Increasing Awareness of Maize and Blue Cupboard Resources through App Development at U-M

Team Members:
Alexa Brzezinski, Trinity Fung, Rachel Li, Larissa Wermers

Abstract

The Maize and Blue Cupboard is a grocery store at the University of Michigan that supplies free food and supplies to students, faculty, and staff to address food insecurity on campus. They are expanding their services into a hub of resources including assistance applying for SNAP benefits and learning healthy recipes. To increase their impact, they need a way to communicate their content and services to those who would benefit on campus. After numerous stakeholder engagement meetings, we have decided to move forward with the development of a mobile application to create a centralized location with features available for users to increase their engagement with the cupboard.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Team 10.2's project focus was originally centered around UNICEF's Target Product Profiles (TPPs) and choosing several to explore possible projects within. The team read through each of the 20+ TPPs and narrowed down several based on team interest to explore and research. Throughout the creation of the five needs research worksheets, the team found themselves not particularly interested in any of the topics after researching into the five chosen TPPs. Throughout a conversation of a possible project focus switch, one of the team members mentioned they had come across the topic of food insecurity and had a basic background of food deserts from previous volunteer work. This idea interested all of the team members more, and all agreed to shift focus to a project we would enjoy working on more.

The team began preliminary background research surrounding food deserts and common causes of food insecurity across the U.S. After a team meeting with Professor Sienko, the team decided to conduct interviews with local organizations that support people living in food deserts and those that have food insecurity. The first organizations that came to mind were Food Gatherers and the Maize and Blue Cupboard which are both local food pantries within the Washtenaw county area. Food Gatherers offered us some great background information and through the interview with Maize and Blue Cupboard, we identified issue areas surrounding the ability to distribute information about their resources and methods for storing a variety of foods due to spatial constraints. Due to their ability and willingness to mentor any project the team choses to help them throughout the semester and provide periodic feedback and insight on possible solutions, the team decided to pursue a project with the Maize and Blue Cupboard.

After discussing as a team the information obtained from the interviews, the team formed two new needs statements surrounding the Maize and Blue Cupboard to add to the three focused on general needs of low-income communities in food deserts. Through the use of a Pugh chart, the team developed criteria, weights, and values to assign to each of the needs and after a final round of information gathering, we decided to move forward with M&BC's communication need.

The anticipated project outcome, after confirming with M&BC, is to develop an app that can help the M&BC spread the word of the work they do to help the U-M community. We researched different free platforms for app development and settled on one called Appgyver. Important requirements for the app are to ensure all content currently on the M&BC website can be displayed on the app and they have access to updates and push notifications. The team began prototyping through adding all website features into the app and exploring push notifications and live server sources for easy information distribution. Currently, the app has all information currently offered on the M&BC website, but further work is being done for push notifications and for the transfer of the app to M&BC's control.

Our main methods of verification and validation will be through many rounds of usability tests. As our project is not a physical prototype, the best way to gain feedback is through asking people to use the app and share their thoughts with us. The user tests will be formatted through one of five types: unmoderated, moderated, unit testing, A/B testing, and co-discovery across a range of participants -- from people who use the M&BC frequently to those who have never heard of it to the staff at M&BC. Due to the learning curve about computer science and app programming, the app is currently not finished, but several team members plan on continuing to help throughout next semester to produce a finished product for the Maize and Blue Cupboard.

OVERVIEW OF NEEDS FINDING PROCESS

Unicef Target Product Profiles

Team 10.2's project focus was originally centered around UNICEF's Target Product Profiles (TPPs). These are guides for industry products that meet UNICEF and partnered community needs that are not currently available in the market and usually have a great impact on low- and middle-income countries (LMICs) around the world [1]. Some TPPs date back over a decade and have current products and solutions that have been developed, however, better solutions may still exist. Many of the TPPs were produced in partnership with NEST360, an international alliance group that focuses on addressing neonatal conditions. Other areas covered by the TPPs include diagnostic aids, water quality tests, and emergency structures. The TPPs are specifically targeted to LMIC populations with a goal of tackling global health threats and reducing disparities between high-income countries and LMICs. Stakeholders in these initiatives include the end users and patients, as well as UNICEF, local medical teams, and engineering teams including ourselves.

The team read through each of the 20+ TPPs and narrowed these down to five needs based on team interest and feasibility of the project. These filtered needs related to syringe pumps, suction pumps, emergency offices, water filtration, and access to nutritional food. The team developed needs research worksheets for each of these subjects, but did not find ourselves particularly drawn to any of the topics.

Change in Focus

After completing the needs research worksheets, the team discussed a possible project focus switch. One team member mentioned they had come across the topic of food insecurity and had a basic background of food deserts from previous volunteer work. This idea interested all of the team members more, and all agreed to shift focus to a project that would be more enjoyable.
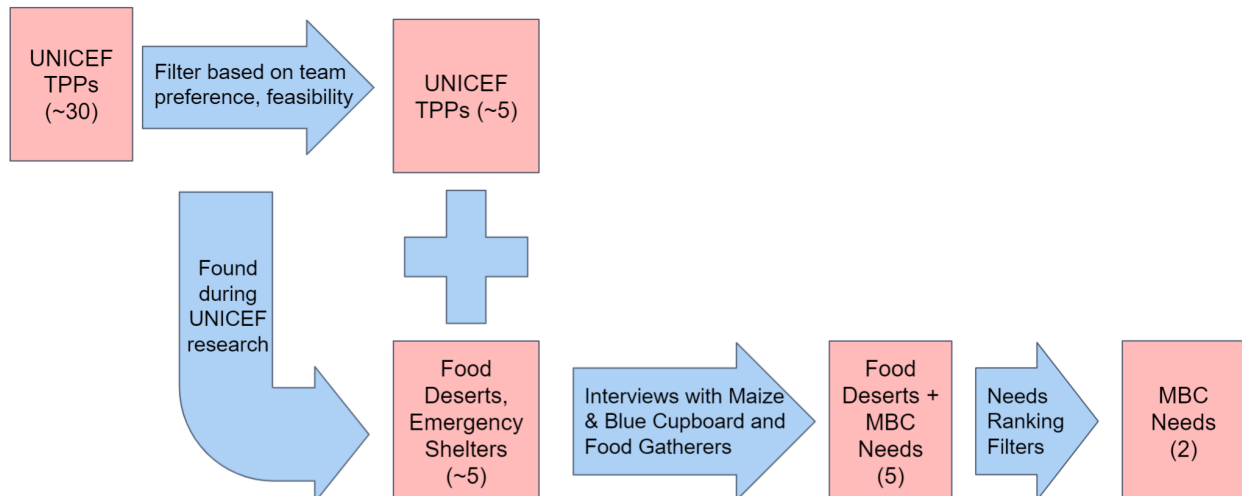

Figure 1. A visual representation of the process of selecting a need statement.

The team began preliminary background research surrounding food deserts and common causes across the world before narrowing the scope to the United States. This narrowing allowed the

team access to possible stakeholders and higher feasibility of implementation, allowing the project to have a larger impact than a broad solution. Each member conducted preliminary background research using various databases through the U-M library and other research methods while recording search methods on a running google doc. After a team meeting with Professor Sienko, the team decided to conduct interviews with local organizations that support people living in food deserts and that have food insecurity.

PROBLEM DESCRIPTION AND BACKGROUND

Food Deserts

Across the United States, many low-income communities in urban and rural communities face food insecurity. The U.S. Department of Agriculture (USDA) defines food insecurity as the disruption of food intake or eating patterns because of lack of money or other resources [1]. A common reason for food insecurity is a lack of access to a supermarket or access to healthy foods due to home locations and the ability to be transported to and from supermarkets. This is referred to as living in a food desert, and can be described as geographic areas without access to affordable, healthy food options. Oftentimes, living in food deserts is akin to living in a food swamp, which is defined as living within a quarter mile of more than four corner stores [2]. These areas are often oversaturated with convenience stores, which provide cheap but unhealthy food for families struggling with money.
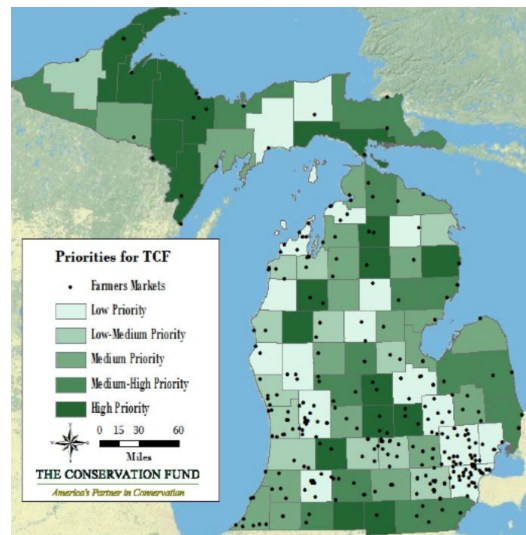
Figure 2. A map of Michigan counties and their access to stores with healthy food.

Food deserts are found disproportionately in low-income communities and in areas occupied by people of color. Parents in these areas are often programmed to buy the cheapest foods possible just to get by based on their own upringings [3]. Systemic inequalities keep residents of these communities, who are often black or Latino, from moving income classes and having the same opportunities as white people [4]. Many families apply for the federally sponsored Supplemental Nutrition Assistance Program (SNAP), but it can be difficult for them to apply and qualify due to lack of knowledge or tools to fill out the application. Those that qualify still struggle with acquiring nutritious food, as government subsidies often favor products high in corn syrup and

6

processed sugar as opposed to healthier alternatives. Additionally, the program limits the type of food that can be purchased, and not all stores are eligible to accept these benefits [5].

Aside from the racial inequalities and higher costs of healthy foods locally, many other things factor into the results of living in a food desert. For low-income families, many adults work multiple jobs just to get by and do not have the time or energy to create healthy, well-balanced meals for their families. Instead, they choose to buy frozen pre-made meals or pick up dinner from the nearest fast food restaurant for cheap. For those without access to a car, it can take several hours to wait for and use public transportation to get to a store, shop, and bring back as much as you can carry. Walking or biking can pose as unsafe options depending on the location and terrain [4].

According to a study done by Tulane in 2009, 2.3 million Americans lived more than one mile away from a supermarket and did not own a car which accounts for about 2% of all households in the US at the time [6]. With the COVID-19 pandemic, food insecurity has increased as many Americans lost their jobs and food insecurity in families increased. With limited access to a supermarket with cheaper and nutritious food options, many Americans have health conditions related to malnutrition and food deserts can exacerbate issues regarding diabetes and high blood pressure. Studies have shown that an increase in price of fruits and vegetables also leads to an increase in children's weight over time, contributing to the estimated $71 billion in health care costs due to chronic diseases related to unhealthy eating [6].

Food Gatherers

Food Gatherers is a non-profit focused on alleviating hunger and eliminating its causes in our local community. Food Gatherers was established in 1988 as Michigan's first food rescue program, and is now the largest anti-hunger program in Washtenaw county. Food rescue involves working with local grocery stores and vendors to reduce the amount of food that would otherwise go to waste. Food Gatherers also is able to purchase and distribute food, with a goal of 60% of distributed food being protein or fresh produce. Volunteers are essential to Food Gatherers, and over 5,500 people volunteer with the non-profit annually [7].

Maize and Blue Cupboard

The Maize and Blue Cupboard (M&BC) is a service on the University of Michigan campus that provides free food and resources to U-M students, faculty, and staff. Several members of the team have utilized its resources and resonate with the mission they are trying to achieve of ensuring the University of Michigan community receives equitable access to healthy, nutritious, and nourishing food and the ability to prepare it for themselves or others no matter the reason they struggle [8].

Figure 3. Image of the pantry at Maize and Blue Cupboard

The team researched the many causes and issues of food insecurity and realized that the flawed infrastructure and systemic issues that surround food insecurity would be difficult to address in a one-semester mechanical engineering class. The team instead looked into partnering with M&BC to try and make change happen first hand, and excitely prepared interview protocols and questions for a meeting with their contact (see Appendix A1). Stakeholders for this project would involve the organization itself, along with staff members, volunteers, and users of the pantry. The team did not have specific anticipated project ideas going into the meeting, but were hopeful to come out with some areas to make the lives easier of either those running the cupboard, or the community that uses it.

The team generated questions (see Appendix A1 and A2) with the intent to confirm and determine the importance of needs identified in preliminary research, including ways to increase access to healthy foods, transport people to supermarkets and grocery stores, and reduce the economic burden of eating healthy. Additionally, some questions were focused on discovering and probing for additional needs in the local community and within the organization. The team used open-ended questions to get a direct perspective of a staff member at M&BC and a better understanding of the challenges they and their customers face on a daily and weekly basis. The flow of questions was flexible to allow the team to probe deeper into all their suggested needs and thoroughly understand the current functionality of the cupboard, regardless of the potential for a mechanical solution.

NEEDS FINDING METHODS AND RESULTS

Need 1

The first need statement developed from a standard literature review of food deserts is a way to provide healthy food to low-income Americans living in food deserts to reduce malnutrition related health conditions. This need statement came out of sources like a National Institute of Health article and a Tulane School of Social Work article. The NIH article explained that malnutrition as a result of living in food deserts can cause diseases like obesity, cardiovascular disease, diabetes, and stunted growth and development in children. [9] The Tulane article

provided some other solutions available for addressing access to healthy food, like a healthy grocery store on a bus. [6]. This solution offers low costs to consumers, but it is not a permanent, stationary solution. Additionally, Food Gatherers provides healthy food locally to Ann Arbor. One strength of their services is that they recover food from grocery stores that would otherwise be thrown away. However their services are largely based on donations and volunteers. [7] Current solutions have high costs and leave room for improvement. Stakeholders involved in this need are families living in food deserts, policy makers, and healthcare workers. The key decision maker is policy makers because they have the ability to impact programs like food stamps and provide subsidies to solutions that bring healthy food into food deserts.

Need 2

The second need statement developed from research on food deserts is a way to transport low-income Americans living in food deserts to grocery stores to to support the purchase of nutritious foods. This need was based on information gathered through secondary research and found from several online sources including USDA reports. Inaccessibility to food is not only caused by proximity to a grocery store, but in many cases it is the access to transportation as highlighted by the fact that 2.3 million American households live more than a mile from a supermarket and do not have access to a vehicle and an additional 3.4 million households live even closer, just between ½-1 mile away and do not have access to a vehicle [10]. There are a plethora of efforts towards public transportation systems that have been implemented in different cities - a notable one being the DASH transit. This is a transit bus that covers downtown Los Angeles as well as many outlying cities with multiple localizing routes, several of which lead to supermarkets and fresh produce based markets [11]. This is a high frequency transit service that offers a direct route to healthier foods. The issue with this system is that there is still a fee for commuters, while the $0.50 fee is not much, it can still take a toll on those who cannot afford little costs that add up. Additionally, the transit tries to cover areas on the outskirts of LA but there are still people who live outside this region who have not been able to take advantage of the services. Another popular existing solution are mobile markets. One in particular is a company called "FarmShare". Fresh produce is delivered to customers at a discounted rate. This provides a way for locally grown food from farmers to be distributed directly to neighborhoods experiencing geographic and economic barriers [12]. However, programs similar to this are not 100% reliable as they are typically smaller companies with a smaller staff. They are also susceptible to shutting down when weather becomes an issue or, for instance, pandemics as they are experiencing a pause on the program right now due to Covid-19. The stakeholders are local transit companies, the government, farmers, and people living in food deserts. The important stakeholders are the transit companies that have the capability to increase transportation support as well as the government who could help fund some of these more substantial transportation changes.

Need 3

The third need statement developed from a literature review about the relationship between food insecurity and food swamps, in which Americans live within a close proximity to a grocery store but live within even closer proximity to corner stores or fast food restaurants that are cheaper than fresh and healthy food. This need originates from secondary research including scientific journals, the National Institute of Health, and the United States Department of Agriculture.

Research from the Centers for Disease Control and Prevention has shown that a lack of access to healthy foods can contribute to obesity, malnutrition, diabetes, and premature births, with high BMI alone adding an estimated 386,000 excess deaths each year in America [13, 14]. Additionally, the prevalence of obesity leads to additional risks of hypertension, stroke, and type two diabetes, all of which contribute to additional health concerns. Current solutions to mitigating the economic concerns often rely on public policy including: taxing sugar-sweetened beverages, requiring front-of-package nutrition labels, marketing healthy foods while limiting marketing of unhealthy foods, subsidizing healthy foods for low-income populations, and many more [11]. These can be very successful measures, with some research showing that a 30% subsidy for recipients of the Supplemental Nutrition Assistance Produce increased produce purchases by 26% [11]. However, their success also depends on the specific policy implemented and the affected population, as well as the legislators and food industry advocates that manage these programs. Additional community based solutions include well-designed cities that include fitness and activity centers, reliable mass transportation, green space, and bike lanes which may slightly increase accessibility but fail to address economic concerns [15]. All of these methods to address the economic restrictions preventing Americans from consuming healthy diets are affected not only by the American population, particularly low-income families in food deserts and food swamps, but also by local and national governments, education systems, hospitals, media, and many more [16]. Primary stakeholders are the individuals and families who have this economic need, the governing bodies that attempt to address their needs using subsidies and other strategies, and health systems including primary doctors as well as hospitals that are affected by the overall health of their local populations. Other solutions that aim to address the greater overall need of food insecurity involve stakeholders such as education systems that aim to teach children the importance of a healthy diet, targeted media that aims to advertise healthy diets and avoid advertising unhealthy lifestyles to children, and many other groups. Because of the large number of stakeholders and affected populations, solutions addressing these economic concerns have wide reaching effects and the potential for a huge amount of positive impact on individual lifestyles and community health [16].

Need 4

The fourth need statement developed was derived after the interview with M&BC and is a way for them to communicate their services and informative content to the University of Michigan community so that those who would benefit from the services are aware of them. As highlighted in the interview summary with Kelly O'Mara [17], the main form of awareness for the cupboard is through word of mouth association. They want to ensure that their resources are reaching anyone in the community who has trouble getting regular access to food regardless of their history or living situation. Their plan to expand resources to include cooking demonstrations and recipes is an exciting initiative, but they want to ensure people know they offer things like that, and they want to make the M&BC a place that people want to go for more than just going in and out to grab a few things. Currently, the M&BC has a weekly newsletter that they send out to an email list, but it can often be out of date by the end of the week and the system is controlled off site by M-Dining which can be difficult to manage. A system that they can control from the M&BC that could easily be run by staff or volunteers could be very beneficial in the long run to publicize their resources. Some solutions that currently exist elsewhere, are apps that send daily notifications for different businesses or a site that consistently updates inventory for shoppers. A reservation system for shoppers could be useful, as could a reservation system for shoppers who

only need a few things to come, grab, and go with. The stakeholders in this need involve the M&BC program along with its workers and end users of a system that will keep them better informed of how M&BC can help them.

Need 5

The fifth need statement was also derived after the M&BC interview and is a way to optimize storage space for Maize and Blue Cupboard so they can accept a wider variety of foods for shoppers. This need was formed out of the struggles highlighted by Kelly O'Mara in her description of the functions of the M&BC [17]. The current space that the main office of M&BC is located in may seem small to the naked eye, but she placed a large emphasis that they are happy with the space they have since it took a lot to get it in the first place. Somewhere in a centralized location, with a loading dock, and some forms of storage is very useful. Throughout the interview it did seem like she was slightly closed off to the idea of changing the storage since there was no easy solution. However, the team recognizes that it is a large issue from listening to concerns and seeing first hand how they had three pallets of gatorade in their conference room, and 150 extra boxes of goods left over from the north campus distribution along with the limited fridge and freezer space. Current solutions for M&BC is to reach out to M-Dining to help store some items along with placing things wherever they fit. Other solutions for storage in the market are external areas to store, or shelving systems to hold items of different capacities. An outdoor area to store items could potentially be implemented, or trying to bring in more fridges or freezers - which would also mean the need to update HVAC systems for temperature control. The team plans to visit the location on site again to see all spaces of storage and get a quantitative measurement of storage space and areas to potentially rework physically or systematically to make life easier for the main stakeholders of staff and employees.

Figure 4. An image of M&BC's only walk-in refrigerator showing the density of storage on a light day.

NEEDS FILTERING AND RESULTS

Initial Filtering

The UNICEF TPPs were each considered, and in the first round of filtering certain TPPs were eliminated due to team interest and certain projects being out of scope of the class. For example, one TPP that required a vaccine be developed was out of the scope of the class and the team did not have the skillset to solve this problem. An example of a TPP that was eliminated based on team interest was height/measurement device, because we did not see it as an interesting problem with much room for innovation. This process of eliminating TPPs based on interest and scope left us with five TPPs that we researched and created the formal need statements for.

At a team meeting after the research on each of the remaining TPPs, the team realized that no one was particularly excited about any of the identified needs. Team interest was very important in this phase of needs filtering, because we knew that our project would have the most success if we were all passionate about the subject area. Once we were able to expand our research into general health insecurities and find food deserts as a group interest area, we were able to come up with the five needs statements previously introduced. Since we knew that we would all be happy with any of these needs, we decided we could do a final filtering process using a formal Pugh chart procedure.

Needs Ranking Filters

The procedure for the Pugh chart involved giving a weight to each of the 6 criteria, and then scoring each need on a scale of -2 to 2. We had a discussion about each criterion and what would make something a certain score before assigning values. For the Pugh chart, team interest was still considered but it was weighted the lowest because at this point, all of the needs had some level of team interest. Negative would have been a lack of interest, 0 was neutral, 1 was some interest, and 2 was significant interest. Next, impact to population was given a high weight because we wanted a project that would make a positive impact to the stakeholders. All of the needs statements had an ability to make an impact on the population, so they were all given positive values, but based on research done about the population some were given a 2 over a 1. Potential for mechanical solutions was given a high weight because we wanted our project to stay within the realm of engineering. In this case, a -2 was given to the economic burden team because this need is very policy based. Communicate services and information was given a negative 1 because although the problem does not seem mechanical in nature, there may be other types of engineering that can be applied to solve the problem. Access to stakeholders and feasibility of creating a solution in 1 semester were both given weights of 2 because they are important but not critical to our vision of a successful project. The needs directly found from Maize and Blue Cupboard scored the highest in access to stakeholders because we have a contact who is based at the University of Michigan. Lastly, stakeholder preference was weighted fairly high because we want to keep the goals of our stakeholder prioritized. The needs not directly related to Maize and Blue Cupboard were given a zero, because our stakeholder is not against us pursuing these needs, but they do not support her interests as well as the needs related to the Cupboard specifically. The Pugh chart is shown below in Table 1.

Table 1. Pugh Chart of Final Five Needs

Criterion	Weight	Provide healthy food...	Transport people to food...	Reduce economic burden...	Communicate services and info...	Optimize storage space...
Team Interest	1	2	0	1	2	2
Impact to Population	5	2	2	2	2	2
Potential for Mechanical Solutions	5	1	0	-2	-1	2
Access to Stakeholders	2	2	-1	-1	2	2
Feasibility of Solution in 1 Semester	2	1	-1	-1	1	1
Stakeholder Preference	3	0	0	0	2	1
Total		**22**	**6**	**-1**	**20**	**24**

The Pugh chart showed that the needs related to transportation and economic burden scored the lowest, so these needs were directly eliminated. The final 3 scored very close, however, the team decided that the first need was very broad and we preferred to work on a need that directly impacted Maize and Blue Cupboard. Thus, we proceeded to conduct benchmarking analyses and generate requirements and specifications for both needs.

Stakeholder Analysis

Figure 5. Interviews conducted through the team's needs filtering and design process

Maize and Blue Cupboard and its employees and users are primary stakeholders because their work and lives are directly impacted by the problem. We kept this in mind throughout the semester by engaging with the staff on a continuous basis. Food Gatherers and Swoops were two sources that we used to gather information about the problem context. They are both secondary stakeholders and may not be directly impacted by the solution. MDining is also a secondary stakeholder because we relied on them for project context. Michigan ITS is a primary stakeholder because their work could be directly impacted by our solution. Ultimately, they are the technology support system for the University and would be impacted by this application existing. CSCAR (Consulting for Statistics, Computing, and Analytics Research), and the subject matter experts that we engaged with on campus are tertiary stakeholders because they are outside of the immediate problem context but may have the ability to influence the success or failure of a potential solution.
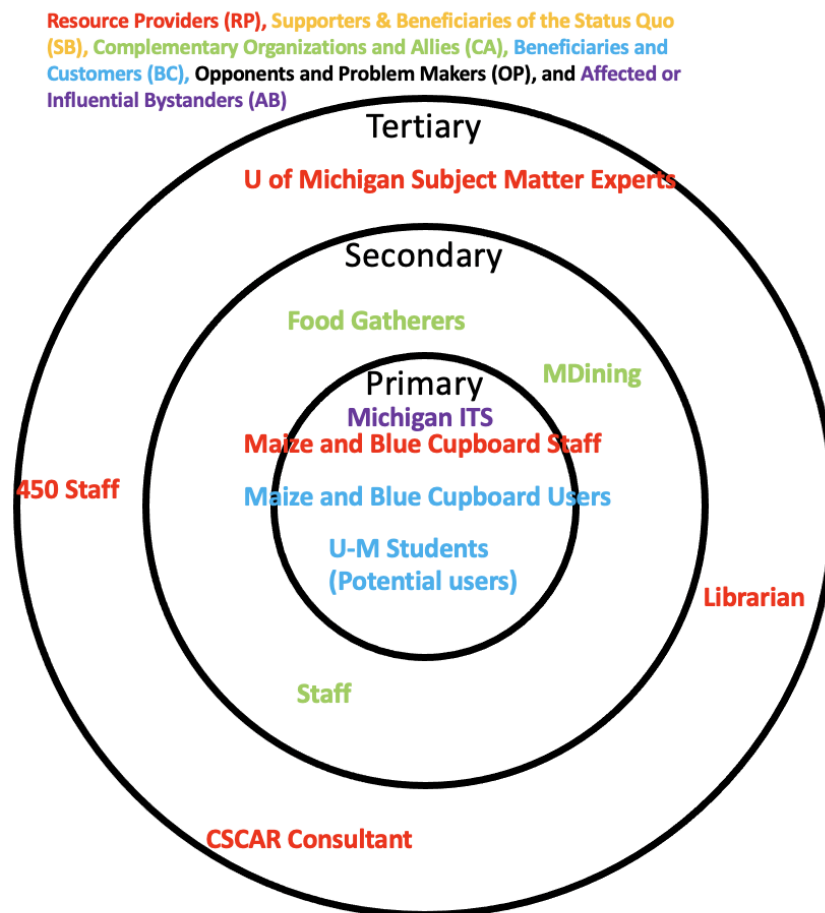
Ecosystem Map

Figure 6. Ecosystem Map

SELECTED NEED

Initial Selected Needs

The team began to explore both a storage- and communication-focused need to explore and learn more about before deciding whether to move forward with one or both of the needs. As we conducted benchmarking analyses and interviewed additional stakeholders to generate requirements and specifications, we realized that it would be difficult to optimize the storage space for M&BC based on existing building codes and available resources.

After our second interview with Kelly O'Mara from M&BC, we were hoping to gather more information on both needs and that a clearer pathway to a solution would reveal itself for us to move forward with our project. The storage problems were still relevant, but the pantry organization changed since the last time we viewed it due to the quick turnaround of supplies in the pantry itself. Interest in an app-like resource was still of value, but the team was wary due to our limited knowledge of software development [27].

In order to gather information from sources outside of M&BC we conducted several other interviews with outside resources that could potentially help us understand methods for organization and efficiency. We conducted an interview with Professor Yavuz Bozer, a professor of Industrial and Operations Engineering and leading researcher in facility logistics and design [18]. His expertise revealed that many industry operations do not translate well to small-scale operations such as M&BC and that their needs are best addressed with extended space and storage. Additionally, we conducted an interview with Swoops Pantry at Eastern Michigan University to learn about their operations and communication methods for their students. Their organization is smaller, but has a similar structure and issues regarding storage and communication. However, when COVID-19 came they were able to obtain more space at their current location and have access to more refrigerators and freezers. Some differences are that they had several other services such as online order pick up and a third party group recently conducting deliveries. They had a few other methods for communication such as having professors present and trying to be part of orientation tours [25].

Both of these interviews were very informative in helping us see a clearer picture of possible projects and plausibility of both needs areas. In addition to our interview with MDining, which we will speak about in our next section, the storage need did not seem as feasible since the best solution seemed to be spatial expansion. Meanwhile, we found many methods to communicate services and information about M&BC including a mobile application, interactive website, or video content describing the cupboard. Based on both these realizations, we decided to focus on the communication need for the next stage of concept generation.

Final Need Selected

The final selected need for the team is a way for M&BC to communicate services and informative content to the University of Michigan community so that those who would benefit from the services are aware of them.

Campus Food Pantry Background

Campus food insecurity affects 29% of four-year college students according to a 2020 survey of 202 colleges and universities [19]. This percentage, while already high, is likely an underestimate due to the decreased enrollment of college students during the COVID-19 pandemic. Numerous studies have shown that students affected by food insecurity are more likely to be students of color, financially independent, younger, or have children/families [20]. These students are susceptible to poor health and academic impacts including lower consumption of fruits and vegetables, worse mental health, lower ability to concentrate in class, and lower GPAs than food secure students [20, 21]. Existing programs such as SNAP often come short of addressing student food insecurity due to requirements such as participating in work-study programs or working a minimum of 20 hours a week [22].

Colleges have responded to student food insecurity by implementing programs including direct food distribution such as pantries and community gardens, SNAP application assistance, policy activities, and others [21, 23]. Often these services are combined in a single program, such as with M&BC [8]. However, these food pantry programs face their own challenges with operations, with the highest reported cause for ineffectiveness being lack of awareness about college hunger and services provided [24]. A survey of 150 food banks, many of which operate multiple campus pantries, revealed that the second highest barrier to college hunger work is lack of awareness, just below the lack of college administrative commitment [24].

Another top barrier for college students to access hunger services is stigma against food assistance [24]. A survey conducted on University of Central Florida students showed that 90% had never used a food pantry before and 25% found using it to be a difficult decision due to feelings of shame and embarrassment [21]. Young college students in particular may fear being called financially irresponsible or immature, which can negatively impact self-esteem and identity [21]. According to our interview with Heidi Bechtel, graduate assistant at the Swoops Pantry at Eastern Michigan University, many shoppers including herself feel an extreme sense of anxiety using the pantry [25]. Many shoppers also worry about privacy and the impact of receiving free food from the University on their financial aid [17]. These can significantly impact students' desire and willingness to utilize food pantry services on campus.

Maize and Blue Cupboard Operations

To gain more information about the specific communication challenges and suspected causes at M&BC, we interviewed program manager Kelly O'Mara [17]. In her opinion, the greatest barrier to effective operation is the lack of awareness by eligible faculty, staff, and students. M&BC currently maintains a website, several social media profiles, and a weekly newsletter to raise awareness of their services, however, word of mouth is still their primary form of publicity. This results in a low awareness of the existence of a food pantry on campus, and even lower knowledge of their services. Additionally, many misconceptions exist about student eligibility for the food pantry due to Ann Arbor's image as an affluent area despite challenges such as large distances and limited public transportation to grocery stores from campus. Students have a tendency to believe they are not food insecure enough to warrant using campus services because they can afford food even if they cannot get to a grocery store.

To learn about how M&BC handles their publicity, we met with Kelly Guralewski, marketing manager for MDining [26]. She handles most of M&BC's publicity needs including maintenance of their social media accounts and development of flyers and other marketing materials. In addition, she serves as the liaison between M&BC and Student Life, the university department that manages M&BC's website. Currently, they do not regularly monitor their publicity engagement, although data on their social media and weekly newsletters are readily available. For Guralewski, the challenges with publicity come down to complexity updating the website and pushing content that takes valuable time by limited staff.

Stigma about using the pantry also prevents UM students from using its services [17]. 65% of undergraduate students have a family income greater than $150,000 or did not apply for financial aid, which indicates a large population of students who have likely never used a pantry and may associate it with poor fiscal responsibility. In order to battle stigma and feelings of shame or embarrassment, M&BC does not record any information about shoppers or the contents or amount of food they collect. They are also providing SNAP application assistance on-site, generating programming to increase awareness of food insecurity on campus, and attempting to expand to pop-up services on campus to distribute food and increase awareness.

Benchmarking

Currently, M&BC does most of their advertising through a partnership with MDining, the U-M department in charge of managing dining halls, on-campus cafes and markets, Blue to Go foods, and Michigan catering. They also work with the Department of Student Life to house and manage their website and communicate services to the broader Michigan community. Their avenues of communication include a page on the Student Life website, a weekly newsletter sent to shoppers, three social media pages, and occasional posters and announcements in university newsletters.

We spoke with O'Mara, Guralewski, and Bechtel about the different avenues of communication that M&BC, MDining, and Swoops use to promote their services [25, 26, 27]. While M&BC uses the methods described above, they are also looking for ways to expand their marketing content to include a larger range of information such as recipes, workshops, and food education. MDining uses many overlapping communication methods but also maintains the Michigan app with daily dining hall menus. Guralewski also informed us of unofficial, student-made chicken tender-finding pages: a mobile app, social media page, and web tool. Meanwhile, Swoop's increases their visibility by including a quick informational summary on their services in student orientation and in class syllabi by participating professors. Finally, background research on other campus food pantries pointed us towards informational video content and channels to promote food pantry use [28].

Using some of the communication methods available to M&BC, we completed a quick comparison using important design considerations we gathered from O'Mara [27]. These considerations for the solution included being simple to use and implement, able to accommodate flexible creative content, quickly updatable, and accessible by a large audience. The simplicity requirements encompass the work required by the author and reader to access and use the information on a daily basis, and the work required by the author to implement from scratch. Solutions like websites and videos require a lot of upfront investment of time to develop

a platform for further content. Flexibility for content refers to the solution's ability to share various content such as recipes, blog posts, or interactive web tools such as streamlined online tools for applying for federal assistance. The consideration of quickly updatable refers to the time required by M&BC employees or volunteers to send out short announcements such as an overflow of radishes [17]. Finally, the large audience design specification considers the work required by the reader to find the information. Syllabi and orientation reach the largest audiences by default since they do not require the reader to locate or operate a website or other tool.

Table 2. Communication Method Benchmarking

	Simple to Use	Simple to Implement	Flexible for Content	Quickly Updatable	Increases Audience
Website	+	−	+	+	−
Class Syllabi	+	+	−	−	+
Orientation Content	+	+	−	−	+
Video Content	+	−	−	+	−
Mobile App	+	−	+	+	+

Table 2 above shows these solutions compared to a website, which is M&BC's current largest information source. None of these solutions satisfy more than three design considerations except for a mobile app, which is simple to use and update, while also reaching large audiences and accommodating many types of content. Preliminary benchmarking for the storage need can be seen in Appendix B1.

As we moved forward with the design project, our major stakeholder was Kelly O'Mara who is the program manager at the Maize and Blue Cupboard as the majority of our work and feedback comes from her as we develop our product. As we develop our design, other important stakeholders involve other staff members who would need to run the app along with users of the M&BC who would benefit from the centralized location of information and push notifications.

REQUIREMENTS AND SPECIFICATIONS

Development of Requirements and Specifications

To develop a complete set of requirements and specifications for our project, we scheduled another meeting with Kelly O'Mara to discuss the need in more detail (see Appendix A3). After we narrowed our needs down to two specific needs to support the Maize and Blue Cupboard, we developed two sets of requirements and specifications to outline possibilities for both needs. As mentioned previously, we decided to move forward only with the communication need. Requirements and specifications for storage can be seen in Appendix B2.

Based on our first two interviews with Kelly O'Mara from Maize and Blue Cupboard, we created a set of requirements and specifications regarding ways to expand knowledge on the resources

that M&BC has to offer members of the university [17, 27]. Originally the requirements were open-ended to allow for different methods of communication such as a website or a mobile app, however, based on input from O'Mara and other stakeholders we decided to focus on an app so we could get more detailed requirements and specifications.

As we developed these requirements, we shaded them green, yellow, or red to indicate that we were very, somewhat, or not at all confident in the requirements. These changed as we conducted research to support the requirement, or spoke to stakeholders about what the appropriate specifications should be. As Table 3 below shows, all but one of our requirements is now green.

Table 3. Updated Requirements and Specifications for App Development

#	Requirement	Specification	Priority	Source
1	A mobile application for centralized information	A mobile app available within the iOS and Google Play Stores for download	High	[1] - M&BC [2] - Mobile App Statistics
2	The app interface must be easy to use for staff, volunteers, and users	Must score at least 68 on the System Usability Scale (SUS)	High	[1] - SUS Scale (Likert) [2] - General Article on UX Survey Models
3	App allows for quick updates and notification pushes	Updates can be made within 30 minutes	High	[1] - M&BC
4	App must be affordable	No cost to M&BC and within ME 450 budget	High	[1] - M-Dining Interview [2] - ME 450 budget
		Free to download for users		
5	Solution helps University of Michigan community to be more aware of M&BC	Traffic and engagement time with the solution increases by 50%	High	[1] - California Agriculture [2] - M&BC Interview
		After using the system, over 80% of student users understand what services M&BC provides		[1] - ProQuest
6	App must be maintainable	App should always be compatible with the latest version of the operating system it is running on	High	[1] - Mobile app requirements reference guide
7	App must allow for several kinds of creative content to be distributed	App must include current item availability, recipes, educational blog/article posts	High	[1] - M&BC Interview
8	App adheres to M&BC's design	App uses M&BC color scheme (#2596BE, #FFCB04, #FFEB29) and fonts	Medium	[1] - M-Dining Interview [2] - University Standards
9	App must load quickly	Mobile app page should load under 3 seconds	Medium	[1] - Google load time statistics [2] - Google's Ranking Factors
10	App must be legible	App must have a 720x1280	Low	[1] - TechRepublic Resolution

		screen resolution		Guide [2] - Perfecto Resolution Guide
		Font size throughout app must be at least 16 pixels		[1] - Reference guide to typography in mobile web design [2] - MIT Study on typographic style legibility in reading at a glance
11	App helps decrease stigma of food pantry use on campus	After using the system, users score lower on the Food Pantry Stigma Scale than non-users	Low	[1] - University of South Dakota Study [2] - ProQuest

The first requirement we have is a mobile application for centralized information which was formed on the basis of M&BC wanting an app that contains all the information they currently stored on their website. We created the specification that the app must be available within the two main smartphone app stores which are the iOS App Store and the Google Play Store so the majority of students could download the app. Most students on campus have a smart phone or device, so M&BC preferred an app for their information and with a source on typical mobile app statistics to determine the platforms we should aim for. This was ranked as a high priority because users/non-users of the pantry need to access the app in order to increase their own awareness.

The second requirement is that the app's interface must be easy to use for staff, volunteers, and users which we have specified through a plan to create surveys using the System Usability Scale (SUS) to achieve a score of at least 68, representing satisfaction and ease of use. This scale was found through sources on Likert scales for mobile applications and general research on the best ways to score opinions on UX (user experience). This was ranked as a high priority because if the app is too difficult to use to send or receive information, it will likely not be used and will not help to spread awareness.

The third requirement is that the app allows for quick updates and notification pushes. The specification for this is that updates can be made within 30 minutes which is a number that we asked Kelly O'Mara from M&BC about since she has a busy schedule along with her staff and we do not want to inhibit any other daily processes and that is a high priority for her.

The fourth requirement is that the app must be affordable and we have specified that by specifying that there should be no cost to M&BC and if there is a cost it should fall within the ME 450 budget. Because we are planning on designing an app, we do not expect a large cost to be associated with creating one if at all. Additionally, we have a second specification that the app must be free to download for all users because students facing food insecurity often have financial problems as well so we believe that an app that costs money would not be purchased and therefore, not used.

The fifth requirement is that the solution helps the U-M community be more aware of the resources M&BC has to offer which is a requirement that we had previously and are still working on gathering information for. This is the main problem for M&BC so it is a high

priority, and ideally all students who use the app would be able to understand what services are offered at M&BC.

The sixth requirement is that the app must be maintainable which we specified as being able to run with the latest operating system versions of the smartphone devices it can be downloaded on. This requirement is color-coded yellow currently because we are not sure if this requirement will be a large issue and the extent of the effect that phone updates have on mobile applications. As the team learns more about app design and development, we will have a better understanding and way to specify an app being easy to maintain.

The seventh requirement is that the app must allow for several kinds of creative content to be distributed which we specified as the app must have pages categorized to M&BC's needs. During our interview with Kelly O'Mara, she said that ideally the app would contain all of the features currently available on their website right now such as recipes, educational series, and the ability to send status updates about current items and supply [29]. This is currently classified as yellow because the specification is not quantifiable and the team needs to do some work to understand how many different features are currently available on the website and a corresponding specification. This is ranked as a medium priority because some aspects

The eighth requirement is that the app must adhere to M&BC's design and communication standards with the specification that no issues arise with MDining or any branding on campus. Additionally, M&BC has a website theme that carries across their site that we will implement for consistency and flow. Through our conversations with M&BC and MDining we do not foresee this being an issue because there are no well-written requirements surrounding this which is only a medium level priority.

The ninth requirement is that the app must load quickly with a specification of loading under 3 seconds because we want to ensure users have a good experience and are not running out of patience. According to Google's analytics, 53% of mobile sites are abandoned if a site takes longer than 3 seconds to load [30]. If people gave up on waiting for the app often, it is likely that the app would not be used and hence there would be no increase in awareness.

The tenth requirement is that the app must be legible which has specifications of having a 720x1280 screen resolution and font sizes of at least 16 pixels. These numbers are pulled from different resolution guides and reference to typography in mobile web design and reading. Smaller font sizes could compromise readability for visually impared and too large could make reading more difficult, 16 pixels is the text size typical browsers display by default according to usability expert Olver Reichenstein [31]. This is ranked as a low priority because as long as the app has all the information necessary, it will still be a success and we do not expect this requirement to be a large problem.

The eleventh requirement is that the app helps to decrease the stigma of food pantry use on campus which has not changed from above. We have specified a plan to determine stigma through the use of the Food Pantry Stigma Scale low score. This scale comes from several studies on food insecurity and social implications that come along with the use of them.

The requirements that must be met for our project are requirements 1-8 whereas requirements 9-11 are more desirable. Requirements 1-8 reference what the app needs to contain and address the overarching goal of ensuring that information is being distributed to make users more aware about M&BC and its resources. Requirements 9-11 are centered more around general user aesthetics and experience that do not have as large of an impact on functionality and information processing as earlier requirements. Requirement 11 is a desire that hopefully the app helps to address, but would be a side benefit and stigmas are not necessarily something that the team can control.

CONCEPT GENERATION

Method for Concept Generation

Our concept generation phase began with a scheduled hour-long brainstorming session. We chose this as our first concept generation method as it was the best method to generate as many ideas as possible in a short period of time. Initially we all came up with ideas individually so as to get a plethora of ideas while not getting stuck simply reiterating on each other's ideas. Then we shared our ideas with one another and allowed this additional time to comment or reiterate on others' concepts. We used whiteboards and iPads to allow ourselves to sketch ideas when helpful. Due to the open-ended nature of the app development process, we brainstormed several aspects such as the layout and functionality of the app as well as app development strategies like what software or language to use. Table 4 displays all the features and functions we brainstormed to incorporate into the app. As shown by the divided columns, we organized the brainstormed features into three different categories: Need, Want, and Nice to have. Under the 'Need' category there were mostly features that currently exist on the M&BC's webpage that would need to be captured and transferred over to a mobile app such as basic information about location, hours, and contact information. Additional features in this category pertain to the major ideas that we want to communicate through this app to end users such as what food is available to students during a given week as well as different program initiatives that M&BC has going on that students are to be aware of. The 'Want' category envelopes features that go beyond the basics and would improve end user interaction whether that's through incorporating push notifications or email notifications as well as give students access to lots of resources to make food, learn more about food, or educate themselves on food insecurity. The 'Nice to have' category consists of more specific and advanced features that will elevate an app but are not essential to the app running and doing its job in spreading awareness of M&BC. For instance short videos are a current way to reach out to the younger generation on campus, however the same information can be translated through some of the recipes or blogs that show up in the 'Want' category. In addition to brainstorming features, the team brainstormed different application softwares that could be used to create our project, these included the following: Appgyver, hard code in Swift, Clutch.co, Ionic, and Flutter.

Table 4. Brainstormed features and functions

Need	Want	Nice to have
- Basic info - locations/hours	Calendar (distribution days)	- Search function - Visual feedback for page

○ about us ○ contact info ○ Socials ○ join email list ● FAQ ● How to help (donate, volunteer) ● Schedule an appointment ● Food availability ● Program initiatives (schedule to let people know what's coming up)	● Educational content ● Recipes ● Blog ● Banner for covid updates ● Resources home 　○ SNAP info 　○ SNAP schedule appointment 　○ Dean of students ● Push, in-app, email notifications	loading, updating, etc. ● Shopping list ● Short videos ● Advanced analytics ● One click phone number

After the initial brainstorming session, we transitioned into using Morphological analysis to generate more concepts. This method was chosen since Morphological analysis would allow us to break the problem into smaller sub-functions. In our case specifically we could look at the features we had come up with in our brainstorming session and think of ways to integrate them into a mobile application. Appendix C2 displays the Morphological chart we created, the features of the app are listed in the left most column and the preceding columns list multiple ways to implement these features. For instance, to make students aware of the Food Availability of the cupboard, we brainstormed several ideas on how to do this including sending push notifications, emails, updating a newsfeed, and sending in app notifications. Another example is incorporating FAQs, there could be a list of standard questions posted on a page within the app, we could provide a space to submit individual questions people have, there could be a live chat option to talk with someone in M&BC, or there could simply be an infographic published on the app that answers preset FAQs. This 9x4 matrix offers over 200,000 combinations of ways to implement every feature on the app, this allows for options and flexibility in how we want to incorporate features.

As a final round of concept generation, we applied the TRIZ method, specifically Ideal Ultimate Result (IUR). The framework of questions used in this method will be a valuable opportunity to reframe the way we are thinking about the solution space. IUR focuses on solutions that can be reached when given unlimited time and resources, otherwise known as the ideal result. This allows us to think of any concepts that we may have subconsciously not included earlier because we thought it was too unfeasible. To start this method we first defined the function we wish to improve, for us that was to improve the awareness of M&BC across campus. Then we defined the ideal ultimate result: we wish to improve the awareness of M&BC across campus by having an app available to all members of the university that centralizes the information M&BC wants to publicize and that this app is easily updatable for staff of M&BC. We then followed the rest of the prompts from this IUR method provided in Appendix C3. The prompts encourage you to think of existing technology or solutions that address components of the defined ideal ultimate result, then use these answers to help formulate concepts that would apply to our own project. From applying this TRIZ method we were encouraged to look at more established mobile applications from companies who had extensive time and resources such as Feeding America Food Bank and apps like Yelp to explore even more features and processes that would help reach our ultimate ideal result such as incorporating Google maps, incorporating a tracking system of on users within the app, or having an automated system update within the app.

In order to determine if we had explored the extent of the concept space and confirm that we were done with concept generation, we took multiple factors into account. First off, we researched existing food pantries and their apps to understand the features and layouts that their webpages or applications offered to ensure our concept generation had covered those bases. Additionally, we researched mobile app best practices to not only understand what layouts and features are most desirable, but to understand prioritizing and limiting features. This allowed for yet another check to ensure that our list of ideas generated was extensive and fitting for our need. Besides this additional research, we held stakeholder interviews to review our generated ideas. We conducted these to confirm that we were on the same page as well as to provide feedback on any other concepts they wanted to see reflected in our project. Finally, we looked at the logistics of the time left within our schedule to determine if additional generation was required. Overall, these checkpoints helped us to come to the conclusion that our concept generation was complete.

CONCEPT SELECTION PROCESS

The list of chosen features was developed from stakeholder input and from consulting best practices for the number of features to include in an app. These features cover all of the current features included in the website. After confirming the structure of the morphological analysis with our stakeholder, we decided to continue with the basic structure of the morphological analysis to determine the ways to implement each feature. A Pugh chart for each feature was developed with decision criteria of stakeholder input, feasibility, and ability to meet requirements and specifications. Some of the features could have multiple final implementations, so we stayed open to ties which would mean multiple implementations. One of these Pugh charts is shown below in Table 5. The remaining charts are in Appendix D.

Table 5. Pugh Chart for food availability

Criteria (Food Availability)	Weight	Emails	Push Notifications	Newsfeed Update	In app notifications
Stakeholder Preference	5	0	1	0	0
Feasibility	4	0	-1	1	1
Accomplishes requirements and specification	4	0	1	0	0
Total		0	5	4	4

In the above Pugh chart, food availability was the feature and the options are ways to implement this feature. The implementation of emails was given a score of 0 since it is a very standard practice for this method. The other options were given scores for each criteria of -1 if it met the criteria less so than the baseline, 0 if it met the criteria in an equal way as the baseline, and +1 if it met the criteria more so than the baseline.

In addition to the way that the features are implemented, the method of developing the app was also part of the concept selection process. Multiple options were considered including coding from scratch, coding in a software package used by Michigan ITS (Ionic), and a couple of

softwares that allow for less coding with built in functionalities. The table below shows the criteria that these options were compared with, including price, easy of use, experience from testing, and general comments.

Table 6. App Development Decision Matrix

	Appgyver	**Hard code in Swift**	**Clutch.co**	**Ionic**	**Flutter.dev**
Price	Free	Free	Monthly Fee	Free for student use	Monthly fee
Ease of use (1-10 easy-hard)	3	8	4	7	2
Experience from testing	Very nice to have connection to app (app in app). Also good online resources	EECS 441 professor did not recommend us pursuing	Easy to use, nice design features	Difficult to download. Need to use Javascript.	Looks straight forward, nice connection to google systems
Comments/ Decision	Pursuing prototyping with this option	Might be outside of the time constraint/our abilities	Fee might not work with M&BC's budget	Would be nice because this is what the Michigan app uses. Not much experience with Javascript	Fee might not work with M&BC's budget

Even though this selection process did not have clear numerical comparisons, Appgyver was easily chosen after experience testing each of the options. The free cost makes this an accessible form of development, it has a very user friendly interface, and the team appreciated the ability to connect to an Appgyver app on our own phones to easily see what adjustments look like on a phone in real time.

SELECTED CONCEPT

After developing the Pugh charts for each feature, the results were summarized in the following table, with the green highlighted boxes as the chosen implementations.

Table 7. Selected implementations of each chosen feature

Features	Ideas →			
Appointments	Link to outside site for scheduling	~~Scheduling built into the app~~	~~SNAP assistance meetings~~	~~Calendar with availability for meetings~~
Donations	Link to leaders and best donation site	~~Donate directly through app~~	~~Directions about how to donate in person~~	~~Provided email contact of financial head of M&BC~~
Food Availability	Push Notifications	~~Emails~~	Newsfeed Update	~~In app notification~~
About Us	General Information	Cupboard history	Option to join email list	Contacts
FAQs	List of standard questions	~~Options to submit your own questions~~	~~Live chat with someone from M&BC~~	~~FAQ infographic~~
Data Analytics	Track where people click	Random surveys on usability	~~Incentivize reviewing app~~	~~Focus group on app functionality~~
Recipes	Cooking tutorials	~~Images of prepared meals~~	~~Meal prep strategies~~	~~Grocery list with each recipe~~
Educational Content	Short videos	News feed	~~Push notifications~~	In-kitchen M&BC workshop times
Contact Info	One click phone number	~~Link to socials~~	~~Staff listings/positions~~	Contact form like on website now

As shown in Table 7 above, some of the features have multiple implementations. These implementations varied enough to consider multiple for one feature and also scored similarly on the Pugh charts. As mentioned in the concept selection section, Appgyver was chosen as our main app development strategy. The software connects to an Appgyver developer app, so although the app has not been released to the app store we are able to see the prototype on our phones. We are able to update the app through Appgyver's website and model the results.
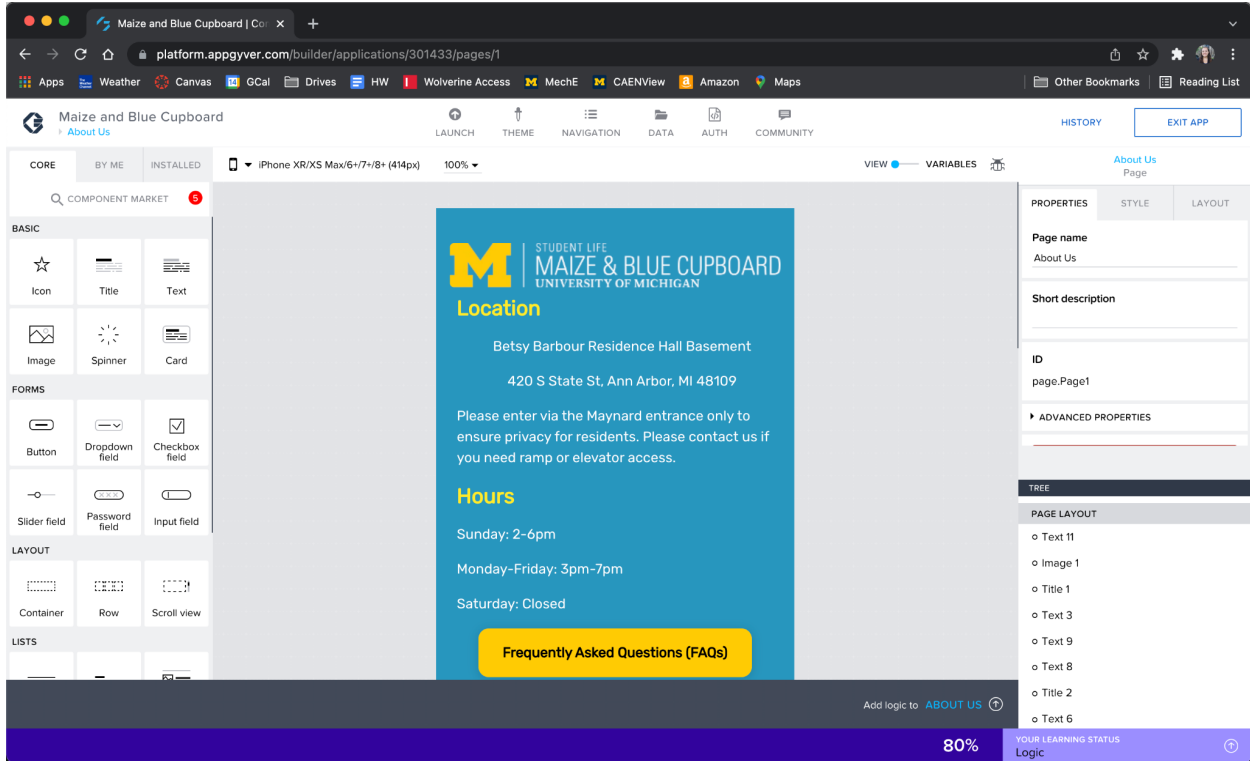

Figure 7. Example of Appgyver's online platform site for app editing

We have begun prototyping with some of the chosen features. Screenshots from our initial prototype are shown in Figure 5 below. Highlighted are the recipes that M&BC currently has on their website along with an example of a push notifications that have the potential to send quick product availability updates.
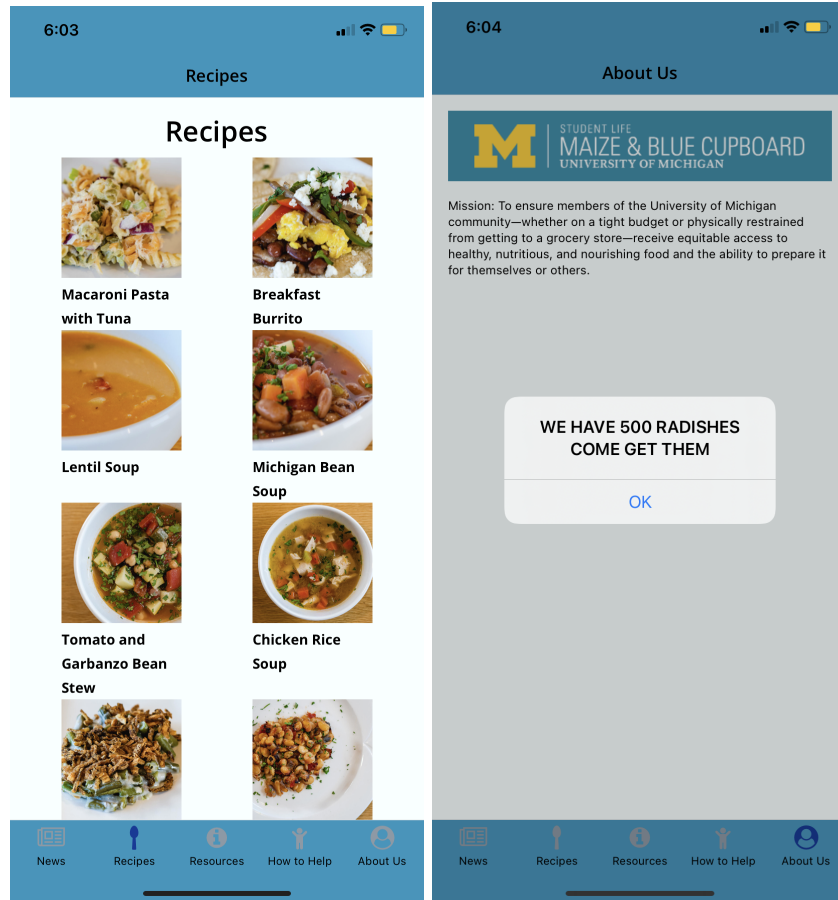
Figure 8. Prototype of app showing a recipes page and a push notification

The initial design is based off of M&BC's typical design standards and the layout of their website. The screenshot shows the first iteration of developing a recipes page and sending a push notification. The team is working to expand to more of the selected features and implementations.

ENGINEERING ANALYSIS AND ITERATION

Due to the nature of our need specifying the use of an app, our concept analysis is heavily geared towards user feedback and usability tests. We plan on conducting multiple rounds of usability testing and iterating our app design based on feedback gathered from those interviews. Although the majority of our requirements and specifications can be viewed as pass/fail requirements (i.e. meeting color codes, how much the app costs, loading capabilities, etc.), a portion of our requirements depend directly on user feedback. In order to measure how easy or difficult the app is to use and how much awareness it raises of the M&BC, we need to talk to users with and without knowledge of the cupboard or the software system itself to gather data, hence the reason we have chosen several usability tests for our engineering analysis. These methods will also support our verification and validation efforts as key requirements revolve around user input.

Usability Testing Background

The overall goal of usability testing is to gather data about a design to identify and rectify any deficiencies or holes in the completion of a product. Basic elements of a usability test include the development of research questions, defining test objectives, finding a representative sample of end users, observations of end users, extensive interviewing, collection of quantitative and qualitative performance and preference measures, and recommendations of improvements for the product [33]. Usability tests tend to focus more on uncovering problems rather than demonstrating the existence of some phenomenon or complete functionality of a product. [34]

Usability tests can be conducted in many different formats, such as focus groups, surveys, walk-throughs, etc. and each test gathers different types of information that can be helpful when prototyping [33]. The short timeline for our project limits us from conducting usability tests with a true sample of all demographics and backgrounds on campus when it comes to knowledge on M&BC. We decided to focus on a few key areas of end users to gather data from the areas we identified as the most important: employees and staff of M&BC, current users of the cupboard, and random students or staff on campus with a range of knowledge on the cupboard. Random students and staff on campus will include team members reaching out to friends and roommates on campus, classmates, staff and employees they interact with. If time permits, the team will also try to send campus-wide blasts about testing through student newsletters and social media.

Our basic test plan format is to have participants participate in a pre-assessment survey, test plan, post-assessment survey, and debrief. The pre-assessment survey will serve as a way to gather demographics and information about a users' social status and background on campus (all parts of the pre-assessment are optional due to not wanting any users to feel uncomfortable while sharing information). The test plan will be used to demonstrate capabilities and features of the app for the user in several different chosen methods explained below. The post-assessment survey will contain feedback forms using the System Usability Scale (SUS), which will be followed by a debrief for us to gather qualitative opinions and feedback about the app and its current design [33].

Usability Test Plans

We have chosen five test plan methods that we believe will be the most effective for our app to gather information about data: unmoderated testing, moderated testing, unit testing, A/B testing, and co-discovery [35]. The team will begin testing with unmoderated and moderated testing and will move towards unit and A/B testing once the app is closer to being fully developed.

Unmoderated Testing - participants complete tasks along to explore the product and the interviewer simply observes methods of exploration [35]. For our app, this can be done through a team member watching a user explore and take notes on any trends in exploration or through screen recordings that can be analyzed later.

Moderated Testing - moderators observe and guide participants as they explore the product remotely or in person. This test method is useful early in the development or prototyping phase before a product is finished to gather reactions and insight into the current status [35]. We can

use this method to ask a participant to explore the current app and see what they are able to discover and learn about M&BC.

Unit Testing - participants are given specific tasks to accomplish on their own while moderators observe areas of confusion [34]. This usability test will be helpful to determine how users expect apps to be set up to find the resources they are looking for. Moderators can ask questions during or after to understand reasoning behind the methods of use for the app.

A/B Testing - A/B testing takes two versions of a product and allows participants to compare the two to determine which works better at addressing the need put forth [35]. Due to the limited software capabilities and time constraints put on our team, we do not plan on developing two different mobile applications to compare, but rather compare the app to the resources currently available on the M&BC website.

Co-discovery - This method involves having two individuals participating in a usability test at the same time. A format with two users allows for open conversation about thoughts, navigation methods, etc. which may otherwise be awkward for individuals to state during a solo test [33]. We can use this test method in conjunction with our other test plans to gather thought processes during exploration and while conducting tasks.

Analyzing Test Results

Each of the test plans will produce a plethora of information for the team to sort through and analyze, both qualitative and quantitative. Our analysis will contain results of the SUS Scale survey and understanding thoughts and opinions of users. Each type of test outlines above has a set of debrief questions to understand any and all feedback from users.

The System Usability Scale (SUS) is a common tool used for measuring usability. The scale consists of 10 questions with five responses ranging from Strongly Disagree to Strongly Agree [36].

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

We have created one google form for users of the app and one for the staff and volunteers of M&BC to ensure that our definition of "easy to use " applies to all users and aligns with expectations for this chosen likert scale. Once users complete this survey, responses are

converted to scores on a 0-100 scale. A score of 68 would be considered average, so anything above a 68 would bring us to the "easy to use" conclusion [36].

Outside of the SUS Scale, we plan on analyzing the responses to our debrief questions as well to understand common trends and trouble from users. There are many ways to analyze qualitative responses such as using a code book to pick up common trends in responses and patterns difficult to see with the common eye, but for this semester the team plans on using basic methods to understand the results.

After all of the debrief interviews, the interviewer will write a summary with key takeaways from the interview for quick full-team understanding and take note of anything that stands out from typical or expected results. After each round of testing, the team will read through other interviews to bring a new perspective to the information gathered and note down any additional takeaways the original interviewer did not notice.

One takeaways have been summarized from the usability tests, all team members will come together to discuss overarching takeaways trending between users and specific suggestions or recommendations users had. Then, the team will discuss design changes and brainstorm ways to eliminate common and expected sources of confusion for future users. Further analysis after the semester ends would be necessary to ensure a successful app rollout for M&BC. With that being said, we are confident that usability testing will give us great insight into the functionality and usability of the app.

Iteration and Limitations

A mobile application can have many rounds of quick iterations because no physical prototyping goes into viewing a new product, and we can view changes immediately. We will have many iterations of the app and design changes that we will keep track of for our final evaluation of our given product.

Limitations of usability testing at the current stage of testing involve physically being with users, or having users that are willing to download new software onto their phones to conduct tests remotely. The software we currently use, Appgyver, allows participants to open the M&BC app within their app using a provided QR code for our platform.

All members of our team currently have AppGyer on our phones to view how the app would appear to users and have the log-in to the mobile build site. End users of the app would either need to meet with a team member and use said member's device to explore the app or download the Appgyver software and scan a QR code we provide remotely to conduct an end user test. Staff and employees of M&BC could meet with a team member for testing or log-in remotely with the provided log-in to explore how to make changes to the app and potentially send push notifications. Luckily, our group has both iphones and androids that we can test the app on in the meantime until we are ready for mass user testing across the university.

FINAL DESIGN DESCRIPTION

Our final design is a mobile app that acts as a hub for Maize & Blue Cupboard's informational content and external communication. There are six pages that are used to organize this content: About Us, Resources, Volunteer, Recipes, Calendar, and News. Each of these pages houses different information, as shown in Table 8 below.

Table 8. Main pages of the app and their information

About Us	● Location ● Hours ● Mission statement ● Other background information
Resources	● FAQs ● Newsletter ● Contact for M&BC and Dean of Students ● Information on SNAP benefits
Volunteer	● External link for monetary donations ● Sign ups to volunteer on-site or at distributions ● Information on hosting a donation drive
Recipes	● List of healthy recipes provided by M&BC ● Filters for dietary restrictions
Calendar	● Embedded Google calendar of events and programming created by M&BC
News	● Feed of weekly blogs and informational content ● Banners with important announcements or information

The style of the app is designed to match M&BC's website for a cohesive look and feel for users. Additionally, the app is intended for new and regular users and provides frequent updates on the home page, as well as background information on other pages. By featuring the newsfeed first and foremost, new and regular users can know what is happening at the cupboard quickly and easily, while still being able to find static information elsewhere. While we are still working on implementing the infrastructure required to push notifications to a user's phone outside of the app, this feature will eventually encourage users to engage with the app and the cupboard by bringing it to their attention as events come up at the cupboard.
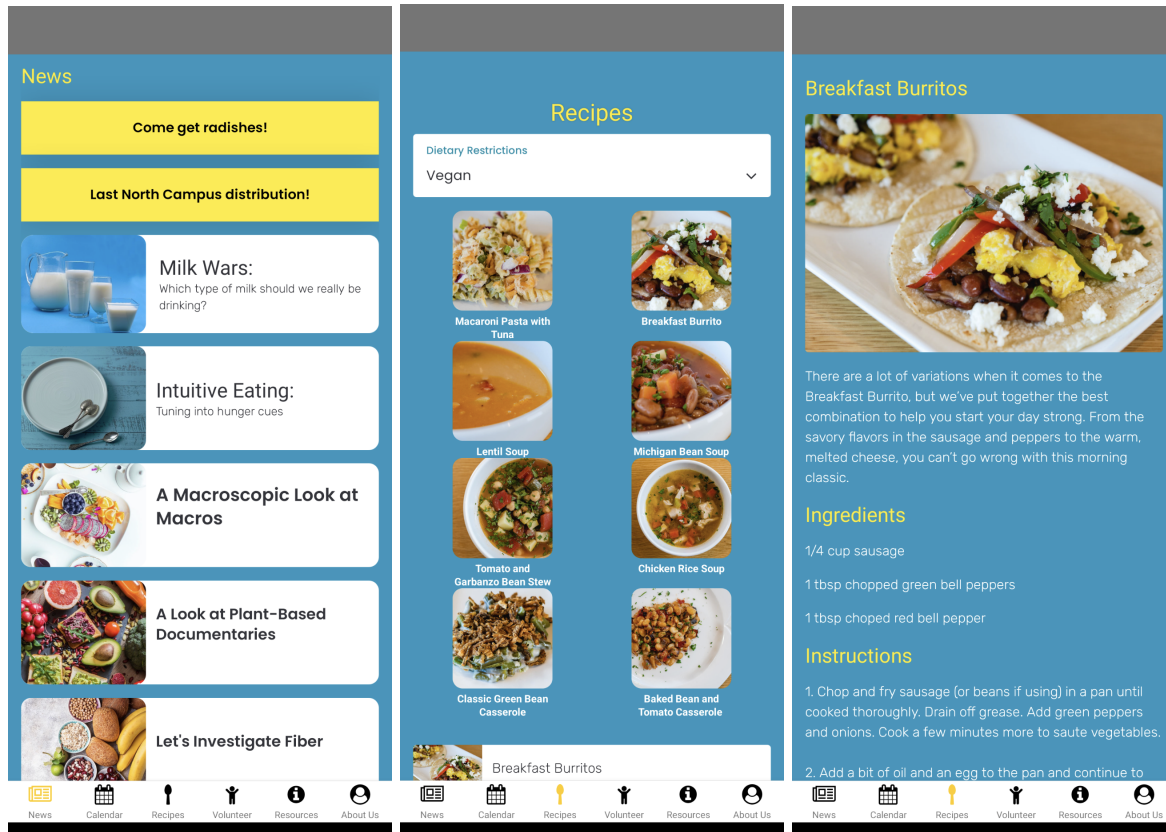
Figure 10. Final design of the app including six easily accessible pages at the bottom. From left to right: newsfeed, recipe page, and individual recipe.

In order to easily allow M&BC staff to add new content and push notifications to the app, we use a backend server to host the information that will be on the app. This information is read into the app using a REST API, a set of architectural constraints that makes interfacing between a client and server simple. Then, this We are currently using a realtime database on Google Firebase to store the app content, which is automatically fed and updated in AppGyver at 5 minute intervals. This information is auto-populated into the app and will create new pages and text boxes as necessary to display the information. Additionally, the use of a REST API makes it easy for this server to be changed in the future if the app is incorporated into the Michigan ITS system.

The data for the app is currently stored in a JSON file on Google Firebase. It features three main sections: recipes, posts, and announcements. Each of these sections has their own subsections to include the name, content, tags, and any other relevant information. Currently, the app can be updated by going into the server and adding updates to the JSON file or uploading a new one. Although JSON file types are well-documented and the requirements for filling one out properly are clear, it can be frustrating and difficult to use for people unfamiliar with them. Thus, we are working on a tool where M&BC staff can simply open a tool that automatically shows what information is required and allows them to fill it in, then formats it properly for uploading.
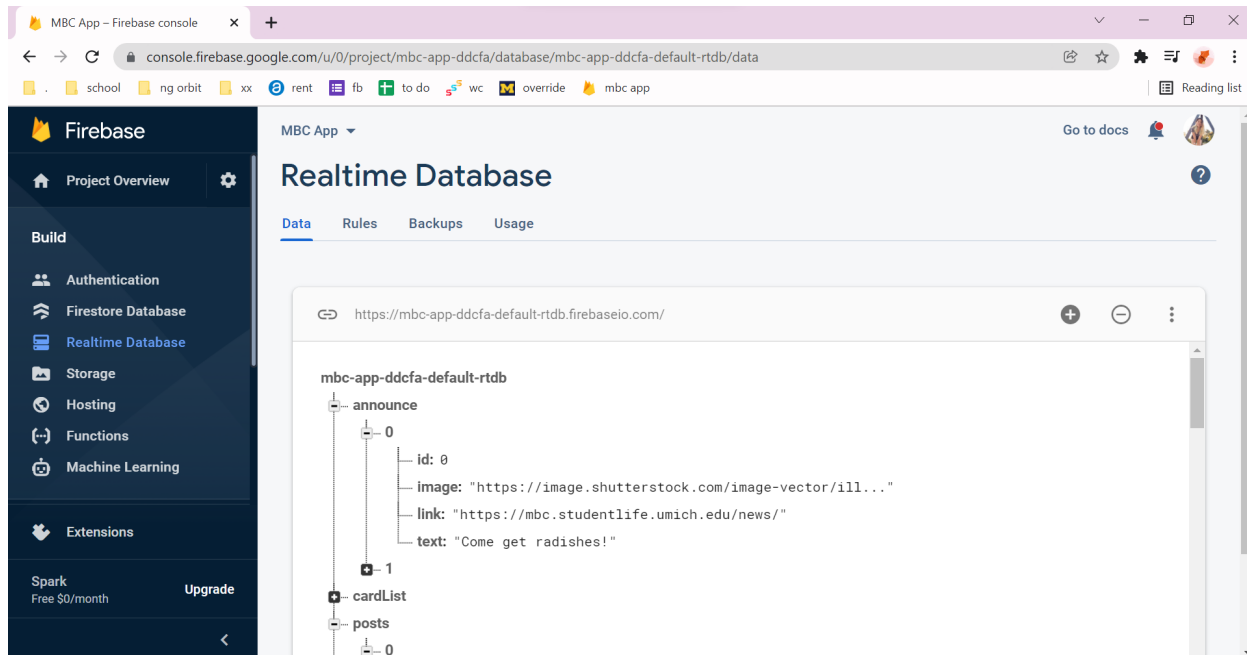
Figure 11. An image of the Realtime Database in Google Firebase used to hold content for the app

Although our app is still in prototyping and development, our ability to be testing the app by ourselves and with other users was extremely helpful in developing the final product. Early on, we manually programmed each article into its own page, which was tedious but allowed us to show it to users and determine how much information was appropriate and what content could and could not be accommodated. It has been important in allowing us to validate many of our specifications including what is possible to be included in an app. We will also be using it moving forward to test and confirm whether it will help increase engagement with the cupboard by users, beginning with a focus group that will use the unpublished prototype app. We expect the final version to be built off the existing progress we have made but with features incorporated based on user testing and feedback. Although we were not able to publish the app this semester, we are still looking to publish it over the next few months using the progress we have made with this build.

The cupboard was first conceptualized and created to address the critical public health issue of food insecurity on campus, and although they are doing a great job already at providing services to help those in need, we hope that our product will help them reach an even larger audience and help more people. Our app was designed with public health and welfare in mind and we considered all the types of users that may benefit from the cupboard's services and made sure the app was easy to use for all.

Since the app was designed with such a specific group in mind it would not have a large impact on a global marketplace, but the idea of using personal technology to increase awareness and distribution of information can definitely be applied in many contexts globally.

Another factor that has been important in our prototyping and design is the social impact of the app in the community. Historically, stigma about using food pantries or stamps has prevented

many eligible people from benefiting from their services. On college campuses in particular, low-income students often feel especially out of place with large populations of high-income students and thus feel shame from using on-campus resources. We are hoping that by increasing awareness of M&BC on campus and increasing the audience that receives their informational programming, we will see this stigma decrease.

We do not expect our app to have a significant economic impact in its development or use. It was developed on a very small scale, and will be free to use for students and only a small fee upon publication for M&BC.

In order to characterize the potential societal impacts of our app, we used a stakeholder map to identify the people and groups most relevant to our project. This included M&BC staff, student and faculty users, and the larger university community. M&BC rank social impact and education as the highest targets for themselves and thus for our project, and despite their frustrations about some of their other needs such as storage, they really encouraged us to go for the app and help increase awareness. Their desire to share their resources is evident in everything they do and every conversation we have with their staff and other stakeholders. Additionally, we have engaged with other groups on campus including the MDining marketing group and Michigan ITS, who have expressed a strong desire to help M&BC with their mission. By following their desires and their example, we hope that our app will have a very positive impact on the community and help people who use their resources.

When our app is finally published, we are hoping that it will make a large impact on the M&BC and its users. By considering the public health and social impacts that our app can have, and by engaging frequently with M&BC stakeholders as well as student users, we are confident that the final app will be successful in making M&BC information more accessible and available to the larger university community.

VERIFICATION AND VALIDATION APPROACHES

Does the Design Work?

The fast pace nature of this class and semester as a whole has allowed us to have verification and validation, but at a limited amount. As mentioned previously, we planned on using a wide array of user testing to analyze our design, but also pave the way to verification and validation of the design as a whole. Despite the fact that we are not finished with our app, we have had multiple meetings with Kelly from M&BC to confirm that the efforts we are making are aligned with the wants and needs of the M&BC.

Publishing an app is a long process that can sometimes cost a lot of money, so we have not been able to fully publish and get public opinion, but we have gathered information from who we know. Our section instructor and sponsor should believe that our design is viable based on the user tests and demonstrations of the product we have provided thus far. We gave our sponsor the app name and QR code for our platform so she could download the app onto her own phone and give direct feedback herself. We figured that just showing her would not be as effective as her

clicking through and pointing out anything that was wrong or that she wanted added. We had her share her phone screen as she explored and took notes on thoughts and ideas she had throughout. As we had a lot of background information on Kelly, we conducted a simple moderated user testing of explaining the features and watching her click through herself. She was happy and very excited with the product thus far and is excited to see how we continue to develop it.

Additionally, each team member conducted preliminary peer unmoderated user tests for feedback and general opinions on what has been developed so far. The team is wary of wide-scale user-testing until we learn push notifications and clean up the current state of the app. Once we work out a few holes in the app, we plan on utilizing university resources and focus groups for further validation.

Have we met our requirements and specifications?

Our requirements and specifications can be sorted into two categories: in development or met. As we are not done working on our project we have not had the opportunity to test every aspect of our design against our 11 requirements.

An example of a requirement that is in development is requirement number two which references scoring at least a 68 on the SUS Scale to gauge easy app interface for use. Since we are early in the design and have not conducted many user tests yet, this is still developing. On the opposite end of the spectrum, a few other requirements are closer to a pass/fail method of verifications. An example is the specifications for the app meeting the same fonts and color codes currently found on the M&BC website, which we currently are able to meet and pass.

At the current stage of our design, we have completed 6/11 of our requirements and 5/11 are still a work in progress for us to achieve next semester. Although the design is not complete yet, we do feel as though we have a successful design thus far and are confident that with more time and effort put in next semester, we can create a useful app for the M&BC.

Throughout the process thus far, our stakeholders have placed a lot of trust and freedom as we go about creating the app and should feel confident that we are trying our best to help due to the fact that we plan to continue the project next semester despite the class ending. For full validation of our project, we expect it to take multiple iterations and prototypes and we understand an ideal solution takes time. Many specifications given to us by our sponsor were flexible in terms or increase communication because any increase of traffic or knowledge on campus is a little victory in and of itself.

ANTICIPATED CHALLENGES

As we think about continuing the project next semester, we are still faced with the learning curve related to developing the mobile application. Although our choice of software is far easier to interface with than our originally anticipated solutions, we still have a lot of unfamiliarity and are working to overcome this by watching video tutorials and spending time learning how to integrate aspects like push notifications and data streams into the app.

Another challenge we anticipate is handling the knowledge transfer of our project after the end of the semester and especially after we graduate. We are planning on addressing this by creating a guide for O'Mara or other new M&BC staff to learn how to also use the app, as well as meeting with Michigan ITS and related departments to discuss integrating these features into the Michigan app.

DISCUSSION

The final design offers a centralized location for M&BC information. The color themes fall within M&BC design standards, and it provides M&BC with quick access to users. Our team has maintained a high level of stakeholder engagement, and our final prototype demonstrates a result driven by input from our main stakeholder. There are remaining requirements that have not been met and some additional areas for improvement. First, we are waiting for information about programming initiatives that will need to be incorporated into the app. Additionally, we have begun testing push notifications but have not yet achieved fully functional notifications. This is a feature that is especially important to our stakeholder. We are also still working on making sure that information can be pushed to the app from an outside source through a data stream. Finally, we still need more usability testing to fully verify our requirements and specifications. This has been limited due to time constraints. However, several team members have agreed to continue working on the project next semester to finish the prototype and hopefully work towards an application that can be downloaded from the app store.

We learned a lot about the importance of stakeholder engagement throughout this project. The process of gathering information and keeping stakeholders involved was important throughout the design process, especially during needs finding and concept selection. We also all learned about the app development process, which was something we all came in with little background on.

If we had more time and resources to collect data and better define the problem for our project, we would have conducted more interviews of current M&BC users and random students. We could have used these surveys to gather data on their knowledge of M&BC. We would explore questions like 'How likely are you to download an app for a resource on campus?' and 'What information would you like to see about M&BC in an app?'

RECOMMENDATIONS

Several of our members are planning on continuing our project throughout next semester so we do not have a fully fleshed out list of recommendations for our project yet. As of right now, the platform we are using to develop the app has been working, but if we passed off the entire platform then a good amount of training would need to be conducted to ensure staff is ready to take on the challenge of editing the app.

Current issues involve the integration of a server so staff do not have to edit the physical app itself every time they want to add information, but to upload to a separate website with info that the app pulls from. If we were to pass off the project right now, we would recommend they learn about online servers and app development, but that is not necessary.

As we move closer towards a final product of the app with working features to ours and M&BC's satisfaction that is reflected in user tests, we will develop a list of recommendations of our learnings, findings, and recommendations.

SOCIAL CONTEXT

Multiple aspects of the social context surrounding our project were considered throughout the semester. Public health, safety, and welfare was critical to our project, especially in regards to the current pandemic. Group members wore masks at each project meeting and completed the ResponsiBLUE screening check as required by our sponsor at meetings inside of M&BC. This product might be of benefit in a global marketplace because university food insecurity is an issue around the world, and food banks on campus need ways to communicate their services to their campuses. The app was developed specifically for M&BC, but the formatting could be reapplied in other locations. Although the manufacturing and disposal impacts of our technology did not need to be considered, one of the possible social impacts of the use of our application is that there is still a stigma around using food banks, and using this app could have a similar stigma. We intend to make the app free on the app store so as to not cause an economic burden to the end users. Due to the lack of physical building, we did not conduct a life cycle cost since it did not seem relevant to the project. However, ecosystem mapping was important throughout the process because of our high level of stakeholder engagement to determine societal impacts.

APPLICATION OF BLOCK CONTENT

IP
Intellectual property protections such as copyright can be applicable to the code that we create to make our app. It is to be determined once the team does put together this app who will own the intellectual property.

Design process
The problem oriented design process model seems the most useful to the context of our project since we are looking to find the best possible solution to our need statements so we must define the problem and use analysis to come up with preliminary or conceptual designs that will ultimately produce solutions. We want to unravel the problem before attempting to synthesize solutions.

An activity-based design process model is also useful in the context of our project because it encourages an iterative movement between different "stages". We are given flexibility working, for instance, with early prototype development before we even select our needs. Our process is not defined by completing stage after stage; there is flexibility and an iterative nature.

As we have conducted multiple interviews and completed benchmarking analysis, the remaining part of the design process for us to complete is the build process along with verification and validation testing. The socially-engaged design model has been very useful for us in the context

of our project because an app that technically works may not functionally work for the M&BC so ensuring we are keeping all users in mind throughout the process has been very important.

As we move towards the completion of our product, usability testing stages will be very important when determining whether the product is successful and any changes that are necessary to satisfy the M&BC, its users, or anyone else who comes into contact with the app.

Problem definition
If we had more time and resources to collect data and better define the problem for our project our team would ask more questions pertaining to end users, further questioning their perspective as a food insecure student on campus as well as questioning if everyday students are aware of M&BC and their mission. We would collect these metrics using surveys. Furthermore, if we had time we would conduct focus groups to see what forms of communication work best for these students, as well as potentially seeing what form of advertising they would like to see from M&BC in order to increase engagement and spread the word. As we wrap up the semester, due to time constraints we have only had time to ask Kelly from the M&BC and friends/roommates about the product as opposed to covering all bases of participants and people on campus.

Social context assessment
M&BC will be affected positively by our project. Our project specifically works with M&BC to benefit them and how they can help the students on the University of Michigan campus. Our project is also geared towards having a software based solution that has no additional cost to M&BC or the University of Michigan, therefore, this project will not have any stakeholders affected negatively in the manufacturing, emissions, disposal, and cost process.

M&BC is a non-profit that aims to help food insecurity on campus so they prioritize social impact above profit and environmental impact. They also aim to educate about food whether that is how to cook, nutrition of food, or eating disorders, therefore, they will also have a secondary priority of education. Their priorities will affect the emphasis we place on certain areas as we are there to help them, so what they consider important is also very valuable to us and the direction of our design. Their priorities of social and educational impact will most likely cause a positive impact of these in our project.

For our project it is important to consider the context of this project is a college campus to understand the target audience and ensure our design will be tailored to this context.

Library
We have met with the librarian and reviewed the scope of our project to which she gave us resources to look into food standards, food bank information, and other research papers on campus food insecurity. We have found that using keywords in research databases and within University of Michigan's library has been most useful in collecting data from reputable sources in order to inform our research on our topic of food insecurity. The main challenge we have found when collecting information is seeing discrepancies on information pertaining to app development mainly when it comes to different people's opinions on what is important to keep in mind when creating one. This challenge can be addressed by ensuring we cover a large breadth of research in the area so we can observe if there are patterns across these opinions. We can also

choose to focus on some of the more technical aspects of this research in order to collect objective data that will help inform our app.

Inclusion and Equity

Under the umbrella term of culture there are many aspects including, but not limited to: values, language, techniques and skills, knowledge, and community. Our team members had several cultural commonalities between us including our values, community, and language. Sharing values such as a good work ethic and integrity allowed our team to stay organized throughout our design process and thorough with our research and work. Additionally, once connected to our stakeholder we wanted to ensure quality work not just for ourselves but for M&BC. That is what encouraged our team to work beyond the allotted semester schedule of ME 450 into next semester. All members also have the experience of being a part of the University of Michigan community, this has allowed us to work together bouncing off ideas of departments and resources to look into on campus.

The team's cultural differences also bring benefits to the project approach. All members bring varying technical skills to the table, there are a couple members who are more familiar with the socially-engaged design process along with rapid prototyping and testing. The team collectively has different experiences that bring varying ideas to our project. For instance, one of our team members had volunteered at Food Gatherers over the summer which led us to have a connection once we pivoted to food deserts as our project focus. Another member of our team works on a project team that works on a project for families in Guatemala where culture is different and user tests are immensely important to ensure an end product will be used and not ignored. One member is also a heavily involved member of M-Rover and has experienced multiple years of experiencing a mechanically-heavy based design process and has a lot of background knowledge on how to conduct progress in a project.

When working with our stakeholders we shared a common language and community. Since English is the primary language for all our team members as well as the staff we spoke with at M&BC, there were no language barriers; we communicated through email as well as zoom calls. M&BC is also part of the University of Michigan which allows for a shared understanding and background knowledge on a majority of their work. It also made communication and connection with our stakeholders more straightforward and direct. As a group of students attending the University of Michigan working on a project pertaining to the betterment of student life, our stakeholders were very willing to meet with our team and recommend us to the necessary connections to make our ideas become a reality at the university. Additionally, the value of wanting to help this common community pivoted our focus to a final product that would specifically help students on campus. The unique techniques and skills that our team members have gained from previous engineering classes allowed us to offer a technical way to address their issue of communication. The difference in our knowledge base allowed our team to offer a solution that the staff members had not previously attempted.

There is a visible power dynamic between our team and end users, the formal processes we make and implement in our design and solution will shape decisions such as who will be able to utilize our solution, otherwise known as our end user. There is a hidden power dynamic between our team and our stakeholders. Meetings with our stakeholders determine what considerations are

prioritized in our decision making process as our goal is to help M&BC. In the case of our project, which addresses food insecurity, none of our team members have experienced this. Therefore our perspective is different from some of the food insecure end users, meaning we had to put in thorough research and educate ourselves on the need. However, being a college student on campus without a vehicle to get groceries at one's own discretion is something that some team members have experienced and therefore can understand what may work or not work in terms of publicizing M&BC's information.

We aim to include every team member and stakeholder viewpoints and opinions through working in invited spaces, meaning we are constantly communicating with our stakeholders whether it is understanding something they want, updating them with our progress, or asking them about a change of route we have had within our project. We also ensure that each team member is heard throughout every meeting we have and that all our decisions are unanimous.

We will balance whose ideas are selected to inform the project based on our need statement and the scope of our project. If there are any competing priorities we will first look at whose idea would directly benefit or address the need statement first. Then, if both fit this description, we will assess which idea is the most logical to pursue based on our time constraints. Overall, keeping a clear communication with everyone involved to explain why one idea makes more sense over someone else's will be beneficial in maintaining this balance.

Ethics

Some ethical dilemmas our team expects to face will surround the time frame of our project, keeping proper protocols for coding an app under pressure of time. We will manage them by prioritizing the proper protocol since team members will be available to follow up on this project next semester if time is an issue.

The professional ethics our team is expected to uphold by the University of Michigan is found within The Engineering Code of Conduct, we must be, "honorable people to ensure safety, health, fairness, and the proper use of available resources in thier [our] undertakings." These are the same expectations by future employers, as engineers we will have influence on future products or processes that society will use and we are expected to design these in a way that protects the safety and welfare of end users, stakeholders, and anyone else affected. Our personal ethics of wanting to maintain integrity and be good citizens in today's society aligns with these factors of helping people and keeping them safe.

Environmental Context Assessment

Considering our project solution will be software based, the manufacturing and disposal of the app is sustainable and will not cause finite resources to be used up or emit pollution. However, the use phase of this app will encourage more time to be spent on one's phone. While it is likely most of our target audience has mobile phones already, and therefore our project is not directly causing those finite resources to be consumed in manufacturing the phone, the utilization of this app will encourage battery loss. Battery loss will then require more frequent charging of the mobile device. It is found that charging smartphones can lead to high CO_2 and other greenhouse gas emissions. To mitigate these emissions attributed to charging our team can work towards having an app that will not drain the battery percentage from a phone. We can make it more

sustainable by having the app automatically stop running when switched to an alternate app so that it is not running in the background. This design upgrade would not have a monetary cost, it would simply cost more time and effort into the coding of the app.

Concept Exploration

Our team is at the early stages of planning our concept generation phase, as stated in the Concept Generation section earlier we plan to start off with a general brainstorming session to look at aspects such as the layout, functionality of the app, coding languages, and user interface design. We will then use morphological analysis to break the problem into smaller sub-functions. Finally, we will be using TRIZ methods to reframe the way we are thinking about the solution space to produce new ideas that are potentially quite different from the ones produced earlier.

Engineering Analysis

Due to the nature of our project being a mobile application, not all engineering analysis techniques can be applied. Our main method of analysis will occur through usability testing with a wide range of participants on campus. We directly referenced some of the sources and books from the blocks to learn about usability testing along with additional internet research.

Within our exploration we determined five best methods of usability testing (unmoderated, moderated, A/B, co-discovery, and unit-testing) that we have decided to incorporate in our testing. Our general format will include a pre-assessment survey to learn about the background and demographic, the user test itself, a post-assessment survey, and a debrief. The pre-assessment survey will allow us to determine whether we are capturing a wide range of participants including those who have used the cupboard one, many times, or never before. Also, since the cupboard is available to students, employees, and staff, we can understand the breadth of knowledge on campus about the Maize and Blue Cupboard. After our chosen user test is completed, we will have participants complete a System Usability Scale (SUS) Survey to gather opinions in a quantitative manner. The debrief will allow our team to understand qualitatively the thoughts and opinions of the app from our users.

Through usability testing, our team will be able to learn perspectives, suggestions, and comments about what is incorporated into our app for possible improvements. We will potentially be able to conduct usability tests for the same users (if not a large range) as we make updates and note whether customer satisfaction is being met quantitatively (with the SUS surveys) or qualitatively (through debriefs).

Verification and Validation

Most of the verification and validation of the design will be completed next semester as some of the team finalizes the design and works on final deliverables. We will begin planning now by working through the process of confirming if the solution works as we designed it and if the solution addresses the design problem. For validation, we will keep our stakeholder engaged by asking critical questions about if she can envision the app helping with M&BC's communication problem. One of our requirements also addresses that the community be more aware of M&BC after the app has been released, so this would be tested 6 months and 1 year after the app has been released. For verification, we will run tests on run time and length of time to make updates

to confirm that the app works as we designed it. We will continue usability testing to ensure that the solution is easy to use.

CONCLUSIONS

The final need that the team decided to address throughout the semester focused on a way for the Maize and Blue Cupboard to increase their methods of communication with users and people on campus through the use of an app. Currently the Maize and Blue Cupboard has a website that is operated through student life at U-M which they send weekly updates to for new content. Although M&BC has a consistent group of users currently, they have trouble getting info out about their resources in terms of programming, their educational series, and quick updates of new items that have recently come into stock. Additionally, they face struggles reaching people who think that if they are not the ones struggling the most on campus – even if they face a daily struggle – they would not want to use the pantry as its resources are best for others. In reality, the pantry is stock on a need-by-need basis so the more reservations and customers, the more food they will receive.

To solve this problem, the team had multiple conversations with Kelly O'Mara, the program manager at M&BC, to decide to pursue an app they could use to distribute content with. Through several rounds of research, our team settled on a platform called Appgyver to use for the formation of an app. So far, the team has been able to create a preliminary prototype of an app that contains the current features of the website. Several features are not fully flushed out due to waiting on resources from the M&BC as well as more research the team needs to complete. For example, the newsletter sign-up is not found on the website so we cannot put it on the app yet, and we have not successfully implemented push notifications yet. Aesthetically, the app is meeting design requirements and specifications and works on multiple types of smart devices, but many requirements are still a work in progress.

At our solutions' current state, the quality is good, but not great due to the outstanding features missing on the app. However, several of our team members plan to continue working on the app next semester in order to produce a product to the highest quality we are capable of before handing it off to the M&BC for good.

ACKNOWLEDGEMENTS

REFERENCES

[1] "Target product profiles (tpps)," *UNICEF Supply Division*. [Online]. Available: https://www.unicef.org/supply/target-product-profiles. [Accessed: 27-Sep-2021].

[2] E. R. Hager, A. Cockerham, N. O'Reilly, D. Harrington, J. Harding, K. M. Hurley, and M. M. Black, "Food swamps and food deserts in Baltimore City, MD, USA: Associations with dietary behaviours among urban adolescent girls: Public health nutrition," *Cambridge Core*, 22-Sep-2016. [Online]. Available: https://www.cambridge.org/core/journals/public-health-nutrition/article/food-swamps-and-food-deserts-in-baltimore-city-md-usa-associations-with-dietary-behaviours-among-urban-adolescent-girls/3E8A0082E3CF8AD5B5B82BB2EC399B36. [Accessed: 28-Sep-2021].

[3] K. I. DiSantis, S. A. Grier, J. M. Oakes, and S. K. Kumanyika, "Food prices and food shopping decisions of black women," *Appetite*, 27-Feb-2014.

[4] "The wheels on the bus go to the grocery store." [Online]. Available: http://www.saferoutespartnership.org/sites/default/files/resource_files/wheels_on_the_bus_0.pdf. [Accessed: 27-Sep-2021].

[5] T. E. King and M. B. Wheeler, "Chapter 37: Obesity as a Clinical and Social Problem," in *Medical Management of vulnerable and underserved patients: Principles, practice, and populations*, New York: McGraw-Hill Medical Pub. Division, 2007.

[6]School of Social Work - Tulane University, "Food deserts in America (infographic)," *Food Deserts in America | Tulane School of Social Work*, 18-Jan-2021. [Online]. Available: https://socialwork.tulane.edu/blog/food-deserts-in-america. [Accessed: 27-Sep-2021].

[7] "Learn about hunger," *Food Gatherers - fighting hunger where we live*. [Online]. Available: https://www.foodgatherers.org/get-involved/advocate/learn-about-hunger/. [Accessed: 26-Sep-2021].

[8] "Homepage," *Maize & blue cupboard*, 22-Jun-2021. [Online]. Available: https://mbc.studentlife.umich.edu/. [Accessed: 29-Sep-2021].

[9] V. J. Christian and K. R. MIller, "Food Insecurity, Malnutrition, and the Microbiome." 10-Nov-2020.

[10] M. V. Ploeg, Washington, D.C.: U.S. Dept. of Agriculture, Economic Research Service, 2009.

[11] "Organic Agriculture: United States," *Farmshare Austin*. [Online]. Available: https://www.farmshareaustin.org/. [Accessed: 27-Sep-2021].

[12] "Healthier Food Retail (HFR) action guide," *Centers for Disease Control and Prevention*, 09-Jun-2021. [Online]. Available:

https://www.cdc.gov/nccdphp/dnpao/state-local-programs/healthier-food-retail.html. [Accessed: 26-Sep-2021].

[13] 2017 Oct 30, 2017 Jul 05, and 2017 Jun 07, "Potential policy approaches to address diet-related diseases," *Healthy Food America*. [Online]. Available: https://www.healthyfoodamerica.org/potential_policy_approaches_to_address_diet_related_disea ses. [Accessed: 27-Sep-2021].

[14] Branca F;Lartey A;Oenema S;Aguayo V;Stordalen GA;Richardson R;Arvelo M;Afshin A; "Transforming the food system to fight non-communicable diseases," *BMJ (Clinical research ed.)*. [Online].

[15] Barnes, Ann Smith, et al. "Obesity as a Clinical and Social Problem." Medical Management of Vulnerable and Underserved Patients: Principles, Practice, and Populations, 2e Eds. Talmadge E. King, and Margaret B. Wheeler. McGraw Hill, 2016.

[16] Nordström J, Thunström L. Can targeted food taxes and subsidies improve the diet? Distributional effects among income groups. Food Policy. 2011;36:259–271.

[17] L. Wermers, R. Li, and K. O'Mara, "Interview with Maize and Blue Cupboards," 30-Sep-2021.

[18] Y. Bozer, A. Brzzezinski, T. Fung, R. Li, and L. Wermers, "Interview with Yavuz Bozer," 21-Oct-2021.

[19] The Hope Center for College, Community, and Justice, "#RealCollege 2021: Basic Needs Insecurity During the Ongoing Pandemic. "

[20] Bruening, M., van Woerden, I., Todd, M., & Laska, M. N. (2018). Hungry to learn: the prevalence and effects of food insecurity on health behaviors and outcomes over time among a diverse sample of university freshmen. The international journal of behavioral nutrition and physical activity, 15(1), 9. https://doi.org/10.1186/s12966-018-0647-7

[21] Jamie B. Daugherty, Matthew Birnbaum & Alena Clark (2019) 'Having Enough': Students' Understanding of Food Insecurity and Campus Food Pantry Use, Journal of Poverty, 23:7, 600-620, DOI: 10.1080/10875549.2019.1652721

[22] Supplemental Nutrition Assistance Program (SNAP). USDA Food and Nutrition Service Website.. In: Published 2021.

[23] Sarah L. Ullevig, Liset L. Vasquez, Lindsay G. Ratcliffe, Sara B. Oswalt, Nikki Lee & C. Austin Lobitz (2021) Establishing a campus garden and food pantry to address food insecurity: lessons learned, Journal of American College Health, 69:6, 684-688, DOI: 10.1080/07448481.2019.1705830

[24] T. Berry, M. Sloper, K. Doll, "Addressing Food Insecurity Among College Students," Feeding America.

[25] H. Bechte, A. Brzezinski, R. Li, L. Wermers, "Interview with Swoop's," 25-Oct-2021.

[26] T. Fung, K. Guralewski, R. Li, "Interview with MDining Marketing," 25-Oct-2021.

[27] A. Brzezinski, T. Fung, R. Li, K. O'Mara, L. Wermers, "Interview with M&BC," 12-Oct-2021.

[28] El Zein, M. Vilaro, K. Walsh-Childers, K. Shelnutt, A. Mathews, Development and Assessment of a Video-Based Communication Campaign to Promote Food Pantry Use by Food Insecure College Students, Journal of the Academy of Nutrition and Dietetics, Volume 121, Issue 10, 2021, Page A152, ISSN 2212-2672, https://doi.org/10.1016/j.jand.2021.08.081.

[29] A. Brzezinski, T. Fung, R. Li, K. O'Mara, L. Wermers, "Interview with M&BC," 29-Oct-2021.

[30] "Mobile site abandonment after delayed load time," *Google*. [Online]. Available: https://www.thinkwithgoogle.com/consumer-insights/consumer-trends/mobile-site-load-time-statistics/. [Accessed: 20-Oct-2021].

[31] S. Scacca, About The Author Suzanne Scacca is a former WordPress implementer, and A. T. Author, "A reference guide for typography in mobile web design," *Smashing Magazine*, 01-Jun-2018. [Online]. Available: https://www.smashingmagazine.com/2018/06/reference-guide-typography-mobile-web-design/. [Accessed: 20-Oct-2021].

[32] A. Brzezinski, J. Everhart, "Interview with Food Gatherers," 30-Sep-2021.

[33] J. Rubin, D. Chisnell, "Handbook of usability testing how to plan, design, and conduct effective tests." Wiley Pub., Indianapolis, IN :, 2008.

[34] J. S. Dumas, J. C. Redish, A Practical Guide to Usability Testing. 14-Nov-2021.

[35] [3] Playbook UX. "10 Popular Usability Testing Methods" https://www.playbookux.com/10-popular-usability-testing-methods/ [Accessed: 14-Nov-2021].

[36] A. S. for P. Affairs, "System usability scale (SUS)," Usability.gov, 06-Sep-2013. [Online]. Available: https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html. [Accessed: 23-Nov-2021].

[37] A. Brzezinski, T. Fung, S. Jamin, "Interview with CS Professor," 9-Nov-2021.

[38] A. Brzezinski, R. Li, W. Burns, "Interview with Michigan ITS," 11-Nov, 2021.

BIOS

Alexa Brezezinski

Alexa Brzezinski is a senior in mechanical engineering with a minor in computer science. She is from Pittsburgh, Pennsylvania. The University of Michigan's strong engineering program and her cousin's positive experience as a Michigan engineering graduate led her to make the move to Ann Arbor for college. She became interested in mechanical engineering because it provides a strong foundation to impact product design, development, and production across multiple different industries. She is also interested in the intersection of mechanical engineering and computer science. After her freshman year, Alexa studied abroad in Dublin, Ireland and had the opportunity to take both a physics course and a modern Irish history course. On campus, she has been involved with research, the Society of Women Engineers, a multidisciplinary design team, and won season 8 of Survivor Michigan. Alexa has completed two internships as a product supply engineer with Procter and Gamble, working in their baby care division on products like Pampers and Luvs. Alexa is currently recruiting for full time job opportunities, and is pursuing options in various parts of the United States in industries like consumer goods and medical devices. Spoiler Alert: Proud winner of Survivor Season 8.

Trinity Fung

Trinity Fung is a senior in mechanical engineering getting a minor in electrical engineering. She was born and raised in Windsor, Ontario and now resides in Rochester Hills, Michigan. She first became interested in engineering after joining the robotics team in high school and becoming mechanical lead of the team. She comes from a family of engineers with her dad being a vehicle dynamics engineer, her sister working at Stellantis, and her twin having done an internship with Stellantis. In 2020 she had a production engineering internship with Gentex Corporation working with their interior electrochromatic mirrors. This past summer she had an internship with Ford Motor Company as a service engineer in their Vehicle Personalization division. She is now looking to start full time employment with Ford Motor Company this spring. Outside of school and work she is involved with the campus orchestra at the University of Michigan as well as the President of the boxing team.

Rachel Li

Rachel Li is a senior studying mechanical engineering with a minor in electrical engineering. She grew up in Fairfax, Virginia and first gained an interest in engineering through model rocketry. She is planning on graduating this fall and continuing her education with a masters in electrical engineering through Michigan's SUGS program before entering industry. She became interested in mechanical engineering because of her love of hands-on work and robotics. Since her freshman year, Rachel has been heavily involved within the student organization MRover and is currently the president of the organization. In the past she also served as the mobility lead and treasurer for the organization. Additionally, Rachel is working with the Multidisciplinary Design Program's Northrop Grumman Orbit Team to provide a proof of concept for a satellite servicing mission to replace solar arrays on failing satellites in orbit. She previously interned at Honeybee Robotics in Altadena, California where she worked on sample transport in cryogenic environments.

Larissa Wermers

Larissa Wermers is a senior studying mechanical engineering with the international minor for engineers which allows her to continue to pursue her spanish language proficiency and learn more about different cultures. She is originally from Doylestown, Pennsylvania which is about an hour outside of Philadelphia. She became interested in mechanical engineering after she arrived at the University of Michigan and learned more about each of the majors through ENGIN 110. Math was always her favorite subject growing up and she loves hands-on work and building things as she helped her dad with a lot of house projects growing up. She is currently in the process of applying to graduate school in renewable energy and hopes to study abroad for her masters if accepted, and eventually wishes to get an MBa. Larissa studied abroad the summer after freshman year for six weeks in Buenos Aires, Argentina where she took a few classes and was able to travel and explore on the weekends. Larissa is currently a project lead for a student project team called BLUElab Sa' Nima' Collaborative who are working on two different projects to reduce the economic burden placed on families in Guatemala so they can fund their children's pursuit of higher education. She was lucky enough to travel with her team before COVID and has learned a lot about the socially engaged design process and the needs assessments. She is also involved in two MDP teams, Mapleseed Sensory Network, and Northrop Grumman's Automated Wire Harness Project. She interned this past summer as a Product Development Intern at Ford Motor Company and the previous summer as a Manufacturing Intern at Graco High Pressure Equipment Co.

APPENDIX A: Interviews & Protocols

Appendix A1. Kelly O'Mara (M&BC) - 9/30

Interview Protocol
- Can you describe your role and job at Maize & Blue Cupboard?
- We have a basic understanding of how Maize & Blue Cupboard works, but can you tell us the process in your own words?
  - Where does your food come from?
- What are the most common reasons why people do not have access to healthy food in Ann Arbor?
  - What are the different needs of UM students versus other Ann Arbor residents in regards to healthy food?
- What is the greatest challenge your organization faces on a frequent basis?
  - Possible follow-up: Inventory (keeping stuff fresh and organized)? Supply chain (sourcing produce and donations)? Transportation?
- Where in you/your staff's day-to-day routines do you face the greatest problems and what are they?
  - Can they be solved with *insert prototype idea thing here*
- Are there specific issues that come up with your North Campus distributions vs. your Central campus shop?
- Does your organization help any customers with growing their own food?
  - Follow up: Are there any common issues with growing food at home?
- How do you publicize your resources to those who need them?
- Are there any future plans to expand your work? What challenges are you facing or foresee?
- What are the challenges that students face while using the cupboard? Does anything specific prevent them from using it?

We have not chosen a need to address directly yet, but have been brainstorming some possible ideas we would love to get your feedback on:
- Supply chain/inventory
  - Apps to track produce and other supplies in and out
  - Long lasting storage solutions (better fridge)
- Transportation (such as to north campus, by students from cupboard)
  - Cart to transport and sell fruit and vegetables
  - Insulated storage carts/bags/etc
  - Carrying the food in a cart - for customers
  - Rideshare
- Other
  - Mini greenhouse
  - App to show where to get food in the local area
- Existing needs statements
  - (can show general ones at ends) can you comment on them? Are they applicable to your organization and population?

Ending questions
- Anything else helpful?
- Do you know of any other people we could reach out to that could help us learn more about food deserts?
- Are there any individuals you know that utilize your organization that would be willing to talk with us?
- If there are any problems that you have, that we think we may be able to address, does your organization have the capacity to possibly mentor our project? This would not entail money or anything like that, just meetings every now and then to review designs and gain feedback. Our professor can also reach out to provide more details before you had to agree to anything.

Show general needs statements for comments
1. A way to provide healthy food to low-income Americans living in food deserts to reduce malnutrition health conditions
2. A way to transport low-income Americans living in food deserts to grocery stores to support the purchase of nutritious foods
3. A way to reduce the amount of time it takes for busy Americans in low-income communities to prepare meals
4. A way to reduce the economic burden associated with purchasing healthy foods for low-income Americans to promote healthy eating

Meeting Summary [17]
We conducted our first interview with Kelly O'Mara who has been the program manager of the Maize and Blue Cupboard since October of 2020. She is in charge of day to day operations and manages a lot of the volunteer work with student groups and oversees marketing of the program. M&BC is supplied by Food Gatherers out of Ann Arbor for most of their food donations in addition to local donations and other orders to fill the gaps in the food and resources they receive. Shipments come twice a week to stock the store and it is open on weekdays from 3-7pm for the U-M community to come and take what they need.

Shipments are delivered to the distribution site, located under the Betsy Barbour dorm on central campus, which has a loading dock and small storage areas in the basement of the residence. O'Mara walked us through the general system of M&BC and how shipments are recorded as poundage and there is no real inventory of what comes in and out since they never want users of the cupboard to feel shame about what or how much they are taking.

O'Mara described how a common problem for the M&BC is spreading the word that its supplies are for anyone who needs food and for any reason. There are misconceptions about food insecurity in Ann Arbor due to the image of being an affluent area and the assumptions that no one has problems with buying or having access to food. However, it is not just food insecure people that do not have access to foods since there is no large grocery store on campus for students to buy those healthy foods -- even despite the new addition of the small Target. She often hears students say "I'm not THAT food insecure" with that being the reason they would not use their resources, but O'Mara emphasizes that they are fully institutionalized and will keep enough food in the space for the students who come. They use a reservation system to predict the

amount of food to order, in addition to predicting a smoother flow of operations when open, and order based on those who sign up.

O'Mara went on to explain how there is a lot of interest from the community to help, and sometimes more volunteers than they know what to do with. The store space only allows 12 shoppers in the space with the addition of staff and volunteers for fire safety standards, the traffic flow can be crowded at times. In addition to the central campus store, they have also started a north campus distribution site at northwood so students living on north campus do not have to lug their supplies all the way up on the buses.

The source of their food is mainly from Food Gatherers in what she describes as "feast or famine" or in other words, they get what they get and are often the last stop on the food's life span before being thrown out. Outside donations are very helpful and they never say no to anyone wanting to donate, but their space does have its limitations. For example, last year they were donated 12,000 bottles of Head and Shoulders that they are still currently going through. This year they are being offered 500 boxes of Bonza pasta and 400 boxes of frozen pizza. They will never say no to a donation, but this can take up a lot of space or force them to use outside resources like M-Dining for storage since the site only has three freezers on the shop floor and one walk-in fridge that is very small. With that being said, most of their storage issues come in the form of keeping fresh and frozen food as opposed to nonperishable items.

The program also helps with other services such as helping people apply for SNAP benefits or finding local food banks for those that are not affiliated with the University to get supplies. Some new initiatives they are working towards are to increase the word of the resources as M&BC since their main marketing is currently through word of mouth and there are new projects being developed to expand their reach. There is a kitchen currently being installed to be used for cooking and recipe demonstrations and a school of social work graduate intern that is exploring the idea of pop up shops and being visible in more areas of campus.

As we finished the interview, they suggested possible solutions to general issues surrounding food insecurity to gather O'Mara's thoughts and opinions on the topic. We suggested ideas or problems such as a system for inventory, an app to track produce, carts to transport food, ways to make transportation more accessible for users, etc. No ideas that the team brought to the meeting were exact solutions to any problems, but we were able to gather insight on the main problems and cross out any potential ideas that could be deemed unrelated.

Appendix A2. James Everhart (Food Gatherers) - 9/30

Interview Protocol
- Can you describe your role at Food Gatherers?
- What does your typical day-to-day look like?
  - What is the greatest challenge you face on a frequent basis?
- What communities does Food Gatherers primarily serve, and what are some common reasons why they do not have access to healthy food?

- I know a bit about how Food Gatherers works, but can you describe more about the supply chain aspects of how you get and distribute all of the food?
  - How did the relationship begin between Food Gatherers and maize and blue cupboard?
    - Food gatherers gives food, goes to maize and blue cupboard to make sure they handle food right
      - Are there any parts of the Food Gatherers process that you think are ineffective or could be improved?
  - How do you achieve the goal of 60% of all food distributed will be protein and fresh produce.
  - What are some of the current issues that your organization faces with meeting the needs of the people you serve?
    - Possible follow-up: Inventory (keeping stuff fresh and organized)? Supply chain (sourcing produce and donations)? Transportation?
  - Does your organization help any customers with growing their own food?
    - Are there any common issues with growing food at home?
  - How do you publicize your resources to those who need them?
  - Are there any future plans to expand your work? What challenges are you facing or foresee?

Meeting Summary [32]
We conducted an interview with James Everhart, who is the volunteer coordinator at Food Gatherers. Due to a busy schedule with Food Gatherers, he had told us before the meeting that he would not be able to provide any long term mentoring for our project, but that he was happy to help with an interview. We went into this meeting with an interview protocol focused on confirming our needs statements and learning more background information about food insecurity in Washtenaw county. James expressed that one of the biggest challenges this past year was Covid related restrictions on the amount of volunteers. Fortunately, Food Gatherers has a very large warehouse with multiple refrigerators and freezers, as well as a fleet of refrigerated trucks, so they do not experience storage issues. We discussed the relationship between Food Gatherers and Maize and Blue Cupboard. Food Gatherers made sure that Maize and Blue Cupboard would be able to handle food correctly, then they committed to sourcing weekly donations to the Cupboard. He also told us more about the goal of achieving 60% of all food being protein or fresh produce, explaining that they do not turn away donations but rather when they do buy food they are mindful of sodium levels and emphasize produce and protein. Finally, James explained that after years of experience, Food Gatherers is very focused on keeping fresh food organized and making sure that they are following a first in first out procedure. Overall, the interview was very helpful to hear about how a large organization is able to stay efficient and maximize their impact.

Appendix A3. Kelly O'Mara (M&BC) - 10/12

Goal of meeting: Review current solutions more in depth (what ways do they publicize themselves, what process was used to figure out organization method). Try to get information for reqs and specs.

Interview Protocol
Communication/Spreading Awareness
- Last meeting you mentioned you were not super involved with social media, would we be able to get the contact of the person who is?
- Is there a method to track student exposure as far as how many people know about your services?
- Can you describe the process of communicating with M-Dining and the use of their resources?
- At our last meeting you talked about the weekly newsletter you send out, what types of information is in these?
  - Follow-up: what are some of your other methods of spreading information about M&BC?
- At the last meeting you mentioned possibly being able to push out information about when certain products are available, etc., how do you envision that information being shared?
  - If stuck prompt: types of products, amount of products, shipment notifications
- If there was some sort of technology available to promote M&BC, how many people would need to be able to operate it?/In an ideal setting, how many people & how much time would you want allocated to upkeep this technology system?
- At the last meeting you mentioned creative content that M&BC would like to produce, like recipes and nutritional information. What has been started in the process of developing this content?
  - How would you like this information to be distributed?
- What are your thoughts on the idea about integrating information into the University of Michigan app with the help of Michigan IT?
- Another prototype idea: Thoughts on a system to pre save orders for quicker shopping flow?

Storage Project
- Could we look at all of your storage areas again? (at least the back ones)
- What are some of the larger products that you typically have to store?
- What about the heaviest?
- What is the largest donation you've ever received?
- What are the smallest donations you usually receive? (size wise)

- When moving to this new space, what sort of process was used to come up with the storage systems?
- Do you ever have issues with fitting items into your current shelving system?
- Do you have room dimensions that we could have? We can also measure if that's easier.
- Do you have information on the fire codes that you have to follow as far as open space vs. storage?
- How often do you need to move things around to accommodate new orders?
  - Is there an organization system/process for your new orders?
  - For example, do toiletries products get stored in one place whereas canned goods are placed elsewhere?
- What is your process for how much of a product to put out daily?
- You mentioned how the U-M farm stand sometimes uses your space, is this mostly fridge space or more?
- What do you think are the largest organizational issues due to the limited fridge space? (The walk in is one large room with limited shelving - try to figure out what helps. More shelves, possible overhead storage, no shelves?)

General:
- Could we have the contact information for the graduate student intern?
- Do you have any connection with the similar service at Eastern Michigan University? Do you have any contacts there that we could connect with?

Meeting Summary [27]
After identifying two needs areas within our first interview with Kelly O'Mara at M&BC, we set up a second meeting with her to gather more information on both of the needs. Within this meeting we were able to gather contact information for several sources such as the person who collects the data from the newsletter, the person in charge of the M&BC social media, their public policy graduate school intern, and the MDining marketing contact who is involved with M&BC.

This meeting was also conducted at the Maize and Blue Cupboard with all team members present to hear first hand about some of the issues they are experiencing and the background of them. We learned about their social media and website and how they are so detached from the control of their own content. She is not very familiar with how social media is run and the website has posts one day a week so being given an option to send out information from a centralized location could be very helpful. Additionally, we learned more about the new content they are trying to push such as the educational series and recipes.

In regards to the storage need, we learned about the range of sizes for products and about some of the heaviest items and typical shipment sizes they receive. We learned about the largest

donations they have received in the past and a little more about her contacts she uses when they get an overload of refrigerated/freezer items that they need to store. She gave us another tour of the storage areas, including an additional room we had not seen briefly and talked about a few of the standards regarding food health and safety that the cupboard needs to ensure they follow. Many of their items come in bulk and the turnaround time is very quick so it is hard to organize it, and the items they had at the time looked very different from the items they stored during our previous visit.

We came out of this meeting without a clear path of whether we could address one or more needs. However, we gathered more information to develop our requirements and specifications in terms of rules and typical sizes of items for storage, and the types of content they wish to distribute along with contact information for our next steps for information gathering.

Appendix A4. Yavuz Bozer (IOE Professor) - 10/21

Interview Protocol
- Our current project involves helping Maize and Blue Cupboard with some of their storage needs. We are considering both rack design as well as general space optimization. Do you think trying to work on one of these areas more in depth would be better than trying to work on both?
- What are some of the current research areas you're involved in?
- Are there any classes at the University focused on storage optimization?
- What resources or articles do you know of that would be a good starting point for understanding storage system design for small space organization?
- M&BC doesn't track inventory right now, do you think that implementing an inventory system would be of any use in regards to storage optimization in the future?
- Do you think some of the principles of warehouse design could be applied to a smaller, grocery store storage space?
- When designing requirements and specifications for storage optimization, what would be some of the main goals of a system that makes the best use of the space?
- Do you have any recommendations for the types of questions we should ask M&BC as far as understanding their needs involved with space optimization?
- What sort of software/tools are available for optimization of small spaces?
- How can unpredictability of deliveries be built into a storage/space optimization solution?

Interview Summary [18]
Professor Bozar gave us multiple valuable resources as far as warehouse design and building layout. He was interested in our project and gave recommendations as far as calculating space utilization at multiple different times to report back to M&BC. He also discussed minimizing aisle size, using as much height as possible, and looking into recommending rental storage

spaces. His research experience is mainly in larger, warehouse layout design, but his overview of industrial engineering practices was informative. He also offered resources from the course he teaches as well.

Appendix A5. Kelly Guralewski (MDining) - 10/25

Interview Protocol
- Can you tell us about your role within M-Dining marketing?
- How does M-Dining manage the M&BC website? Is it usually one person, a team or people, alternates, etc.?
- Kelly mentioned that they have no access to the website since M-Dining is in charge, what are the rules behind that?/why aren't the M&BC allowed to operate it from their office?
- Has it ever been discussed integrating the M&BC website with the Michigan app at all?
- If we were to potentially design something that could be a centralized location for M&BC information, would that be going against any U-M rules?
- What do you find to be the most effective methods to spread information on campus?
  - What metrics do you use to track the effectiveness of different tactics?
  - Are there general guidelines or goals for engagement or metrics to determine the success of a project?
- How long does it typically take to train someone on a new form or communication/typical U-M system?
- Do you have an advertising budget for M&BC?

Meeting Summary [26]
Kelly Guralewski is the director of M-Dining marketing, she runs the social media and marketing for M-Dining which includes M&BC. She explained to us that the website for M&BC is currently run by the Student Life marketing team, they are currently in charge of the website and are the ones responsible for making updates. Conversations are in the works to bring those updates and ownership to MDining so that access can be given to Keith and Kelly who are in charge of M&BC. When asked if an app had been considered for M&BC or integration into MDining's app, she responded that that had not been explored but was very excited about the proposition. She explained how there would be no difficulty in designing an app in terms of following University guidelines and regulations and gave us contact information for the Director of Systems for Dining who is in charge of the MDining app. Additionally, Kelly gave us insight on the training process as a new member had just joined their team and taken over M&BC's social media. The last thing we then discussed was the budget where we learned M&BC does not get its personally allocated budget, it all falls under the MDining marketing's budget.

Appendix A6. Heidi Bechtel (Swoop's) - 10/25

Interview Protocol
- Can you explain to us a little bit about how swoop's work on campus?
- Can you tell us about your job(s) and role within the organization?

- How do your daily operations work currently?
- Where do the majority of your food and supplies donations come from?
- How do your partnerships with local grocery stores work?
- What is your process to unload food/supplies delivered to you?
- We know from the research article/study that most of your awareness comes from word of mouth, but what other methods do you use to promote being a resource on campus?
    - Do you control the university website or is that an external group?
- Does keeping track of what comes in and out help you stay organized with inventory and organization or is it more of just data to have?
- Where did the two times per month visit maximum come from?
    - Is the reason that there are not enough resources to get food, equality, or something else?
    - How often do you have users that need to shop more than 2x a month recently?
- How have the first time intake forms helped Swoop's? (or was that more beneficial to the study?)
    - Have the forms led to any changes in operations?
    - Are the results ever used to prevent students from using the pantry? / Are students ever concerned about that affecting their aid & what not?
- Do users ever feel ashamed or embarrassed by how much they take when they are weighed out?
- Can you explain how your online shopping forms work? Is there a limit? How do you ensure resources requested do not run out?
- We saw that with increased usage you had to move to a new location, did this make people less likely to use it or cause any issues for users?
    - How did you go about acquiring this newer space?
    - Can you explain your new space a bit? (# fridges, freezers, storage rooms, etc.)
    - Did the spatial increase solve your storage problems, or do you still face issues?
    - Are you familiar with storage tactics to solve the smaller space from previously? Like certain storage shelves or stacking methods or what not?
    - Budget? What is it like?
- Would we potentially be able to come visit your pantry for a small tour and to see how you do things? Or get pictures/measurements of your space if there are restrictions?
- Other policies?

Meeting Summary [25]
Heidi explained how Swoop's operates including explaining their deliveries from Food Gatherers and purchases made with donated money. She told us about the online shopping form that shoppers can fill out to place orders, which includes broad labels like 'cereal' on the options so that they can be sure to fill orders. Heidi also explained that they are able to deliver food to students in need through a third party student organization that offered to help. In contrast to M&BC, Swoop's does weigh the amount of food that people are checking out. She mentioned that this does not help with the stigma of students feeling like they are taking too much. She

explained that Swoop's also had storage issues in their previous space, but they were able to move to a larger space that solved their issues.

Appendix A7. Kelly O'Mara (M&BC) - 10/29

First we summarized our findings from our meeting with MDining and Swoops to make sure we were all on the same page before summarizing possible recommendations and reviewing our requirements and specifications with her.

Interview Protocol
"Based on our interview with Swoops and M-Dining we think that moving forward with the communication need as our main project (probably an app), but have a few ideas in terms of ways to help with the pantry's efficiency in general because from our other interviews it seems like the best way to solve storage issues is to move to a larger space. We will also compile a list of recommendations based on our research that will cover additional ways to increase communication and efficiency."

M-Dining
- We heard that they are trying to get website access from student life for moving the website back under M-Dining so that's why we are thinking of an app
- She gave us the contact info for the Michigan app which we were thinking about trying to do a feature for M&BC

Swoops
- Organization
  - Not supported by the school as much as M&BC, operate like their own little non-profit
  - Much smaller than M&BC (one or two people shopping at a time)
  - Small staff as well (most are part time as well)
- Storage
  - They were working out of one room in their basement before they gained access to more space in the building which alleviated their storage problems
  - They have an industrial fridge and freezer along with two commercial fridge/freezers and a meat freezer
- Online ordering system and in-person shopping
  - Online orders are centered around basics they can pick out (cereal but not the type, general condiments, etc.)
  - Started during covid and they still operate that way
  - Separate space that they have for that streamlined process
- Deliveries
  - 3rd party group stepped in to start doing deliveries
  - They prioritize disabled, pregnant, women with children or no transport

- Intake form
  - they ask people to fill out when using the pantry
  - Use it for emails, demographics, and see traffic from same customers
  - Ideally they fill it out before they come but do not hold people to it
- Donations
  - go directly to an account with a debit card
  - Go to kroger or SAMs to do local shopping for things they are missing
- Marketing
  - Also mostly word of mouth
  - Talks in classes, orientation and tours
  - Admin team controls all of their marketing, but they are not very skilled in it
- Food
  - Also comes from food gatherers, donations, a farm, or they buy it
  - Changed from bi-weekly orders to weekly orders to accommodate storage
  - They also look for grant sources and stuff on campus
  - Tracking food → they track poundage, but don't do much with it)
- Other
  - Donate meal swipes to swoops shoppers

Recommendations from findings
- Still consider online ordering but with more general options
- Working with student orgs for delivery (Swoops has a student org help deliver to disabled students/students in need)
- Publicity recommendations were a volunteer student ambassador, working with professors to put info in syllabus, orientation info out to students
- Orientation and on campus tours
- Donate meal swipes

Questions
1. What are the ideal features you would want this app to include?
   - Push notifications, ordering features, cooking videos, articles/blogs on nutrition, etc.
2. If you had an app on your phone for M&BC, what would you envision it would look like?
   - Colors, flow, fonts, etc
3. Would you want this app to be available on phones and desktop? Just mobile?
4. Would you want this app to capture any metrics?
   - I.e demographics, location, time spent, etc.

Reviewed our requirements and specifications

Due to Kelly having such a busy schedule, she has always been meaning to reach out to Swoops pantry at Eastern Michigan University to learn about their structure and operations, but had never found the time. Due to this, we began with a summary of our meeting with Swoops categorized to the main areas of differences. She was interested in the idea of a third party delivery, and mentioned how they had tried to integrate into orientation in the past, but freshmen are not the students who need their resources the most. She also mentioned that she thought about trying to implement their resources into syllabi in the past, but did not know a ton about where to start.

Next, as described in the needs selection section, the team decided to focus our main efforts towards an app for M&BC because we thought it was where we could make the most impact and saw a clearer solution. To develop our updated requirements and specifications, we asked her questions regarding designs and features where she emphasized the importance of an app having all the features that the website currently offers and would prefer it over another website since they already have one. Additionally, we learned about the theme that their website operates on and had the information to collect those specifics from MDining. She did not know a ton about social media, but said she thinks the creation of an app would be a lot. She mentioned how having access to data about what people are opening and what they click versus what on the app is background noise could be very helpful.

Lastly, we reviewed our requirements and specifications we developed and she gave us feedback regarding time it takes to update and how ideally if everyone who used the app understood what M&BC does, then it would be fairly successful. With her approval or the requirements and specifications thus far, we have a great general framework to move forward with the project.

Appendix A8. Professor Jamin (Computer Science) - 11/9

Interview Protocol
Before we begin, are you familiar with Maize and Blue Cupboard? (If not explain)

- Can you tell us a bit about your background and position at University of Michigan?
- How did the class EECS 441 come about?
- Are there resources you know of that would be a good starting point for learning basic app development techniques?
- One of the softwares that we have been looking at is App Gyver, which is essentially a way to build an app without much coding involved. Have you heard anything about or used this tool?
  - Are there any other softwares you recommend for a similar use
- What would be some of the pros and cons of trying to code the app from scratch?
- How do apps tend to get maintained by people outside of those who develop them?
  - How would one create an app that is simple for others without any background to update?

- What is the process like for getting an app out on the app store?
- What are some main things to keep in mind when creating an app? Mistakes to avoid? Important content to include?
- How do you measure or determine whether an app is successful or effective? And what metrics do you take/monitor do you associate with that?
- What methods do students in the class use for analysis of app design decisions?

Meeting Summary [37]

Professor Jamin helped us understand the app development process that computer science students would go through. He explained the details about his class, EECS 441-App Development, and how the class functions. He was surprised to hear that a group of mechanical engineering students were trying to design an app in one semester, and advised against coding it from scratch in a way similar to how his students do so. He mentioned that the process of releasing to the app store can be difficult due to Apple and Google standards. He had not heard of AppGyver.

Appendix A9. Will Burns (Michigan ITS) - 11/9

Interview Protocol

Before we begin, are you familiar with Maize and Blue Cupboard? (If not explain)

- What is your role at Michigan ITS and how are you involved with the app?
- Can you tell us a little bit about the background of the app and its origins?
- How many people/who runs the app and its updates?
    - How often do full app updates need to be rolled out?
- What software do you use for the programming of the app?
- Can you describe the process that groups like MDining go through to update meals and information on the Michigan app?
- Have you guys ever added new features and ran focus groups or studies about them? If so, how exactly do you go about that?
- How long does it typically take to train someone to run the app?
- Can people with less experience easily update the app?
- Does Michigan ITS track data about the app? Do you keep track of certain metrics of clicks, downloads, etc.?
    - What do you guys do with that information?
- In addition to creating our own app, we were wondering if there was any way to integrate or add a page about the cupboard? (Hours, about, etc. in the MDining section)
    - Are there criteria for what can and cannot get added to the app?
- Do you have any recommendations for software or steps we should take while developing our app?

Meeting Summary [38]
Will Burns is the product owner of the University of Michigan app. He gave us valuable information about how the Michigan app was developed, how it gets updated, and how new features are implemented. He summarized the process we would need to take to add the M&BC hours to the Michigan app. He also gave us contacts to discuss usability and analytics with. Finally, he explained what software Michigan uses for app development and how the licensing works.

APPENDIX B: Storage Need Research

Appendix B1. Storage Benchmarking

	Cost	Adjustability	Ease of Assembly	Ease of Mobility	Durable Material
Mobile Shelving	x		x	x	x
Channel Shelving		x	x		x
Wall Climbing Shelving Unit			x		
Inlaid Racks	x		x		x

One storage solution that is common in establishments like cafeterias are metal shelves on wheels. While this solution provides a very portable option with easy rearranging abilities, however this can become unstable or dangerous for employees.

Appendix B2. Storage Preliminary Requirements and Specifications

Before we decided to focus our project on M&BC's communication needs, we developed this preliminary set of requirements and specifications for the project. They are not fully developed and would need additional work if we were to move forward with this project. The table is also color coded with our confidence in sources we have for each requirement and specification.

Requirement	Specification	Priority	Source
Solution must follow all local health codes	Food must be stored 6 inches above the ground and 6 inches below the ceiling	High	[1] - Michigan food safety standards [2] - M&BC Interview
Solution must follow all local fire and building codes	Follows Ann Arbor fire code standards	High	[1] - Standards for fire code [2] - Michigan Legislature Food Law
Solution must be robust	Withstand totals of at least 3000 lbs [1]	High	[1] - Food supply and storage article [2] - Reviews from WebstarauntStore (site with commercial and restaurant storage equipment)
Solution must be implemented at current location	The system fits within the current M&BC space (see floor plan)	High	[1] - Insert floor plan map dimensions [2] - Get dimensions of outside

Solution must be easily assembled and readjusted	Fully assembled by 2 people in < 30 min	Medium	[1] - Reviews from WebstarauntStore (site with commercial and restaurant storage equipment) [2] - M&BC Interview
	Adjusted with no more than 1 additional tool		[1] - Reviews from IKEA kitchen pantry storage products [2] - M&BC Interview
The solution must be adaptable for holding different items	Accommodate items on pallets or smaller	Medium	[1] - Swoops Interview [2] - Typical M&BC items (pallets or smaller)
Solution must be easily removed	Can be removed/disassembled in less than 20 minutes	Medium	[1] - Reviews from site with commercial and restaurant storage equipment [2] - Reviews from IKEA kitchen pantry storage products
Solution must be affordable	Low to no cost to M&BC and within ME450 Budget	Medium	[1] - M&BC - ask about possible budget [2] - Reference 450 budget

As this is not our main need, I will do a brief summary of each of the requirements and specifications. Our first two requirements surround local building and fire codes because that is a requirement that came up during our initial interview with M&BC because they work out of a small building with spatial constraints. Because they are a small grocery store, we would need to ensure we follow any food health and safety codes.

Next, we put that the solution must be robust to hold many different items and based the number 3000lbs off of the current metal shelving they use currently in the location. We wanted to ensure any solution can be implemented at their current location since it took a lot for them to get that space and it could create more issues if we were to try and expand elsewhere.

Our next requirements revolve around a solution that is easily assembled and readjusted and with that, something that is adaptable. There is limited staff and volunteers at M&BC so we want to ensure that any solution is easy to use and not a hassle. If they need to adjust it for holding a wide variety of different items since it is unpredictable for them to know what is going to be delivered as M&BC told us and Swoops also expressed the same concerns. We based these specifications on typical restaurant storage solutions and what can be classified as an "easy build" from IKEA and other commercial restaurant equipment. Our next requirement was that the solution must be easily removed because sometimes they will receive large amounts of food on pallets that they store and cannot be transferred to a shelf, so we based this specification off of storage solutions and reviews from different commercial and restaurant storage products.

Our last requirement was that the solution must be affordable which we specified as low to no cost to M&BC and within the ME 450 budget due to the fact that a large amount of the funds M&BC has access to are donations from donors and it can be hard to predict what they will receive and have access to so, ideally any solution we come up with will not cost them any money.

APPENDIX C: Concept Generation Results

Appendix C1. Brainstorming

App Development Options
- Appgyver
- Hard code in Swift
- Clutch.co
- Ionic
- Flutter.dev

Appendix C2. Morphological Analysis

Features	Ideas →			
Appointments	Link to outside site for scheduling	Scheduling built into the app	SNAP assistance meetings	Calendar with availability for meetings
Donations	Link to leaders and best donation site	Donate directly through app	Directions about how to donate in person	Provided email contact of financial head of M&BC
Food Availability	Push notifications	Emails	Newsfeed Update	In app notification
About Us	General Information	Cupboard history	Video history	Contacts
FAQs	List of standard questions	Options to submit your own questions	Live chat with someone from M&BC	FAQ infographic
Data Analytics	Track where people click	Random surveys on usability	Incentivize reviewing app	Focus group on app functionality
Recipes	Cooking tutorials	Images of prepared meals	Meal prep strategies	Grocery list with each recipe
Educational Content	Short videos	News feed	Push notifications	Option to join email list
Contact Info	One click phone number	Link to socials	Staff listings/positions	Contact form like on website now

Appendix C3. TRIZ Ideal Ultimate Result Prompts (IUR)

1. Establish the function which you wish to improve

2. Formulate the Ideal Ultimate Result

3. Spend time and effort to reflect on the direction of the solution that is suggested by the IUR,reframe your task and record solution ideas

    a.   Visualize the system that is proposed by IUR and try to find an image of any existing system that in the some way delivers the function by itself

    b.   Answer questions on existing technologies that can deliver the function under improvement

        i.   Do I know of any system that accomplishes the function by itself? How does it work?

        ii.   What ways to fulfill the Function are known

        iii.   What are possible means to achieve self0fulfillmet of the Function?

        iv.   Can I use any existing technology to accomplish self fulfillment of the Function?

        v.   Can I use any existing Natural concept from Mother Nature to realise self-fulfillment of the Function

    c.   Search for the Natural examples of self-fulfillment of functions, which are similar to that under improvement

    d.   Reframe your task and record solution ideas

APPENDIX D: Concept Selection Pugh Charts

Criteria (Appointments)	Weight	Scheduling built into the app	Link to outside site for scheduling	SNAP assistance meetings	Calendar with availability for meetings
Stakeholder Preference	5	0	1	-1	0
Feasibility	4	0	1	-1	0
Accomplishes requirements and specification	4	0	0	0	0
Total		0	9	-9	0

Criteria (Donations)	Weight	Directions about how to donate in person	Donate directly through app	Link to leaders and best donation site	Provided email contact of financial head of M&BC
Stakeholder Preference	5	0	0	0	-1
Feasibility	4	0	-1	1	1
Accomplishes requirements and specification	4	0	0	0	0
Total		0	-4	4	-1

Criteria (Food Availability)	Weight	Emails	Push Notifications	Newsfeed Update	In app notifications
Stakeholder Preference	5	0	1	0	0
Feasibility	4	0	-1	1	1
Accomplishes requirements and specification	4	0	1	0	0
Total		0	5	4	4

Criteria (FAQs)	Weight	Options to submit your own questions	List of standard questions	Live chat with someone from M&BC	FAQ infographic
Stakeholder Preference	5	0	0	0	-1
Feasibility	4	0	1	-1	1
Accomplishes requirements and specification	4	0	0	0	0
Total		0	4	-4	-1

Criteria (Data Analytics)	Weight	Incentivize reviewing app	Random surveys on usability	Track where people click	Focus group on app functionality
Stakeholder Preference	5	0	0	1	0
Feasibility	4	0	1	-1	0
Accomplishes requirements and specification	4	0	0	1	0
Total		0	4	5	0

Criteria (Educational Content)	Weight	Grocery list with each recipe	Images of prepared meals	Meal prep strategies	Cooking tutorials
Stakeholder Preference	5	0	0	1	1
Feasibility	4	0	1	1	1
Accomplishes requirements and specification	4	0	0	0	1
Total		0	4	9	13

Criteria (Contact Info)	Weight	Staff listings/ positions	One click phone number	Link to socials	Contact form like on website now
Stakeholder Preference	5	0	1	1	1
Feasibility	4	0	0	1	0
Accomplishes requirements and specification	4	0	1	0	1
Total		0	9		9

Criteria (Educational Content)	Weight	Push notifications	News feed	Short videos	Option to join email list

Stakeholder Preference	5	0	0	0	0
Feasibility	4	0	1	1	1
Accomplishes requirements and specification	4	0	0	0	0
Total		0	4	4	4

APPENDIX E: Past Project Plans and Gantt Charts

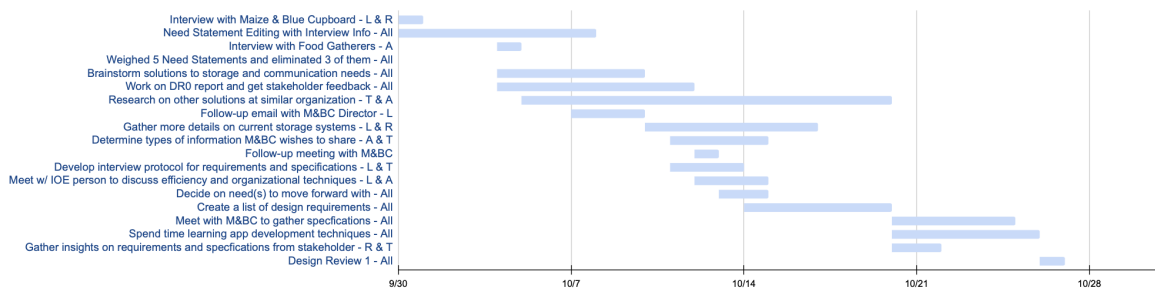**Design Review 0**

Previous Project Plan
The initial task for our project was deciding our topic, given such a broad scope of global health our team delved into research with the TPPs provided by UNICEF. After narrowing the 30 TPPs to the top 5 we were interested in, each team member took on a TPP to research further. Through our individual research we discovered a lack of interest among the group and a milepost was then changing the direction of our topic to food insecurity, specifically food deserts. Each member did more research on food deserts to develop several need statements and each member then came up with some early prototype ideas that were introduced later in our interviews.

The next step was getting stakeholders involved. Larissa and Alexa reached out to M&BC and Food Gatherers to confirm the needs that our team had found in our prior research, as well as to give us potential new need statements. Our team put together an interview protocol for both stakeholder interviews, drafting up questions which were then run by Professor Sienko. Larissa and Rachel interviewed Kelly O'Mara from Maize & Blue Cupboard on 9/30, following this interview the team came together to edit our need statements based on what our stakeholders had to say. The following two need statements were added 1) A way for Maize and Blue Cupboard to communicate their services and informative content to the University of Michigan community so that those who would benefit from the services are aware of them and 2) A way to optimize storage space for Maize and Blue Cupboard so they can accept a wider variety of foods for shoppers. The following Tuesday the team brainstormed potential solutions to the storage and communication needs that Kelly had expressed. On 10/04 Alexa interviewed James Everhart from Food Gatherers to gain further insight on confirming our need statements. Our team then weighed the five Need Statements we had using a Pugh chart and eliminated the three Need Statements not pertaining to M&BC. These stakeholder interactions were major milestones for our project as it not only gave us new need statements, it allowed us to attain a sponsor - M&BC. The trajectory of our project took a turn to focusing more on how we can help M&BC with their mission to help food insecurity across campus. Following our interviews, the team worked on our DR0 report and got stakeholder feedback.

On 10/07 Larissa sent out a follow up email to the M&BC Director proposing to move forward with a project to help their organization. The team collectively created a preliminary chart of reqs and specs for our two needs and presented them to Jeremy Punch and Nick Moses. Based on their feedback, Larissa and Alexa will meet with an IOE professor before 10/15 to discuss efficiency and organization techniques that

could aid us in our project. Advice from this interaction could also combat our anticipated challenge of the spatial and safety constraints that M&BC's storage offers. Larissa and Rachel spent the next day gathering more details and information on the current M&BC storage system while Alexa and Trinity learned more about the types of information M&BC wanted to share, whether that be recipe boxes or cooking tutorials. On 10/11 Larissa and Trinity developed an interview protocol for the requirements and specifications for the two need statements pertaining to M&BC that we will use when meeting a second time with our stakeholders. We will then make the final decision on whether to pursue both of the remaining needs or a single one by 10/13. The next task will be having the team create a finalized list of design requirements. We will then meet with M&BC the following week to gather specifications for these requirements. Additionally, that week our team will spend time learning app development techniques in order to prepare for a less mechanical, more CS focused solution. Once the requirements and specifications are put together, Rachel and Trinity will review these requirements and specifications with stakeholders in order to gain their insight. By the following week, 10/26 we will have completed DR1.
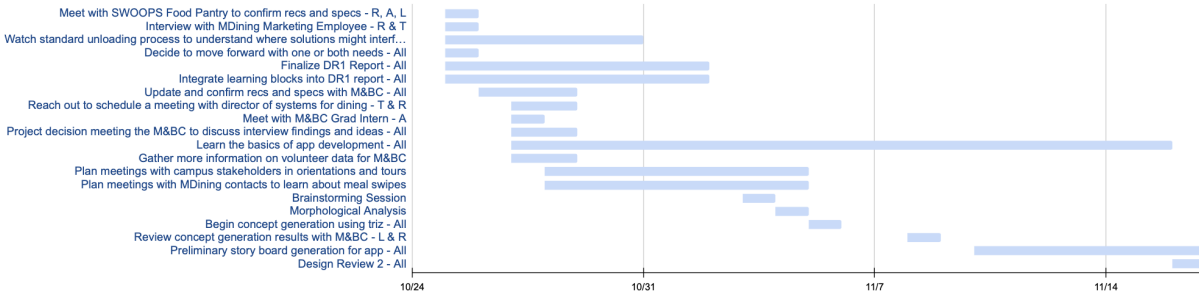
Gantt Chart

Design Review 1

At the beginning of the semester, the team focused its time on background research into UNICEF needs, food deserts, and food insecurity on college campuses. We met with local stakeholders at Food Gatherers and Maize and Blue Cupboard to help understand more background information. We also dedicated time to need selection [17, 32], including the development of selection criteria and discussions as a team about general interest. After we selected our need and M&BC agreed to mentor our project, we have continued to regularly speak with our contact there to get feedback on project updates. Since the first design review, our team has continued to prioritize stakeholder engagement and has conducted interviews with M-Dining, Swoops food pantry, and Professor Yavuz Bozer. These interviews were critical to moving forward with requirements and specifications and allowed us to get valuable feedback on our project plan.

Moving forward, we will be entering the concept generation phase of our project cycle, and have scheduled times for the three concept generation methods previously discussed. We will also schedule a meeting with Kelly O'Mara at M&BC after the concept generation phase so that we can get her feedback on our ideas. Due to our team's concern over our lack of experience with app development, we have also blocked off time to learn app development techniques throughout the beginning of November. We will make sure to start a storyboard for an app by 11/17 so that we can have a prototype to continue to discuss with our stakeholder.

Design Review 2

At the beginning of the semester, the team focused its time on background research into UNICEF needs, food deserts, and food insecurity on college campuses. We met with local stakeholders at Food Gatherers and Maize and Blue Cupboard to help understand more background information. We also dedicated time to need selection [17, 32], including the development of selection criteria and discussions as a team about general interest. After we selected our need and M&BC agreed to mentor our project, we have continued to regularly speak with our contact there to get feedback on project updates. Since the second design review, our team has continued to prioritize stakeholder engagement and has conducted interviews with M-Dining, Swoops food pantry, Professor Yavuz Bozer, Michigan ITS, and others. These interviews were critical to moving forward with requirements and specifications and allowed us to get valuable feedback on our project plan. They also helped us through our concept generation phase to get feedback on our ideas and make decisions on selected concepts.

Our project plan through the end of the semester includes completion of the mobile application, including all the features that we chose in our concept selection, as well as implementation of our developed user testing. We are also starting to wrap up the project by preparing for the in-class design expo, conducting user testing, and writing up our recommendations for M&BC. We will begin on these deadlines as early as possible to ensure we complete them, and we will also meet to discuss the project going forward, particularly the transfer of knowledge from our team to our stakeholders and our role in the next semester getting the app off the ground.