IQP REPORT 2024

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Proposal for Improving the Inventory System of the Worcester County Food Bank

Background Research on Food Insecurity in Worcester and Proposal for Improving the Inventory System of the Worcester County Food Bank

An Interactive Qualifying Project submitted to the Faculty of

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfilment of the requirements for the degree of Bachelor of Science/Arts.

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Date:

6/28/2024

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Abstract

Food insecurity is an ongoing issue where people have little to no access to high-quality food. Food banks were formed to counter this, and play a large role in assisting people in accessing food. Our team worked with the Worcester County Food Bank (WCFB), a local food bank looking for ways of improving its current inventory check-out process. We did independent research, made observations, and interviewed employees from both the WCFB and other food banks until we reached a proposal of recommendations. This included introducing a scanner and barcode system to the WCFB's check-out process in the near future, introducing the Agency Express software system that other food banks use for online orders, and introducing some combination of the "push" and "choice" models that food banks use.

Executive Summary

Background

Food insecurity means people are accessing low quality, variety and desirability or have reduced intake. The primary causes for food insecurity are affordability and accessibility. The affordability problem is due to the fast-rising of grocery prices and the slow-rising salaries. In the last year, the rising speed of grocery prices is almost double of the price of the salaries' growing speeds. This encouraged people to consume unhealthier but cheaper processed foods. According to the WCFB (Worcester County Food Bank), 1 in 12 people and 1 in 9 children are lacking access to affordable foods and 19.3% of the population in Massachusetts are facing poverty. COVID-19 is also considered a significant factor for such a situation. Based on statistics done in 2022, the usage of food pantries (organizations that distribute food donations) increased from 27% to 46% from 2019 to 2021, which was considered as a consequence of government support programs being cut during the pandemic.

To understand the problem of accessibility, it's necessary to introduce the concept of the "food desert", also known as the "Grocery gap", which refers to the area with no access to fresh fruits or vegetables at an immediate distance. Based on data from 2017, 2.8 million people in Massachusetts have recently suffered from low access to supermarkets. In Worcester County, 29 Census tract areas are qualified as low-income communities and 20 are qualified as food deserts based on a report from 2021.

To help solve the problems mentioned above, the Worcester County Food Bank (WCFB) was founded in 1982 and is currently led by its CEO Jean G. McMurray. The WCFB takes in food donations from both the government and private donors, and works with approximately 115 partner agencies in Worcester County to distribute these donations from their warehouse to people facing food insecurity. They have recently been using a warehouse management

system (WMS) named Ceres version 5.5 for tracking their inventories. This software system was developed using Microsoft Dynamic, is maintained by Wye, and is deployed by Feeding American to its partner agencies. Ceres is a powerful system that is not only able to track inventories by ID but can also integrate with other hardware and software systems to satisfy the demand of the user(s). Recently, the WCFB has been looking for ways of improving the accuracy and efficiency of its current checkout process. Since partner agencies may not take an entire SKU (storage-keeping unit, one pallet of items in this case) at once, the staff members have to manually keep track of how many items are taken from each pallet at a time. The current method of inventory tracking is to first write down the number of items taken out on a paper packet, then pass this packet to the staff member responsible for typing updates into the WMS. This current system has room for human error caused by miswriting and/or mistyping. Providing solutions to this problem was our primary objective for this project. Furthermore, we were also asked to try to find more information about the Ceres system itself to help the WCFB fully utilize this system.

Methodology

Our research methods included a combination of qualitative and quantitative data collection, with a greater focus on qualitative data collection. Before going into our research, we settled on our research objectives:

1. To determine the benefits and challenges of the current checkout system. We also determined if any existing solution helped to increase efficiency and if it could be incorporated into the WCFB.

2. To recommend short-term and long-term ways to improve the accuracy and efficiency of the checkout process at Worcester County Food Bank.

With these objectives in mind, our group decided that observational research and interviews would be the best research methods for achieving our research objectives. Our group first toured the Worcester County Food Bank's warehouse facility, which gave us strong insight into how the WCFB operates and uses Ceres. Each group member asked questions and took notes on whatever we felt was necessary during our meeting. We also conducted numerous interviews with members of the WCFB to gain further insight into the opinions on how the

WCFB operates. Additionally, in order to learn more about how other food banks handle their own check-out processes, we researched and reached out to various other food banks. Most of the food banks we reached out to use Ceres. We conducted an interview with a staff member from each food bank that followed up with us. Conducting research was not without its challenges. We first researched the times and days where the WCFB is busiest. We wanted to shadow at the WCFB while it was busy so that we'd get a better sense of how it operates. However, the WCFB has a relatively small staff. This meant that any interruptions would substantially decrease the workforce, especially while the organization was busy. This meant that we had to be careful about interrupting the staff.

Findings

In total, we conducted one observation session and seven interviews. Four of these interviews were with Worcester County Food Bank employees, and the other three were with other food banks. From our tour of the WCFB, we learned more details about how the organization operated. We learned that the WCFB allowed three partner agencies in the warehouse at a time, and they allow for fifteen visits per day. Food donations are separated based on if they were donated by MEFAP or the USDA, and are kept on pallets on opposite sides of the warehouse.

From our interviews with the WCFB, we learned that the current checkout system's primary issue was human error. Due to inventory tracking being a manual paper-to-computer system in which inventory data is taken

down on paper and then copied into Ceres, some inventory items may be incorrectly listed. We also learned that the Ceres software was not being used to its full potential due to no one being trained specifically on how to use Ceres. This resulted in several features either not being used properly or not being used at all.

Our interviews with the other three food banks also yielded valuable information. One food bank was unable to interview via zoom, and instead answered our questions in an email. We learned that they place ID barcodes on each pallet and track inventory by inputting data into a wrist computer. The other two food banks were able to interview over Zoom, and gave us insight into how their checkout systems worked. We learned that as their organizations grew over time, they started to adopt a software named Agency Express and a barcode system. This helped them improve their inventory tracking system and allow partner agencies to place orders more efficiently.

Recommendations

Short-Term

We determined that the use of scanners and barcodes will be enough to increase the efficiency and reduce the human error of the Worcester County Food Bank's checkout process. During our meeting with Zebra Technologies, the scanner models TC22 and MC3300x were suggested. While placing a barcode on every individual item would be impractical and hard to implement due to a lack of staff, keeping barcodes for individual items in a book to scan during checkout could be the most optimal way to implement the barcode system. On the scanner end, we recommend that the WCFB looks into using the TC22 scanner from Zebra. This is due to its relatively low cost and the fact that the warehouse floor is not a hazardous environment.

Zebra Technologies also suggests purchasing their label printers to print receipts on the floor. With the implementation of the scanner, updates on the inventories will be automatically synchronized to Ceres system without going into the office to transcribe the numbers. As this is updated automatically, the order to print a receipt could be input directly, and staff member managing the checkout could avoid going back and forth to and from the office in order to get the partner agencies their receipt. As the WCFB already has a printer, they may decide if purchasing a new one makes sense based on the demo

results.

Long-Term

In the long-term, we recommend that the Worcester County Food Bank start to use software such as Agency Express in their system. As the food bank continues to grow and expand, it will need an efficient way to take the orders of partner agencies. Agency Express has been utilized by various food banks in Feeding America based on our interview result and has proven to be a reliable system for food banks as they grow and expand. It allows for accurate inventory tracking and partner agencies to place online orders. It also gives partner agencies the ability to distribute recipes and share resources with their community so they can make healthier meals. As the WCFB keeps growing, these changes should be considered in the future.

Conclusions

Our experience of working with the Worcester County Food Bank helped us understand not only how the WCFB's current checkout system worked, but also what issues existed with it. We learned a great deal about those issues, and through both our research with the WCFB and other agencies, we were able to provide recommendations that could remedy the issues with the current system while still keeping the WCFB's best interests in mind. We hope our recommendations will be implemented, and that they will successfully address any issues with the current checkout system.

Acknowledgements

We are grateful for the opportunity to work with the Worcester County Food Bank on this project, and for our sponsor liaison, Sarah Walker, who was incredibly accommodating with our requests for meetings and observations. We would also like to thank our advisors, Professor Laura Roberts and Dr. Amanda Wittman, for their guidance and expertise during this research. This was an incredible learning experience. Thank you to the staff members from Feeding America and the other food banks that met with us for all of the useful information provided, and for helping us come up with our solution. Finally, we want to thank the other IQP group working with EBS for inviting us to attend the distribution process of food pantries, which helped us to form a complete understanding of the entire workflow involved in food distribution. We hope that our research will help the Worcester County Food Bank as they carry out their mission.

Authorship / Team Introductions

Our group found that assigning each person to work on individual sections was not conducive to a smooth, cohesive paper. Because of this, an authorship page with each group member assigned to a different section would not be an accurate reflection of our workflow. Instead, we all worked on each section, breaking things down into paragraphs and then having other group members review our work. We would leave suggestions on each others' paragraphs, so each edit was seen and approved by at least two members. This led to a paper that reflects all of our research and conclusions accurately according to group consensus, rather than having one group member take over each section.
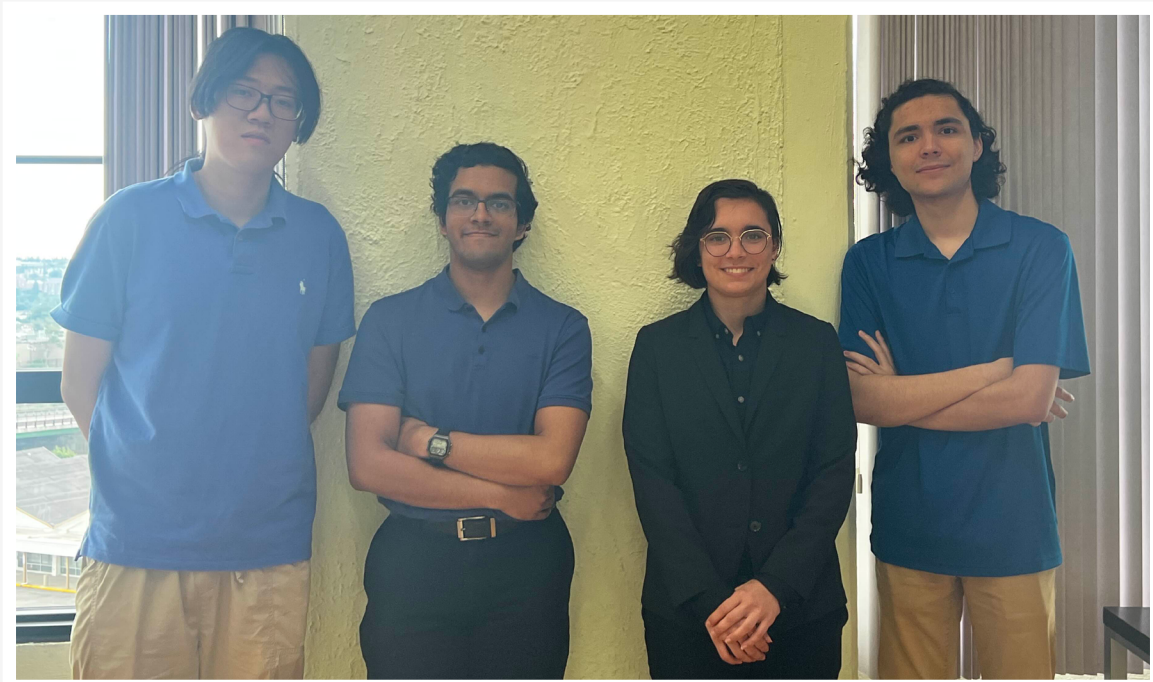
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Table of Contents

Table of Figures / Table of Tables

Introduction 1

Food insecurity is when an individual's access to food is reported to have reduced quality, variety, or desirability of diet, and possibly even reported with indications of disrupted eating patterns and reduced food intake (Christofa et al., 2023). Food insecurity is a massive, systemic issue in most societies, and the factors that contribute to it in the US are varied and complex in their own right. 12.8% of US households lack consistent access to enough food to support all of the members of the household in healthy daily life activities (Rabbitt, et al, 2023), and about 36% of American college students in 2020 were considered food insecure (Sullivan, 2021, p. 14). Affordability, access, and education surrounding food and nutrition are deficient in serving the needs of many communities experiencing food insecurity. Many of these issues were exacerbated by the pandemic, and support systems such as food banks, food pantries, and government-funded subsidies are under more strain than ever.

Food banks were first formed in 1967 in order to help people experiencing food insecurity overcome difficulties in accessing food. They are non-profit organizations that collect food from government programs and private donations and distribute the food to the community through partner agencies. These agencies then distribute the food directly to those who need it (Global FoodBanking How, 2011). Food banks play a large role in combating food insecurity (Bazerghi et al., 2016). According to Feeding America, there are 200 food banks in their network nationwide, which are responsible for distributing food to as many as 49 million people in 2022 (How Food Banks, 2023). The majority of these food banks source their food from the United States Department of Agriculture (USDA), state-funded programs such as the Massachusetts Emergency Food Assistance Program (MEFAP), private donations, or

purchased food. These resources are then distributed to food pantries in the area of the food bank, which distribute food to those in need. The nature of food banks means they have to construct a warehouse management system to ensure the flow of food is correctly recorded and tracked.

The Worcester County Food Bank is one of the largest food banks within Massachusetts and works with over 100 different agencies within Worcester County to distribute healthy food to people facing food insecurity and to raise awareness about food insecurity. For our IQP, we worked closely with the WCFB to address potential concerns regarding the efficiency and accuracy of their inventory check-out process. Having a more accurate and efficient inventory check-out system would not only help streamline the WCFB's operations, but would also be a big step towards the organization being able to expand their operations and help more people.

Over the course of our project, we analyzed how the WCFB operates, researched how other food banks manage their own inventory check-out systems, researched various softwares that were applicable to the WCFB, and offered recommendations based on our findings for how the WCFB could improve upon their own check-out process. This report will provide an overview of the research we conducted over the course of our IQP project and our findings. The following chapter (chapter 2) will cover the background research we conducted regarding food insecurity and the Worcester County Food Bank. Chapter 3 will cover our group's research methods, which involved a mix of quantitative and qualitative research with a heavier focus on qualitative data collection primarily through observations and interviews. Chapter 4 covers the results of this research and our group's recommendations. Finally, chapter 5 acts as a conclusion for the entire report.

Background 2

2.1 - Overview

The following section will provide further background information on food insecurity, its impact across Massachusetts and in Worcester county specifically, and its root causes. This section will also offer further information about food banks, introducing the "push" and "choice" models for food bank item distribution and introducing the software Ceres. This section will also provide background information about the Worcester County Food Bank (WCFB). This background information will be important to understand before analyzing how and why the Worcester County Food Bank operates in the way that it does and before proposing any potential improvements to the WCFB's current operations.

2.2 - Affordability

Affordability of healthy food is one of the biggest contributing factors to food and nutrition insecurity, with grocery prices in some states rising faster than salaries, and with less choice for fresh food due to decreases in farm-to-table systems. Food price inflation is higher than overall inflation in 55.4% of countries, many of which are low- and middle-income (World Bank Group, 2024). In Massachusetts, grocery prices have been increasing by 6.6%, while compensation has only increased by 3.1% on average (U.S. Bureau of Labor Statistics, 2024; Consumer Affairs, 2023). Increasing prices, combined with processed food becoming more affordable than healthier options, is leading to processed food becoming more prevalent (Tulleken, 2023).

According to the Worcester County Food Bank, 1 in 12 people and 1 in 9 children lack access to healthy food (Campbell, n.d.). 19.3% of the Worcester population faces poverty (The Census Bureau, 2021), and food affordability is the largest contributing

Figure 1

Food pantry use among Massachusetts adults with food insecurity
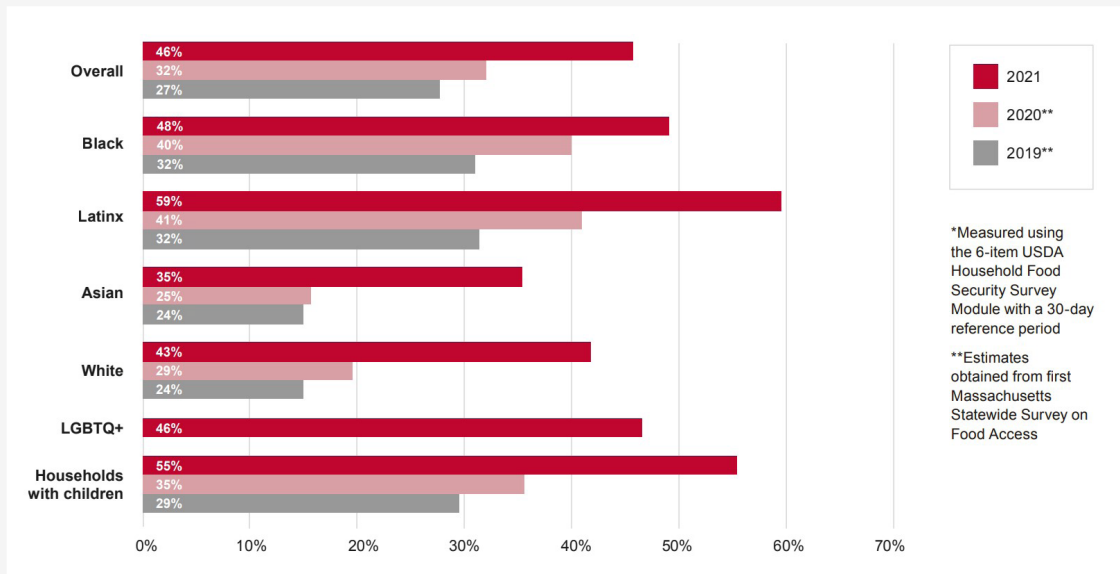
Note. This figure includes a breakdown of the percentage of food-insecure Massachusetts adults who used food pantries in 2019, 2020, and 2021, divided into different percentages based on the backgrounds of the surveyed adults and the year they were surveyed. These results were then averaged out to find the total percentage of food-insecure adults in Massachusetts who used food pantries for each year in this timeframe (Zack et al., 2022).

factor to food and nutrition insecurity. The poverty level in Worcester is one of the main reasons many families in Worcester County lack proper access to healthy food. As shown in Figure 1, in Massachusetts, due to the aftermath of the COVID-19 pandemic and in combination with inflation and cuts in government support programs, the usage of food pantries increased from 27% to 46% of Massachusetts's population from 2019 to 2021 (Zack et al., 2022). During the pandemic, the prevalence of food insecurity ranged from 3% to as high as 58% in households with incomes ranging from above $150,000 to below $15,000 annually (Drewnowski, 2020).

2.3 - Accessibility

Accessibility of food contributes to food and nutrition insecurity as well, with some areas lacking access to grocery stores or farm stands. The term "food desert" refers to an area with no access to fresh fruits or vegetables within immediate traveling distance, and many areas of the US fall under this definition

(Food Empowerment Project, n.d.). In Massachusetts, a large number of areas are identified as part of the "Grocery gap" (Figure 2) (Norton, 2017), which represents low income areas lacking access to supermarkets (grocery stores with annual sales more than $2 million). In 2017, 2.8 million people in Massachusetts including 700,000 children and 523,000 senior citizens were reported to be suffering from lack of grocery access (Norton, 2017). For Worcester County, as of 2021, 29 Census tract areas are qualified as low-income, and 20 qualify as food deserts (Sullivan, 2021, pp 12-1).

Low access to food in Worcester (Figure 3) due to the presence of food deserts is a large contributor to food insecurity, especially in minority communities (Christofa et al., 2023); food pantries can mitigate this to some extent, but lack of knowledge of food pantry locations and hours contributes to food insecurity (Marriott et. al., 2022). Food insecurity is related to poorer health outcomes, which can lead to further economic insecurity (Marriott et al., 2022). This disproportionately impacts low-income minority communities.

Several groups in Worcester County disproportionately experience

Figure 2

Map showing which areas of Massachusetts suffer from low grocery store access
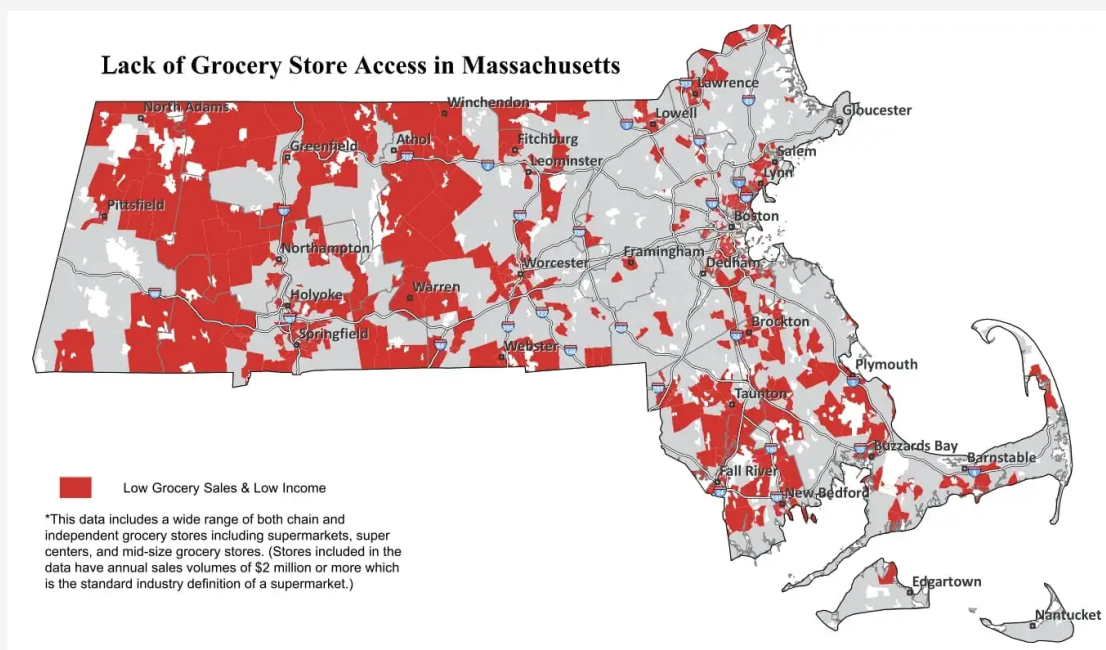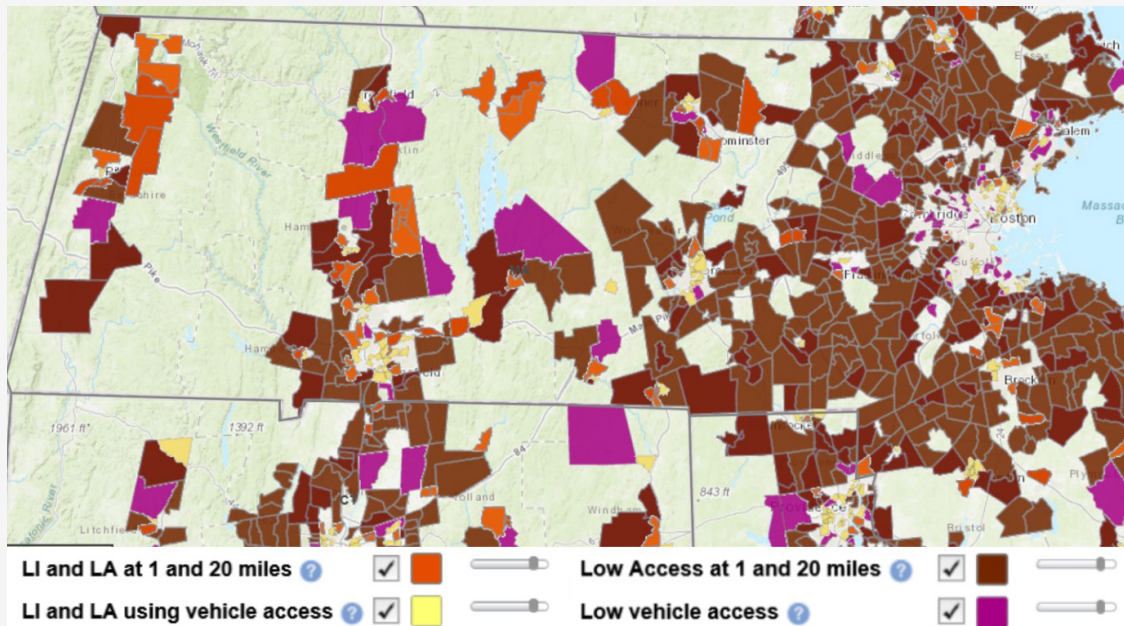
Figure 3

Map showing the areas of Worcester county that lack sufficient vehicle access

Note. This map shows supermarket accessibility across Massachusetts. "LI" stands for "low income" and "LA" stands for "low access". The areas on the map that are a slightly darker shade of brown include both low vehicle access and low access at 1 and 20 miles (Rhone, 2019).

food insecurity. including ethnic minorities, households with young children, community college students, and retired veterans. According to the Worcester County Food Bank, another group that is disproportionately impacted by food insecurity is senior citizens, who account for approximately 14% of people utilizing the services of the WCFB's partner agencies (Marriott., 2022). A major reason for the food insecurity experienced by these aforementioned groups is that they live in food deserts, thus hindering their ability to access healthier foods (Alexis, 2021).

Food pantries and banks became even more important after the COVID-19 pandemic, with a 70% increase in food insecurity between 2019 and 2023 (Fiscal Year 2023, 2024). During the height of the COVID-19 Pandemic, the Supplemental Nutrition Assistance Program (SNAP) benefits increased, but significant cuts were made in February 2023, resulting in 640,000 Massachusetts households losing access to these benefits (LeMoult,

2023; Kim, 2023). MEFAP funding, however, remained the same between 2022 and 2023 because emergency SNAP had supported people enough that they didn't rely on food banks as much (Adams et al., 2023). These cuts resulted in an increased need for private donations to food banks and pantries.

Food pantries are the main point of contact for people experiencing food insecurity, and they source their food from many places including private donations, supermarkets, and food banks. Food banks provide the bulk of the food, and they interact with hundreds of partner agencies in order to quickly distribute healthy food to the community. These agencies, along with programs like SNAP and Women, Infants and Children (WIC), provide a massive web of support in Massachusetts for communities and individuals in the fight against hunger. There are at least 60,000 food pantries and food access programs in the US (53 Million People Visited Food Banks | Feeding America, 2022), and over 700 in Massachusetts ("Locate a Food Bank/Pantry" 2024). Food pantries often receive a variety of food from their regional food bank, as well as from private donations, and then they distribute food to hungry families (Waite, 2019). They will also

sometimes provide employment counseling, clothing, hygiene products, and educational material around nutrition and cooking as well (Local Food Pantry, 2021; Daponte, 2000).

In recent years, client choice has become the preferred method of distribution, as opposed to a push system due to greater overall client satisfaction (Martin et al., 2023). Choice allows for cultural foods to be chosen, and people will know how to cook dishes that work with their lifestyles better if they can pick ingredients that they are familiar with. This choice model decreases waste, increases time efficiency, and decreases stigma and shame, which is considered one of the primary barriers to people accessing food from food pantries (El Zein et al., 2018). In order to facilitate the choice model, food banks must allow food pantries and partner agencies to choose food based on their clients. While some food banks still use the "push" model— where food banks choose what to give food pantries— many have moved over to a choice model as well. This model leads to less food waste overall, and while there are some difficulties with distributing more perishable foods, it is often more effective at combating food insecurity due to the decrease in stigma.

2.4 - Worcester County Food Bank

To combat food insecurity in Worcester, the Worcester County Food Bank (WCFB) was founded in 1982. The Shrewsbury-based organization is led by CEO Jean G. McMurray, and works with approximately 120 partner agencies in the county to both distribute food and advocate for community involvement and government action to tackle the problem of food insecurity in Worcester County (Food Bank/ Pantry, n.d.; Home, 2024). In 2011, they founded a fundraiser called the Worcester County Food Bank Fund to End Hunger, which functions as a resource to support nonprofit organizations partnered with the WCFB to reduce and eliminate food insecurity in Worcester County (WCFB Fund, 2024). The WCFB also hosted events

Figure 4

Photo of the Workers Credit Union presenting a $29,150 donation to the WCFB

Note. This photo was taken in the WCFB's warehouse facility. Pictured from left to right are Astha Shrestha (development manager, WCFB), Agnes Gordon (area manager, WCU), Shaw Linehan (area manager, Workers Credit Union), Jean McMurray (executive director, WCFB), Sandra Sagehorn-Elliot (COO, WCU), Robert Markley (Markley Law, Board of Directors, WCU), and Dough Petersen (president and CEO, WCU) (Gardner News, 2019).

to inform and educate people on food insecurity in the Worcester area before the COVID-19 pandemic, such as the "kNOw Hunger Trivia Night" (Events, 2024). The WCFB's success has earned it a significant amount of recognition and partnerships, including donations from foundations like the Workers Credit Union (Figure 4) (Gardner News, 2019). The WCFB uses a digital tracking system in order to keep track of its inventory. It uses Ceres version 5.5, a software designed specifically for food banks, in order to track food items.

2.5 - Ceres

Software usage for warehouse management with food banks is a pressing issue, as they need to run efficiently and require the right software within a reasonable price point to do so. In response, Ceres was created by the company Wye (formerly known as eProject Professionals) using Microsoft Dynamics NAV (Ceres Dynamics Solutions, n.d.), and was designed specifically for food banks. Among the 200 food banks within the Feeding America network, Ceres is widely used for inventory tracking. From their official website, Ceres is a Warehouse Management System (WMS) which specifically focuses on

the management of daily warehouse operations of inventories in a warehouse until they leave the storage. With the help of the WMS, the inbound and outbound tracking can be automated, which means human error can be reduced and unnecessary reputation can be eliminated, enabling the warehouse system to be able to handle a higher volume of workflow, the WMS also usually able to be integrated with useful hardware tools such as RFID system (radio frequency ID system, barcode and scanner is one example of that system) for enabling more visibility on the movement of inventories and a real-time update on the status of storages (SAP WMS, n.d.). Worcester County Food Bank currently uses Ceres version 5.5 for managing their inventory process. The primary functions of Ceres are automatically consolidating and tracking information within whatever system it is applied to, while also being able to easily adapt to whatever changes are made within the organization using Ceres (ERP Industries, n.d.). For example, if an organization needs to change information within numerous spreadsheets because changes were made to another spreadsheet, Ceres will help link these spreadsheets together. This will make it so that the information can be easily relayed

between documents, minimizing the organization's need to manually and tediously transfer data between documents, saving the organization time and energy that can be used elsewhere. Additionally, as the organization changes over time, Ceres can be scaled up or down and can gain more functions to account for whatever the organization needs.

2.6 - Beginning Research

Our project took place between May 13th and June 28th, and we worked with the Worcester County Food Bank to optimize their usage of Ceres to distribute food to partner agencies more efficiently. We conducted further research using various methods in order to better understand the issues that the WCFB faced with their current checkout system, and used our research to propose potential solutions to the aforementioned issues.

Methodology 3

3.1 - Objectives

To understand and improve the accuracy and efficiency of the checkout process at Worcester County Food Bank, our group first researched the inner workings of the Worcester County Food Bank and how it compared to other food banks in Feeding America's network. Other food banks were then interviewed in order to gain information on their checkout systems, providing information on potential alternative solutions. The research gathered on food bank checkout systems focused on two key objectives:

To determine the benefits and challenges of the current checkout system. We also determined if any existing solution helped to increase efficiency and if it could be incorporated into the WCFB.
To recommend short and long term ways to improve the accuracy and efficiency of the checkout process at Worcester County Food Bank.
In order to achieve these objectives, we used observation and interviews and conducted background research on potential improvements implemented by other food banks.

3.2 - Research Methods

Social research on these issues required qualitative and quantitative data to reach solutions that were humanitarian and effective. The resources of the community needed to be taken into consideration before implementing solutions, and our first priority was exploring ways to propose solutions while keeping the Worcester community's best interests in mind. Increasing the efficiency and accuracy of inventory-taking should allow for optimal redistribution of resources. The best method for doing this research involved using mixed methods with a more qualitative leaning (Creswell & Creswell, 2018), such as interviews and direct observation

through active engagement in the warehouse.

In performing this research, we shadowed at the food bank and we conducted interviews with some of the WCFB's employees (Knott, et al, 2022). We used these interviews to gain knowledge surrounding different perspectives on WCFB's check out processes and warehouse management system. We also interviewed other food banks, along with Feeding America, to learn from their existing solutions. A combination of snowball sampling and quota sampling was used to find interviewees at WCFB and other food banks, ensuring that multiple employees in different roles were interviewed thoroughly in order to provide a well-rounded view of food banks as a whole. To do that, we first prepared IRB-compliant questions and set up an appointment to visit the WCFB's warehouse (Ponto, 2015).

While visiting the WCFB, every group member took one version of notes independently, to make sure while some of us are asking questions, the conversation always has a chance to be recorded. We also took notes on the checkout process as it occurred based on direct observations. Sarah Walker (COO) and Josh Fask (warehouse manager), walked us

through the entire warehouse and gave an overview of how the process functioned from start to finish. Josh Fask was willing to walk the group through Ceres, the current system for taking inventory and performing checkout functions. He gave us a more detailed view of the checkout system, and we were able to ask some of the interview questions. We also observed the process as Paul Kunz (Food Sourcing Coordinator) interacted with partner agencies.

Other food banks' inventory-taking systems were then researched via interviews to compare them to the WCFB's system. We primarily sought out food banks that were within Feeding America's network and utilized digital inventory tracking and check-out systems. Most of the food banks we reached out to utilized Ceres; given that the WCFB uses Ceres, finding other food banks that do the same would yield the most relevant information. However, we kept our scope broad for what softwares we were looking for, allowing us to keep our options open. This research led to us finding over half a dozen food banks that use online ordering, most of which also use Ceres. We reached out to each of these food banks via email for interviews. During each of these interviews, we spoke

with one person who worked at the organization. We primarily asked about their involvement in their respective organization and how their organization manages its check-out process.

3.3 - Challenges / Limitations

The research protocols were challenging, and navigating those was crucial to the success of our project. The group scheduled interviews and visits to avoid disrupting the staff members and volunteers as much as possible: The staff only consists of 9 members which is a relatively small number, so interrupting one volunteer or staff member for an interview or for research purposes decreases the workforce by a considerable percentage. Shadowing the WCFB while it was busier allowed for better data collection, so we

needed to ensure relatively few disruptions occurred. During our first meeting with WCFB, we learned that the facility tended to be at its busiest between 8:00 am and 12:00 pm during the week. Additionally, the WCFB's warehouse closes early on Friday afternoons for clean-up, and warehouse procedures had to be followed, i.e. close-toed shoes, no phone calls, and no eating in warehouse areas.

Finding appropriate interview subjects who used Ceres took longer than planned, and replies from potential interviewees were limited. In total, we were able to interview only 4 food banks (including the Worcester County Food Bank), along with a Feeding America representative. We also researched some food banks that did not use Ceres, such as a food bank that began using an e-commerce platform from NetSuite in 2022 (McCue, 2018).

4 Findings / Results

4.2 - Findings from First Visit to Food Bank

4.1 - Overview

Over seven weeks of observation, our group gathered data regarding the WCFB's checkout system and interviewed three other agencies to understand how their checkout systems work in order to determine appropriate changes to the WCFB's operation.

We compiled all of the data collected from observations and interviews and recorded it in chronological order. Starting with the observation of the Worcester County Food Bank's checkout system allowed us to tailor later interviews to fit the issues we were addressing, and the meetings helped us better understand how to apply the data we gathered.

Our first visit to the Worcester County Food Bank's warehouse facility proved to be highly beneficial in better understanding how the checkout system functioned and what areas for improvement existed. Knowing what days of the week and times of the day were busiest, we scheduled a meeting at the WCFB for 8:00am on a Thursday. This allowed us to see how the WCFB operates on a typical, slightly busier day. We learned that in order to pick up food, partner agencies must first make an appointment with customer service. The staff members operating the customer service rotate, and only one lane is open for checkout at a time in order to minimize inaccuracies.

Under the current system, only about three agencies are allowed into the warehouse at a time, with approximately fifteen visits per day. During these appointments, the partners first pull up to the customer service side of the WCFB's facility

with whatever vehicles they're using for transporting goods, and enter the warehouse. The warehouse area on the customer service side included a large open floor area and two large cold storage units. Each of these areas were lined with pallets of food from the USDA and MEFAP, and they are sorted according to source, with USDA on one side of the warehouse and MEFAP on the other.

There is a separate intake area connected to the customer service floor. Stock is kept here and rationed out for the month. This is where food deliveries from USDA and MEFAP are sorted and stored. These are where the stacks of goods are kept to restock the customer service floor when a pallet is emptied. Private donations are also kept here, which are primarily sourced from food drives. The private donations are first given a quality check and then either discarded or sorted based on the items' categories (such as cereals and cleaning products). They are then placed into "banana boxes" which are then placed onto different

Figure 5

Photo of the Worcester County Food Bank's facility's sorting process for private donations

Note. This image shows a staff member sorting private donations in the WCFB's facility's secondary floor area (Campbell, 2022).

pallets that correspond to the items' categories. In Figure 5, the banana boxes and pallets can be seen in the background right above where the items are being sorted. There are also signs right above the pallets stating what item category each pallet holds onto. The banana boxes are tracked by weight and category. We learned that the systems for both taking in all items and managing private donations worked efficiently for the WCFB and did not need further adjustments.

Managing intake of USDA and MEFAP items is a relatively smooth process. USDA and MEFAP items are first counted and assigned IDs as soon as they are received. These pallets are moved into the WCFB's warehouse, and each pallet is logged into the Ceres system with its Stock Keeping Unit (SKU – the number of items on the pallet), and is then searchable by its ID. Several of these pallets and IDs can be seen in Figure 6. This

system allows for the WCFB to easily keep track of what is available in their inventory at the time, which the WCFB then posts to their website for partner agencies to see. There are also several papers hung up on the wall each day showing whatever's currently in the inventory.

The WCFB's inventory is directly intertwined with its checkout process. This process involves a staff

Figure 6

Signs pointing towards the labeled USDA and MEFAP pallets and products

member manually taking note of USDA and MEFAP inventory items withdrawn by partner agencies, and then inputting that information into a computer. As partner agencies enter the warehouse's main floor area, they are immediately greeted by the aforementioned pallets of USDA and MEFAP products. They then pick out the items and the number of cases of each that they want to take out of the inventory. Staff members and volunteers then begin transferring the items over to a line of rollers that lead into the partner agencies' vehicles. As the items are loaded onto the rollers, one staff member managing the checkout counts each case from each category and deducts the value of the SKU in the Ceres System. The method they use involves first preparing a packet of paper which features all the food categories in stock along with their respective IDs. After taking away

cases from pallets, staff members then find the row in the packet which features the pallet label, and then write down the number needed to reduce from the SKU number associated with this ID in the system. After all of the items are written down, the packet with all the changes is passed to Josh Fask, the warehouse manager. Josh then types in every single change, using the SKU number, one by one into the Ceres system.

Based on our interviews with numerous staff members, the paper packet is the primary cause for errors; it's easy to write down the wrong number and types of items being taken out of the system into the packet. Even though the staff make a conscious effort to monitor information effectively, it is still easy to accidentally write down the wrong information for all of the items being checked out. This was exacerbated by some items that are more difficult to track. For example, many different frozen meat products sourced from the USDA and MEFAP have boxes that look identical to each other, with the only way to differentiate them being a small label on them that says what is in it and where it is from. This makes these particular items more difficult to properly count and record. The process of typing the SKU numbers into Ceres

one line at a time is described as boring and repetitive work, and it creates room for error while typing in values. These processes are even more prone to errors when the WCFB is rushed, with some bigger partner agencies checking out large amounts of food.

Based on the observations we made and interviews we conducted, it was determined that the root causes for the checkout system's issues comes down to the potential for human error, facilitated by a paper system. Therefore, finding ways of improving the accuracy of the system were prioritized. Additionally, we learned that Ceres has a lot more functionalities that the WCFB isn't utilizing, and we decided to learn more

from other food banks about how they utilize Ceres. Following the visit to the WCFB's warehouse, we began reaching out to and speaking with various other food banks for further information on how other food banks tackle similar issues within their respective checkout processes and how they utilize Ceres.

4.3 - Information From Other Food Banks/Agencies

In order to understand how to implement potential solutions, we interviewed three food banks and one Feeding America representative who had transferred from another food bank. The interview results are listed below in the order of the date the

interview was hosted, and are also written in Table 1.

Interview food bank #1 - Midwestern food bank

This food bank has a larger staff and is slightly larger than the WCFB, so they have a Ceres specialist that we were directed to, and we proceeded to interview them regarding their checkout system and usage of Ceres. The specialist told us about the checkout system, Ceres, a software called Agency Express, and the food bank's usage of a barcode system. The food bank's transition to a more digital system was facilitated by reaching out to Feeding America and requesting assistance with Ceres, then listing the ID number of each food item it was distributing. Subsequently, it was also given access to the Agency Express software, which allows for partner agencies to place orders on the food bank's website. These orders would be limited to one pallet per customer and include the name of the customer, the contents of the customer's order, and the shipment/pickup date.

Interview food bank #2 - Northeastern food bank

This food bank was only able to answer the interview questions (appendix A) via email reply. However, we still gained valuable information from them: the food bank has barcodes on each pallet as IDs, and each ID has SKU information

associated with it. After items have been taken off of the pallet, the staff members will scan the ID to look up the item and then type the decrease in SKU using their wrist computer. This is automatically inputted into the food bank's warehouse management system, keeping its inventory up to date with minimal inaccuracies.

Interview with Feeding America representative

The representative mentioned that almost all food banks are currently using a digitalized system, and most had already adopted Agency Express years ago. They mentioned that pallets with their case numbers about the inventory unit as the SKU is a common approach for inventory keeping with Ceres. The representative also discussed the "push" and "choice" models of food banks. Under the push model, partner agencies have no freedom on what they take. They must accept or refuse the items given to them. The choice model — also known as the pull model — allows partner agencies to choose whatever they want within their quota. This is the model that the WCFB currently uses, and it can reduce food waste because food pantries have a good idea of what their clients will eat, and what will be thrown out. A hybrid model that combines both of these practices

was also discussed: for example, for the perishable items, the push model can be utilized to make sure they are not going to expire or go bad in the warehouse. For other items that last longer, the choice model can still be used to give partner agencies more freedom to fulfill their specific needs.

We also learned that none of the 20 food banks managed by this representative use a paper or manual model, making the WCFB unique in that regard. Six of these food banks use Agency Express, a software system that integrates with Ceres and allows partner agencies to put in orders online. Most of these food banks use the choice model, as the WCFB does, however they receive the partner agencies' choices via Agency Express in advance and then they have staff members at the food bank pick out the items and package them into a pallet for the partner agencies to pick up.

Interview food bank #3 - Northwestern food bank

This food bank uses Ceres and Agency Express, and it made the shift over a decade ago. It also uses a hybrid push/choice model, where perishable goods are pushed out to partner agencies in pallet or half–pallet denominations. Partner agencies can refuse or accept the pushed goods, and they can choose the less perishable goods however they need.

This model is good for larger food banks, so it may not yet be useful for WCFB, but it is good to keep in mind if the food bank receives more produce than they can distribute.

4.4 - Interviews with WCFB representatives

We interviewed four employees at the Worcester County Food Bank, all of whom gave us valuable insight into the operation of the checkout system. Each interviewee was receptive to potential changes to the system, but had varying levels of hesitancy in regards to how drastic those changes should be. Most criticisms of the current checkout system were directed towards the fact that it is somewhat prone to human error and it could be more streamlined.

The general consensus from the interviews was that transitioning to a scanner based system was desirable, but the implementation of more drastic changes such as Agency Express received mixed reactions. We also found that while Ceres was being utilized well, it was not being used to its full potential. There was no formal education about Ceres, and employees often had to teach themselves how to use the system using a website named Hunger-net. As a result, there were

no real specialists trained to utilize Ceres. Due to this, there are many features that have potentially not been explored or utilized properly.
It was also mentioned that some food banks use different software for their WMS, such as Primarius, Eci Macola, Dogwood Operations, and AGI Worldwide, but the majority of them still use scanners, online orders, and a system where the food bank packs up orders for partner agencies to pick up.

Table 1

Anonymized data from different food banks discussing the system they use to distribute food to partner agencies

	MW FB	NW FB	NE FB	WCFB
WMS System Used	Agency Express / Ceres	Agency Express / Ceres	N/A	Ceres
Hardware System Used	Barcode	Barcode	Barcode	Paper sheet
Cost	Variable	$400 / month	N/A	N/A
Size of Food Bank	~300 partner agencies	~300 partner agencies	~600 partner agencies	115 partner agencies
Benefits of This Method	Fast on the partner agency side; accurate for both the food bank and the partner agency; offers choice for partner agencies	Fast on the partner agency side; accurate for both the food bank and the partner agency; offers choice for partner agencies	Fast on the partner agency side; accurate for both the food bank and the partner agency; offers choice for partner agencies	Low cost
Areas of Improvement	Impersonal; requires more staff	Impersonal; requires more staff	Impersonal; requires more staff	Move to a more digitized system

Note. MW stands for midwestern, NW stands for northwestern, and NE stands for northeastern

4.5 - Summary of Findings

1. Worcester County Food Bank has a very unique system of letting partner agencies "shop" for what they want by coming directly into the warehouse. We found no other food banks that have a system where partner agencies come into the warehouse and pick their own goods, and we found no other food bank that uses the manual paper system.

2. Agency Express ensures expedited, accurate checkout: all of the food banks that use Ceres stated that they use Agency Express to record orders from partner agencies. They began using Agency Express to expedite food distribution to partner agencies, as it allowed for online orders. This allows partner agencies to plan ahead, ordering food that they know they will run out of, and planning for vehicle space and recipes for clients ahead of time.

3. A combination of the push and choice models is useful: some food banks — especially food banks that focus on distributing fresh produce — will distribute produce that expires quickly in half- or full-pallet denominations to food pantries, often using a truck to deliver these pallets to food pantries. Food pantries have the option of refusing or accepting the pallets, and they can pick the other food items as they wish while still getting fresh produce quickly.

4. All of these food banks started using Agency Express many years ago by directly contacting Feeding America. Once they got access to the system, they told the Feeding America representatives the ID numbers for each food item they wished to distribute. The perishables needed to be ordered by the agencies within a certain time frame to ensure they were distributed before their expiration date, which could easily be implemented with a hybrid of the push and choice models.

4.6 - Communication with Zebra Technology

We learned from interviews with food banks that some food banks that use Ceres use the MC930B as their scanner model. In researching the model of this scanner, we learned that it is provided by a supplier named Zebra Technology. Given that the Worcester County Food Bank is also using Ceres as its inventory system, we contacted the sales team of Zebra for

consulting on if we can be provided with a similar solution. During the meeting, Zebra Technology suggested the TC22 or the MC3300 as options for scanners, and the ZQ511/521 or the ZD621T/D as options for printers. Based on the suggestion of Zebra technology and our research on the datasheet provided, the TC22 is likely a more appropriate option for a scanner, since it costs roughly half the price of the MC3300 according to Barcode Factory prices. The working conditions of WCFB's warehouse are not too extreme, so both of these two devices' protection level should be good enough to handle it. The TC22 is a phone-shaped device with a touch screen as the only interaction method, which brings up a similar user interface as a phone, which is more convenient for people not trained to use different kinds of devices. We were not given an official price for either the scanners or the printers, and thus any prices stated are approximations.All of the information was consolidated into Table 2.

Table 2

Anonymized data from different food banks discussing the system they use to distribute food to partner agencies

Model	TC22	MC3300x
Price	Around $1000	Around $2000
Sensor / HCI Features	Has a touch screen, one 14MP camera, one 5MP camera, and a SE4710 scanner unit	Has a keypad, a touch screen, one 13MP camera, and a SE4770 scanner unit
Specifications	Android 16 8-core 2.1 Ghz processor 6 GB RAM + 64 GB storage/ 8GB RAM + 128 GB storage	Android 14 8-core 2.2 Ghz processor 4GB RAM + 32GB storage
User Environment	14 F- 122 F 5 ft drop 3.3 ft 500 tumbles IP68 and IP65	-4 F- 122 F 6 ft drop 3.3 ft 3000 tumbles IP64

5 Recommendations

5.1 - Overview

This research yielded findings about some solutions that could be implemented quickly with minimal effort, and some solutions that would require a significant overhaul of the systems in place. For this reason, we divided the recommendations into two sections, one for long-term and one for short-term. The short-term recommendations could reasonably be implemented relatively quickly, just allowing for streamlining of the current process, while the long-term recommendations require experts to come in and help with new technology implementation.

5.2 Short-Term Recommendations

After analyzing the data sheets provided by Zebra Technology and discussing the data with the WCFB's members, we determined that the TC22 scanner is the best option for the Worcester County Food Bank. This is because there are no extreme working conditions in the WCFB's warehouse, thus a more durable model such as the MC3300x is not necessary. The TC22 is also approximately $1000 cheaper than the MC3300x based on the unofficial price provided by an e-store. As for the label printer, the WCFB hopes to make a decision after receiving the demo devices. This is to verify if their current printer can effectively print barcodes or if a Zebra-manufactured printer is needed. Due to the project's schedule, we may not have the chance to follow up on the result of their demo, thus the future project team can observe if the new system is moving the WCFB in the right direction.

We also believe that assistance with further implementation of Ceres would help streamline internal functioning, so we recommend getting in contact with a Ceres expert, Sarah Jacobson. She and her team have

worked with Feeding America food banks for many years, and proper utilization of Ceres even outside of the checkout system, such as for finances and record keeping, could make many processes smoother and easier for the entire organization.

5.2 Long-Term Recommen-dations

Many food banks shifted to taking online orders via Agency Express and having staff members at the food bank pack orders for pickup by partner agencies. We recommend this as a good system for Worcester County Food Bank to slowly adopt as they expand over the years to accommodate increasing needs in Worcester County. Adopting this system will require more employees and volunteers at the food bank for picking and packing orders, but checking partner agencies in and out is much more efficient. The Agency Express system allows for more accurate inventory tracking, and gives partner agencies the ability to educate and engage with their community more through distributing recipes and resources for making healthy food. It also allows for partner agencies to select what items they want to check out with.

6 Conclusion

Our work with the Worcester County Food Bank was an extremely informative experience. From this project, we learned about the role of the Worcester County Food Bank in food insecurity and their interaction with government institutions providing food, food pantries distributing it, and the community members who rely on these institutions to have consistent access to nutritious food. We hope that this project will help them in their work to mitigate the impacts of food insecurity.

We are grateful that we could observe and understand the WCFB's current checkout system, along with the systems of many other food banks, which allowed us to make recommendations that are potentially useful in streamlining the checkout process at WCFB. With this collaboration, the Worcester County Food Bank has gotten into contact with Zebra Technologies, and they should be able to implement the digitalization of their checkout process. We hope that our recommendations will be easy to implement with Ceres and be helpful for WCFB to optimize the functionality of their checkout process.

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Appendix

Appendix A

Consent script

We are researching (food bank name)'s checkout system, and we are interested in your experiences as a(n) (employee position). The purpose of the research is to analyze the current checkout system in place, and to diagnose issues to propose a potential solution. Your participation will involve one informal interview that will last about 30 minutes. This research has no known risks, and it will benefit the community because it helps us improve the efficiency and accuracy of checkout systems at food banks.

We will do everything we can to protect your privacy. Your identity or personal information will not be disclosed without your consent in any publication that may result from the study.

First version of interview questions

Warm-up:

    - Introductions

Interview Questions:

1. What's your role in the organization?

2. How long have you been with the company and what brought you here?

3. How has the company changed during your time here?

4. What is your role within the company's inventory check-out process?

5. What are your thoughts on the company's current check-out process?

6. What do you like about the current system?

7. What do you feel could be changed about the current checkout process (must be specific)?

8. Have any changes been implemented in the checkout system before with regards to automation or improvement?

Interview Questions for Feeding America rep

Warm-up:

    - Introductions

    - How has your day been?

Interview Questions:

1. What's your role in the organization?

2. How many food banks do you work with?

3. How many work with Ceres?

4. How is Ceres integrated into / distributed to food banks?

5. How many food banks use digitized order and checkout systems vs manual picking systems?

6. Have you assisted any food banks in transitioning from a manual check-out system to Agency Express? If so, how did that transition work?

7. How do you convince people / organizations to make the shift ? What are their reasons for not wanting to shift to digital systems?

8. What is the cost generally like for transferring over to digital orders using Agency Express and handheld devices?

Updated interview questions after the first interview

Warm-up:

    - Introductions

    - How has your day been?

Interview Questions:

1. How long have you been with the organization, and what brought you here?

2. How has the WCFB changed during your time here?

3. Can you describe your role in the Worcester County Food Bank?

4. What is your role within the company's inventory check-out process?

5. What do you like about the current system?

6. Is there anything about the current checkout process that you feel could be improved?

Questions around food pantries

Warm-up:

    - Introductions

Questions:

1. Can you tell us more about your role in the organization?

2. How do you feel about the checkout process?

3. How do other agencies (such as food pantries) feel about the checkout process

4. Any likes?

5. Any dislikes?

6. When and how do you use Ceres?

7. What do you like and dislike

8. What do you hope to do with Ceres

9. What do you hope changes/stays the same?

Some modifications were made based on who was interviewed; when interviewing other food banks, we first introduced the current manual system. We asked how the other food banks made the transition from manual checkout to digital, what software they integrated with Ceres, and we removed questions that did not apply to those food banks. While conversations flowed naturally, we used the above questions as a framework, so as not to deviate from the main topic of the interview.