Thesis Project Portfolio

Design and Construction of Modern University of Virginia Themed Pinball Machine

(Technical Report)

Engineering Education and its Connection to the Defense Industry

(STS Research Paper)

An Undergraduate Thesis

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Matthew David Leclair

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Department of Mechanical Engineering

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Executive Summary

Many engineering programs across the country prepare their students for the technical work in any future career but these programs might not provide their students with the ethical and moral education to evaluate the morality of future work. My technical research this semester involved developing a UVA themed pinball machine with modern mechatronics systems that include a sensor, microcontroller, and actuator. We decided to build a pinball machine because the system is small enough for us to iterate and a UVA themed pinball machine would bring joy to the university community. My STS research was about the intertwinement between engineering education and the defense industry. The defense industry has affected my own engineering education through my grade school activities and a college scholarship. My STS and technical topics are loosely connected through mechatronics. The pinball machine and modern defense technology all include mechatronics systems. However, I think the differences between these two topics illustrate how engineering education focuses on technical work instead of ethical education to evaluate our future work.

The building of a UVA pinball machine was first attempted by students in 2009 and 2016 but they did not complete the machine. Our goal was to complete the pinball machine and put it into 1515 or another student center for everyone to play. Our group kept the general layout and gameplay design developed by previous groups. However, we needed to change the design of every major mechanical component as many were too heavy or did not work.

Our group was able to make some important progress on the UVA themed pinball machine. By the end of the single semester accelerated capstone, our group created the final version of important mechanisms that future groups will not have to redesign. One of those mechanisms was the drop targets that I spent months working on. The drop targets are the squares that you aim for when playing pinball and they disappear into the machine when you hit

them. When designing the drop targets, my teammate and I immediately started creating prototype designs that were tested extensively. After about five different iterations and hours of testing, we arrived at a final product that was successful, light, and future groups would not need to redesign.

My STS research looked at the intertwinement between the defense industry and engineering education. To study this connection I asked the question, why is working in the defense industry one of the most prominent career paths for Mechanical Engineering students? I then asked a follow-up question, is the intertwined education affecting the engagement of engineers? I believe this intertwinement between the defense industry and engineering education is important to everyone in society because I believe it can reveal some of our priorities for engineers. The industries that receive the most engineers are the fields where the most scientific design and progress will take place. To study this intertwinement, I looked at government policy, engineering curriculum, and academic writing about the current state of engineering education.

My STS research has shown that the federal government has made a strong effort through public policy to develop engineering education as a means of national defense. University officials, students and defense corporations have also contributed to the intertwinement of engineering education and the defense industry. The data gathered by academia has shown a decrease in public welfare concern by students after different engineering programs across the country. Current engineering education, which is heavily influenced by the defense industry, does not focus on the humanities which are necessary to develop critical thinking skills and promote public welfare concern. I believe a change in national engineering curriculum requirements and engineering education priorities might be necessary if we want to see more engaged engineers.