

# Reusing & Recycling | bloomarbl

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### **Defining the Problem**

Currently, Cal Poly transports collected waste and recyclables to off campus landfills and recycling centers which results in a loss of potential monetary and informational gain. The lack of a central sorting and data collection system on campus contributes to high levels of contamination in recycling bins with no clear path for improvement without accurate current state data. The concept of operations for Bloomarbl Inc. includes an on-campus sorting facility however there is no clear design or process established for implementation.

### **Current State**

Cal Poly currently lacks an informed and consistent schedule for emptying on-campus waste bins.

- Campus Facilities: visually assess
  each bin
- Emptied when bins appear 50% full
- Bin Contents: taken to Cold Canyon Materials Recovery Facility for processing

This system isn't streamlined or consistent which leads to wasted labor, lost CRV revenue, and ineffective campus cleanliness.

### Ideal State

Establish a start-to-finish system to track, transport, sort, and benefit from waste produced on the Cal Poly campus.

- Bins should be emptied according to a streamlined collection process, with consistent scheduling
- All recyclables should go to a well equipped, accurate, on-campus sorting facility
- Recyclable materials should be extracted for revenue (CRV) to fund internal, sustainability-based programs
- Sorted waste should be sent to a designated, off-campus facility for CRV redemption
- Material revenue should account for maintenance of sorting facility to minimize strain on existing campus entities

A trackable rewards program would encourage students and faculty to deposit recyclable waste in Bloomarbl tagged bins.

 Revenue from CRV redemption should fund the Bloomarbl rewards program to further increase recycling on campus



### **Root Cause Analysis**

A root cause analysis was conducted to identify the root causes contributing to unregulated/overflowing bin capacity, lost CRV revenue, bin contamination, and lack of student participation in on-campus recycling.



### **Developing Solution Hypothesis**

The flow chart below lists the considerations for each original focus area to demonstrate how the team's solution fits into the end-goal, start-to-finish recycling system:

- Collect: how/when waste is emptied and transported from individual waste bins around campus
- Sort: how collected recyclables are sorted and processed in an on-campus waste sorting facility (labor, machinery, etc.)
- Sell: the program-funding CRV gain from sorted.recvclable materials



### **Conducting Experiments**

Sorting Facility:

- Sorting facility layout designs modeled in AutoCAD
- Scaled, aerial view layouts with proper dimensions created to consider various labor/machinery configurations in a given space
- Cost and impact analysis to compare economic implications of different design solutions



### Collection:

- 3-day waste audit (measured fullness levels of 12 Cal Poly recycling bins 3 times per day)
- Waste audit data obtained to evaluate Excel model performance

### **Evaluating Results**

Each teammate did the following to evaluate the Excel Model: The raw waste audit data was pre-processed in the **Waste Audit Data Conversion** model which transforms the percentage fullness measurements into fill rates for each bin in the system. These rates along with location data for each bin was then used as input data for the **Waste Collection Shift Generator** which generates lists of bins to be emptied on each collection shift. Lastly, the **Route Optimization** model recommended an optimal pick-up route for waste collection on each shift.



### **Implementing the Best Ideas**

The team used Excel in order to simulate a route optimization trash collection system. The following were the final deliverables:

- An Excel Model used to input the hours of the shifts and maximum bins capacity to produce which bins need to be emptied and their corresponding latitude and longitude (user should provide information regarding bin ID's and latitude/longitude coordinates).
- An outsourced Excel model that produces an optimized route given the bin locations (latitude and longitude coordinates)
- An (optional) final, visual mapping of the locations of each bin to be serviced (mapping generated using BatchGeo)



### **Institutionalizing Change**

Bloomarbl Inc. aims to establish circular-economy recycling systems in communities to encourage a refuse, reduce and reuse mentality. To recognize and build upon the *existing* bin system in every community, **Bloomarbl can use the senior project team's Waste Collection Model to generate optimal pick-up routes for each unique ecosystem.** The team wrote a user guide to direct users through each step of the Waste Collection Model. Ideally, in the future the team's Excel model can serve as an outline for a more established Bloomarbl route optimization software. However, as this senior project comes to a close, this detailed user guide is essential in establishing an active change in how trash is being collected on Cal Poly campus and beyond.



## CUTTING TOOL INVENTORY MANAGEMENT AND ORGANIZATION SYSTEM: KAL MACHINING

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