

Thesis Project Portfolio

Design of a High-Performance, Low-Cost Pickleball Training Machine

(Technical Report)

An Actor Network Theory Analysis of Barriers to High-Speed Rail Expansion in the Amtrak Acela Express 2021 Program

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

My technical work and STS research are related through the actor network theory (ANT) framework. ANT states that sociotechnical systems can be viewed as a network of human and non-human actors. The success or failure of a particular system therefore depends on the relationships among these different actors. In my technical project, my team and I constructed a pickleball training machine and developed the design specifications after identifying the relevant human and non-human actors in the network. My STS research utilizes ANT to gain insight into how the network created by Amtrak for the Acela Express 2021 program failed to accomplish its project objectives before its deadline.

In my technical project, I worked with my capstone team to design an affordable pickleball training machine that launches balls at different speeds, spins, and angles to a player from across the court. While outlining the project specifications, it was crucial to consider the various actors in the pickleball network and their requirements for the machine. Many existing pickleball machines with the same training flexibility retail for over \$1000, so the \$500 development budget for this project challenged us to prioritize affordability in our design. My team built the prototype for the machine from scratch and designed the printed circuit board (PCB) responsible for supplying power and regulating heat for the different mechanical components including the motors, linear actuators, and microcontroller. We also coded the microcontroller and display screen, which is the interface for the user to select different settings and training modes. The final prototype was tested on the pickleball courts to ensure the model met all project specifications.

My STS research explores the failure of Amtrak's Acela Express 2021 program. The goal of this program was to purchase 28 new high-speed trains and improve the existing rail

infrastructure for these trains by 2021. But, as of 2024, the Acela program is anticipated to face further delays with no set completion date. ANT was used to examine the roles of different technical and non-technical actors. I argue that Amtrak failed to create a high-speed rail network due to the interrelationships among several key technical and non-technical factors, including inadequate project specifications, funding allocation issues, and problems with project management.

Working on my technical design project and STS research simultaneously has added a useful perspective. Designing a consumer-facing machine for my technical project required me to understand the human and non-human actors related to my technology. This network informed our project specifications and improved how our design catered to the needs of different stakeholder groups. In my STS research, I examined how Amtrak, as the network builder, failed to construct a high-speed rail network which led to numerous delays in the completion of the Acela Express 2021 program. Applying the ANT framework to this case allowed me to understand how the interplay of actors such as government policy, infrastructure, and contracted companies, impact the success of a project. Ultimately, working on my technical capstone project and STS research paper together has allowed me to put ANT into practice when developing and analyzing sociotechnical systems.