

Thesis Portfolio

Scale-Up Design for Biodegradable Vanillin-Based Polymer Production

(Technical Report)

A Perspective on the Digitalization of the American Church

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

In a broad sense, both the capstone and STS portion of this thesis consist of the adoption of technology in a way that impacts the broader society in some context. While in terms of the content of these projects there is very little connection and also operate on very different scales, nonetheless they both are heavily driven by socially conscious frameworks. The capstone portion focuses on the global environmental impact of plastics, and the STS portion dives into the impact that digital technologies have on local church communities. The capstone project is technically rigorous focusing on the details of polymer production, whereas the STS portion is much more socially focused, providing a good balance between two very different types of research. The research done for the capstone project is motivated primarily out of an environmentally conscious mindset and desire to see plastic waste reduced on the global scale; whereas, the STS portion is motivated by personal observation of how churches use technology and a perceived need for a new framework through which to view these technologies.

This capstone project is to industrially produce a biodegradable polymer, poly(dihydroferulic acid) (PHFA), from vanillin, a compound found in most biomass. PHFA exhibits very similar thermal and mechanical properties to polyethylene terephthalate (PET), so it will serve as a mimic plastic to provide an environmentally friendly alternative. PET accounts for roughly 20% of the global plastic market, so this product could serve to minimize the amount of plastic waste. The hope of this project is to account for human irresponsibility since there are billions of tons of plastic that are thrown away without recycling our plastic, even if disposed of improperly will be able to biodegrade into its constituents without producing any harmful byproducts or microplastics. This product was produced in three distinct manufacturing steps: acetylation, hydrogenation, and polymerization. Throughout production acetic acid is produced

as a byproduct, which was recovered and purified to be sold to help offset the cost of a potentially more expensive production process compared to that of making PET. In addition to this, this project has the potential to be sustainably sourced at a future date. The project was designed to be able to be easily transitioned to sustainable sourcing, once the market for biological vanillin adjusts to meet the demand of this production line. At the moment, this project utilizes petrochemically-derived vanillin to simply minimize the production cost.

What does innovation look like within a 2,000-year-old system founded on a reverent view of the past? Churches in America are being faced with this question in many different ways, and as a result, are transitioning from physical services to digital communities – and from promoting the use of a Bible with physical pages to a digital application. By making content both digitally available and at no cost to the user, in theory, the reach of the church becomes significantly larger. However, it is less commonly considered as to how these technologies affect the level of engagement in the church. The argument here is that the church is experiencing a serious paradigm shift in how it must view new technologies. This paradigm shift is being studied using document-based analysis examining research specifically into the YouVersion Bible Application and the advent of the live-streamed church service. In addition to this, research on digital learning and e-reading will be used to more broadly analyze how engagement changes in the digital sphere. In this study, it is expected that a tradeoff will be identified between reverence and innovation. The hope is that by analyzing the level of engagement affected by these technologies, churches will be able to make their own well-informed decisions about whether or not to adopt new technology into their church service. Shifting the focus back to user engagement also opens the door for new technologies to be created that dive more profoundly into deepening human interaction.

Through the completion of this project, it has provided a broader perspective on how technology impacts multiple spheres of society. While the capstone portion of this project focuses on a more environmental and sustainability approach to technological impacts on society. Whereas, the STS portion of my project focuses on how particular technologies impact the social interactions among religious groups. Since my capstone project focuses more on a global scale, namely how the world uses plastics, it has provided helpful insight to study the impacts of technology on smaller church communities. Overall, these projects are largely disjointed, nonetheless, it has provided a healthy balance between the technical and social rigor in this research. It also has revealed to me that my personal fulfillment in this project has been largely derived from studying the communities that I interact with on a daily basis and seeing how technology impacts the people with which I personally commune.