Thesis Project Portfolio

Forecasting Breakthroughs: Identifying Future Leaders in the Semiconductor Industry

(Technical Report)

Actor Network Theory of Systems and Information Engineering Technical Projects and How Universities Act as Centers of Research to Society

(STS Research Paper)

An Undergraduate Thesis

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Adam Rogers

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Department of Systems Engineering

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Executive Summary

Advancements in capabilities and systems such as large language models, cryptocurrency, advanced battery technology, sub-5 nanometer semiconductor manufacturing, and pebble bed nuclear reactors have already disrupted or are poised to disrupt markets, society, and spawn new branches of research. Predicting the likelihood or even extent of these disruptions remains extremely complex. That is what the technical project of this Thesis will focus on, predicting the future of technological disruptions in the semiconductor industry specifically. The STS research paper of this Thesis examines the politics of the technical project itself. An outside organization had tasked students at the University of Virginia with completing research in technological diruptions because of the University's access to expertise, resources, and opportunities for innovation and talent development that can contribute to its long-term success and competitiveness.

Technological disruptions altogether are extremely convoluted and overexpansive for the scope of the technical project. With that, students and the client agreed to focus on the semiconductor industry because of its surging profitability due to growing demand for chips in emerging technologies like 5G, artificial intelligence, and electric vehicles. This is an industry that has grown well over 300% in the past two decades. The ultimate objective was to construct a binary classsification model to forecast whether a company would achieve a valuation of over $500 million within five years following its first recorded funding round as it presents a substantial investment opportunity. All of the data on the company, funding rounds, and anything else required for analysis was acquired through Pitchbook. In doing this, a network of stakeholders were analyzed to monitor capital deployment, feature engineering was utilized to transform raw data into a usable form, and metrics indicative of success were leveraged in order

to build the models. AUC (Area Under Curve) Scores and Confusion Matrices were used to assess the performance of the models on trained datasets. Results and analysis led to further discussion including an apparent greater success of semiconductor companies in China, limitations on our specific areas of research, and implications of further research.

Politics of the students and client relationship for the technical project were unique in the sense that the project was organized as a business venture but the students carrying out the work did not reap the benefits of success or shoulder the costs of failure. The STS paper lays out all of the identifiable human and non-human actors of the system in an effort to understand who gets the "short end of the stick" in the particular arrangement and what sort of social dimensions form between the University of Virginia and the client. Social dimensions were vastly similar to that of traditional workplaces where there is a relationship between employees and management, between employees and their jobs/company, and between employees and other employees. Interviews were conducted on all human actors (capstone students, capstone advisor, Systems and Information Engineerning Department Chair, and client) via critical ethnography. This goes beyond conventional ethnography as it takes answers from interviewees and examines power, inequality, and injustices. Interviews presented that there was overwhelming support from all parties involved in the actor network theory, everyone shared a common goal despite the potential (or lack thereof) for rewards. There was clear discussion on employee performance with organizational goals which likely empowered members of the technical project to complete tasks but this still raised the discussions of social desirability bias, power structures at play in the university environment, and how the surrounding community can utilize a university for their human intelligence and technological resources.