Human Powered Vehicle
(Technical Paper)

Robots & Society: Robots influence on manufacturing
(STS Paper)

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

Introduction

Mass manufacturing in the automotive industry is evolving with the introduction of robots that can perform more complex tasks, creating new manufacturing methods that improve the quality of goods. In industrialized countries about half of the jobs are at risk of computerization (Frase 2016). The Institute of Electrical and Electronics Engineers defines a robot as "an autonomous machine capable of sensing its environment, carrying out computations to make decisions, and performing actions in the real world." (Guizzo 2019). Therefore, robots are the physical actuators of the computerization of manufacturing processes. Therefore, there needs to be a discussion on how to ethically introduce robots into manufacturing. To expand on this idea to include having a healthy economy with natural unemployment rate proposed by Milton Freidman a Nobel prize winning economist (Hetzel 2007).

The technical topic in this prospectus will cover the design and manufacturing of a human powered vehicle. Human powered vehicles were created in the late nineteenth century with the introduction of the bicycle. Bicycles went through many design and manufacturing changes over the next century. Even the bicycle industry has seen an influx of robots used in the manufacturing process. The human powered vehicle has inherent safety concerns with increased traffic. The rules set forth by American Society of Mechanical Engineers (ASME) seek to reduce those risks by setting a series of safety regulations implemented in the Human Powered Vehicle Challenge (HPVC) (ASME 2019). The goal is for the vehicle is to use a collection of skills in the design and manufacturing processes on a unique vehicle. The manufacturing process is based on the craftmanship ideals that were present before the industrial era. The science technology and society (STS) proposed research will cover the how the implementation of robots into mass manufacturing can affect society.

Technical Topic

The general design of the vehicle will follow a tadpole style recumbent bicycle with two wheels in the front (Horwitz 2010). In addition, the vehicle will have front steering and rear wheel drive. The human powered vehicle design has to meet the design specifications of both the team and ASME. The ASME specifications suggest loading scenarios on a roll-over protection system (RPS) as seen in Figure 1, which our team expects to exceed by a safety factor of 1.75. Specifications set by the team are a turning radius of 12 feet, ability to drive at 15.5 miles per hour, ability to fit riders of heights from 5 foot 4 inches to 6 foot 3 inches, and reach a maximum speed of 25.5 miles per hour. These last specifications are stricter specification of the regulations set forth by ASME. The goals of the human powered vehicle are a weight limit of 60 pounds, ability to accommodate a 15 inches by 13 inches with a capacity of 12 pounds. In addition, the total weight goal of sixty pounds or less with a weight distribution of seventy percent to thirty percent front to rear used in Fenner's *On the Golden Rule of Trike Design* (Fenner 2010). Finally, the team posted a survey to get a sense of customer needs to create an efficient and ergonomic design. This data collection will affect the final design.

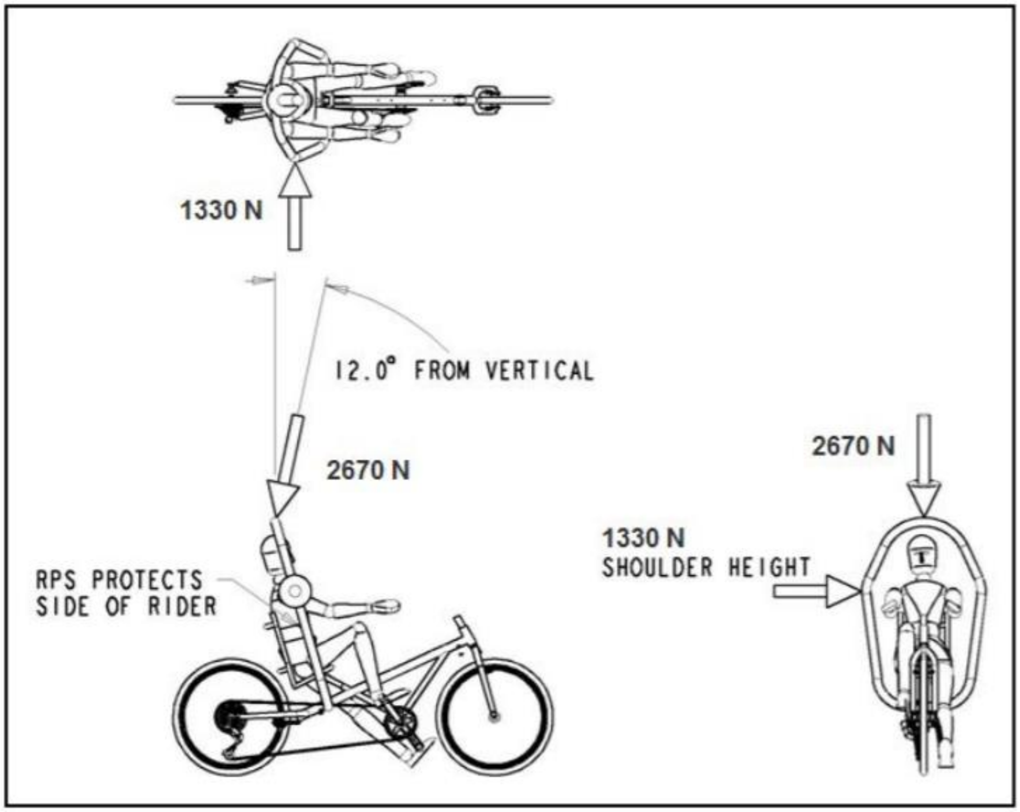

Figure 1: ASME loading scenarios. Rules for the 2020 Human Powered Vehicle Challenge. (2019, February). Retrieved from https://community.asme.org/hpvc/w/wiki/13013.competition-rules.aspx.

The total team will divide into separate sub-teams that will have their own responsibilities. The sub-teams consist of a drivetrain, frame, fairing, innovation, and steering. Frame is responsible for the material decisions, frame geometry, finite element analysis (FEA), and construction techniques, welding, and heat treatment of parts. Drivetrain deliverables are chain path management, chain gobbler, general drivetrain components, and biomechanics. Fairing responsibilities include the fairing design, fairing material choices, computational fluid dynamics (CFD), and molding techniques. Innovation is accountable for implementing safety precautions and environmental impact. The last sub-team steering will manage the steering design, methodology, implementation, and braking. The whole team will also use the consumer data collected through a survey to influence our design decisions. Finally, each sub-team will work synergistically to integrate each of these system into the final product.

In order to get an idea of this project this is an initial rendering of the frame, and fairing (Figure 2 & Figure 3). Note that these are the concepts that the final design will be based on, and improved based on several iterations. The fall project schedule is broken down in Figure 4, which shows each sub-team’s deliverables until the spring. Then a new production schedule will be created for manufacturing and testing. The competition is scheduled at Michigan State University on the weekend of April 4, 2019.

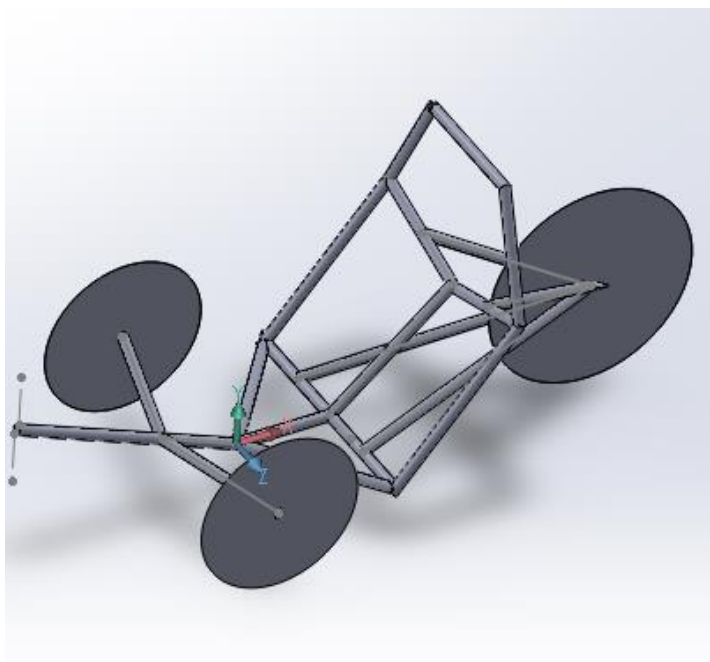

Figure 2: Initial Rendering of Human Powered Vehicle

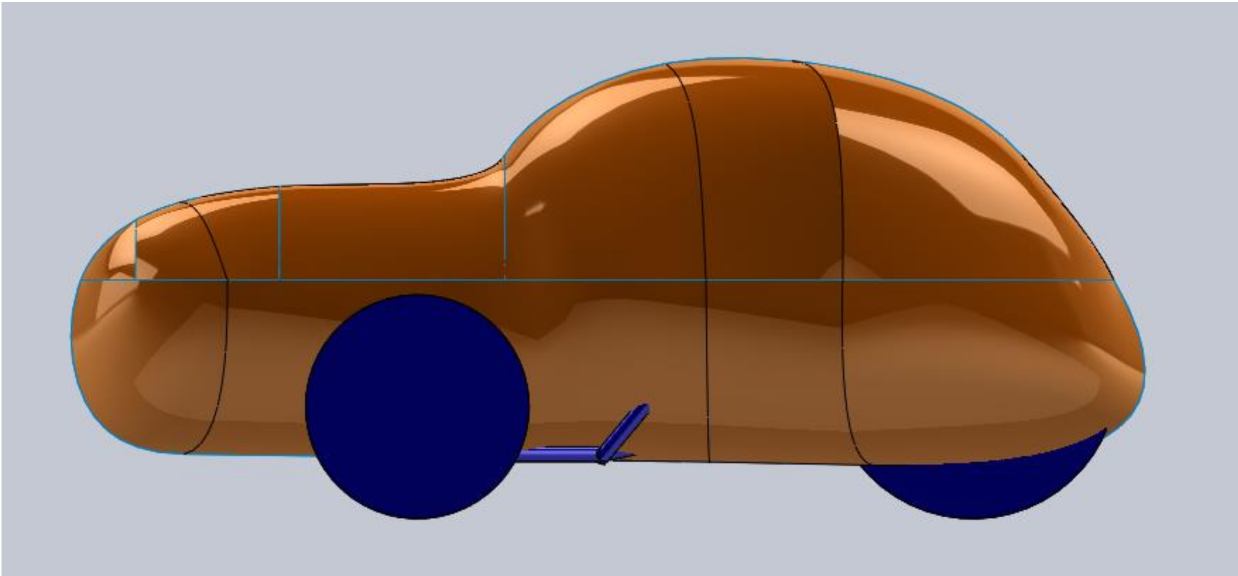

Figure 3: Initial Concept of the Fairing

	Week						
Items	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Biomechanics Research							
Full CAD Design and Manufacturing Plan							
FEA+CFD Testing							
Generate Purchase List and BoM							

Figure 4: Timeline of Work and sub-team breakdown

STS Topic

Robots and Society: How can robots be ethically integrated into manufacturing in order to benefit society? With the introduction of artificial intelligence into robots, their abilities to complete more complex tasks have improved. The notion that only unskilled workers will be replaced by robots is not a safe assumption. Carl Frey and Michael Osborne of Oxford University analyzed job descriptions in 2013 and predicted that 47 percent of employment in the United States was at risk of computerization (Frase, 2016).

Jobs have been displaced through the invention and implementation of new technology across history such as those in the automotive factories. Mass auto industry manufacturing started in in the early 1900's with the introduction of the assembly line. The concept of the assembly line was created by Henry Ford using the ideas of constant workflow and interchangeable parts (Hounshell, 1985). Constant work flow and interchangeable parts are the processes have laid the foundation for the current mass production methods with a paradigm shift from craftmanship to specific repetitive task completion.

The stakeholders for robot's introduction into manufacturing are the factory workers, roboticists, manufactures, and society. The factory worker stakeholders' jobs are at risk of replacement by robots. The roboticists are another stakeholder as their interests are to design and distribute robots that accomplish difficult and mundane tasks. Furthermore, the factories that implement these robots in a manufacturing setting are stakeholders. Finally, society as the beneficiary of better products and the support system that creates value for the factories. It is important to note that robots have a disproportionate effect on impoverished peoples whose jobs are affected more by the introduction of robots (Berg). To better understand the importance of robots in manufacturing the connection between factories and society is important, because a healthy economy benefits the company. This benefit also increases the need for factory workers and roboticists. Therefore, the need to create a symbiotic environment where robots improve the manufacturing process in a way that supports all stakeholders.

The framework that will be used to study the impact of robots on society is Kuhn's ideas of paradigms (Kuhn 1962). The paradigms are defined as model problems and solutions that are modified usually for situations that are not fully understood by society. Paradigms offer a unique method to discuss an ongoing industry that is rapidly changing. Kuhn's theory shows how the rules that have defined society and labor markets for centuries are in flux, and how the process of using rules changes during the period of fluctuation. Therefore, it has made society uncomfortable by changing the rules, and now people have to reassess the rules of economics. Where paradigm theory lacks is in the relativism of the new paradigms compared to the old paradigms (Mitra, 1994).

Methods

The research topic will be how to ethically introduce robots into manufacturing. As a historical case Ford Motor Company is a long-standing American manufacturer that has brought vehicles to the world for over a hundred years. In order to get a perspective of how mass introduction of robots has affected an industry I will use Ford Motor Company as a historical case. To gather historical evidence about the implementation of robots in a set of newspaper articles form the late twentieth century. The Ludington Daily News 1986 had an excerpt from a Ford executive about the introduction of robots to the factory, and how people will have to adapt to the changes (Reed 1986). To get a perception the Observer-Reporter 1991 of how the different countries have been more accepting of robots in manufacturing such as Japan and Germany (Bergstrom 1991). Finally, the last newspaper article from Telegraph-Herald 1983 to discuss the levels of autonomy, and how an increase in autonomy could affect the labor market (Taylor 1990).

Then I will use these factors to create a historical case study of how robots effected a large market, and the society that was crafted around this market. Subsequently I will use discourse analysis to review scholarly articles that give alternative views on robot's effect on society and economics. An example of an alternative opinion that robots positively impact labor markets and the communities that surround them (Djankov & Saliola 2018). Contrastingly a

Canadian study shows that robots will have a negative forty-two percent impact on job market, and that the economy is no longer labor dependent (Stevens 2016). In addition, the Yale Law Journal states that by 2025 artificial intelligence will replace more jobs than it creates by 2025 (Estlund 2018).

Finally, using documentary research I will use the scholarly articles to make suggestions based on proposed solutions to the introduction of robots. Documentary research will show how to understand and regulate disruptive technology, as robots are a disruptive technology in manufacturing (Kaal et al 2017). In addition, how roboticists have set their own set of ethics (Boden et al. 2017). The changing ideas of how people should change their focus on jobs from production to a creative market explored in the United Kingdom in 2015 (Bakhshi & Windsor 2015).

Conclusion

The deliverables of the technical capstone are the design and construction of a human powered vehicle. In addition, the vehicle will represent a culmination of design and manufacturing skills. Integrate multiple sub-systems into a physical artifact in a synergistic fashion using cross-team work structure. The design will create a vehicle based on consumer data analysis. This human powered vehicle will compete in a HPVC by ASME. The goal is to meet all the rules and regulations put forth by this organization. In addition, it will meet the design specifications and goals set forth by the team.

The STS topic will seek to discover the relationship of robots and society, and how to introduce robots into manufacturing at a large scale. First, the goal is to understand the historical case of robots' introduction into mass manufacturing with Ford Motor Company. Then to define the similarities and differences of the historical and modern cases using discourse analysis.

Furthermore, to understand how robots affects the stakeholder's ecosystem. Then documentary research set forth by scholars in the field to suggest a way to integrate robots responsibly into manufacturing.

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