

Project Number: 19725

DONATION FACILITATION

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FOOD INVENTORY TRACKING SYSTEM AT FOODSHARE

FoodShare at RIT is a food pantry in which RIT students, alumni, and faculty can come to daily and receive food if they feel that they are suffering from food scarcity. The population of students suffering from food scarcity at RIT is growing every year. The idea for FoodShare was developed by former President Dr. Desler's wife to help battle this ever-growing crisis. However, FoodShare was struggling to keep track of the inventory, and knowledge of what food was available to the visitors (and inventory system) was nonexistent. FoodShare solicited the help of the Senior Design team to help with just that: create an Inventory Management System (IMS) to help RIT's management staff to know what the current inventory levels are at any given time. The scope of this project was that the system needed to be able to be operated by the student staff that work at FoodShare, it had to adhere to the core FoodShare values and beliefs, and it could not require major facility layout changes. The Senior Design team, over the course of 2 academic semesters, developed what is known as the Food Inventory Tracking System for FoodShare. The FIT System is run on Microsoft Excel and operates using macros that were developed in Visual Basic for Applications (VBA). This system not only tracks inventory, but it also records donations and develops reports so that management can prove the need for funding for FoodShare through the use of real, quantitative statistics.

NOMENCLATURE

(FIT) = Food Inventory Tracking System
(RIT) = Rochester Institute of Technology
(MSD) = Multidisciplinary Senior Design
(IMS) = Inventory Management System
(VBA) = Visual Basic for Application
(ER) = Engineering Requirements
(CR) = Customer Requirements
(IISE) = Institute of Industrial Engineers

Design Objective / Background of Project

FoodShare is an RIT initiative formed by Dr. Destler's wife to address the food insecurity faced by students on campus. FoodShare opened in the Fall of 2015 and has been helping RIT students ever since. One issue that FoodShare has always faced is generating data that upper management at RIT can view and analyze. FoodShare records the number of student visits but has never been able to capture input and output metrics related to the food students are taking and donating. Sharon Kompalla-Porter, the Associate Director at the Center for Residence Life, reached out to MSD for some help with this problem. The objective that the team was to address was to provide Sharon with complete knowledge of what items are needed in terms of replenishment and provide Sharon with input and output metrics

(amount and type going in, and amount and type going out). The senior design team set out to help Sharon and FoodShare with this problem and implement a solution within two semesters. Many other FoodShare employees have spent time on this objective, and other solutions were developed. The one tool that held the most ground, but still fell short, was an inventory tracking system that was formed in google sheets by a FoodShare graduate student. This document was a long and extensive sheet that tried to capture what FoodShare had on hand. This document eventually failed because it was too granular in trying to capture the data. Each listing had items with the different weights, rather than saying “Chicken Noodle Soup”; it listed “Chicken Noodle Soup 8 oz, Chicken Noodle Soup 16 oz, etc.” This granularity lead to a lot of difficulties and confusion with the document. It was challenging to interact with the system because it was too specific, and because it was too specific, it was hard to generate reports on a higher level. Some other shortcomings were that it lacked visuals and a simple data summary for the FoodShare staff to see and utilize. The team studied this previous attempt and learned from its shortcomings so the team’s new solution would not fail for the same reasons.

Prior to designing a system, the team spent a lot of time researching what options exist and connecting with subject matter experts. The team was put into contact with the inventory manager at CrossRoads, a dining service at RIT. The employees that helped the team were insightful and gave the team an insider look on how they managed inventory. CrossRoads use a system called Yellow Dog, an alternative that the MSD team was considering. However, Yellow Dog had some shortcomings. The main shortcomings included being expensive and out of the team’s budget. This system was more price-focused, purchased cost versus selling cost, and included details that were not necessary to the project. This was not the solution that FoodShare needed, but meeting with CrossRoads still provided value to the team. The next location the team benchmarked was Perinton Food Shelf. The team’s main focus was looking at their facility layout and getting advice. At Perinton Food Shelf, the volunteers do the “shopping” then go make deliveries to the people in need. This was different from the process at FoodShare, but there was still a lot to learn from the visit. The visit helped narrow the scope of the project and let the team learn about new ways of conducting a food pantry. One learning lesson was the importance of visuals in the shopping area; all customers and visitors should be able to look around and find the items they need. Lastly, the team reached out to the IISE group for some advice. The IISE group is a local chapter of Industrial Engineers that help support the companies in the community. Together, both teams focused on brainstorming preliminary ideas and different alternatives for inventory tracking. The best outcome of this meeting was defining the problem statement. At the time, the project had a long list of potential deliverables which were not clearly defined. After this meeting, the project went a lot smoother as the team now had an end objective in mind. The team is appreciative of all work completed by the groups who helped the team.

DESCRIPTION OF DESIGN

Before initiating the design process, it was necessary for the team to develop a high-level list of assumptions under which the product would be developed. The first assumption was that the employees of FoodShare all had basic computer knowledge. In addition, the team also assumed that the employees of FoodShare would utilize any implemented solution. The team needed to make this assumption because any solution would be useless if the employees did not utilize it. While it was still the team’s responsibility to ensure that the system was easy to use and user-friendly, the employees were still assumed to utilize the system, once implemented. Along with this, it was assumed that the employees would offer feedback on any proposed prototype. This would allow for the team to implement a system that met the employees’ needs, hopefully adding to the desirability of the final system. As discussed above, assumptions were made that allowed the team to be able to explore computer options for a solution. But in addition to this, it had to be assumed that RIT would provide the senior design team with either a computer on which to run any program that was developed, or enough money to purchase a new device. Lastly, as per request from the customer, it had to be assumed that FoodShare would not remain in its current location forever. This was an important assumption to make because it forced the team to develop a solution that was not location specific; the system had to be able to be utilized, regardless of the physical location of FoodShare. Once all the assumptions were made and the foundation in which the design process was to be built on was complete, it was time to look at the Engineering and Customer Requirements.

Customer Requirements (CR) and Engineering Requirements (ER) build the foundation for the inventory management system (IMS). Customer Requirements contain specifications such as “The IMS must be easy to use” or, “The IMS can be operated by one person.” The project consisted of 18 customer requirements which are important to ensure all customer’s expectations are met. Engineering requirements are more technical and ensure the system functions as it should. An example of an ER is, “Time to process 20 items is ideally less than 12 minutes.” Utilizing both the CRs and the ERs, the team was able to brainstorm many different options and the way the project may

proceed. The team considered physical applications like digital counters, color changing cards for low stock warnings, as well as electronic applications such as Microsoft Excel and Microsoft Access. After many considerations, experiments, and discussions both internally and externally, it was decided that the team would proceed with an Excel-based IMS. The excel based system suited the engineering and customer requirements better than all other options and the team found that it could address multiple issues within FoodShare. The intent of the system was to give FoodShare three major components it previously did not have: there was no data about what is coming in or going out of FoodShare, current inventory levels, and no way to generate visual and numerical reports. Excel was able to provide a solution to all of these types of issues.

The IMS, now known as the FIT System, quickly gained speed after the customer's interest was known. This led the team to develop a functional prototype. During the initial stages of design, the focus was to develop a digital counter. However, before the team could proceed further, it was determined that all the food must be categorized to keep the system simple. The team initially came up with 16 categories, which slowly crept to 22 over time. After the categories were implemented, the digital counter, or checkout page, was designed. The checkout page consists of macro buttons for each category and a checkout button, all coded with Visual Basic for Applications (VBA). Clicking on a category on the checkout page and clicking "Checkout" allowed the system to add a quantity, determined by the number of clicks, to the inventory page. At this time, the inventory page was simply a list of the categories and the current quantity of each category. Slightly after the checkout page was working, a receiving page was also implemented to allow donations to be put into the system for each category. This donation page takes an alternate approach to the checkout page because it needs to allow larger quantities to be input into the system. The donation page contains a "Save Inventory Changes" button coded with VBA which saves all of the quantity entered and adjusts the inventory page.

With the big picture in mind, the team also knew the FIT System needed to be able to generate reports which would populate all of the data the customer wished to receive. The customer wanted to be able to generate reports through a given date range. To do so, three logs were added to the system which includes the inventory log, donation log, and consumer log. The inventory log would track the current stock levels of each category at the end of each day. The consumer log tracks the number of goods being consumed each day. And the donation log tracks the number of goods that were donated to FoodShare each day. To populate data to the logs the FIT System is required to track daily usage. This was implemented by creating a hidden worksheet in the FIT System called today's action as well as adding two new buttons to the checkout page. The two new buttons were "Begin daily log" and "Save daily log". The checkout button on the checkout page was redesigned to send categorical quantities to the today's action worksheet rather than automatically updating the inventory page. With the new implementations, the system functioned a bit differently than before. To use the system, the user must now click "Begin Daily Log" at the start of the day which clears the today's action page through VBA macros. Throughout the day as consumers checkout and donations are received, the today's action page collects all of the data. At the end of the day, the "Save Daily Log" button must be clicked which populates the quantity received, quantity consumed, and current inventory into each of the three logs with the date.

The arguably most important part of the system is the report generation, and after the logs were functional, it was now possible to attempt report generation. The goal of the report generation was to select a date range and have the system collect how much food was received and how much was consumed within that date range. This step proved to be a nightmare with VBA coding, but after many hours of trial an error the team was able to manipulate code and other features of the system to achieve the goal. The report generation page consists of a "Generate Report" button, a column of categories and their quantities received and consumed, and two tables were added to provide data visibility. After clicking "Generate Report" the user is prompted to enter the date range and all of the data is instantly populated, far exceeding a couple of the Engineering Requirements. At this point in time, it was clear that the FIT System is well suited for a touchscreen device. All of the buttons and worksheets were formatted to fit the screen of a touchscreen laptop. The team was able to procure a device for FoodShare to use. This allowed the FIT System to be mobile throughout the FoodShare facility which is valuable when processing donations or completing other tasks.

With the FIT System meeting expectations, the team implemented minor changes within the system. These changes include giving each food category a reference number, implementing an audit system, implementing a poka-yoke (a lean manufacturing tool that prevents a worker from performing a job/task incorrectly), implementing no stacking cans, making labels, adjusting shelving layout, and developing standard work. These implementations were deemed necessary during the testing phase of the system. During testing, the team realized that they needed a way to ensure that items that went into the system under a specific category, came out of the system as that same category. This is where the team implemented the numbering system. Each category was given a number both written on the

physical item and in the checkout page of the FIT System. Food items like canned green beans are in somewhat of a gray area between canned vegetables and canned beans, but the numbering system eliminates the need to be punctual about which category the food item belongs to. The reason being, no matter what green beans are logged in as, they will come out the FoodShare facility as the same category. During testing, the team also realized that the inventory quantities in the FIT System do not always accurately reflect the actual food quantity in FoodShare which led to the development of the audit system. The audit system is designed to replace the quantity in the FIT system with the actual quantities and each category has a specific audit frequency which can be updated as needed. Poka-Yoke was determined to be a necessary component on the checkout page where many of the employees would spend their time. A poka-yoke was implemented to prevent misclicks and other errors during use of the system. An example of this is when clicking “Checkout”, an employee may receive a notification that says, “You must Begin Daily Log before continuing.” This verifies that yesterday’s data has been cleared before today’s data is collected. Another example of a poka-yoke is when clicking “Begin Daily Log” the employee is prompted with “Is FoodShare opening for the day?” and the users are presented with a yes or no dialogue box.

Changes to the physical layout of FoodShare consisted of organizing the food category locations on the shelving units and labeling all categories in both the Share Room and the Inventory Room. The labels were designed with a white background and large blue font to provide a large enough viewing distance to be read anywhere in the room. The label contains the category name as well as the number designation for that category as mentioned previously. After rearranging the shelving layout it came to the team's attention that the shelves looked bare and must appear to be populated with food. This led to eliminating the stacking of cans which also assists with locating food which may be past expiration.

Standard work was designed for each of the additional task employees are now responsible for. The standard work covers tasks such as Audit Instructions, Setting the Reorder Point, Changing a Category Name, Report Generation, Receiving, Checkout, and Removing Expired Items. All of the standard work is generated on a standardized template with descriptive steps of the process supported by a visual snapshot of the FIT System for each of the steps in the process. The standard work is designed to assist with training new employees and allowing senior employees to reference in the future. It is Donation Facilitation’s goal to provide standard work that has been designed in such a way that FoodShare staff will be able to continue using the FIT System after the project is completed.

SUPPORTING FEASIBILITY EVIDENCE

As one can see from the previous sections, there were two different types of systems implemented in order to make this project successful. The first system has to do with the FoodShare facility regarding the physical space to make it more efficient; the second system implemented would be the FIT system. To start off with the physical system, the team improved three different areas of the facility. The first being the organization of the shelves in the customer room. The team changed the overall layout of the room because the room was disorganized in the beginning. Food items were scattered all over the place and there was no clear grouping that took place. On top of that, both the customers and employees had to perform a lot of searching in order to find the correct food items they were looking for. The solution to this problem was to create 22 categories that grouped food items in natural ways. In other words, all soup that contains chicken is one category, all drink related items are their own category, and all cereal related items are their own category. On top of creating the grouping system, the team then grouped together categories that had similar uses such as cereal are close to oatmeal and all of the soup categories are close to each other.

The next improvement the team made to the FoodShare facility is with the numbering and stickering system. This system came out of a necessity when the FIT system was being tested. In the FIT system, it was hard for a new employee to understand where the category was on the checkout page and as a result, the overall cycle time for the employee was drastically inflated along with the task having a long learning curve. To circumvent this issue, the team decided to implement a numbering system that would be much easier and faster to use as opposed to the food item names. Instead of the employee looking at a food item and then cross-referencing it to a chart with the correct category on it, now all the employee has to do is look for the sticker with a number on it and then check out the corresponding number in the FIT system. This greatly reduced the amount of time it took to check out a customer as well as improved employee satisfaction. The picture below shows the vegetable soup category with its accompanying number. As one can see, the employees are processing the cans of soup in with the correct category and numbering system. Also, the graph below shows the categories that the team chose and a few example food items in each category.

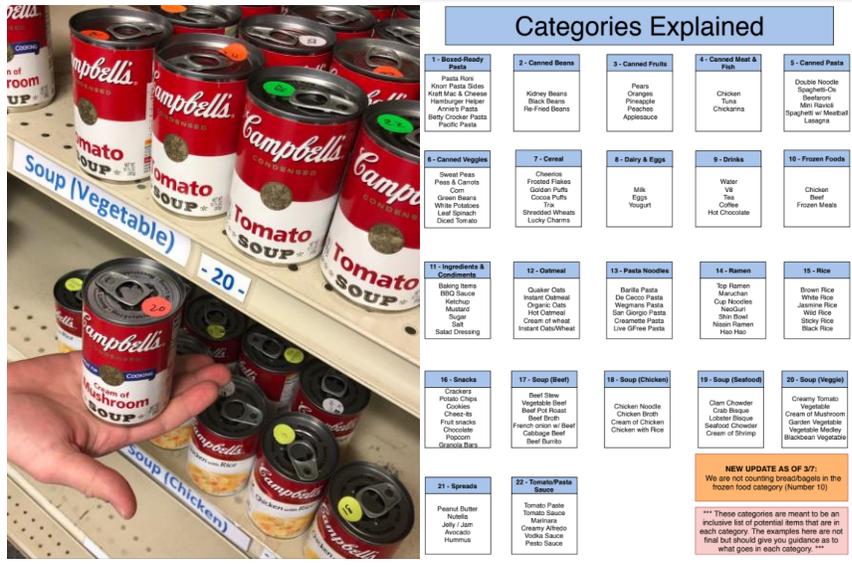


Figure 1: Example of numbering system (left), What kinds of food items fall into which categories (right)

The last improvement the team made to the physical space was the creation of standard work. As one might think, it would be hard for a new employee to come into the FoodShare facility on their first day and know what to do in order to perform their job appropriately. This is why the team created several standard work documents in order to have new employees be able to read what their responsibilities are and then be able to perform their duties with confidence.

Now to move onto the FIT system itself. To begin, it is an excel spreadsheet with macros enabled; this allows there to be buttons and powerful “behind the scenes” data transformations and calculations which overall helps to not only track the data going in and out of FoodShare, but also generate multiple reports in order to give the customer what she wants in terms of reports and graphs.

The first page of the FIT system is the checkout page. Here, the employees will be able to check out the customers that come into the FoodShare facility. The 22 categories are listed as buttons that the employees can click on in order to subtract food items from the inventory numbers. Along with the food item buttons, there are also two separate buttons that help with report generation. The first being begin daily log. This button creates a new day in the system and zeros out all of the cells so that they can be populated with food tracking metrics. The next button is save daily log. This button finalized a row of food data so that it can be saved for later and to be used for report generation. This can all be seen from the image below.

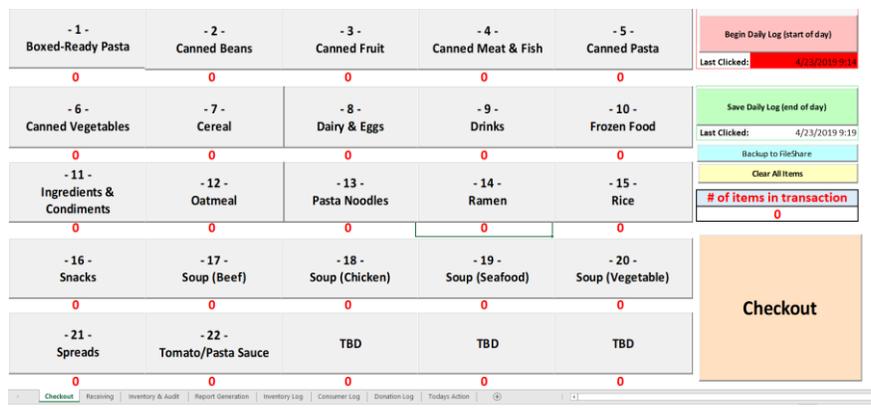


Figure 2: The Checkout Page

The next page is the receiving page and can be seen in the picture below. This page allows an employee to add quantities to the FIT system in accordance with what has been either donated to the FoodShare facility or has been purchased by the facility. Not only that, but it also has a graph that updates in real time to show the employee what is currently being donated. The team found this useful to have because it allows the employee to easily be able to report what has been received to a donator that is looking for tax reimbursement.

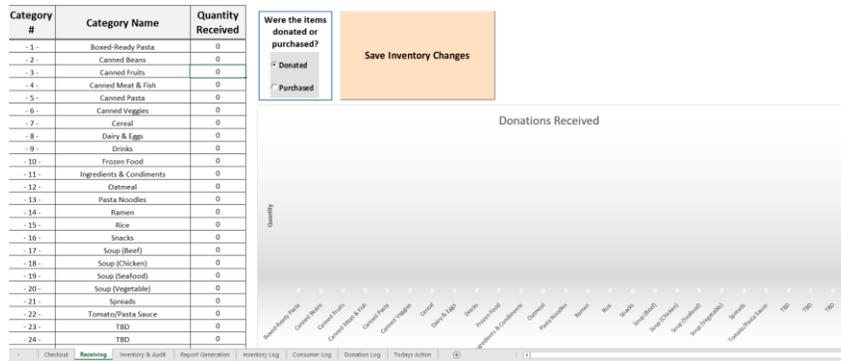


Figure 3: The Receiving Page

Inventory and audit page is where the employees will update the inventory after physically counting it from the sharing room and the inventory room. This page will be important moving forward because mistakes by the employees will be natural for them to make, whether it is not checking everything out or adding too many items to the system. This is why the auditing page will allow the employees to fix the numbers in inventory once the page tells the employees that a specific food item is ready to be audited. More specifically, one of the columns will turn red once X number of days has passed and no audit will have been completed. This ensures that audits are regularly done and the inventory sheet is constantly up to date. This can all be seen from the picture below.



Figure 4: The Audit Page

Next is report generation. This page is used for Sharon to give to her managers in order to show real numbers around food usage and donations regarding FoodShare. Here one can see quantities received, consumed, related histograms, and total food items purchased vs donated. While the team did not see the full use of this page, they are confident that it will be an immeasurable benefit for Sharon.



Figure 5: The Report Generation Page

The last 4 pages are inventory logs: consumer log, donation log, and today’s action. All of these pages keep the information that has been input by the customers and employees. In other words, this is where all of the data is stored for later analysis.

For, if this project was successful, the short answer is yes. The group’s customer wanted a system that could track the number of food items being donated and being given to customers as well as being able to report the data and metrics to upper management. The FIT system and the changes the team made to the physical space of FoodShare was able to take care of all of Sharon’s issues. In order to more mathematically understand the success of the project, one can take a look at the test plans that were generated for the project. When looking at the test plan document, it is clear that all 19 of the test plans devised passed with moderate to extreme success. For instance, “All indoor food signs need to be on display and read from at least 5 ft. away”. The team was able to beat this requirement and push it to 7 feet. Another example is “frequency of inventory updates”, this engineering requirement had an ideal value of 1 day, but the team was able to design the system to be able to update every second. One last thing to note is that while there were originally 33 engineering requirements, only 19 test plans were generated because the other 14 engineering requirements were deemed to be out of scope and as a result, it would not be value added to test to see if those requirements passed or succeeded.

RESULTS, CONCLUSION, AND RECOMMENDATIONS

As this two-semester project is coming to a conclusion the team has started to reflect on the results. This project had a lot of wins and successes. The main overall success is that the team was able to implement a functioning inventory management system into the FoodShare to help the customer. However, along the way, the team completed a lot of important steps to make the final product more impressive. The first action and success of the team were to defining categories. The team had to determine a less granular way of categorizing all items. The team spent a lot of time and resources on determining optimal categories. With the help of the customer and the graduate student, the team finalized the perfect number of categories, to help Sharon do data analysis. This was a major challenge because there couldn’t have been too many, or not enough. Overall, the team defined the optimal number to be 22, allowing the FIT system to be more effective. Another major success was implementing a feedback loop. The purpose of this loop was to connect the team to the FoodShare employees. The employees do the work every day, and therefore usually have the best ideas on how to improve the system. The team opened up the communication flow at the beginning of the second semester. Since then, the team received 9 different improvement ideas, analyzed 100% of them, and implemented 54% of them. The other ideas that didn’t get implemented were solved by providing a further explanation into the team’s thought process. This communication loop was one of the biggest successes as it led to more improvement ideas to make the system more effective. Another major success of the project was forming the sticker numbering process. The largest priority of the project was data integrity, the team wanted to form a system that could generate data that was trusted. The team developed the sticker system to ensure items go into and out of the system in the same category. The process was that whoever accepted the donation would write the category number on the item, as it was checked into the system. When items were checked out, the employee would reference the number on the item and check it out as that. This ensures that a can of green beans wouldn’t be inputted into the system as canned beans and checked out as canned vegetables. This improved data integrity and helped make the check-out process run smoother.

The team experienced a couple instances of failure during this project. However, they didn't affect the team's success, the team learned from these failures and improved upon them. The largest failure endured by the team was going out of scope for 4-5 weeks. The team spent time researching and conducting experiments on changing who did the shopping at FoodShare. Once the team presented this to the customer, it was realized that the customer shopping was a foundational block of FoodShare that couldn't be changed. The team walked out of the second meeting feeling overwhelmed, and unsuccessful as weeks had been wasted brainstorming this concept. However, this led to defining the problem statement, and focusing on it until completion. The team may look at these 4-5 weeks as wasted time, however they were a stepping stone to success.

If the team could repeat the project again, there are several things that would be done differently. The first being, spending more time defining the project deliverables. As discussed in the paragraph above, a lot of time could have been used more effectively if the team knew the goal of the project. Another major change would be to not force fit project tools. Senior design offers a lot of tools to help the teams progress. However, it isn't a one tool fits all solution. This senior design team ended up force-fitting some of those tools and as a result, the project was diverted for 4-5 weeks. The learning lesson here is, be practical about the tools and don't force fit anything. If the team was to repeat the project, conducting more face to face meetings with the employees and start the feedback earlier would have also helped to expedite some of the issues that arose. One example of this was when the team would send out mass emails. This was a one-way communication flow; the team had no input from the employees who did the work. By opening the two-way communication flow earlier, the team could have learned a lot more. Overall, the team could have done some things differently if they started fresh but are happy with the path they took and their end deliverables.

If this project was to be worked on in the future, there are a couple of recommendations from the team. The first is to spend a lot of time focusing on categories. There can be an effective IMS system but without the right categories, the correct picture cannot be painted. It is critical to find out company values and foundational blocks before you start a project. Knowing what the company holds tight and will never change is important, to know what is out of bounds. By knowing ahead of time, less time will be wasted evaluating out of scope alternatives.

Overall, throughout the failures and successes, the team is leaving FoodShare with an effective and easy to interact with Inventory Management System called FIT.



Figure 6: Team Donation Facilitation

ACKNOWLEDGMENTS

There are a ton of acknowledgments to be made, as the team got a lot of help throughout the system. The first main acknowledgment to be made is the customer, Sharon. Sharon was flexible throughout the project and provided a lot of value-added feedback and project ideas. Without her commitment and drive, this project couldn't have been completed. Another acknowledgment is FoodShare employees. The employees were accepting of new ideas, and eager to interact with the FIT system. The system is only successful if the employees used it. Also, the visitors of FoodShare should be recognized. Dealing with the experiments and changes, they were receptive and accepting. The team's guide, Professor Kaemmerlen also contributed a lot of the team's success. He was supportive and helped give the team innovative ideas. The list of acknowledgments goes on and on, but the team would also like to thank: MSD Teachers, CrossRoads Manager, IISE Group, Graduate Student at FoodShare, Perinton FoodShelf, and RIT's ITS.