1.0 Introduction

The goal of our design project is to create a product utilizing the intrinsic properties of aluminum to make Penn State more energy efficient and sustainable.

Our project kicked off with a presentation from our corporate sponsor, ALCOA, which emphasized the recyclability and sustainability of aluminum.

The problem of our design centered around creating a cheap and user friendly coffee refilling station in convenient locations on campus. In order to figure out a solution to this problem, we utilized customer needs and concept generation techniques.

This report expands on the customer needs assessment, external research, and concept generation and selection that went into designing our coffee system.

1.1 Initial Problem Statement

Aluminum must be used in such a way to promote sustainability and energy efficiency on Penn State campuses.

2.0 Consumer Needs

The customer needs criteria were generated in a very specific manner that the group thought would produce the most accurate results. Each of us stood in front of a different store that sold coffee. The locations were the Starbucks on College Ave, The Mix at Pollock Commons, The Big Onion at Findlay Commons, and Off the Ground at South Commons. Each group member was designated to one spot and stood there and attempted to survey as many people as possible. Questions were asked from the interview script (provided below) and properly recorded. This method was very efficient at generating results quickly and from the proper audience, but it was a convenience sample and therefore was most likely not representative of the whole population here at Penn State University Park Campus.

The next method we used was a simple random sample. We used a random number generator to select 10 rooms from Mifflin and Pollock Halls and went to the doors and asked the subject the questions from the interview script. Most people answered their doors, but for the few that did not, a new room number was selected and the new subject was questioned appropriately. This method was also a convenience sample but the advantage was that we got a broader view of the customer needs this time. Everyone's results were confidential and remained anonymous, no names were used.

The sample script attempted to help the group with generating ideas for our design. If the subject did not drink coffee, the survey was discontinued as they would most likely not produce the most accurate results that we were looking for due to the subject's lack of interest in the topic. A sample of the script lies below.

<u>Interview Script</u>

1) Do you drink coffee? (If no, discontinue survey)

2) How often do you drink coffee?
3) How much are you willing to pay for a good cup of coffee?
4) Do you use a travel mug or paper cups?
5) Would you use a travel mug if a convenient system was available?
6) What would you want to see in that system?

A very wide range of subjects were used in the study and we produced about 50 results for the study to have a large enough sample size. The results that we found are listed below.

Table 1 Interview Results

Question Number	Result
2	Less than a cup a day: 10% One Cup a day: 24% Two Cups a Day: 42% Three or More 24%
3	50cents-1 dollar: 100%, 1-2 dollars: 91%, 3-4.50 dollars: 38%
4	Travel Mug: 16% Paper Cups: 84%
5	Yes: 81% No: 19%
6	Easy paying Easy payment system, user friendly, convenient locations, cool design, fast system, coffee variety

We did not record the number of people who said they did not drink coffee as their results were not important to conducting our survey.

After the group finished the results of question two, we found that in our sample, people drank an average of two cups of coffee a day. However, more than half of our subjects drank two or more coffees a day which we interpreted as a clear demand for coffee on campus. If a convenient system was generated that would suit their needs, our design and system could be successful. We continued to ask the next important question.

Question 3 asked how much a person would be willing to pay for a good cup of coffee. On campus coffee is generally very cheap especially with the campus meal points system. The people who drink

coffee were all willing to pay 50 cents to a dollar on a cup of coffee. The percentage of people willing to pay for a cup of coffee decreased as the price increased. This inversely proportional relationship was not surprising but it did vary based on location. The subjects that were questioned in Starbucks were willing to pay a significantly high price for a cup of coffee. This made sense because the price for a cup of coffee at a Starbucks coffee shop is on average 3 dollars more than on the Penn State Campus.

The next question was not a shock to our group. Based on the survey, a vast majority of people on campus use a paper cup that is supplied to them at the store they purchase their coffee at. This is because it is convenient to them and they can just throw that cup away and buy a new one the next time they want a cup of Joe. This really is not a problem for the average person but in reality this generates a lot of unneeded waste at Penn State that could be prevented. The problem is that there really is not a suitable coffee refilling system on campus that people could take advantage of so they do what they can to get coffee. The team found out that the people who used a travel mug usually made their own coffee in their place of residence. However this is not very easy to do for most people especially for the students that live in the dorms. The next question made it clear that our system could be a success if conducted properly.

We asked the subjects if they would use a travel mug if a convenient system was created here on campus. We explained our general idea and we watched the number of people willing to use a travel mug dramatically shift. It was important that while we explained our ideas, we did not bias the subject and they gave us their honest opinion. However, we concluded that people's choice of where they drink their coffee from was just a convenience factor because there was no better trade off. Sustainability is commonly not important to most people, because the opportunity cost for being environmentally friendly and making their own coffee is too high for most.

The following customer needs were generated for a new system of buying coffee.

Table 2 List of Consumer Needs

1. Cheap
2. User friendly
3. Convenient locations
4. Efficient system
5. Coffee variety
6. Standard Sized Cup
7. Durable

After the customer needs were collected, we weighed them based on importance

2.1 Weighting of Consumer needs

Table 3 Hierarchy of Consumer Needs

1. Efficient System
    - 1.1 Coffee can be purchased and received quickly
    - 1.2 The paying system is easy to use and utilizes Meal Point/Lion Cash
2. Cheap
    - 2.1 People can buy as much as they want at a good price
    - 2.2 Demand for coffee will stay high
3. User Friendly
    - 3.1 Interface is self-explanatory and easy to use
    - 3.2 Few steps required to receive coffee
4. Convenient Locations
    - 4.1 Coffee stations are located throughout campus
    - 4.2 Many stations are present
    - 4.3 The stations are easily accessible to all students all over campus
5. Coffee Variety
    - 5.1 Many different types of coffee are available
    - 5.2 Multiple brews provide a higher demand for our system
6. Durable
    - 6.1 Machine won't have to be replaced often
    - 6.2 Cups won't have to be repurchased
    - 6.3 Low maintenance is required
7. Standard Sized Cup
    - 7.1 Cup that is provided fits in standard cup holder
    - 7.2 Cup is not too big or too small
    - 7.3 Size of cup is maximized

We weighed efficiency as the number one priority because it was a common request from our subjects. A majority of people already get their coffee from a shop in a paper cup because there is no other alternative. If the next big coffee dispenser is not efficient, what's the point? It will utilize a credit system that is common on the Penn State campus like lion cash or meal points.

Many people who order their coffee now get it from an on campus store. They use their meal points which gives them a large discount so they pay a very minimal fee. In order to attract customers with our new system, it must be cheap and efficient. In order to sell coffee at a cheap price, it must be produced at a cheap price to in order to make a profit.

In order to keep customers coming back the system must have an easy to use interface. Not all people are good at using technology so the system where the coffee is ordered must be simple and user friendly. Very few steps should be used to buy the coffee. If the system is easy then people will keep coming back and the demand for our product will stay high which is the ultimate goal.

Another very important feature that the new coffee dispensing system must have is convenience. If the coffee machines are located at almost every corner of campus then people will see it as a new standard because they can fill their aluminum coffee mug up anytime and anywhere. This is vital to the success of this idea. The more coffee dispensers that can be present on campus and effectively maintained, the better.

Most coffee connoisseurs prefer more than the average cup of coffee. For the more frequent coffee drinkers their tastes can evolve into a more specific taste. This is why it is important to have a variety of different brews available in the dispenser. This way, the people who don't drink as much can get a regular cup of coffee and the people who drink more coffee can get their prefered flavor and all of the audiences are satisfied.

In order to be cost effective and sustainable, both the coffee machine and mug must be durable and last a long time. If people hear that the machine is always breaking down or the mug is poorly designed and breaks after a while, they will get discouraged to try it and that means a profit cut for our team. The more durable the machine, the lower the maintenance is and this cuts down on costs that could be used as profit.

The size and shape of the cup are very important to the attractiveness of the product. The cup must be a pretty standard size and fit all cup holders for the people who use them. The cup must be cool looking to attract customers, but it cannot be too irregular of a shape or it will not work as properly.

3.0 Concept Generation

In order to generate concepts for our design we utilized three methods of brainstorming. Mycoted.com provided a list of professionally used concept generation techniques. As a team, we researched the techniques and chose the methods that we felt were most applicable to our problem statement. The concept generation techniques we chose include "Bodystorming", "Listing Pros and Cons", and "Circle Time."

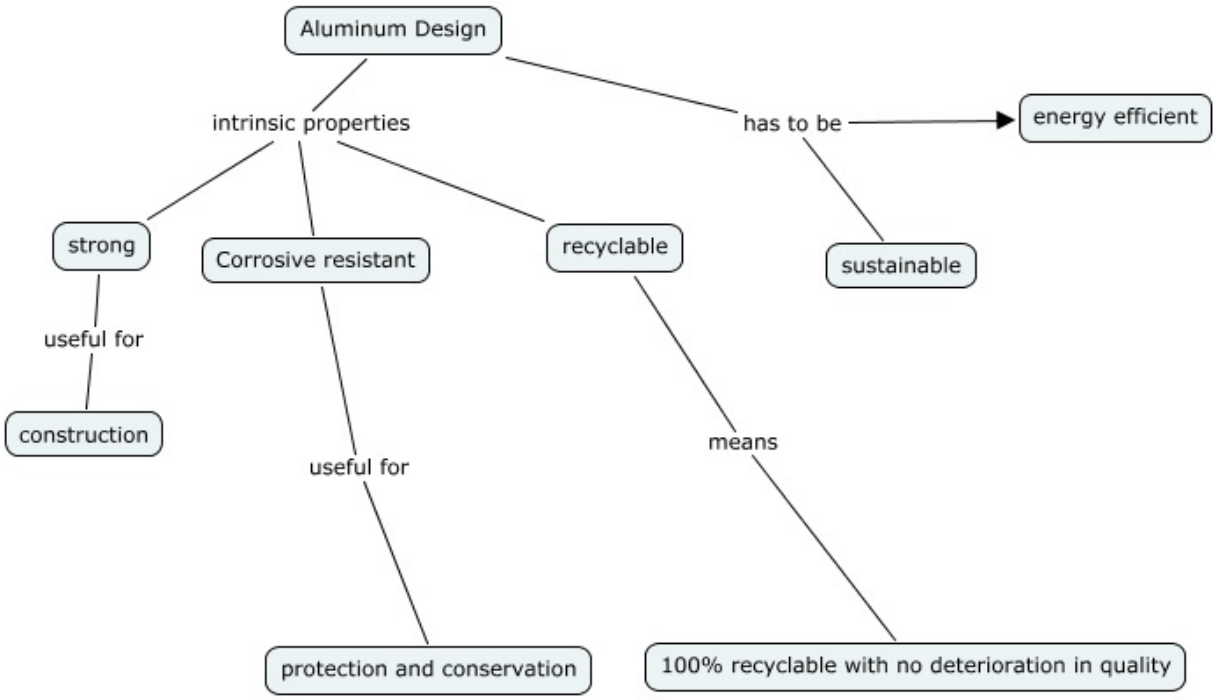
The idea of Bodystorming is to pretend that the product we are designing actually exists, and to act out how it would work in real life. This technique emphasises the idea of getting up, moving, and testing with your own body, rather than sitting at a table and brainstorming. Allowing your body to run through the motion of utilizing a product gives the designer an idea whether a design function is feasible or not.

Circle time refers to any moment that a group of people are together for an activity that involves everyone and makes sure to never exclude anyone. Circle time is also called group time. Mycoted's "Circle Time" is a method with a particular procedure that mainly involves sitting in a circle in chairs or on cushions and using an object that signifies the holder's ability to speak without interruption. For our project, the speaker shared their idea for a concept to solve the weight and size problem with our

toothbrush. No negative feedback was allowed in response to the speaker's concept idea. This promoted idea production without fear of judgement to make sure that every concept thought of was spoken and heard.

These concept generation techniques allowed us to create five design concepts that centered around our problem statement. Each concept centered around utilizing aluminum in a fashion that would make Penn State more energy efficient and sustainable.

Figure 1: CMAP



3.1 Design Concepts

(Each concept includes a refillable aluminum coffee mug)

1. Vending machine sized coffee dispenser that needs to be refilled less, costs more, and takes more space
2. Small automatic machine put on a separate table that needs to be taken care of by students and occasionally maintained by maintenance faculty (one in the commons)
3. A machine that requires constant maintenance by an employee that would limit the potential locations for these machines
4. Numerous coffee pots that require the coffee to be made by the user

5. Large machine to be filled the morning of each day and provide a limited amount of coffee for the day

3.2 System Concept

Students can buy an aluminum coffee travel mug to promote waste reduction. These cups could feature different designs. Each mug would be linked with the students' PSU ID+ accounts and have a barcode on the side. The coffee dispenser has a barcode scanner that reads the barcodes on the travel mugs. This reading provides a discount on coffee when purchased with meal points or Lion Cash.

<u>Abbreviations for Spreadsheet</u>

1. Vending Machine
2. Table-Sized Machine
3. Worker Machine
4. Coffee Pots
5. One-Fill Machine

Figure 2: Concept Selection Matrix

		Concepts									
		A		B		C		D		E	
		Vending Machine		Table-Sized Machine		Worker Machine		Coffee Pots		One-Fill Machine	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Size	20%	1	0.2	5	1	5	1	4	0.8	5	1
Machine Cost	15%	2	0.3	4	0.6	4	0.6	5	0.75	5	0.75
Location Potential	15%	4	0.6	5	0.75	2	0.3	2	0.3	4	0.6
Effeciency	15%	5	0.75	4	0.6	5	0.75	1	0.15	2	0.3
Maintence (hi # = lo)	15%	4	0.6	4	0.6	1	0.15	2	0.3	4	0.6
Coffee Variety	10%	4	0.4	3	0.3	3	0.3	3	0.3	1	0.1
Cleanliness	10%	4	0.4	3	0.3	5	0.5	2	0.2	2	0.2
			0		0		0		0		0
			0		0		0		0		0
			0		0		0		0		0
	Total Score	3.25		4.15		3.60		2.80		3.55	
	Rank										
	Continue?	No		Yes		No		No		No	