Deep Learning Based Predictions for Smart Buildings
(Technical Report)

Using Actor Network Theory to analyze the success of the Amsterdam Smart City
(STS Research Paper)

An Undergraduate Thesis Portfolio

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Socio-Technical Synthesis

My technical and STS work both address aspects of the socio-technical problem of improving people's quality of life using smart technology. The technical project aims to create a more accurate deep learning model to predict desired physical room settings (temperature, lighting, etc.) in smart buildings. The STS project uses actor-network theory to analyze what actor-networks are integral to the creation and maintenance of successful smart cities, specifically Amsterdam. Smart cities require the same machine learning framework as in smart buildings but other social factors need to be considered in understanding why some smart cities are successful. My technical work deals with individual buildings and the corresponding enabling technology, while my STS research analyzes the social factors that make large networks of smart buildings in an urban setting (smart cities) succeed.

Smart building infrastructures are equipped with hundreds of sensors to monitor physical building aspects and provide smart solutions for occupant comfortability and energy efficiency. Ideally, a smart building system can predict and adjust the physical features (e.g., lighting, air quality, temperature, etc.) in a person's office based on his/her personalized preferences and activities. Though, since the data is from one person, there may not be sufficient data for the machine learning model training to be accurate, and the data's quality may be low. Then, it is a challenge to conduct accurate predictions to provide personalized environment adjustment. The technical project attempts to handle this problem by using various data analysis techniques and feature selection procedures to maximize the expressiveness of the collected dataset. Deep neural nets will also be used in conjunction to predict patterns more effectively.

The STS project uses actor-network theory to analyze why the smart city of Amsterdam was so successful, so that we better understand what makes smart cities successful for future smart city projects. I point towards the collaborative "startup" culture of Amsterdam that led to the city's widespread success. I examine the components of this "startup" culture, the Amsterdam Smart City online platform and the various startups, to support my argument.

I think approaching a problem from both the technical and social aspects is very important for engineers. For me, understanding that engineering work is not purely technical is the best thing engineers can take away from STS. Putting this thinking into practice with the STS research paper was a great learning experience as an engineer. If I had worked on the technical project in isolation, I would have learned a great deal about machine learning algorithms and how to program training sets. This is not unlike an academic class, but one would miss the valuable thinking process of translating this into the real world. Researching and understanding the social factors that go into smart cities made me realize that even though making sure the algorithms are accurate is crucial to the success of technology, if the social factors are not in place, then no project can succeed. This is because engineers solve problems for humanity, making the products of their work social in nature. If I had done the STS project on isolation, I would've brushed away any technical details and undermined the complexity of the technical problems. Not understanding the technical problem would lead to limited understanding of what social factors are needed to remedy the issue. Working on both projects simultaneously has given me a wider perspective on what is needed for engineering projects to succeed. I will now be more cognizant of the greater socio-technical problem at hand, and in my future engineering work, I hope I will design technical problems to synergize better with the social factors at play.

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