

## **Thesis Project Portfolio**

### **Electrification of Utility Tractors at Maritime Container Ports**

(Technical Report)

### **An analysis of Mass Transit Infrastructure in Southern Sweden and the National Capital Region of India**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

**Bethany Bazemore**

Spring, 2024

Department of Systems and Information Engineering

## **Table of Contents**

Sociotechnical Synthesis

Electricification of Utility Tractors at Maritime Container Ports

An analysis of Mass Transit Infrastructure in Southern Sweden and the National Capital Region of India

Prospectus

## **Sociotechnical Synthesis**

Both my technical project and STS research paper focus on different areas of transportation (the movements of both goods and people) and their future iterations as the world moves to a more electric, green, multi-model dominated culture.

The technical project entitled *Electrification of Utility Tractors at Maritime Ports* focuses on the Port of Virginia and models the internal operation of moving twenty-foot equivalent units (TEUs) from various points throughout the port. The main path that was focused on was the path from the TEU stacks on the shore to the rail facilities that transport the TEUs off the premises across land to their final destination. The simulation focuses on using electric vehicles as the modes of transportation rather than the current diesel-fuel fleet the port currently operates. This simulation included both the vehicles and the respective charging infrastructure needed on site to run the system efficiently. After interviewing the client, multiple “stressors” were identified that are both electric and non-electric related and were introduced in order to understand the effects on the all-electric model. These stressors were introduced into the model to create four (4) different scenarios and measured the effect on the port’s main metric: TEUs moved. The different scenarios focus on the arrivals of TEUs from the ships, the battery life of the Utility Tractor Rigs (UTRs), the ratio of UTRs per stack of TEUs, and increased charging ability of the UTRs. Additionally, the project looked at the environmental impact of these improvements as it relates to the Port’s goal of reaching carbon neutrality by 2040. This was done by looking at the carbon emissions being saved by the conversion to electric vehicles in partnership with receiving the electricity from all clean sources. A mathematical model was created to quantify the carbon emissions being saved based on our base model that was made to accurately represent the current number of stacks, UTRs, and TEUs moving throughout the system. The project produced utilization rates for the UTRs, number of TEUs moved, and the average time of TEUs in the

system given the different scenarios as well as conclusions and recommendations for moving forward in their electrification strategy.

The STS project entitled *An Analysis of Mass Transit Infrastructure in Southern Sweden and the National Capital Region of India* focuses on the different areas of the world with different histories and contexts and how this has impacted their transportation infrastructure currently. The paper uses the Actor Network Theory (ANT) and the Social Construction of Technology (SCOT) to understand the complexities that come along with the design and implementation of the multi-billion dollar projects that inevitably impact not only the economic stakeholders but the governments and the individuals that depend on their reliability. The paper opens with brief literature reviews of the history of both of the regions as well as major projects that have been seen as transportation feats. In Sweden, the creation of the Oresund Bridge which connects southern Sweden and Copenhagen, Denmark, is known for its feat of overcoming historical geopolitical tension and facilitates major economic opportunities for both of the countries. In India, the creation of the Delhi Metro is credited for reducing a portion of the car and rickshaw-related congestion that currently exists within the city of nearly 20 million people. The commonality between these two very different cities and projects is the combination of government influence as well as private industry innovation. This relationship has been proved crucial to the success of these projects and the level of their impact. The paper concluded with recommendations of this type of partnership being implemented in the United States, citing the success of this in other industries such as space exploration with the National Aeronautics and Space Administration and companies such as SpaceX and Blue Origin.