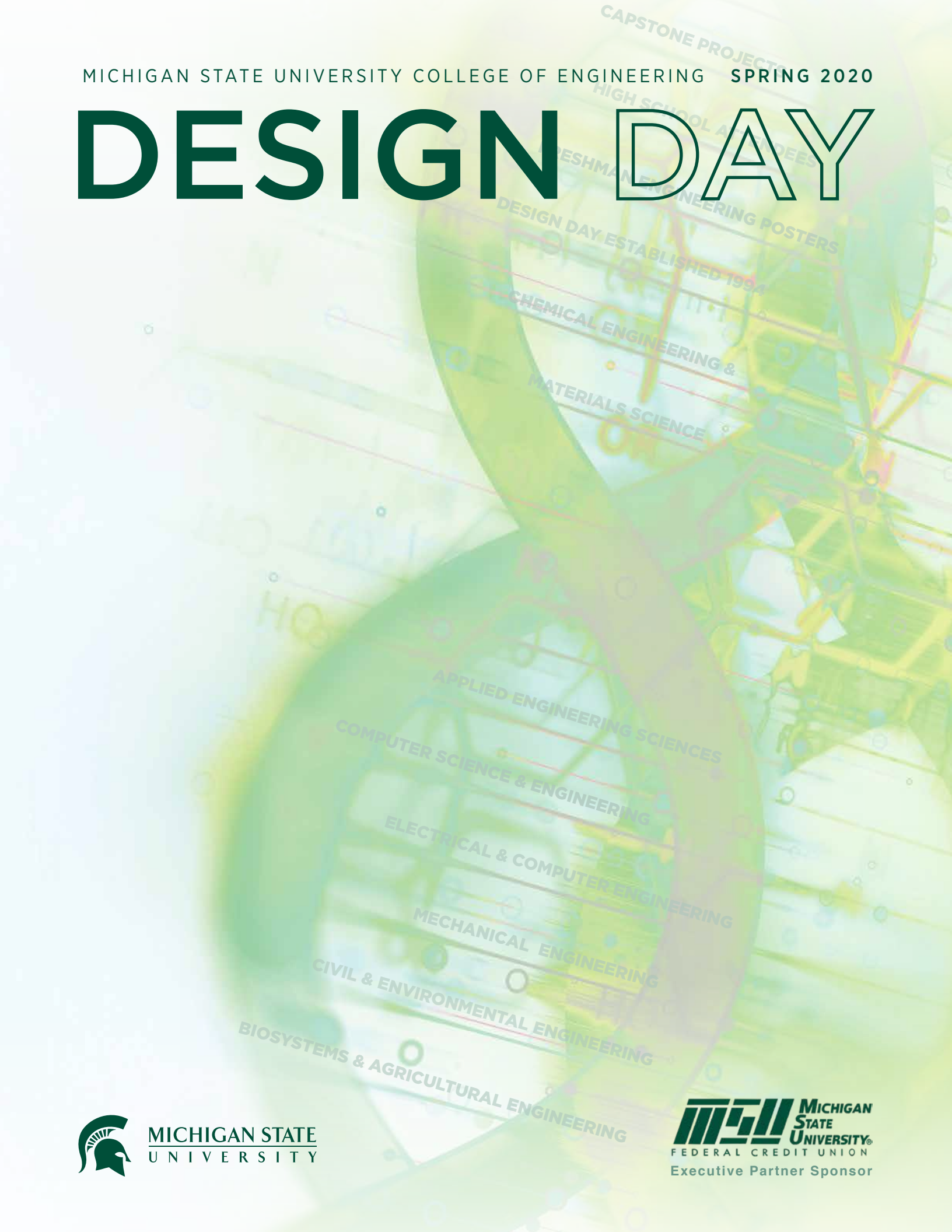
MICHIGAN STATE UNIVERSITY COLLEGE OF ENGINEERING **SPRING 2020**

DESIGN DAY



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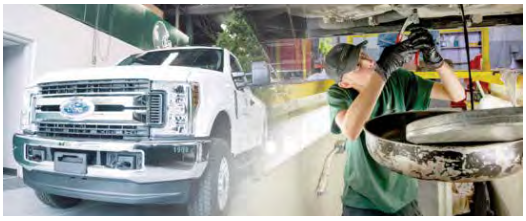
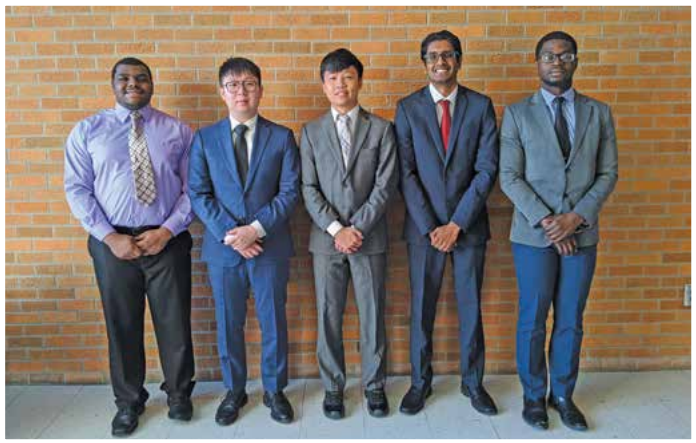
MSU IPF: Maintenance Services
Mobilize the Maintenance Stockroom

The MSU Infrastructure and Planning Facilities (IPF) Maintenance Services department is responsible for the maintenance and operations of all buildings on campus. IPF handles issues ranging from servicing dormitories to any general maintenance requests. Currently, tradesmen drive service vans around campus, carrying a limited supply of materials and tools. When a tradesman requires a certain part that is not in their vehicle, they drive to the IPF stockroom for additional materials. This can occur numerous times per day, leading to decreased productivity and increased vehicle usage by tradesmen.

For this project, the plumbing tradesmen were the only team within the scope of analysis. IPF utilizes Verizon Networkfleet, a vehicle tracking software that generates reports for vehicle metrics such as: miles per gallon, vehicle emissions, length of trips, etc. Monthly reports were generated for 2019 and 2020 to analyze the following: average trip time, average miles driven, and mpg. Included in the multi-factor analysis were the labor rates of the plumbing tradesmen and other vehicle costs provided by IPF. The recommendation is to implement a student delivery model, where a student will deliver materials to multiple tradesmen when they request additional materials. IPF already has a mobile application with the capacity to implement the recommendation. The application has the capability for tradesmen to place orders from their mobile phone, and workers in the warehouse will receive a notification to pick, package, and deliver the requested materials to the tradesmen. The biggest success of this project will be eliminating the need for tradesmen to travel from their work site to the IPF stockroom to collect additional materials. In turn, there will be an increase in tradesmen productivity and a decrease in vehicle usage by the entire fleet of tradesmen vehicles, leading to less non-value add trips, fuel consumption, and emissions.



Infrastructure Planning and Facilities
MICHIGAN STATE UNIVERSITY



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MSU IPF: Sustainability: Carbon Sequestration & Carrying Capacity of MSU Trees

Michigan State University Infrastructure Planning and Facilities Sustainability department is responsible for analyzing how MSU contributes to global climate and carbon systems. As a land grant institution, MSU has a longstanding commitment to the environment. This is evident in the many green spaces and wooded areas on campus. Currently, MSU has over 20,000 trees on campus and cuts down, on average, 300 trees per year. MSU would like to collect data and design a system that will allow them to not only understand but also manage the carbon sequestration capacity of campus.

This project is focused on calculating the carbon sequestration value of Michigan State's campus in order to have a better understanding of how MSU is contributing to the local and global environment. This includes a method for calculating carbon sequestration that allows IPF to easily calculate an updated value on a yearly basis. The team is also responsible for identifying the canopy coverage of campus and mapping areas of campus where trees can be planted. This will aid IPF in the future with their plans for tree planting on campus. The project also includes creating a process to score trees based on age, canopy cover, carbon sequestration, and DBH. This score helps IPF determine which trees are most valuable to them and helps them maintain the diversity of trees on campus. Upon completion of this project, IPF will have a method of calculating the carbon sequestration value of campus, a better understanding of where to plant trees in the future, and which trees are most important to them. All of these will aid IPF in maintaining the beauty of Michigan State's campus for years to come.

Infrastructure Planning and Facilities
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MSU IPF: Custodial Services
Robotics Workforce Analysis

MSU IPF Custodial Services hires over 330 employees to clean over 13.5 million gross square feet of campus facilities. High turnover rate is a current challenge, such as the 200% rate of temporary positions in 2018. In order to combat this challenge, semi-autonomous floor cleaning robots have been purchased and deployed so that employees can be allocated to other cleaning tasks. This project will work towards creating an understanding for how the fleet of robots can be employed to improve efficiency from a man hours and financial perspective. By continuing to pursue an interest in robotics, this provides an opportunity to enhance the custodial workforce through increased performance and provide new ways for custodial employees to align with strategic planning initiatives.

The goal of the project is to deliver the requested current state analysis with documentation and information gathered throughout the investigative process specifically looking into finances, operations, and efficiency reports. A PowerPoint presentation of the project will be used in future conferences to share MSU Custodial Services' pioneering research in the application of robotics to custodial services. The current state analysis will provide the framework to assist with the current and future integration of robotics into the custodial workforce at MSU and will show MSU's commitment to maintaining its cutting-edge status with technology integration into custodial work.

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Infrastructure Planning and Facilities
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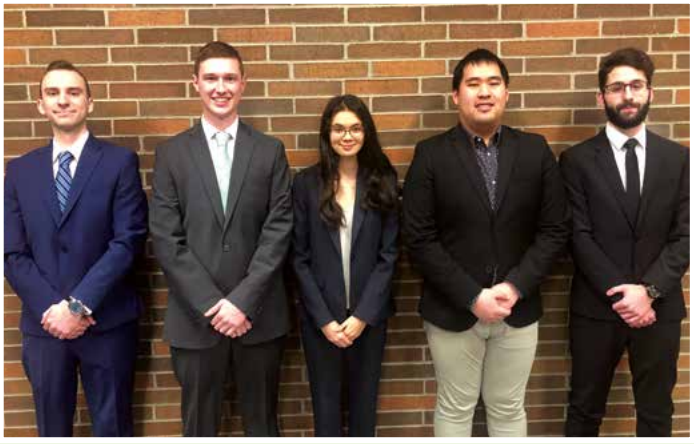

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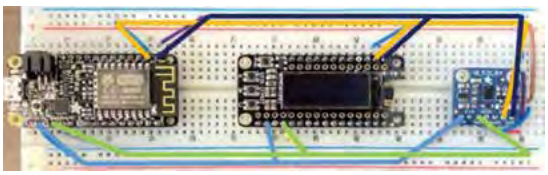
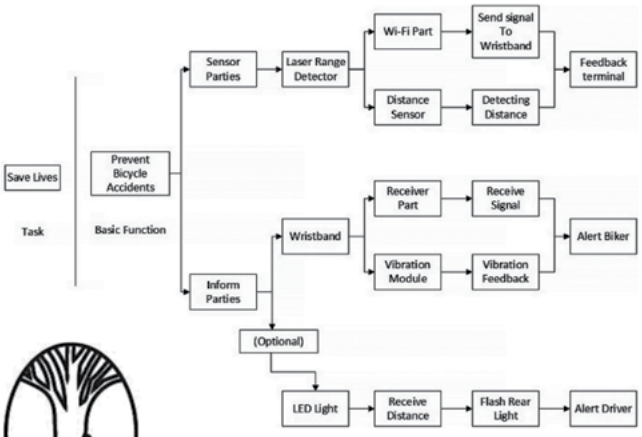
MSU RCPD/MSU Bikes
Intelligent Defense System (IDS)

Due to the increasing number of people distracted by their cellphone use while walking or driving, the safety of cyclists is severely threatened. Our project is to develop a lightweight, portable and simple system that can alert cyclists to impending danger.

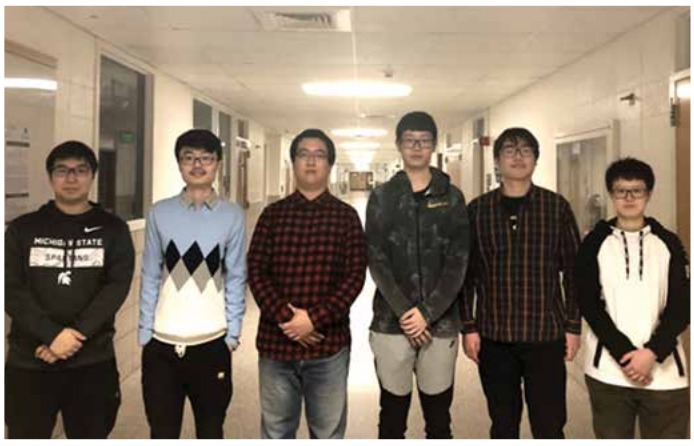
There are several systems that have been implemented, including radar and camera detection. Neither of these systems is optimal. Radar detection is expensive, and the reaction time using camera detection is slow.

We plan to create a distance sensor, which uses light that reflects the area around a bike. The system is lightweight, portable and inexpensive, making it a better alternative. A WiFi module will be used to transmit the signal. It will have a microcontroller for processing data and sending a signal to a band mounted on the bike. The band then vibrates, warning the cyclist of potential danger. The use of WiFi allows the system to be hands-free as well.





RCPD
Maximizing Ability & Opportunity



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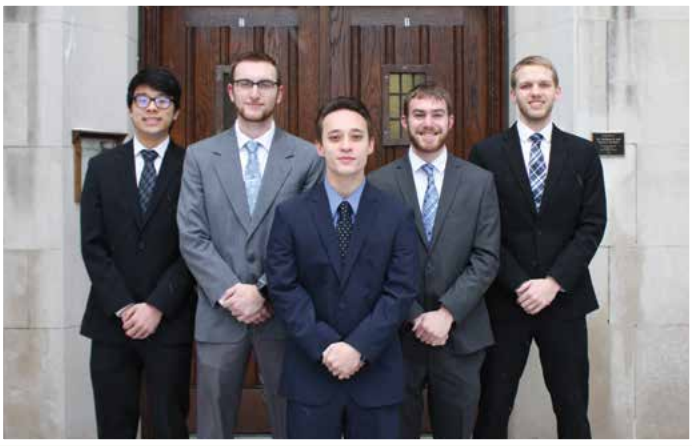
MSU Recycling Center
Reduction in Consumption of Plastic Bags

MSU Recycling strives to keep the community clean and green by reusing and recycling materials, collaborating with the community, and educating the public on best practices of recycling. This results in nine million pounds of materials being recycled each year at their Materials Recycling Facility (MRF). The MRF is a plant that receives, sorts, and bales materials received from the many recycling bins located across the MSU campus. In addition to recycling materials, the MSU Surplus Store provides community members with the opportunity to purchase used items, as well as to prevent their own unwanted goods from ending up in a landfill.

Despite the plethora of recycling occurring on campus, many of the collection bins for recycled material and trash use plastic bags to collect the material. The bags used often become contaminated with food waste and can result in inefficiencies in the collection and sorting process. In this project, we worked towards a goal of standardizing a new system to reduce the waste of plastic bags and increase the efficiency of the material collection process throughout the Michigan State University campus.

Surplus Store and Recycling
managing waste as a resource



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MSU Recycling Center
Pallet Recycling Initiative

The MSU Recycling center manages the university's waste with the goal of reducing, reusing, and recycling as much of it as possible. Established in 1988, the Recycling Center is a self-reliant entity within Michigan State University. In 2019, they were able to divert 15 million pounds of waste from reaching local landfills. Their goal is to eventually keep 90% of the received waste from being diverted to landfills. As part of achieving this goal, the recycling center needs to mitigate the quantity of pallets that are disposed of in landfills.

The MSU Surplus Store and Recycling Center collects and processes about 7,500 pallets annually for recycling, resale or waste. Pallets that are in good condition are sold to pallet remanufacturing companies. Pallets that are in poor condition are given away or sent to the landfill. This project identified safe, cost-effective, and efficient ways to disassemble and repurpose pallets. There are multiple ways to effectively recycle pallets, including creating woodchips, disassembling the pallet and selling the wood, or redistributing them directly to specialized recycling centers.

Surplus Store and Recycling
managing waste as a resource

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MSU Recycling Center
Food Waste Collection Cart Redesign

The MSU Surplus Store and Recycling Center, located on Michigan State's campus in East Lansing, oversees the processing of many different materials. All recycling and food waste from on campus plus recycling from their 24/7 public drop-off center gets taken care of at this facility. All the food collected on campus is either used to power the anerobic digestor or turned into compost. At the center, once the food waste is collected in bins, they are dumped and rinsed with a power washer into a larger dumpster. About 1 million pounds of food waste are processed annually.

Our project focused on clean, efficient removal of food waste from the bins located around campus. The process of emptying and cleaning the bins is time-consuming and uses a lot of water and energy. As a continuation from a prior capstone project, the cart needed to be redesigned. It was suggested by the previous group to switch from HDPE plastic to ABS with an LPS coating. We tested different food safe coatings applied to existing bins in order to prevent food from sticking to the sides. This allowed for the removal of many steps, such as heated power washing and transporting the bins back and forth from the recycling center. We tested many different applications to ensure that even the worst food materials, such as peanut butter and pizza, would come off cleanly.

Surplus Store and Recycling
managing waste as a resource

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