society as a balance between the engineers and the humanitarians. Building a bridge between to become a liaison on the subject is vital for a complete understanding of an issue on both sides. While the Engineering Studies major has a focus on socio technological issues built into the curriculum, it is time to update it and include issues on social justice and environmental justice.

Political Context

The Engineering Studies major itself emerged from an ongoing debate of science and technology vs the humanities. As mentioned in *The Lafayette,* "it will explore the nature and roles of engineering, the problem solving skills employed by engineers, and the socio-political issues involved in the direction and control of technology" (1970). This was the description of a course named "Foundations of Modern Engineering." Unfortunately, the syllabus is most likely lost in history, but from the title and description, one can only assume the topics are focused on the politics of engineering and technology and how the rapid advancements of the time were questioned from automation in industrial settings to military engineering. Now, especially in a time where racial justice and environmental justice are at the forefront of political debates, why is it not at the forefront of our curriculum? There is a hole that needs to be filled for the Engineering Studies program to be current and successful in its teachings. Also, the questions of how engineering can be related to social and environmental justice must be asked in the beginning of the curriculum so students can constantly evaluate throughout their college experience. The politics involved in engineering should be everchanging with the current climate and woven into the curriculum seamlessly.

The politics that were the driving force when the Engineering Studies major was created were surrounding a boom in engineering that would almost too fast to evaluate and was determined by some as the driving force of society. This technological determinist viewpoint was met with much criticism. A response was met and described in *Engineers for Change,* when it mentions, "Humanistic engineering programs flourished at elite universities and a small group of liberal arts colleges whose faculty were drawn to the theories of technological politics" (Wisnioski, 2016, p. 165). This describes Lafayette exceptionally well and shows the reason for

the emergence of the Engineering Studies Major. In comparison to the politics of today in technology, there are clearly missing pieces to our curriculum.

One of the missing pieces in the current Engineering Studies major is race and technology. There are plans to make the major more focused on how new technologies have an impact on race. The EGRS faculty plan to accomplish this by slowly introducing more courses, but one has been told to our team during our Senior Project course. Professor Cohen, who leads the course, specified that there will be a race and technology course offered in the near future. This Race and Technology course plans to focus on how technology isn't a neutral entity and that technology's creators can be biased. Professor Rossmann, a Mechanical Engineering Professor, a co-director of the Hanson Center of Inclusion and also sits on the Engineering Studies advisory board, is set to teach this course next couple years. The course will be cross listed between Engineering Studies and Africana Studies, open to students from both majors to learn more about algorithmic biases against marginalized communities (J.Rossmann, personal communication, October 25, 2020). Since we currently have no evaluation of the hypothetical Race and Technology course, we will evaluate the current state and need for a course of its nature in a manner of politics. The technological bias field has grown over the years with several studies and reports about their findings. In this field, Ruha Benjamin has explained several terms, one being the "New Jim Code". Benjamin describes the New Jim Code in *Race After Technology* as the following: "Some algorithms are racist; We have a problem: Racist and sexist robots; Robotic racists: AI technologies could inherit their creators' biases" (2019, p. 52). She came to this conclusion after mentioning a beauty contest going wrong after the AI judge clearly discriminated against those with darker skin. Benjamin continues explains the danger of algorithms in technology in this section and throughout her book. This is important as even

though the civil rights movement created change during the 1960s with the Civil Rights Act, there must be an awareness that there are still effects on people of color today in engineering and technology.

This effect on people of color is manifested through algorithms whether in google searches, social media, police cameras, or many other places. Police systems today are focused on predictive policing where police use algorithms to focus their efforts on marginalized communities, further causing more potential for discrimination (Black Future Month, 2019). The issue is at least partially due to the whiteness in the tech industry, as black persons are underrepresented in this important technological implementation. This issue's source can be found in the average engineering graduate program, as stated by Juan C. Lucena and Jon A Leydens. Lucena and Leydens indicate the following on inclusion and diversity opportunities in engineering programs: "Today's typical engineering students graduate ill-equipped to properly frame and define engineering problems and solution spaces, to adequately identify the benefits and constraints of engineering, to holistically conceive of sustainability in their work, and to commit fully to dismantle power and privilege in an effort to foster diversity and inclusion." (Lucena, Leydens, 2010, p. xix). In order to be able to address discrimination, the leaders who emerge from these engineering programs must understand their privilege and oppression's chains on black folks in the technology sector. Instead of having black people involved in creating technologies, they become the targets for discrimination and further oppression whether it is the intention or not. Including more inclusivity could be crucial in including more black people in technology. If there are more black people involved in technology, they can help develop technologies that are not oppressive towards their own or any other communities.

There is hope as there are black leaders in technology who are pushing towards black people being more in the center in technologies. In a video presented on TBS on afrofuturism, tech leader Y-Vonne Hutchinson indicates that change can emerge by imagining black people in the center of technology (2019). The Black Lives Matter movement has caught headlines across the nation and the world, as the black community is calling out for major reform in policing. As described in the video, "Algorithmic bias means that all of our technology could be racist" (Black Future Month, 2019). We have seen this during the BLM protests, where police are using technologies like tear gas to separate protestors. This is only possible due to the lack of diversity and consideration by the engineers who created this technology, and laws being put into place that have allowed this action to be deemed legal. When it comes to politics and policy in our American history, black people have not been treated fairly. These algorithms are another mode of racism that is perpetuated into all of society. Lucena and Leyden put this best with the following: "Engineers and engineering societies have a heritage of concern for ethics and ethical issues. Yet in fulfilling its professional responsibilities, engineering has for too long neglected questions about social justice and sustainable community development." (*Engineering and Sustainable Community Development*, 2010, p.170). When questions about social justice aren't being answered then biased technologies continue to make it to the hands of those with power and authority. Engineers are bystanders, watching their unchecked technologies be used by unconsciously biased organizations.

An overarching theme of evaluating how race relations must play a part in the EGRS curriculum. One course can have an impact, but in order to have significant experiences throughout the major's four years there must be reform in the program. In the program's four year cycle, there is one required class that brings attention to race and technology. The course

that brings up this idea is the Capstone course, Engineering and Society. In this class, students spent one week learning about race and technology in student led lessons. We, Kyle Blumenthal and Benny Molina, were the ones responsible for this unit as we prepared questions and activities to lead the class to our best ability. We established among our group that crime is predicted to be in black neighborhoods within algorithms. By the unit's end, students recognized that algorithms are not neutral, and are inherently racist. However, we did not feel satisfied in how little time this topic was focused on through the jam-packed fourteen weeks of the senior project. In reflection of our Engineering Studies curriculum, we asked: why is this something we are not learning about until our senior year of the program? Being at the center of politics in our current climate, racism and technology should be implemented in much of the engineering curriculum in Acopian. The Lafayette College Engineering Studies website states "The curriculum empowers students to meet society's current and emerging complex, multi-disciplinary challenges" (2020). How are Engineering Studies majors supposed to meet society's challenges if they only spend a week with material that should be brought up throughout their entire college careers? The major lacks the social justice framework in order to create meaningful experiences that students can apply throughout their EGRS course experiences. Lucena and Leydens point out the role of social justice in the profession in the political context when it relates to engineers; "...Engineers are obligated to serve the public interest. To honor this commitment to public service, engineers should pay greater attention to social justice and sustainable community development." (*Engineering and Sustainable Community Development*, 2010, p. 170). If Lafayette's Engineering Studies program isn't focusing on the social justice aspect, can the students truly serve their communities effectively? With a layer of the cake missing (EGRS Vision Cake), then Engineering Studies may have a difficult time addressing issues related to diversity as the

experiences they receive related to social justice are outside of the major. The Engineering Studies program claims to bring in the liberal arts to create connections with engineering, but in order to do this in the most effective manner, one week in the final class most Engineering Studies majors cannot be the most in depth interaction they have with the real issues facing people of color.

The other part of the cake that needs attention by the Engineering Studies major is the environmental justice layer. Environmental justice has become heavily politicized over the last twenty years; the issue affects everyone, yet the issue is considered partisan. Three environmental investigators (Riley E. Dunlap, Aaron McCright, and Jerrod H. Yarosh) decided to investigate the history of partisanship when it comes to climate change. According to the three, "...Not only has the gap between Democrats' and Republicans' climate change beliefs increased over time, but the political moderator effect appears to be holding steady and shows no signs of subsiding." (2016, p.19). This issue came into the mainstream during the 2000 election when then Vice President Al Gore decided to focus on climate change. This quickly set a precedent that followed Republicans and Democrats since and has defined the Presidencies of the 2010s. President Obama followed climate action reform by joining the Paris Climate Accord and set regulations to ensure the environment was protected. However, in President Donald Trump's presidency, the United States removed themselves from all of these commitments, as predicted by Dunlap, McCright and Yarosh. They indicated the issue that we are currently facing in a Trump presidency, "Conversely, a Republican President, especially paired with a Republican- controlled Congress (and a conservative majority on the Supreme Court), might well take a huge step backward in our nation's efforts to reduce greenhouse gas emissions and also undermine interna- tional cooperation to deal with climate change." (2016, p.20).

Environmental Environmental ethics is the thought that comes to mind in the thought of environmental justice and politics. The argument of whether focusing on the protection of the natural environment of our planet, and if it is worth our time, money, and effort to fix the issues we have created as the human race. We as students are the ones who should be evaluating whether a new technology is ethical when it comes to the environment's well being. As mentioned in an article from the Pew Research Center, "Political fissures on climate issues extend far beyond beliefs about whether climate change is occurring and whether humans are playing a role...These divisions reach across every dimension of the climate debate, down to people's basic trust in the motivations that drive climate scientists to conduct their research" (2016). Just as in 2016, we just saw this in the current US Presidential election debates between Trump and Biden. One is a doubter of climate change and downplays any negative events that are an effect of our poor climate control. On the contrary, the latter supports scientists who show the effects of climate change and supports new methods of how the effects can be turned around. This bipartisan issue should not be bipartisan, but rather a joined effort to fix an issue that can affect anyone regardless of socioeconomic status or political party. Climate change should not be something that one person believes in and the next does not, it clearly needs to be understood on a deeper level of how to comprehend climate change, so everyone supports action against it. We, as students, must also have experiences of evaluating how climate change can affect us and also who it affects the most.

Engineering Studies majors should care about environmental justice, especially if they care about social justice as well. The biggest issue we see in environmental justice is environmental racism, especially when it comes to engineer's roles. As defined by Green Action, "Environmental racism is the disproportionate impact of environmental hazards on people of

color. Environmental justice is the movement's response to environmental racism. Environmental racism shows the effects on how policy can impact the well being of marginalized groups. According to *The Insider,* "An estimated 70% of contaminated waste sites are located in low-income neighborhoods, and an upwards of 2 million Americans live within a mile of sites that are vulnerable to flooding — the majority of which are in Black and brown communities" (2020). Within the policy of our government, there has been action in place originating with redlining, that kept minorities and people of a lower socioeconomic status near these contaminated waste sites, near nuclear power plants, and other major impacts to a human's health and the environment. I cannot recall a time where we deeply analyzed this in a course while in the Engineering Studies major. If there is a course within the Environmental Studies department that would fulfill this, then EGRS majors should be required to learn about these topics. Unfortunately, even with a course on the topic of environmental racism and environmental justice, it would need a focus on the engineering side of it. Perhaps delving into the effects of the contaminated waste sites, and what are ways to take better precautions to minimize these harmful effects. Why are the policies in place that make these great engineering feats of nuclear power plants typically being placed in areas of black and brown neighborhoods? We learn how the processes of major factories get built and how to manage the economics of it within our project management courses, but we do not analyze the politics of what happens when that factory is built. Policy certainly allows these facilities to be placed in certain communities, and we as EGRS majors should understand the details why that happens.

When it comes to the Engineering Studies major, Lafayette's website explains that "Engineering happens in the real world, every day, all around us, and the challenges that face society require engineering solutions. This means the social, economic, managerial, and policy

environments determine both what kind of problems are solved and how those solutions are put into place in society" (Lafayette Engineering Studies Program, 2020). With policy being referenced, and in reflection of only being required to take one policy course in the major, either policy should be taken out of the description, or this area must be bolstered. The Intro to Policy course certainly referenced issues surrounding policy and environmental issues, but the curriculum did not do the best at addressing racial justice in relation to environmental racism. The EGRS major was in reaction to the political conversation of the time of humanities vs engineers. It has been debated for over decades of whether certain advancements of technology are necessary. With that being said, and being part of the emergence of the Engineering Studies major, there is the debate of who shall make the decisions in engineering: the engineers or the humanitarians. Engineers will have a voice in these discussions, but it is important that the EGRS program prepare their own students for these conversations as without this layer, they will fall back into tendencies that caused the creation of the major in the first place.

When it comes to the overhaul of the curriculum, there will imminently be the debate on how topics of environmental justice and racial justice shall be included in our education in Acopian. As we have established so far in this report, there are differing opinions on the role environmental and social justice have in engineering. In the outside world, we can see that politicians are divided on how to best manage the environment. Within engineering itself, students and faculty debate on how to implement justice without removing the technical knowledge that defines the students as engineers. Engineering Studies will be participating in the world by working in their respective fields and that in itself is a huge opportunity to change the status quo. The very political world we have that divides engineering and sciences with the humanities can be challenged by Engineering Studies students who have gone through a program

that challenged them to become interdisciplinary individuals. Engineering Studies students may create or facilitate technologies that will determine people's lives; their perspectives can make technology less problematic and give more victories for marginalized communities. With those two layers of the EGRS cake, Engineering Studies students will be able to influence others in their scope to think deeply about the implications of technology, just as they did in Lafayette College. The divided nature of this country will be difficult to manage, but the Engineering Studies program must adapt to prepare these students for that. People want social justice reform and Engineering Studies can be a part of that conversation by including meaningful experiences that analyze the politics in the engineering field.

Economic Context

Economic Context inside Acopian

Founded in 1970, the Engineering Studies program at Lafayette College has extended

past its 50th anniversary at this point. Certainly the name of the program has changed, but the

original intentions have remained unaltered. As noted in this report previously and further on,

there is a need for an update to keep those intentions and create meaningful outcomes for the

students who complete the curriculum. This part of the report will assess the resources that are

allocated to the Engineering Studies Major. We compare the major to others at Lafayette, from

within and outside of Acopian to get a grasp on how the interdisciplinary majors operate on

college hill. Engineering Studies has a notably different curriculum than the other majors,

specifically engineering majors at Lafayette, and it also has a different allocation of resources for

the major. Given the three core courses that the major presents, many of the other courses that

EGRS students take, will be across engineering departments. While EGRS students often use the

resources officially allotted for other departments and are shared within engineering courses at

Lafayette, claiming an EGRS identity is imperative for an update to the program. More emphasis

is required for our major, and this can come in a diverse set of forms; this will be explored later

in the report in the next section. Additionally, we will assess the outcomes of racial diversity in

the workplace and beyond, and how it leaves an effect on the success and direct profit of an

organization and the entire economy. With a reassessment of the resources available for EGRS,

we will give a clearer understanding of why we need more backing and support for the major.

Without more support, the major will be left without completely fulfilling the original goals of

being "socio-technical engineers," and it will fail to keep up with the times. An assessment of the

effects of not being inclusive within Acopian and not being inclusive in our world as a whole

will be explained further. Without an addition of resources to the Engineering Studies program, it will be difficult to make the major accomplish its ambitions, and we believe that the major will fall behind the general trend of socio technical engineering programs.

The major must be revamped to be allocated more resources in order to guarantee its success. This can come in several different ways: visiting professor, another dedicated professor to the major, or another course, or courses added to the curriculum. Before we assess alternatives, we must note how the major has progressed up until now. Dr. Rossmann spoke on how when she began her time at Lafayette fifteen years ago, the major was not well resourced at all. Rossmann mentioned that "There was no dedicated faculty and it started with all cross listed programs to please multiple stakeholders" (J.Rossmann, personal communication, October 25, 2020). She also mentioned, "It was possible to get the major very quickly, many students switched (from another engineering major) at the end of their curriculum." Later on, with much improvement in the structure of the major and establishment of an identity, a three core Engineering Studies course was created. This includes Engineering and Public Policy, Engineering Economics and Management, and Engineering and Society (Capstone Course) (An Integrative Education in Engineering, 2019, pg. 8). This was set up in 2007, and the curriculum has stayed almost unchanged since then. With a change in how engineering, technology and the rest of society today in regards to social and environmental justice movements, a reassessment to the major is pertinent for its relevance in Acopian and for each student's educational experience during their four years. Engineering Studies being an interdisciplinary major, there are many positives to this aspect, but also many challenges.

The interdisciplinarity of the major is a sought after aspect for the Engineering Studies students. The ability to take a core of courses as well as in many other different disciplines is an

attractive trait for the program. Students often use different pathways to complete their degree. In 2012, the Engineering Studies program was under a review as the program's stakeholders looked for an update. A mission statement of what the major looked for was "To provide a rigorous liberal arts curriculum built on an engineering foundation that prepares graduates to effectively address society's increasingly complex, multi-disciplinary challenges. Graduates gain expertise in examining the place of engineering and technology in society, with interdisciplinary skills to lead public technology debates around policy, management, economic, and environmental issues" (An Integrative Education in Engineering and the Liberal Arts, 2019, p.7). With an interdisciplinarity in the description of the mission statement multiple times, a striking emphasis of the characteristic is put in place. On the contrary, the issues of interdisciplinary majors were explored through a discussion with Andrea Armstrong, a professor of Lafayette.

While Engineering Studies is the interdisciplinary major that this report is revolving around, there are others at Lafayette. In conversation with Professor Andrea Armstrong, an Environmental Studies and Environmental Science Professor at Lafayette, there were some key points highlighted on the matter. She spoke on how there are several majors that fit a similar description: Environmental Studies and Sciences, Engineering Studies, Africana Studies, Women and Gender Studies, and more. She mentioned how "WGS (Women and Gender Studies) shows chronic issues at campus about not being able to fund the school but flaunt the school." A large contributor to this is "the repetitive overuse of professors, but without the same energy" Armstrong stated (A. Armstrong, personal communication, October 25, 2020). While there are distinct positives of interdisciplinarity of these types of majors with allowing students to get a broad array of perspectives and knowledge for a variety of courses, the downsides are evident. The specific details of the implementation of an interdisciplinary cross listed course will

be described later in the technical context of our report. The lack of resources given to majors like Engineering Studies creates a disparity between them and other majors, which can leave the opportunity for an addition to the curriculum to feel daunting.

The resources allocated to Engineering Studies are noticeably less than its neighboring majors. The major currently has two dedicated professors, and one shared, to its curriculum. When compared to the other engineering majors, Civil Engineering has ten, Mechanical Engineering has fifteen, Chemical Engineering has twelve, Computer Science has ten, and Electrical Computer Engineering has seven (Lafayette College, 2020). In comparison to the other majors in Acopian, the Engineering Studies program has required less dedicated faculty since there is only a three core course for the major. The other majors have many more requirements for their major specifically: Civil Engineering requires ten core courses just for its major as compared to Engineering Studies' three (Lafayette College, 2020). Although there is much more demand in regards to course load when comparing Engineering Studies and the other Engineering majors within Acopian, a small addition to the engineering studies majors could round out the major very well. With an addition, this could be, an additional course, professor, cross listed course, or another method.

When it comes to adding an additional professor, we have come across many logistical factors that come into play. If a professor is dedicated just to the Engineering Studies department, that would be a remarkable increase in resources and a remarkable increase in payroll. With only two professors fully dedicated to the major, a third would allow for a complete restructuring and addition to the courses. Another course or cross listed courses are another prospective pathway to help curate a clear cut identity of Engineering Studies. This would not necessarily have an impact on funding for the major specifically if current engineering

professors would be able to fit these courses into their own schedule, but it does have logistical implications in the amount of credits professors need to teach each semester. This will be explored more in the next section of the report.

Additionally, another comparable program, Environmental Science and Environmental Studies, is in a similar situation when in relation to adding resources to the already existing curriculum of the programs. Between both programs, there are twelve faculty members (Lafayette College, 2020). When speaking to Dr. Andrea Armstrong, the program is lacking professors to teach all of the courses. Over the last several years, courses have been taught by different professors across different departments. They have not consistently been able to offer the same courses (A.Armstrong, personal communication, October 25, 2020). This is also explained by Professor Rossmann as a difficulty for the EGRS Department to add courses. She mentioned how there are "Courses that all Lafayette students know exist, but the classes are too full" (J.Rossmann, personal communication, October 25, 2020). This results back to the point previously of how programs like Environmental Science and Studies and Engineering Studies lack funding that they desire to fulfill the original intentions of the major. There are only so many opportunities for cross listed courses and a limitation of credits for each professor. These stipulations will be explained in the next section of the report. As for adding a course overall that relates to social justice, environmental justice, or both, there would have to be some restructuring of sorts whether it would be a cross listed course, a new professor, or some other method.

The Hanson Center for Inclusive STEM, donated by Daniel and Heidi Hanson, aims to "Coordinate support for students and faculty in STEM with excluded identities, faculty development of inclusive pedagogies and curricula, and faculty research in inclusive education and STEM studies" (Lafayette College, 2020). With our goals of bringing environmental and

racial justice into the engineering curriculum, the Hanson Center is the ideal place to present this report, and they may be able to provide the funding and push for an addition of courses within our suggestions, social and environmental justice, to the existing curriculum. The Hanson Center and its impact on the Engineering Studies major has a high bar for its potential effect. While an assessment of the resources and funding for Engineering Studies is necessary for increased success for the program, an analysis of the potential growth with the addition of courses like these is crucial.

The newly established Hanson Center for Inclusive STEM Education could help alleviate or fix the gap in resources provided by the Engineering Studies when it comes to thickening the layers of the cake for environmental justice and social/racial justice. The Hanson Center was initiated from a $5 million gift to fulfill its intentions (Lafayette Student News, 2019). With this being a capital fund to start a new wave of activism and courses within the Lafayette College community for inclusive STEM, it seems as this could jumpstart a long awaited change. With the donation from the Hanson couple being a private donation, it is distinct from other advancements on social and environmental justice in educational funding.

One organization that has pushed for change, at least monetarily, is the NSF, the National Science Foundation. Their mission statement is as follows: "To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense; and for other purposes." That quote being from 1950, they have consequently updated their vision: "NSF envisions a nation that capitalizes on new concepts in science and engineering and provides global leadership in advancing research and education" (NSF, 2014). The NSF gives out grants and funding for many different applications all in the realm of engineering and science. As mentioned in *Engineering Justice,* "There are NSF programs that fund research and

educational development such as the Revolutionizing Engineering Departments; the University

of San Diego received a $2 million grant to integrate social justice and humanitarian engineering

across the multiple programs in its school of engineering" (2018, p. 247). While the NSF has an

annual budget of $8.28 billion in 2020 (NSF, 2020), relatively miniscule amounts of investment

have been opportunities to make crucial changes in our engineering education to become more

ethically aware in regards to justice. Additionally, this being a government agency which is

federally funded, there is a major difference between a donation from the NSF and a donation

given by the Hansons. Nevertheless, they both mark advancements in the field of technology

education.

From seeing the millions of dollars invested in the University of San Diego, the $5

million dollar donation appears to be the funding that could push Lafayette ahead of the curve in

socio technological education and adding social justice and environmental justice to its

repertoire. If the funds are allocated proficiently, Lafayette can become a leader in socio

technical education.

Economic Context Outside Lafayette

Outside of Acopian and outside of Lafayette, there is a gap in success for companies that

do not have racial equality factored into their business. With more diversity and inclusion within

a company, more opportunities for success and larger profits will be available and up for grabs.

As mentioned in an article by Saijel Kishan in Bloomberg, "Closing racial gaps would have

generated an additional $16 trillion in economic output since 2000, her research showed" (2020).

The article also mentions, "Peterson showed how disparities along racial fault lines in housing,

education, policing, and voting all feed into one another to restrict the access of Black Americans

and other minorities to employment, higher incomes, and the ability to build wealth." The lack of

change in racial justice allows for companies and the economy at large to not benefit as much as they could. With more perspectives and minds being involved in the economy, more solutions, and in result, more profit and success will result in the end.

With many important industries lacking diversity, there is a failure to fulfill the potential of a business. Without taking into consideration the perspective of everyone from a diverse set of backgrounds, profits will be lost. In Figure 3 below, from Citi Group's analysis of racial inequality in economics, it shows the gap between white and Black people. The report states, "Racial and gender wage gaps remain wide in the U.S., signaling lost opportunity for income, consumption, investment, and real GDP growth" (Citi GPS, 2020, p.37). With this lost opportunity, not only are the citizens of these minority communities not reaching their potential, the entire economy is being held back. The article also mentions, "The wage gaps between minorities and white males, if closed 20 years ago might have generated $12 trillion in additional income, and indeed for Black workers an additional $2.7 trillion" (2020, p.38). Without companies and industries as a whole not including Black people into their businesses whether it is employment or based on salaries, it results in a lack of progression socially and a lack of success financially. This is something that needs to be introduced into our education as engineering and technology can be lacking in success without a diverse workforce and diversity of input into a new advancement.
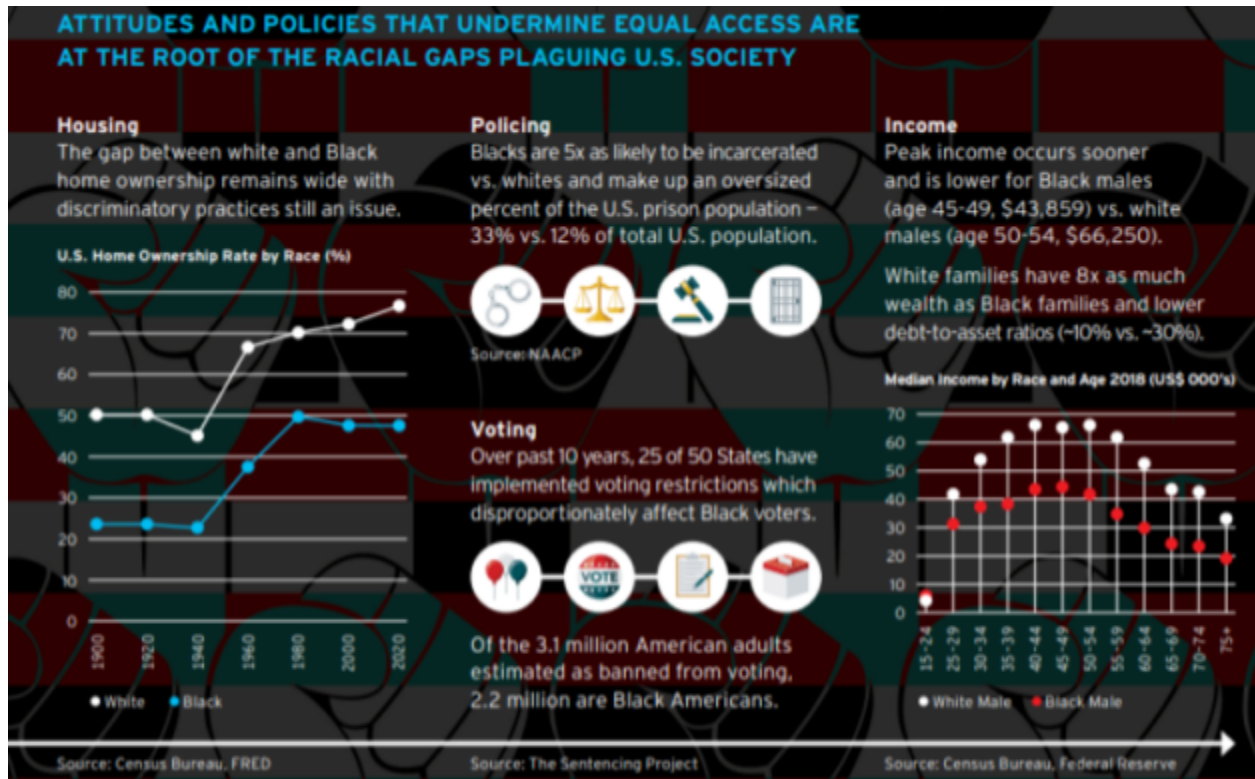
ATTITUDES AND POLICIES THAT UNDERMINE EQUAL ACCESS ARE AT THE ROOT OF THE RACIAL GAPS PLAGUING U.S. SOCIETY

Housing
The gap between white and Black home ownership remains wide with discriminatory practices still an issue.

U.S. Home Ownership Rate by Race (%)

Source: Census Bureau, FRED

Policing
Blacks are 5x as likely to be incarcerated vs. whites and make up an oversized percent of the U.S. prison population – 33% vs. 12% of total U.S. population.

Source: NAACP

Voting
Over past 10 years, 25 of 50 States have implemented voting restrictions which disproportionately affect Black voters.

Of the 3.1 million American adults estimated as banned from voting, 2.2 million are Black Americans.

Source: The Sentencing Project

Income
Peak income occurs sooner and is lower for Black males (age 45-49, $43,859) vs. white males (age 50-54, $66,250).

White families have 8x as much wealth as Black families and lower debt-to-asset ratios (~10% vs. ~30%).

Median Income by Race and Age 2018 (US$ 000's)

Source: Census Bureau, Federal Reserve

Figure 4: This graphic from *Closing The Racial Inequality* Citi GPS (Global Perspectives and Solutions) (Citi GPS, 2020, p.37).

STEM fields are cursed by a lack of diversity. As mentioned in the *Lafayette Student News* article, "despite making up about 50% of the labor market, only 28% of women are in STEM fields while men make up about 72% of the sector, according to the National Girls Collaborative Project" (2019). With this distinct difference in who is doing the engineering, and it certainly results in a lack of focus on women when in search of solutions. The same article also mentions, "although over a third of Black, Latino, and Native American students enter college with an interest in studying STEM, only 16% go on to obtain bachelor's degrees in these fields." These are all statistics that point to the need to fill a void in our system that restricts what seems to be all but the white male from being in the engineering and technology realm. Only time will tell to see if the investment in the Hanson Center will prove to be adequate in attaining a more inclusive curriculum in Lafayette College Engineering.

Curricular Implementation Context (Technical Context):

We understand that it would be difficult to radically change the structure of the Engineering Studies program overnight. In order to start the changes that we will be proposing, we would need collaboration from the Hanson Center, EGRS faculty and EGRS students. We started this process by interviewing Lafayette College faculty and realized our limitations with our timeline and resources. Our main proposal is to send this report to Lafayette College's Hanson Center for Inclusive STEM. In the Justice in Acopian proposal, we suggest what changes could be made to the EGRS program. These suggestions would face constraints due to the state of the world as currently there's a worldwide pandemic. Lafayette College's budget is lower and the opportunity to hire new professors would be unrealistic at this moment in time. However, our suggestions can be implemented with the current resources the college has; these would be the first steps in moving the Engineering Studies program to be more racially and environmentally focused. Our goal was to get some insight if our assumptions about constraints were true. Additionally, we seeked to ask all the professors we interviewed what actions would be best to implement our ideas. While planning out who we were planning to interview, we aimed to ask professors from different departments who focused on justice within their curriculums. After performing some interviews and finding sources, we understood that our constraints were a reality and justice is possible in the EGRS curriculum.

Our first component for our suggestion focuses heavily on the topic of environmental justice. Professor Cohen, the current head for the Engineering Studies department, describes environmental justice as the following: "At the start, EJ (Environmental Justice) is more an argument about the environment that requires attention to how people live in the world than an

environmental argument about nature or the natural." (2018, p. 4). Keeping the environment in good standing is important, but Professor Cohen is focusing more towards the human aspect with the environment. Unfortunately, there are poorer communities who have seen environmental disasters simply because their concerns are not listened to. For example, the Flint, Michigan water crisis made it clear that the blacker communities in Michigan were most affected. Learning these facts in the Engineering Studies program hasn't been required though. According to Professor Armstrong, an environmental studies professor, Professor Cohen has collaborated with the Environmental Studies program in a teaching capacity. Professor Cohen taught an Environmental Justice course during the 2017 Spring semester (A.Armstrong, Personal Conversation, October 25, 2020). In Armstrong's three plus years at Lafayette College, she hasn't seen many cross listed courses between both programs, but there have been clear contributions from Professor Cohen. This shows us that there may be a deeper issue at play; Engineering Studies appears to be promoting their desire for environmental justice, but hasn't been able to create more meaningful connections in the required courses. These connections are necessary for the EGRS major to live up to its own standards. Professor Cohen himself says, "Given the degree to which engineering work is implicated and embedded in ecosystem health, lacing together engineering and environmental ethics is not only helpful but necessary." (2018, p. 21). The focus on environmental justice within the curriculum should be a priority as we are in a climate change crisis currently. Injustices are plaguing less privileged communities within the pandemic and connections like that shouldn't be left for EGRS students to figure out on their own.

We wanted to create more classes within the EGRS major related to environmental and social justice by collaborating with professors within the environmental studies program and

other engineering professors. However, while talking to Professor Armstrong, she told us that their program also lacked funding. Because of the COVID-19 pandemic, the program went from being able to hire a new tenure-track professor to having to wait at least three years in order to get to that point (A.Armstrong, Personal Conversation, October 25. 2020). This revelation allowed us to reflect and reassess our plan to accommodate this new information, but to also keep the root of the goal; more collaboration between our programs to create more humanitarian engineers. Our updated suggestion is that the Engineering Studies department add more cross listed courses with Environmental Studies and are taught by two professors, one from each department or focus (whichever is more feasible). Originally, our main suggestion was to create more classes for the Engineering Studies program related to racial and environmental justice. In order to do this, we thought of collaborating with professors within the environmental studies program and other engineering professors.

However, we will have to work with more constraints within the cross listed course idea. Lafayette College currently requires that at least 30 students be enrolled in the course in order for both professors to get half a credit for the year. For some context, professors need at least 5 teaching credits every year. Professors are already teaching several courses, so adding a course with 30 individuals would be unrealistic and unfair to them. This would mean that they would have more student material to grade over what they have already. Trying to create a discussion-based, interdisciplinary course that challenges students with potential essays, projects and other assessments would be a tall task with such a large roster. This appears to be one of the main reasons this cross list model isn't being used as often as it might be if the constraints weren't as difficult to accomplish. While we interviewed Professor Kimber, a math professor and major contributor to the Hanson Center, she mentioned that it is possible to make smaller, cross

listed courses, as long as they met the requirements of the Common Course of Study. The Common Course of Study is Lafayette College's catalogue of requirements that students must complete throughout their time at the school (C.Kimber, Personal Conversation, October 25. 2020). If this suggestion was to go through, a cross listed course would need to include an attribute that students need for graduation. This cross listed course could focus on a worldview of engineering and environmental justice, allowing EGRS students to ask what can be done for the most environmentally vulnerable communities. Cohen agrees with this, stating, "Thus, a future direction for engineering and EJ is to include the necessary attention to environmental impacts while broadening the purview to include questions about equitable participation and beyond." (2018, p. 22). Engineering Studies students must understand local communities to find ways and potential implementations of technologies to mitigate the impact on these communities. However, the starting point is recognizing that environmental injustice exists and affects marginalized communities more than more privileged communities. This could be connected to the history of technology and how it has affected the environmental injustices the world is seeing today. When we look at the corporate production process, we can see a clear connection between technology and how it unfairly impacts more vulnerable communities. If the Engineering Studies directly taught this information throughout the program's four year track, then students would have stronger connections with how the environment affects people.

We spoke with Professor Rossmann, who has been involved in the Engineering Studies program for quite some time. Her input has been useful as she started all the engineering cross listed programs so she knows the effectiveness of this program and potential areas for improvement. Professor Rossman has taught for fifteen years and has been around and involved in the latest changes towards the Engineering Studies program. Professor Rossman has proposed

a Race and Technology course that would resemble a unit that EGRS majors encountered during their Senior Capstone course. This course would tackle the idea about technology and the bias that is built into them. Race and Technology will also ask who creates this technology and the negative effects technology have on vulnerable communities, specifically communities of color (J. Rossmann, Personal Conversation, October 25, 2020). This class will fall under the Engineering Studies program and we believe it could be a useful class that could be required for students in the major.

In order to implement such a course, we suggest that the Hanson Center talk to the Provost's Office and Professor Sabatino, who is the chair of the Faculty Academic Policy. During one of the interviews, we were told that these two stakeholders would help us understand more about the cross list program. Both are gatekeepers who would allow us to carry on with creating an opportunity where Engineering Studies, Environmental Studies, and potentially Africana Studies could create more cross listed courses that anyone from each major could take. However, for Engineering Studies, we suggest that these cross listed courses should be required for anyone who is in the major. This would ensure the most effectiveness within our modified Engineering Studies program. If Engineering Studies wants to create a program focused on environmental and environmental justice, then there should be required courses that integrate these perspectives directly and not passively. This approach would also respect the amount of time, money, and effort that the school and professors would be willing to put into such courses.

We believe that justice in engineering is an ethical obligation to society as the Engineering Studies program is seeking to create adults who listen and try to understand their surroundings. Cohen says this best with the following quote: "Incorporating further attention to EJ in those studies can inculcate a next generation of scholarship and encourage further

emphases in engineering ethics to make matters of environmental injustice core elements of engineering education, practice, and identity." (2018, p. 23). The same principle can be applied to social justice as all types of justices connect to one another and should be valued equally in a potential EGRS justice reform. In order to bring more attention to justice within Acopian's Engineering Studies program, these courses and experiences must penetrate throughout the curriculum; students should be able to say that they've interacted with justice at least a few times by the time they reach their capstone course.

Our second suggestion would be to integrate racial and environmental justice concepts as crucial parts of the existing Engineering Studies curricula. The second suggestion could serve as an alternative to the first suggestion if there are issues implementing cross listing courses. Additionally, we see this suggestion being implemented before any new classes as this suggestion is more feasible. This idea would be considered less invasive but would also accomplish the same goal of promoting racial and environmental justice. This idea would involve that Hanson Center asks that existing Engineering Studies courses make more efforts to incorporate ideas of justice in a meaningful manner. In order to do this, we believe that these classes should incorporate the cake philosophy discussed during the social context portion of this report. In one of Professor Donna Riley's works, *Engineering, Social Justice, and Peace: Strategies for Pedagogical, Curricular, and Institutional Reform*, she discusses the disconnect between engineering and the humanities on a departmental level. To be more specific, Riley states, "...Even where these courses connect directly to science, technology, and engineering, they are typically disassociated with "engineering" courses—institutionally (e.g., departmentally), in terms of curriculum requirements, and in students' own imaginations (where H&SS (Humanities and Social Science) electives are often understood to be a "break" from the

rigors of their core engineering courses)." (2015, p.5). Engineering Studies does seem disconnected from social and environmental issues besides its required capstone offering and open social science and science offerings. This could be an issue as some of these majors may never take any course related to environmental justice and how crucial of a role that engineers have in this area. Racial justice has also been neglected by the major up until the capstone, leaving it as a requirement in the humanities and social science departments. Not only that, but environmentally justice is heavily intertwined with racial justice. Ignoring justice brews a concoction that will create a focus around technology and not the other crucial components of humanistic engineering.

We also suggest that EGRS could be included in ES 101 by adding a module and we would be benefiting students and solidifying the engineering studies major's identity and presence in Acopian. ES 101 is a required engineering introductory course that all Lafayette College engineering majors must take. However, we've realized that this course doesn't cover every engineering major fairly. For example, ES 101 didn't promote it besides a lunch event that was optional and limited. Including a race and technology module would expose more students to the major and let them get a taste of what they could learn as an engineering studies major. Some engineering studies majors simply didn't realize the major existed until they went to an EGRS focused event. Unfortunately, some other engineering majors tend to devalue Engineering Studies importance within Lafayette College. We've heard instances where Engineering Studies is called "fake engineering", but that isn't the case. This program connects the liberal arts more with engineering and including justice could only further that trend. In Professor Riley's experience, she found that her students grew by incorporating more social justice themes in their courses, allowing there to be a broader conversation about her engineering program as a whole.

Riley states, "Taken as a whole, the reflective engagement of students in thermodynamics produced gains in critical thinking and reflective action, along with resistance from some students policing disciplinary boundaries of the course, opening space for motivating conversations about the syllabus in the context of the larger engineering program." (2015, p. 8). While Riley did face some challenges in challenging traditional perceptions about engineering and justice being different areas of focus, she was able to talk to students about the real world implications of the class. The Engineering Studies program can do the same from engineer's first semesters, challenging their mindsets and building a foundation that includes an interdisciplinary framework from the start of their Laf experiences.

The ES 101 proposal could introduce a new wave of awareness of the engineering studies program, allowing students to better understand what the major entails and would offer them. In order to accomplish this, we ask that the Hanson Center communicate with the Engineering Program head Scott Hummel. In this conversation, we would like to see two sections of the same EGRS lecture throughout the semester. The ES 101 could be named Engineering and Justice, potentially holding a description mentioning the building of humanitarian engineers. The course could have discussions about technology and how the justice framework can be applied to several engineering disciplines. This course would be incredibly important in allowing more Engineers to get the EGRS experience in a small dose. Engineering Studies does not have its own showcase during such a crucial class; this is the first experience engineers have at Laf. This would be the first step in including the EGRS program within the ES 101 modules, showing students how engineering and justice can be connected to one another and can be applied to technical knowledge. Including the Engineering Studies program in some capacity would promote the awareness and show the passion of the EGRS faculty. EGRS is a crucial part of

Acopian, often bragged about by Lafayette College, but it turns out to be one of the smallest and mislabeled majors in the college. This gesture alone could help Engineering Studies become a better known program amongst the engineering community at Lafayette.

We expect some setbacks to teaching a humanist perspective along with engineering. Professor Donna Riley, faced resistance when she tried to implement environmental justice topics in her thermodynamics class. In her experience, she had an instance where a student told her that her talking about the social implications of thermodynamics wasn't what she signed up for the course for. Riley said, "I was taken aback when students began in 2010 – in the ninth and tenth offerings of the course -- to state that climate change discussions did not belong in a course on thermodynamics." (2015, p.8). We may expect some questioning and in order to address that, it would be best to bring up the Engineering Studies program's website page. The EGRS website's focus on being able to meet society's complex challenges will require conversations about difficult topics. Resistance should be expected and also praised as this allows there to be a deeper conversation as to why these topics are being discussed. In Professor Riley's case, this allowed her to reflect and come back with a deeper conversation, better connecting environmental matters to thermodynamics. Engineering Studies professors can learn about their teaching and their students in these types of experiences, being able to adapt their lessons better to address concerns and challenges. Today's world presents challenges that will require socially and environmentally aware engineers and discussions about complex social and environmental issues will only benefit them for the future. The Bachelors of Arts in Engineering helps with that, but that shouldn't be the crutch of the program; there are fundamental changes and mindsets that can only make this major better than it is currently.

The outcomes of such a program are quite beneficial to engineering students as well. During our interview with Professor Kimber, she has indicated that she has tried to introduce more social justice topics within her Math and Social Justice course. She told us that she was able to teach students the technical aspect of the course and was able to apply this knowledge in social justice issues. This course uses the Math 104 framework to teach students who won't be taking many technical classes. If a similar framework could be applied to the Engineering Studies program's curriculum, it could be quite effective. There are clear examples of this framework thriving in Engineering programs, more specifically at the Colorado School of Mines. Lucena and Leydens brought up the effectiveness of mixing social justice within engineering in a meaningful way. They focused on a student's perspective and they said, "[Colorado School of] Mines taught me how to excel with the technical, but this course taught me about social work. With this course, I can actually be the engineer I wanted to be when I enrolled at Mines. It is ironic how a social course taught me more about what being an engineer is really about than my technical courses—especially in an engineering school—but I will embrace this irony and do my best to bring social justice and engineering together..." (2018, p. 51). Colorado School of Mines students received this experience because the faculty decided to incorporate this material into a traditionally single-laned course. EGRS professors should take a new step and challenge themselves to make stronger connections in justice. They are helping form the next generation of Engineering leaders; they can help fuel a stronger sense of justice in this generation's engineers. Engineers will play a role in this society, but instead of being problematic, Engineering Studies students could initiate conversations about justice in their workplaces, setting up the foundation for future long-term change in the Engineering culture.

Outro:

In our rapidly changing world, the Engineering Studies major will need reform sooner rather than later. We are at a crucial point in history; we are seeing the impacts technology has on society, the environment and the economy more than ever before with the COVID-19 pandemic. This pandemic has set restrictions in how we interact, but have also given us the opportunity to see injustices unfold in front of our eyes. In our courses, we have discussed the impact of the Black Lives Matter and how engineers and the history of technology has contributed to the issue. The EGRS major itself is in a crucial period of change as the pandemic has affected how the school will fund and create future courses going forward. The Engineering Studies identity has different potential paths, but more importantly, the major isn't accomplishing its own goals. The courses required for EGRS haven't changed in over thirteen years now, but that must change; complacency should be mitigated and have no place in a program dedicated to creating engineers who will serve to listen to today's problems. In order to ensure that engineering studies majors don't make the mistakes our predecessors made, they must understand the engineering history and why things are the way they are. There is a disconnect between engineering and society that remains prevalent in our society, but this can be addressed through educational reform. Engineering Studies conforms to this disconnection; the humanities, environment and engineering are not discussed together until the program's final course. This last minute addition makes it difficult to build reflective students long-term; one course can be impactful, but it should not be the only course promoting these ideals. The Capstone course represents the program as a whole, but the other classes in the program don't reflect the same way it does. Including these experiences allows students to help their

workplaces become more justice-aware places, speaking up for issues that wouldn't have been talked about.

This proposal required thinking within the box as there were several constraints we couldn't control in such a limited time. The college appears to be undergoing financial hardship and the effect can already be felt within departments. However, that isn't to say that nothing can be done to change the EGRS major; we must work with what we currently have. We have professors who are willing and have listened to including more justice in their courses. In our conversation with Professor Kimber, she told us that The Hanson Center is currently assisting professors in bringing more ways to bring in racial justice into their courses. After the coverage of the murder of George Floyd, Breonna Taylor and other innocent black folks and protest against racism, professors came to consult the center. The Hanson Center is currently at capacity in assisting professors, but the better news is that Professor Cohen is involved in this group, learning about potential ways to include justice in his own courses. This is good to hear as Professor Cohen is the head of the Engineering Studies program, so it can be expected that the major will at least start discussions on change within the program with other faculty members involved.

However, there are still constraints currently as there won't be any immediate changes happening due to the Pandemic. As stated before, we hope that the Hanson Center will start conversations with key figures who can help change the EGRS program in the long term. Understanding these constraints, any suggestion that involves the school spending money or hiring another professor for the short-term is considered not feasible. These are good long-term suggestions that were made but the purpose of the report was focused on initiatives that could happen under current circumstances. The suggestions are realistic and could be implemented

with the right support and effort put into the conversations and eventual creation of a mock curriculum that can be eventually executed. We have confidence in the Hanson Center to ensure these ideas can become a reality in one way or another, benefiting the Engineering Studies major and the other majors that would be willing to collaborate with the major. In the conversations we had with professors from other majors, we've seen that other studies-based majors are also struggling with similar issues as the EGRS program. There appears to be a desire throughout the campus to involve more conversations about race at Laf, but we are still in the early stages and cannot determine what will happen next. While we talked to a few professors at Laf, we don't know what other perspectives we may have missed. The purpose of the report is to show our findings about Lafayette's EGRS program to gather the perspectives that can improve and change the major.

Going forward, we would ask the Hanson Center and future Engineering Studies majors to take on the cause, slowly moving these ideas forward and creating real long-term change. This will be difficult to measure, but we believe that conversations and action regarding the involvement of the environment and race in the EGRS program will be a step in the right direction. Lucena and Leyden noted the following about environmental justice: "As the environmental justice movement raised concerns about the inequitable distribution of environmental harms by race and by class, I saw no recognition, let alone a thoughtful response, from the engineering community. This book gives me hope that today's engineering students will have a different experience, where relevant justice concerns are taken up as part and parcel of what engineers do." (2018, p. xviii). Our group used this book as a significant reference towards creating our suggestions for the program. We are suggesting a program that will allow EGRS students to have the justice perspective in their toolset. Justice in our curriculum will not be a fad

and it will most likely be relevant for decades to come. The suggestions that were proposed were based on the current constraints that the Engineering Studies class of 2021 had during the Capstone course. Due to the virtual nature of the semester, it was difficult to condense the suggestions from big ideas to smaller, more realistic changes. Ideally, future classes will have less constraints and be able to push this project forward, keeping the essence of the changes towards the program but refining it to how they see fit. Changing the Engineering Studies program will be a difficult task to accomplish, but won't be impossible.

In future adaptations of Justice in Acopian, there could be more collaboration with other projects in the Engineering Studies Capstone course. There were other projects that aligned with this one, all promoting justice and inclusion towards the curriculum in their own ways. For example, there is the Disability Studies capstone group who were proposing similar changes in the curriculum. The Disability Studies group proposed teaching about disabilities and discussed how they can include accommodations for this group using engineering design. Future Justice in Acopian iterations could partner or combine with Disability Studies to introduce an even bigger initiative. This could serve to be the future framework that Engineering Studies work with, seeking to understand these communities better and using their technical knowledge to aid them towards equality. Engineering Studies students would be socially and environmentally aware of potential issues in their sector by applying this mindset. Every proposal, whether it be from our group or from the Disabilities Studies group, are aiming to create more inclusivity in our program. We hope the major will eventually be allies to justice issues and be a significant bridge between the technical, environmental and social.

These changes to the Engineering Studies program will require several iterations to create a framework that students and faculty can thrive in and promote justice throughout the

curriculum. As established before, there currently are conversations between the Hanson Center and Professor Cohen on including more justice in existing classes. We hope that future groups will eventually help create curriculums for existing EGRS classes and potentially future ones as well. This is a plan that is easier said than done; the plan requires the environmental studies department, social science departments and most importantly the engineering studies department itself to contribute the significant changes that we are proposing. More developments in the field of justice may occur and we hope that our current faculty and students can incorporate more of them in future iterations of this project. When the curriculum change comes to fruition, this may be one of the biggest seen in the engineering studies program's modern history. We expect several conversations between professors and students, figuring out what the students want and what hasn't been considered in this large and broad conversation about reform. The EGRS program has been important in the history of Humanitarian Engineering and once again, the program must address the current issues our society faces with technology and the impending threat of climate change. Engineers have a role in these conversations; technology must not be in the middle, but the passion for more justice and equity in our society.

Bibliography

$5 million gift leads to creation of Hanson Center for Inclusive STEM Education – The

Lafayette. (n.d.). Retrieved November 10, 2020, from

https://www.lafayettestudentnews.com/blog/2019/11/01/draft-hanson-center/

02_mission_vision.pdf. (n.d.). Retrieved November 10, 2020, from

https://www.nsf.gov/pubs/2014/nsf14002/pdf/02_mission_vision.pdf

Benjamin, R. (2019). Race after technology: Abolitionist tools for the New Jim Code.

Cambridge: UK.

"Black Future Month | March 20, 2019 Act 3 | Full Frontal on TBS." Full Frontal with Samantha

Bee, 21 Mar. 2019, youtu.be/vJrHFBCa4MQ.

Boyle, K. [ICG-R. (2020). CLOSING THE RACIAL INEQUALITY GAPS: The Economic Cost

of Black Inequality in the U.S. 104.

Cohen, B. R. (2018). Engineering and Environmental Justice. Handbook of Philosophy of

Engineering.

Colarossi, N. (2020, August 13). 10 egregious examples of environmental racism in the US.

Retrieved November 10, 2020, from

https://www.insider.com/environmental-racism-examples-united-states-2020-8

Engineering Justice: Transforming Engineering Education and Practice (1st ed.). (2017). John

Wiley & Sons, Ltd. https://doi.org/10.1002/9781118757369

Kraaijenbrink, J. (n.d.). What The 3Ps Of The Triple Bottom Line Really Mean. Forbes.

Retrieved November 10, 2020, from

https://www.forbes.com/sites/jeroenkraaijenbrink/2019/12/10/what-the-3ps-of-the-triple-

bottom-line-really-mean/

Leydens, J. A., & Lucena, J. C. (2018). Engineering Justice: Transforming Engineering

    Education and Practice. Hoboken, New Jersey: Wiley.

Lucena, J., Schneider, J., & Leydens, J. A. (2010). Engineering and Sustainable Community

    Development. Synthesis Lectures on Engineers, Technology and Society, 5(1), 1–230.

    https://doi.org/10.2200/S00247ED1V01Y201001ETS011

MIT's Anti-War Protests 1967-1972. (n.d.). Science and Revolution. Retrieved December 3,

    2020, from

    http://scienceandrevolution.org/blog/2016/7/8/v7rxigo0aw4it8niy6k4szbm4yiq2i

Nieusma, D. (n.d.). Engineering, Social Justice, and Peace: Strategies for Pedagogical,

    Curricular, and Institutional Reform. 2011 ASEE Annual Conference & Exposition

    Proceedings. doi:10.18260/1-2–17890

Riley, D. (n.d.). Pushing the Boundaries of Mass and Energy: Sustainability and Social Justice

    Integration in Core Engineering Science Courses. 2015 ASEE Annual Conference and

    Exposition Proceedings. doi:10.18260/p.24623

Says, T. C.-G. (2019, July 15). Lafayette Adds Bachelor of Science in Engineering. News.

    https://news.lafayette.edu/2019/07/15/lafayette-adds-bachelor-of-science-in-engineering/

Spitzer, S. (n.d.). A Wrong Assumption, A Wrong Decision. The Lafayette, 5–6.

The Engineer of 2020.through Chapters 1 and 2.pdf. (n.d.). Retrieved September 22, 2020, from

    https://moodle.lafayette.edu/pluginfile.php/588004/course/section/252635/The%20Engin

    eer%20of%202020.through%20Chapters%201%20and%202.pdf

Wisnioski, M. (2016). Engineers for change: Competing visions of technology in 1960s

    America.

    Cambridge, MA: MIT Press.

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2019 | NSF –

National Science Foundation. (n.d.). Retrieved December 3, 2020, from

https://ncses.nsf.gov/pubs/nsf19304/digest/introduction