Design and Construction of Modern
University of Virginia Themed Pinball Machine
(Technical project)

SCOT Analysis of Corporate Social Responsibility
of Gaming Corporations
(STS project)

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Mechanical Engineering

by Patrick Nguyen

October 24, 2023

Technical Team Members: Mina Ansari, Olivia Bearman, Phillip Bongiorno, Adam Centanni, Ian Chang, Thomas Cook, Benen Crombie, Scott Durkin, Ethan Green, Thomas Habron, Matthew Leclair, Issac Leshok, Jacob Leynes, Gabriel Lu, William McClung, Colin Sartori, Keith Tam

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

ADVISORS

MC Forelle, Department of Engineering and Society

Gavin Garner, Department of Mechanical Engineering

Introduction

Gaming is a popular hobby and pastime for children and young adults. It provides gamers with a fun distraction from the real world and even an opportunity to connect and make relations with other gamers. In 2002, the Pew Research Center conducted a survey to determine the percentage of college students who play online, computer, or video games. The study was conducted on students from 1162 students from 27 different U.S. college-level institutions. One of the findings from the survey was that about 70% of students stated they played computer, online, or video games at least occasionally (Jones, 2003). Since then, video games have only become more popular, with innovations in gameplay and technology. The prominence of gaming in college life, an already stress-filled environment, calls for a closer look into the effects of gaming on mental health.

In an effort to uncover the underlying effects of gaming, we must look further than just video games' surface level value of gameplay. Engineers often base the design of their technologies on efficiency and direct achievement of goals. This causes involved parties implementing these technologies to overlook how they may socially and politically affect consumers (Winner, 1980). In relation to video games, this calls for a closer look at their underlying social consequences. In a survey conducted by Qutee, a data-led organization that focuses on eliminating unfair stereotypes about video games, 835 gamers were asked questions about the personal and social impacts of gaming. Over 40% of the respondents believed the main benefit of gaming was mental health, referencing how gaming provided a way to relieve stress and have fun. Another benefit the majority of respondents talked about was friendships formed through gaming. 89% of the gamers believed that gaming overall is beneficial to society (Anderton, 2018). These benefits of gaming were provided through a first-person gamer set of

lenses, which may carry some bias. On the contrary, through more scientific and unbiased research, the adverse effects of gaming can be seen. In 2011, a study was conducted at the University of the Cumberlands to explore the relationship between playing video games and academic performance, primarily focusing on GPA. The study involved 198 participants who completed a Gaming Habits Survey consisting of 11 items, gathering demographic information, GPA, player status, gaming habits, and preferences. The primary finding of the analysis was that participants who played video games had lower GPAs compared to non-players, indicating a negative correlation between video game play and academic performance as measured by GPA (Wright, 2011).

I believe that gaming presents an effect on the mental health of gamers. The producers of games, therefore, directly impact the mental health of those who play their games. Corporate social responsibility is the concept in which companies have an ethical responsibility to be accountable to themselves, stakeholders, and patrons (Fernando, 2023). They are responsible for enhancing society and the environment rather than degrading them. This inspires my STS question: "What is the extent of social corporate responsibility that gaming companies should exhibit towards college gamers, considering their impact on mental health, academic performance, and overall well-being?"

To contribute to the fun and stressless student life at UVA, my technical project will focus on a pinball machine. My group is picking up an old, unfinished project from 2016 in which another capstone class attempted to build a pinball machine from scratch. There were many flaws with their procedure and design, and we will aim to learn from their mistakes. Upon completion of the pinball machine, it will be donated to 1515, a study lounge designed for the students of UVA to have a comfortable space to study, socialize, and relax (Alderman, 2017).

1515 currently includes comfortable study and social spaces, a stage for performances, student artwork, a dessert cafe, and a basement that has a gaming room. With this ambitious project, we hope to provide students with a fun, attractive pinball game while contributing to the stress-free environment created by 1515.

Technical Topic

We must clear several issues and obstacles if we wish to design and build the pinball game we envision. One issue to address is the game's attractiveness to gamers. The key component of a pinball machine that attracts gamers is the theme of the machine in reference to movies, video games, and TV shows. Pinball machines are as much about the work they reference as it is about the gameplay itself (Banfi, 2022). The main attraction of our pinball machine will be its references to UVA. These could include many inside jokes, such as going to bars on the Corner, staying up for late-night study sessions, and finals season. The challenge of creating the gameplay around UVA references is choosing references that will transcend generations. If we choose UVA references that only our generation would understand, such as Running with Jim, Kihei Clark's infamous turnover against Furman during March Madness, and dormitory lockdowns during the COVID-19 epidemic, the game would become less attractive to future generations of students. We must be sure to select references that all future UVA students will understand in order to preserve the nostalgia and attractiveness of the game.

One problem we aim to solve is the compilation of mechanisms from the 2016 pinball group. In theory, many of the mechanisms from the 2016 design were amazing and unique. However, some of these were too impractical for the machine. For example, a main feature of the game is its drop targets in the center of the board. The 2016 group was too ambitious, attempting to create the mechanism from scratch with metalwork, digital screens, motors for each target,

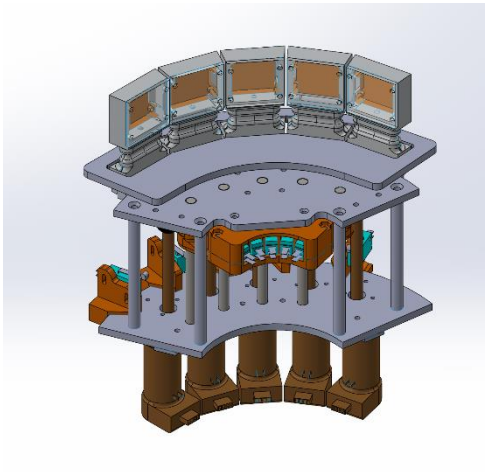

Figure 1: Drop target assembly from 2016 pinball project

motor shafts, bearing rods, and an aluminum base, as seen in Figure 1. While in theory this mechanism worked great, it was much too bulky and complicated for the pinball playfield. Another example of an overcomplicated mechanism from 2016 is the rotating UVA Rotunda ball trap in the middle of the playfield. In creating a UVA-themed pinball machine, it is absolutely essential to include the Rotunda as the centerpiece of the playfield. As seen in Figure 2, the design for the rotating Rotunda consisted of an assembly of bearings and gear, a large slip ring

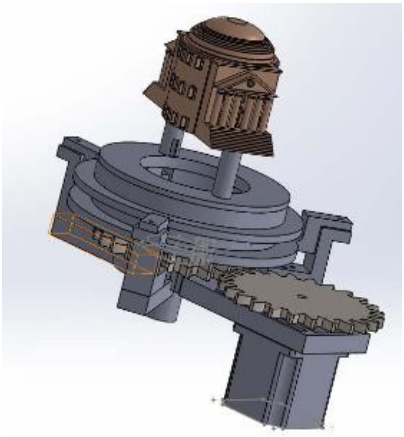

Figure 2: Rotating Rotunda assembly from 2016 pinball project

support, a motor mount, a track to support the assembly, and large base pieces to hold everything

within a single structure. The result was a massively overcomplicated assembly that took up too much space underneath the playfield and weighed too much. These overcomplicated mechanisms worked great in theory but need to be redesigned to be more efficient and made more easily.

In order to ensure that all the mechanisms and pieces of the game come together well, we will need to test each component separately. The 2016 pinball group constructed a physical playfield from wood and a few working mechanisms. We will deconstruct the playfield in order to have a clean test field where we can test out new mechanisms as they are finished. Once tested on the test field, new mechanisms can be added to the new pinball playfield, which we will design and cut ourselves. This method of implementation will ensure that only working mechanisms will make it on the final pinball machine.

The main challenge we will face is time. Given we will only have a semester to complete this project. The pinball machine requires many different parts to come together in very little time. It is extremely ambitious to aim to complete the game by the end of the semester, however, it is not impossible. We will attack this challenge by distributing all work among all team members. We will not split into sub teams or assign designs to individual team members. Instead, everyone will get a chance to work on everything, equally dividing all that needs to be done.

This UVA-themed pinball machine can positively impact student life at the University of Virginia. Its addition to the game room at 1515 will enhance the atmosphere in the building and provide students with a fun and nostalgic game to play in their free time. This technical project along with my STS investigation regarding the research of whether gaming companies have a corporate social responsibility to college gamers both aim for the betterment of college students through gaming.

STS Topic

As a popular pastime, gaming has a large influence on many people, including college student gamers. The content and quality of the games they play can heavily influence their mental health and performance. Corporate gaming companies, who oversee the content they produce and publish to these college gamers, are therefore directly linked to the mental health of these gamers. This calls into question the extent of which these gaming companies have a corporate social responsibility to their consumers, specifically college student gamers.

There are many studies that investigate not only the mental health but also the physical health consequences of gaming. In one literature study, there are multiple cases of gaming negatively impacting a person's health. In one case, a boy in 1993 choked to death on his own vomit due to a seizure caused by the video game he was playing (Ayenigbara, 2018). There are also multiple cases of musculoskeletal problems caused by gaming. One case reported in the *New England Journal of Medicine* described a condition, not uncommon, where people would suffer a fracture of their fifth metatarsal due to playing Wii video games (Ayenigbara, 2018). In a 2011 study investigating the relation between gaming and eating, a correlation was found linking playing video games and increased food intake (Ayenigbara, 2018). Though separate from mental health, gamers' physical health also calls into question the accountability of gaming companies for the games they publish.

During the COVID-19 pandemic, gaming became much more popular as kids and adults were forced into isolation. One video game that was already a household title and flourished during the pandemic was *Call of Duty*. Activision Blizzard, the producer, and publisher of *Call of Duty* created a new mode called Warzone, a battle royale-type mode. Within the game, Activision Blizzard pushed their product of loot boxes. The loot box system is not uncommon, as

it is used in many games in the modern era. Loot boxes reward players with exclusive in-game content that gives them a tactical advantage, depending on their luck. Loot boxes are usually purchased through in-game currency, which can be bought with real-world currency. The loot box system is comparable to traditional gambling, as gamers are spending real money on a change to receive certain in-game items. A study published in 2022 investigated the "loot box expenditure alongside peer engagement, perceptions of gaming value, self-worth, and problematic gambling" of 130 *Call of Duty* gamers (Hunt, 2023). The results of the study identified many more scores for high and medium-risk gamblers than non-problem gamers. Overall, the findings supported associations between loot box systems and problematic gambling. I recognize that this study is not decisive, but its suggestive findings about associating gaming and gambling are a cause for concern. I believe it is a prime example of negative mental health ramifications due to gaming.

In addition to gambling, competitive gaming can also lead to increased levels of aggression. In a study published in 2013, about 1500 high school students were surveyed annually from ninth grade through twelfth grade about their video game play, gambling, and aggression (Adachi and Willoughby, 2013). The study found that increased involvement in competitive video game play along with increased gambling predicted high levels of aggression. Vice versa, higher levels of aggression predicted increased competitive gaming and gambling. Given that gaming already promotes gambling-like reward systems, it is imperative to look more closely at mental health in correlation to gaming, as video games seem to have a large influence on human behavior.

The negative effects of gaming have been seen in both physical and mental health. Peter Grinspoon, MD, a primary care physician and educator, calls for gaming in moderation

(Grinspoon, 2020) amid gaming's association with addiction, sleep deprivation, insomnia, anxiety, and other mental disorders . Self-moderation is a self-regulated solution to the mental issues gaming causes. However, this puts responsibility on the gamers alone, instead of also looking towards the game producers. The accountability these corporations have is found in the theory of corporate social responsibility.

In order to further investigate the role of corporate social responsibility in the gaming industry, I will utilize the social construction of technology (SCOT) framework. The SCOT framework aims to study the specific parties and groups involved in a certain technology. Technologies depend on their actors, societal norms at the time, and how they are used. By closely looking at the social groups concerned with technology, we may better understand its true influence (Pinch & Bijker, 1984). I wish to use the SCOT framework and study the major social groups involved with video games, which include gaming corporations and gamers themselves. Hopefully, through this framework I shall gain a better understanding of the relationship between gaming companies and gamers, informing me of gaming companies' social corporate responsibility towards gamers.

Conclusion

The expected outcome of the technical project is a functional and enjoyable pinball machine themed around the University of Virginia. Upon its donation to 1515, any UVA student, faculty, or alumni will enjoy the nostalgic and fun game that the pinball machine provides. The anticipated result of my STS research will be a better understanding of the corporate social responsibility that gaming companies hold towards college-aged gamers. With a better understanding of their corporate social responsibility, gaming companies will take better accountability for the content and games they produce and release. Together, the outcomes of

both the technical project and the STS research will move toward the betterment of college students' mental health in relation to gaming.

References

Adachi, P. J. C., & Willoughby, T. (2013). Demolishing the Competition: The Longitudinal Link Between Competitive Video Games, Competitive Gambling, and Aggression. *Journal of Youth and Adolescence*, *42*(7), 1090–1104. https://doi.org/10.1007/s10964-013-9952-2

Anderton, K. (2018). *The Impact Of Gaming: A Benefit To Society [Infographic]*. Forbes. Retrieved October 5, 2023, from https://www.forbes.com/sites/kevinanderton/2018/06/25/the-impact-of-gaming-a-benefit-to-society-infographic/

Ayenigbara, Israel Oluwasegun. (2018). Gaming Disorder and Effects of Gaming on Health: an Overview. *Journal of Addiction Medicine and Therapeutic Science*. http://dx.doi.org/10.17352/jamts

Banfi, R. (2022). Toward a Study of Pinball. *Games and Culture*, 17(7–8), 931–953. https://doi-org.proxy1.library.virginia.edu/10.1177/15554120211058315

Corporate Social Responsibility (CSR) Explained With Examples. (n.d.). Investopedia. Retrieved October 19, 2023, from https://www.investopedia.com/terms/c/corp-social-responsibility.asp

Grinspoon, Peter. *The health effects of too much gaming*. (2020, December 22). Harvard Health. https://www.health.harvard.edu/blog/the-health-effects-of-too-much-gaming-2020122221645

Hunt, D. (2023). Microtransaction spending and problematic gambling of UK university call of duty gamers. *International Gambling Studies*, *23*(1), 15–34. https://doi.org/10.1080/14459795.2022.2046843

Jones, S. (2003, July 6). Gaming Comes of Age. *Pew Research Center: Internet, Science &*

Tech. https://www.pewresearch.org/internet/2003/07/06/gaming-comes-of-age/

Pinch, T. J., & Bijker, W. E. (1984, August). The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. *Social Studies of Science*, 14(3), 399–441. http://www.jstor.org/stable/285355

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus*, *109*(1), 121–136.

Wright, J. (2011). The effects of video game play on academic performance. *Modern Psychological Studies*, *17*(1). https://scholar.utc.edu/mps/vol17/iss1/6

1515 and counting: New student center builds on a patchwork past. (n.d.). C-VILLE Weekly. Retrieved October 3, 2023, from https://www.c-ville.com/1515-counting-new-student-center-builds-patchwork-past

Word count: 2304