Sociotechnical Synthesis

STS 4600

Spring 2021

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Mechanical Engineering

Signature _____ Date _____
Trevor Marchhart 4/27/21

Approved _____ Date _____
Richard Jacques

Introduction

My technical research focused on developing a recumbent tricycle for use in city communities. It was designed to compete in the American Society of Mechanical Engineers (ASME) Human Powered Vehicle Challenge (HPVC). It was manufactured by myself and my capstone team at UVA's Lacy Hall to be a realistic alternative to cars, busses, taxis, and subways in cities around the US. My STS research coupled very closely with my technical project. I conducted research on how replacing the majority of automobile and subway commuting with bicycles in large cities would affect global emissions over time.

Summaries

My capstone team and I designed, developed, and manufactured an efficient recumbent tricycle capable of replacing automobiles and subways in formatted cities. The goals of the project were to be competitive in the ASME HVP Challenge (we placed 7th internationally and 3rd domestically), and to create a vehicle easier to ride, more comfortable, and much safer than typical recumbents and bicycles. Our design went through extensive SolidWorks Finite Element Analysis (FEA) iterations in order to help choose a pipe size for that frame that was not exceedingly heavy and met the ASME (and our own) rollover safety performance metrics. The final design resulted in a factor safety of >3.5 in reference to the ASME HPVC top load rollover protection system forces. A wind fairing was also designed and incorporated using SolidWorks Computational Fluid Dynamics (CFD). The fairing design resulted in a 43% reduced drag force as compared to without. The final vehicle has been fully welded and assembled in Lacy Hall this semester.

My STS research focused on the effect that replacing the majority of commuting modes of transportation with cycling in large cities would have on global emissions. Particularly, I looked at how reductions in automobile and subway usage in New York City would change carbon

emissions globally, and how incorporating this change in large cities worldwide would change our path to a greener future. I found that even relatively gradually changes over a 7-year period on transportation patterns in a couple of large cities could have significant affects on global carbon emissions. These changes could greatly help with putting us on the ideal path for limiting global temperature rise to less than 2 degrees until 2100.

Conclusion

I have learned a great deal about design and manufacturing processes of industrial/consumer vehicles and products. In cohesion with the goal of sustainability, my capstone team and I focused on using materials and resources efficiently throughout the design and manufacturing processes. Additionally, I have gained a lot of experience working with a team on a multi-faceted project. My STS research project has taught me that every small effort towards a more sustainable future is worthwhile. Every person can change some aspects of their lives in order to reduce the carbon emissions they directly or indirectly emit in a given year. If everyone on the planet takes a few small steps, then significant progress can be made over a reasonably short amount of time.