Project Nurture

The Digital, Data Driven Food Bank

P3 - Final Report

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Problem Statement

Hunger in our Community

Key social elements that were once considered common to all have become increasingly hard to reach by a growing number of people. This tear within the social fabric of our community has become too large to ignore as it has a significant impact on the conditions in which people live, grow, and learn. It may not be immediately apparent, but we are surrounded by people who are struggling for food, education, healthcare, housing, and employment.

These conditions have grown to become large barriers to entry for social mobility within our community, and if not corrected now, whole generations may be at risk of poverty. In addition, these conditions are not mutually exclusive - they are systemically embedded within our society, compounding the magnitude of their impact on the community. The majority of people in need struggle to meet most of these conditions, and one project cannot realistically solve for everything across employment, housing, healthcare, education, and hunger. Therefore, the key question to answer when trying to have a significant impact on social good is where to start.

From our research, we believe that targeting hunger is an actionable first-step to improving the social-mobility of our community and the lives of its members. Our team views the issue of hunger as an optimization problem that we can solve for by embedding digital technologies into key areas of the existing supply chain infrastructure and food distribution network. We do not need to change how we distribute food, we just need to improve the efficiency and visibility of the process.

Understanding the Need

Given this problem statement, our research team decided to focus on the food donation process, since it directly touches the hunger needs of the community. Knowing the complexities involved in maintaining and distributing food, we saw an opportunity to realistically improve the existing system, instead of attempting to build a new one. We then identified the key parties and processes within the food donation system and used them to guide our needfinding activities.

Through our needfinding activities, the food bank quickly emerged as the most critical piece of the distribution system. As we worked to understand their activities, goals, and needs, we started to see patterns and repetition among the problems that they face. This allowed us to categorize the identified problems into 3 major categories for improvement:

1.) The first major point of improvement targets their inventory data. From the sourcing to donation of food, data is never accurately collected at any point, leading to operational

confusion and lower efficiency. It becomes hard for the food bank to perform any type of reporting or business intelligence if they do not collect granular inventory data.

2.) The second point of improvement targets their manual processes. A lot of what the foodbank does is completely manual, with information recorded on paper or keyed into spreadsheets. In addition, the food bank doesn't use any technological aids to improve the volunteer activities of sorting and distributing food. There is a high dependence on memory in the mind, rather than memory in the world. These types of manual processes lower the overall efficiency and effectiveness of the foodbank.

3.) Finally, the third point of improvement targets their volunteer management. The food bank heavily depends on volunteers to be able to operate, yet they do not have a way to manage their volunteer base, let alone grow it.

By focusing our solution to target these three categories of improvement, we believed that we would be able to solve for the biggest problems that the food bank faces and not waste time building out other functionality that would have a very minor impact on the food bank's operations or make it more complex and harder to adopt the solution. Since the food bank sits at the heart of the food donation process, we realized that all it would take were a set of simple and actionable improvements in those three categories to have significant impacts to the upstream and downstream groups within the food donation ecosystem, and ultimately, improve the access to clean and healthy food for our community.

Design and Usability Goals

To design a solution that could effectively solve for the food bank's problems identified during needfinding, our research team created a set of design and usability goals to guide our work. To develop our core design and usability goals, we integrated the insights we built during data gathering and activity analysis with our key user groups. Since we were leveraging an existing system, we wanted to make sure the design and usability goals accurately built upon the existing workflow and effectively transformed it into something that is preferable in use and in functionality. In development of these goals, we tried to maintain the core components of the system to facilitate a smooth user adoption phase, while targeting specific functionalities to redesign and improve.

Design Goals

- Quick and simple way to scan donated inventory in and out of the food bank, allowing the food bank to effectively manage inventory.
- Automate and streamline the existing manual and error prone processes of tracking inventory, accounts, and volunteers.

- Provide accurate and detailed data (at an item level) to optimize the day-to-day operations of the food bank.
- Drive increased and enhanced collaboration among upstream supplier, the food bank, and downstream agencies.
- Provide needed visibility and control to the food bank management that they currently do not have.

Usability Goals

- Easy to Use: Nurture should be easy to operate in both a warehouse and office environment.
- Error Tolerant: Nurture should be error tolerant, guiding users of various skill levels through natural interfaces and allowing users to easily reverse undesired actions.
- Easy to Learn: Nurture should be easy to learn and intuitive given the wide range of users that will operate the application.
- Safe to Use: Nurture should be safe to use across the various tasks involved in sourcing, sorting, and distributing food.
- Effective: Nurture should improve the current process of sourcing, managing, and donating food against defined key performance indicators.
- Efficient: Nurture should be able to quickly respond to various user commands and execute the required actions.

Given the overall design and usability goals, we broke down the user goals into the two groups of users that would interact with our solution. Since their roles are different, the overall solution had to be built to facilitate the unique goals for each type of role. The following lists outline the different user goals for each group:

User Goals for Volunteers and Food Bank Drivers

- Scan-in sourced inventory.
- Sort and assign warehouse location .
- Assist in determining inventory to discard.
- Scan-out distributed inventory.
- Sign-in for shift or session.
- Download daily activity (route or session details).

User Goals for Food Bank Manager

- View inventory availability, count, and location.
- Track location of drivers.
- Manage volunteer activity and needs.
- Manage accounts, partners, and events.

- Generate reports for funding requests and leadership meetings.

In addition, we abstracted a high level goal to make sure that every decision we made was in line with the objective that we were trying to achieve. Since this system has various users with different tasks, the high level goal for each user can be summarized as: quickly and accurately move the donated item to the next phase. Since the users within our system are in series with each other, the integration of their high level goals ultimately represent the movement of food from the supplier to the community. This high level goal tied back to our initial problem statement and helped keep our design and build decisions closely tied to the objectives that we were trying to accomplish, without overcomplicating the solution.

Design - Description and Rationale

Given our understanding of the food donation ecosystem and the specific needs of the key users within it, our research team used the defined design and usability goals to create three conceptual solutions that could enable the food bank to more effectively source, manage, and distribute food to the hands of those in need**.** Figure 1 shows the integration points of our solution within the food donation process.

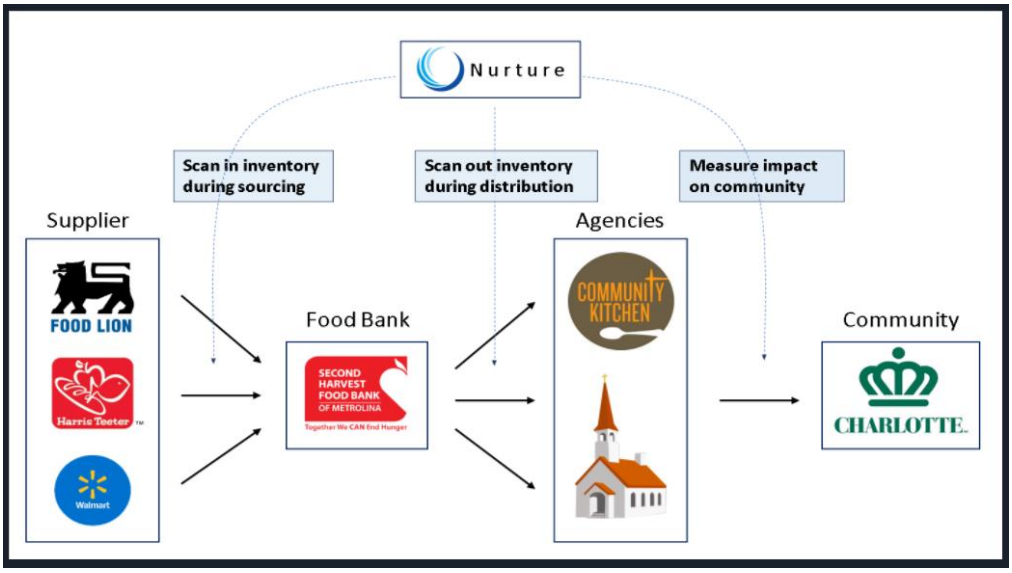


Figure 1 - Integration into the food donation ecosystem.

We then went through multiple iterations of solution evaluation and validation to score the three solutions and ultimately select the best one. The chosen solution consisted of two main components - a mobile application to scan inventory in / out of the food bank, as well as a dynamic web portal and dashboard for inventory management and business intelligence. Figure 2 outlines the conceptual architecture of the solution.

Figure 2 - Solution Architecture: End to end inventory scanning, data capture, and inventory management

Mobile App

The first component of the solution is the custom mobile application with QR and barcode scanning functionalities. This app can be downloaded by the food bank's drivers and volunteers, and is supported by iOS and Android smartphones. The core functionalities that this app supports are login and authentication, presentation of relevant and helpful information, and inventory scanning. The app plays a critical component to the overall Nurture solution since it is the interface through which data is collected. Given that the capture and management of the food bank's data is the core component to our solution, the design and functionality of the app were built to facilitate the data capture process in the quickest and easiest way possible. In addition to being efficient and effective, the application was designed to be error tolerant, easy to learn, and most importantly, safe to use - aligning with our usability goals. We applied these usability design features in combination with the design goals to ensure that the app was also able streamline the existing processes, provide accurate data, increase collaboration, and provide visibility into the process.

The following set of high fidelity images outline the features and functionalities that the app supports. Furthermore, our descriptions for each image will explain how the design meets our stated goals and our rationale behind each design.

Starting with login, the app provides the users the option to enter the app as a volunteer or as a truck driver, and then authenticates the user to display the appropriate home page - Figure 3 and 4 shows the login process and the customized home page displaying important and relevant information for the given user.

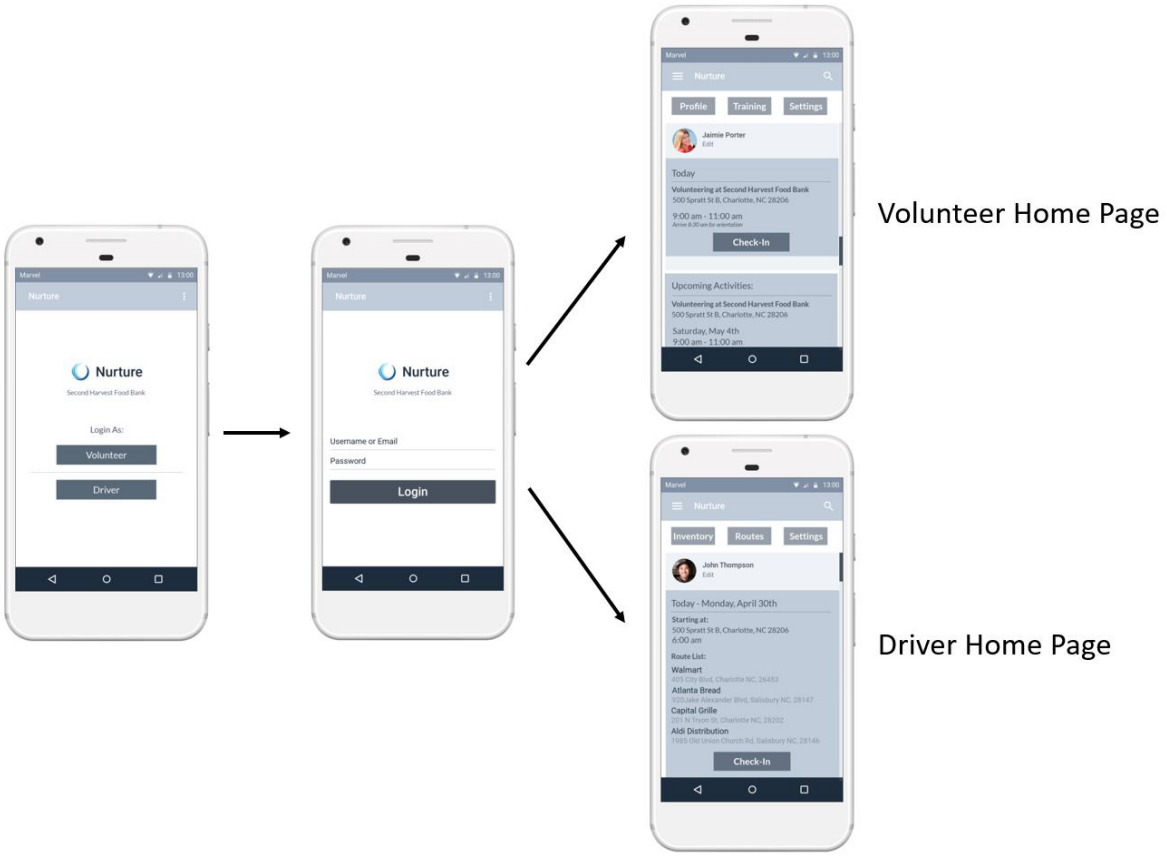


Figure 3 - Login, authentication, and customized homepage for volunteer (left) and driver (right)

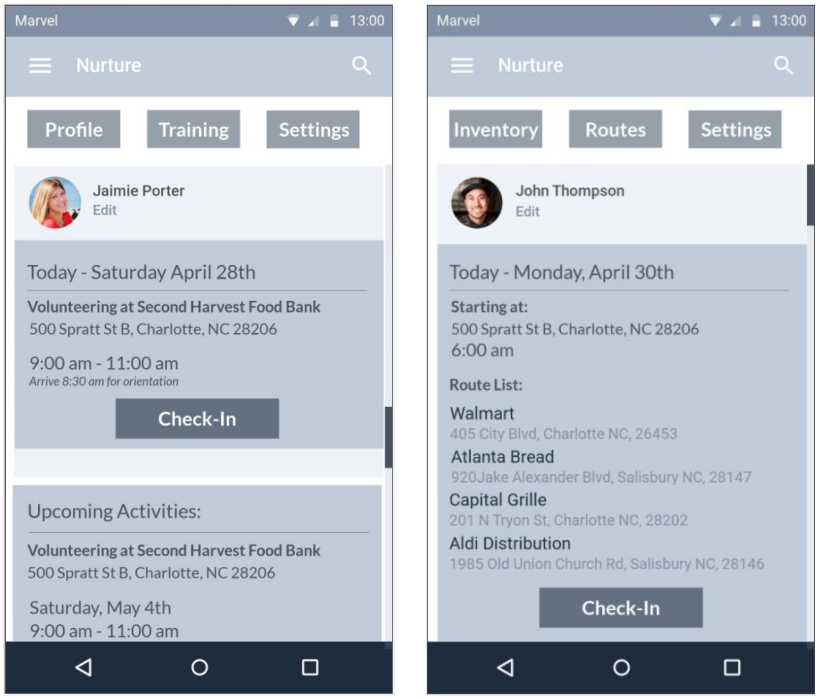


Figure 4 - Detailed view of the Customized home screen for volunteer (left) and driver (right)

We chose to support both the volunteer and the truck driver user types in a single app, and use the login process to authenticate and guide the users. Based on the type of user, the experience will differ, so the initial login interaction serves as the experience gateway. We went with this approach to simplify the solution for the food bank (manage 1 application instead of 2) and allow us to maintain a consistent look and feel across the two types of users, since a single user can be both types depending on the needed role. To maintain the consistent look and feel, we used a single column grid structure, with information spanning across as rows. We also used the same typography, color, and contrast themes, as well as incorporating positioning and hierarchy guidelines for the information on the page and the menu bar at the top. To separate information and allow the user to easily scan the page for items of interest, we used white space instead of a physical grid or boundary structure. These design choices were made to ensure that the app aligned with the defined usability (easy and effective to use) and design goals (visibility, control, and simplicity). In addition,, the information presented on the homepage is what we identified to be the information that the user would need to quickly see up front, instead of having to search for it - for ex: the volunteering day details (and the next activity) for the volunteer and the current route list for the truck driver. Finally, the home page provides the users the ability to check into their shift and provide the foodbank with engagement and activity data.

After the initial homepage, the experience and activity flow differs across the two volunteer types, so we will cover the volunteer features first and then the truck driver features.

Volunteer Features

The volunteers can access the Training functionality within the app, where they can watch all of the required videos and complete the certification quiz **(**Figure 5). Including the training functionality in the app was a key design decision since we had identified a huge need and opportunity to optimize the current training process. Before each volunteering sessions, all volunteers are legally required to watch a series of training videos to certify that they are capable of performing the food sorting activities at the food bank - this applies to both new and experienced volunteers. This was a very time consuming and repetitive process, so we decided to include it in the functionality of the app. Now the volunteers can watch the training modules and complete a certification quiz before they even enter the food bank. Not only does this improve the efficiency and effectiveness of the foodbank, it provides the management with volunteer data they didn’t have before - they are able to see which volunteers are or are not certified. The design of the training page follows the same design principles as the home page to maintain consistency and ease of use. We also incorporated an alert functionality at the top of the page to help guide the users on what needs to be done, as well as making the certification quiz unavailable to tap (grayed out) when the full set of training videos are not complete. If the users attempt to take the certification quiz before completing the training, they receive a pop-up alert (not shown in Figure 5) reminding them to complete all of the videos first.

After the users are certified to volunteer at the food bank, they can access the check-in confirmation page from the homepage and begin their volunteering session - also displayed in Figure 5. This confirmation page presents the users with information around the specific activity they will be doing, the duration, and their registration and training status. It also guides the user with directions on how to begin the session. They still have access to the home page, and can also use the back functionality at any time in the app to revert to the previous screen - allowing the app to be error tolerant and increasing the ease of use and learnability.

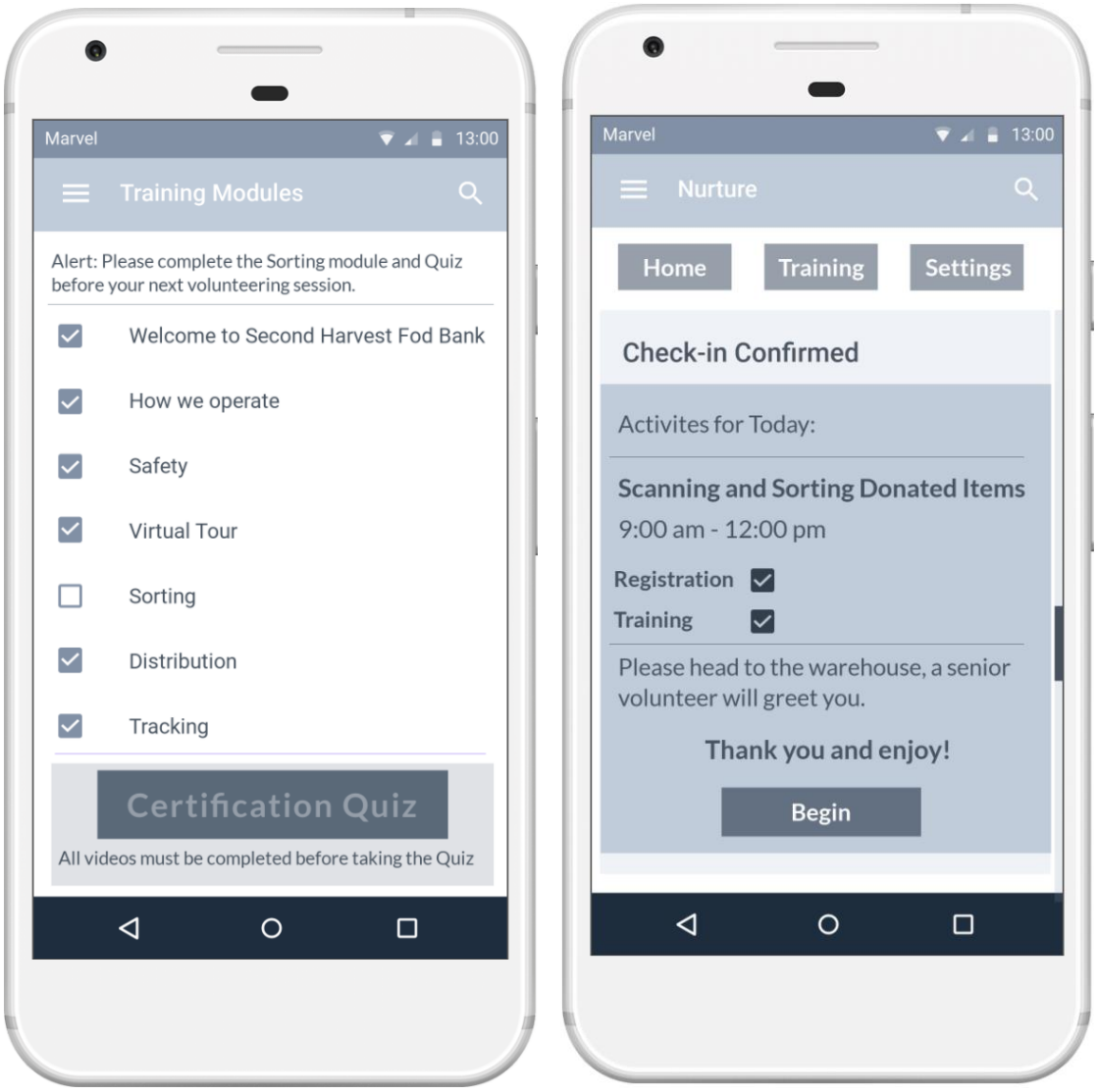


Figure 5 - The in-app training modules and certification quiz functionality (left) as well as the session confirmation screen to begin volunteering (right)

Once the user needs to begin the food sorting volunteer session, they just tap the Begin button. The app sends this data to the management dashboard, allowing them to have a real-time view of how many volunteers are beginning their shift and make any adjustments if they need to.

Figure 6 outlines the end-to-end scanning and food donation process. Once a user picks up an individual item that was received in the bulk donation packages, they are given a notification to tap on the screen to auto detect the barcode. By tapping on the image, Nurture identifies the bar code and marks it with blue corners. This type of feedback and visibility provides the user information into what the app is doing and what state it is currently in. Also, this simplistic interface involving minimal taps allows for a more streamlined and easy-to-use / easy-to-learn experience with the app. The user can then select the shutter button to capture the item. This causes a semi-transparent screen to come up with further options and instructions. All interactions and decisions occur on this screen within the camera. We chose to design the app like this so that the user doesn't have to switch screens and will always maintain a view of the item they are working with - again increasing the visibility and efficiency of the app.

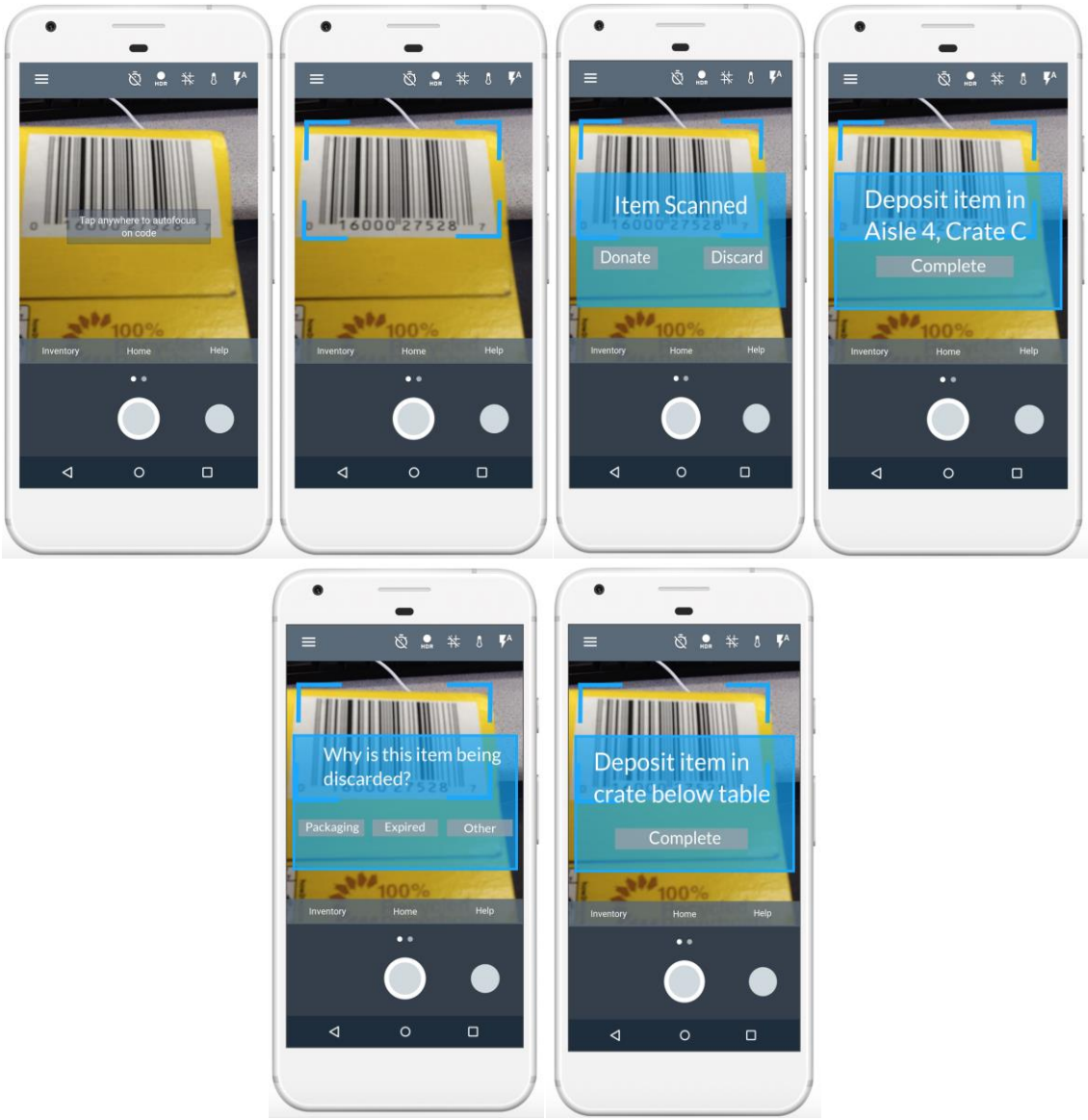


Figure 6 - Shows the end-to-end scanning and process within the app. The top shows the donate sequence, and the bottom shows the discard sequence.

The user must then select if they will be moving this item into the donate inventory or the discard inventory. If an item is damaged, expired, or has other health or safety problems, the item must be discarded. If the user selects donate, the app provides them with a confirmation screen and helpful information about where they should drop the item off. If the user selects discard, the app generates a screen asking for the user's input as to why the item is being discarded. The user has the option to select "Packaging", "Expired", or "Other". Once the user selects a reason, they are provided a confirmation screen that tells them where to discard the items. When the user taps complete, the item and destination are logged to the database. If the user had selected discard, this then marks that specific item with the reason that it was being discarded and provides this data to the management portal for quality analysis around the items that they are sourcing.

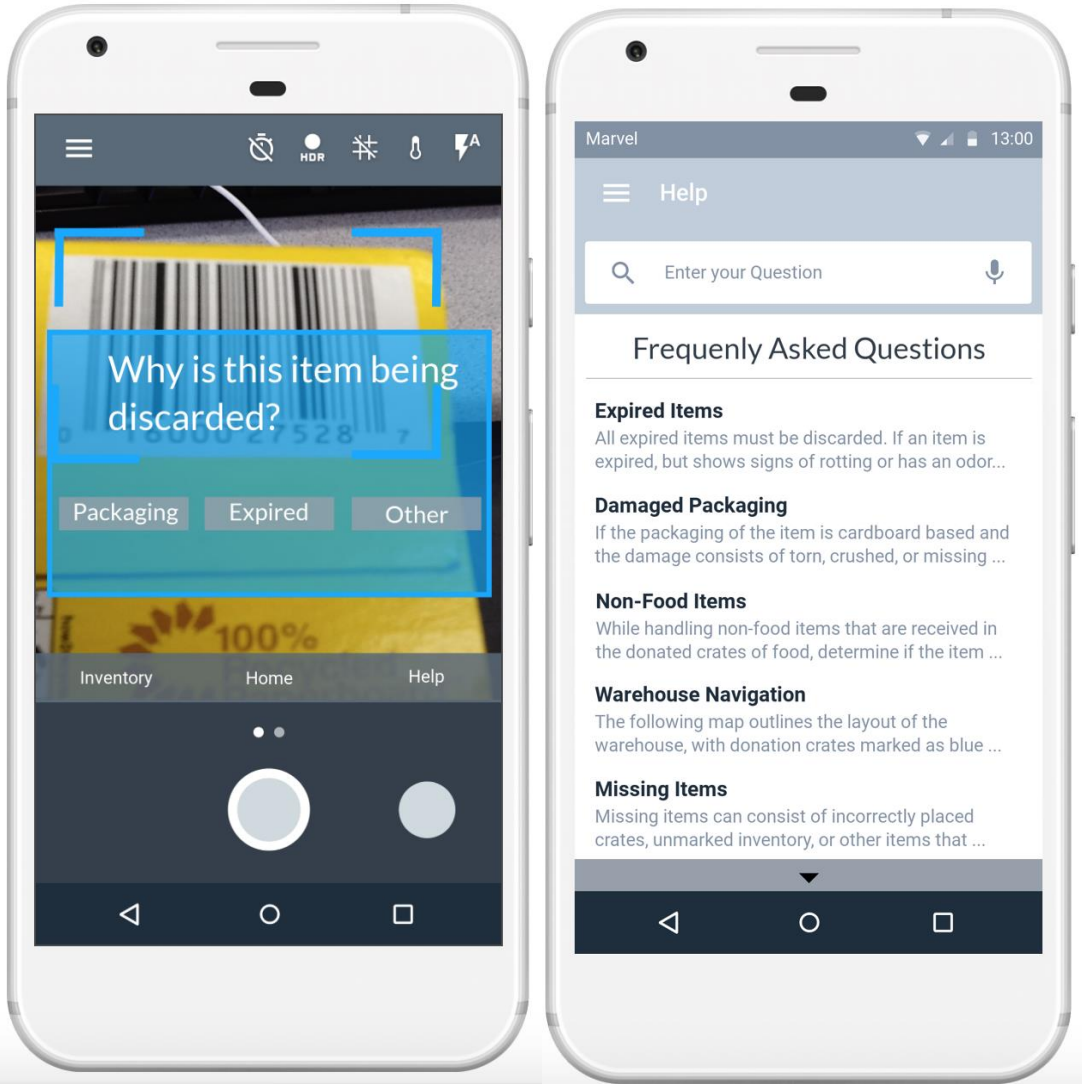


Figure 7 - Detailed view of the Discard screen (Left), as well as the Help screen (Right) which is accessed by tapping help on the lower menu bar.

Figure 7 provides a detailed view of the Discard screen and the built in help functionality to allow volunteers to make better decisions about the items they are processing for the food bank. For example, if they are not sure if a small crack in the packaging will cause an item to be discarded, they can open up the help functionality from the lower bar of the camera and either search for their question or select one of the Frequently Asked Questions. This type of built in help and guidance functionality relieves some of the mental burden put on the users, allowing for more enjoyable and effective food sorting activities.

Another key feature in Figures 6 and 7 is the back functionality. At all times, the user can go back and reclassify an item or even rescan it. They are not stuck at any point in the process. It is not until they confirm the item that they log it to the database and move on to the next one.

Overall, this process is closely linked to both the design and usability goals. This is the core functionality of the solution, since it allows the food bank to collect granular data while streamlining the existing process and increasing the overall accuracy. Given its high visibility and simple processing steps, we expect the users to have no challenges in performing their tasks with this functionality.

Driver Features

Transition from the volunteer experience, the following set of high fidelity images highlight the functionality and features that a user can experience after selecting the driver login and authenticating as a driver:

From their homepage (Figure 4), the driver is able to access a dynamically generated list of expected inventory to be received today, as well as the specific routes that they will have to cover (Figure 8). This type of information is dynamically generated for the driver to help solve a specific need our research team identified at the food bank.

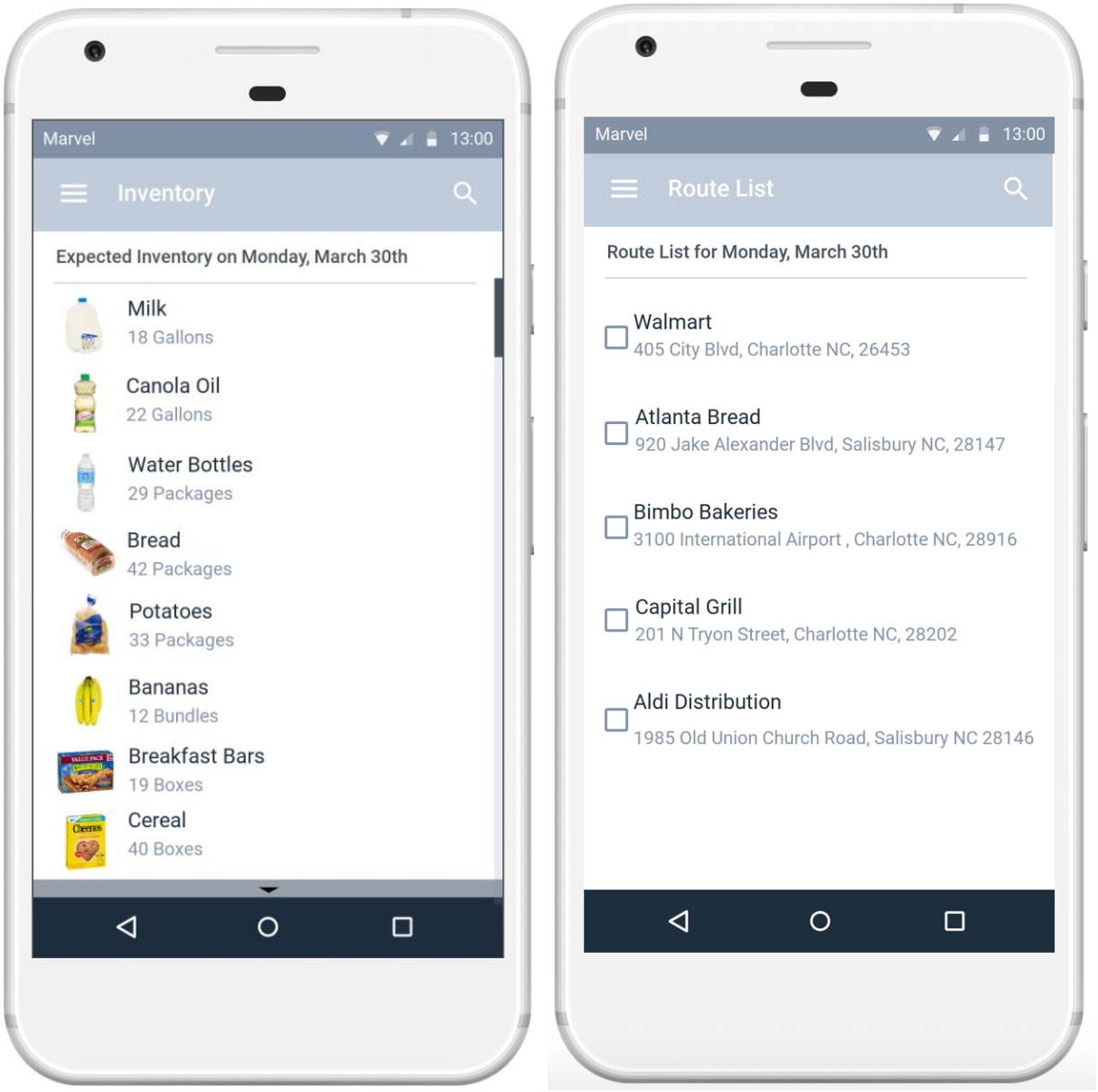


Figure 8 - Driver can view expected inventory to be received during their daily route (left) and confirm the stops and addresses of their routes along the way (right).

In the scenario that a driver cancels or breaks down on the way, the food bank would have a very hard time in manually rescheduling routes and making sure their expected inventory was sourced. Given this new functionality, Nurture can dynamically generate an optimized route list and update the Route screen of the app, allowing the drivers to see their new route list and expected inventory. This design decision greatly increases the efficiency of the food bank by automating an existing manual process and providing the food bank with the data needed to maintain control and visibility into their operations. In addition, the inventory list allows the user to compare the items that they actually received to what the food bank was expecting to receive.

This lowers the error rate during food sourcing and makes the initial intake process more effective.

Following in the design principles of the other pages, these page also utilizes top-down hierarchy to order information - for ex: the list of stops is ordered by sequence from top to bottom. Furthermore, the color theme, the alignment, and proximity is maintained to make information easy and quick to consume.

The next figure (Figure 9) shows the route details and map that the driver can access by pressing an individual route on the Routes screen, as well as the Route Tracker page that they will access when they check into their shift. The route map makes it easier for the driver to get to their destination quickly, as it links with the existing navigation app, like Google Maps (functionality not built into the demonstration prototype) on their smartphone. Once the driver reviews their route list, they can choose to check in on the home page and will be taken to the Route Tracker page. This page displays the upcoming route information and provides the driver with the next immediate stop. They can also view any Notifications they have related to their route on the Route Tracker page as well. This functionalities allows the driver to be aware of any critical information related to their destination, like which bay they should park the truck or a specific reminder for that location. Including the detailed route information and map, as well as the important notifications functionality in the route tracker screen were design decisions that the team made to improve visibility and control, while increasing the ease of use and effectiveness of the app for the driver. In addition, this type of information allows the driver to make better decisions and not have to remember specific details regarding his various stops, like where to park and how to identify inventory that is marked as donation (handled through notifications). This transfers what previously was knowledge in the head to knowledge in the world.

Not only do these functionalities improve the process for the driver, they make it easier for the food bank to manage their routes and schedules. Since each app can link to the existing GPS functionality on the phone, it is able to send back geospatial data, which the web portal uses to display driver location and status. This increases the visibility of the management into the critical process of sourcing food from the suppliers.

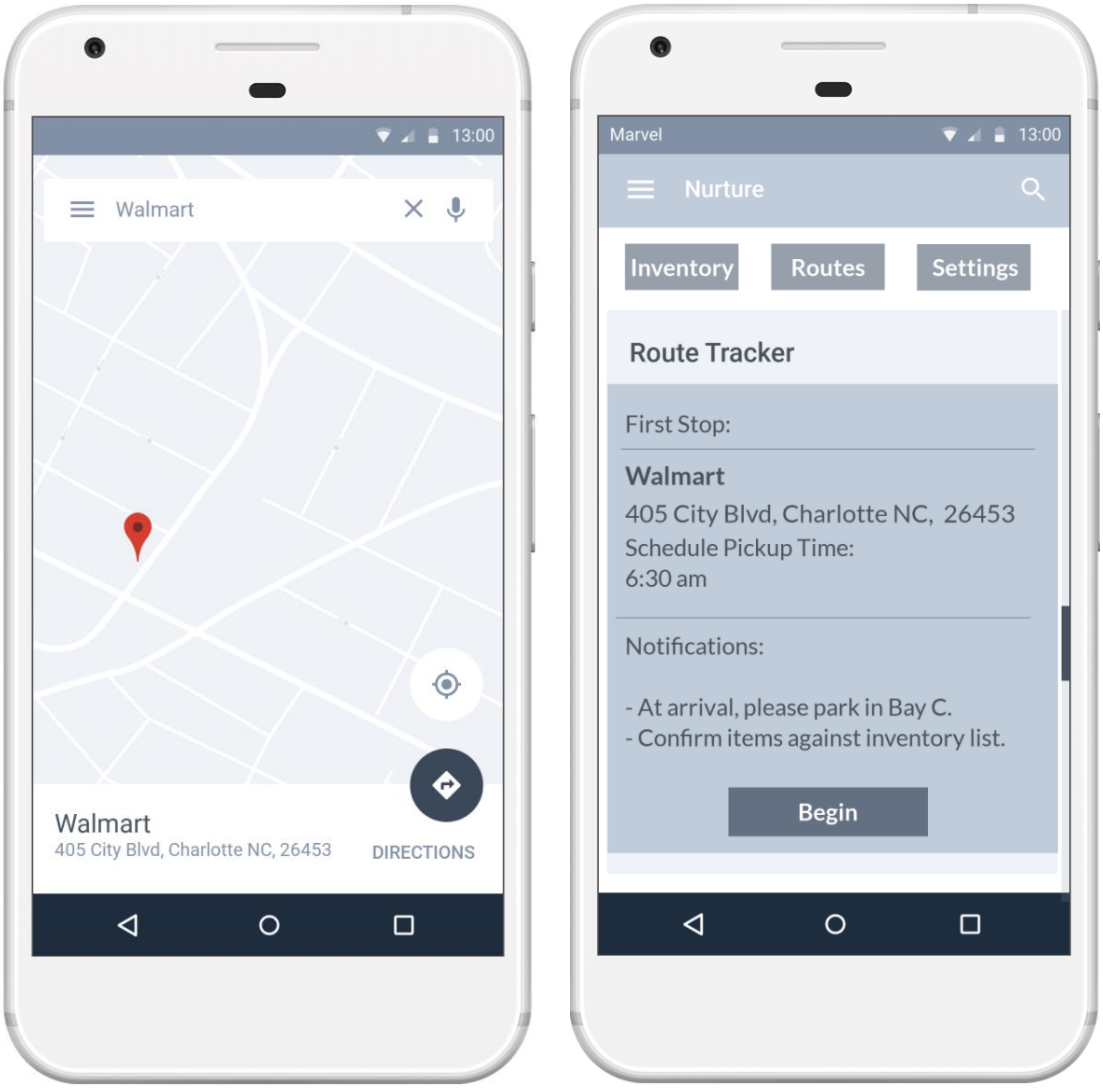


Figure 9 - For each stop, driver can view detailed location information (left). When ready, driver can head to the first stop and begin the sourcing process (right).

From the Route Tracker page, the driver can select Begin to initiate the scanning process and open the camera page. Figure 10 shows the autofocus functionality that identifies the bar code, and the subsequent Item Scanned page. To activate the autofocus functionality, the driver needs to tap on the image and the focus boundary appears. The driver can then tap the capture button to initiate the scanning of the item. The driver will have to enter the count of items that are being scanned in bulk from the supplier and then tap next to reach the confirmation screen. The driver can exit the scanning process at any time and go back to the camera using the Undo or Back functionality. The only time that the item will be recorded to the inventory is when the driver taps next and confirms the scanning process. Although this scanning process is shown in the two images in Figure 10, it actually consists of 4 total steps - Figure 10 just captures the main screens.

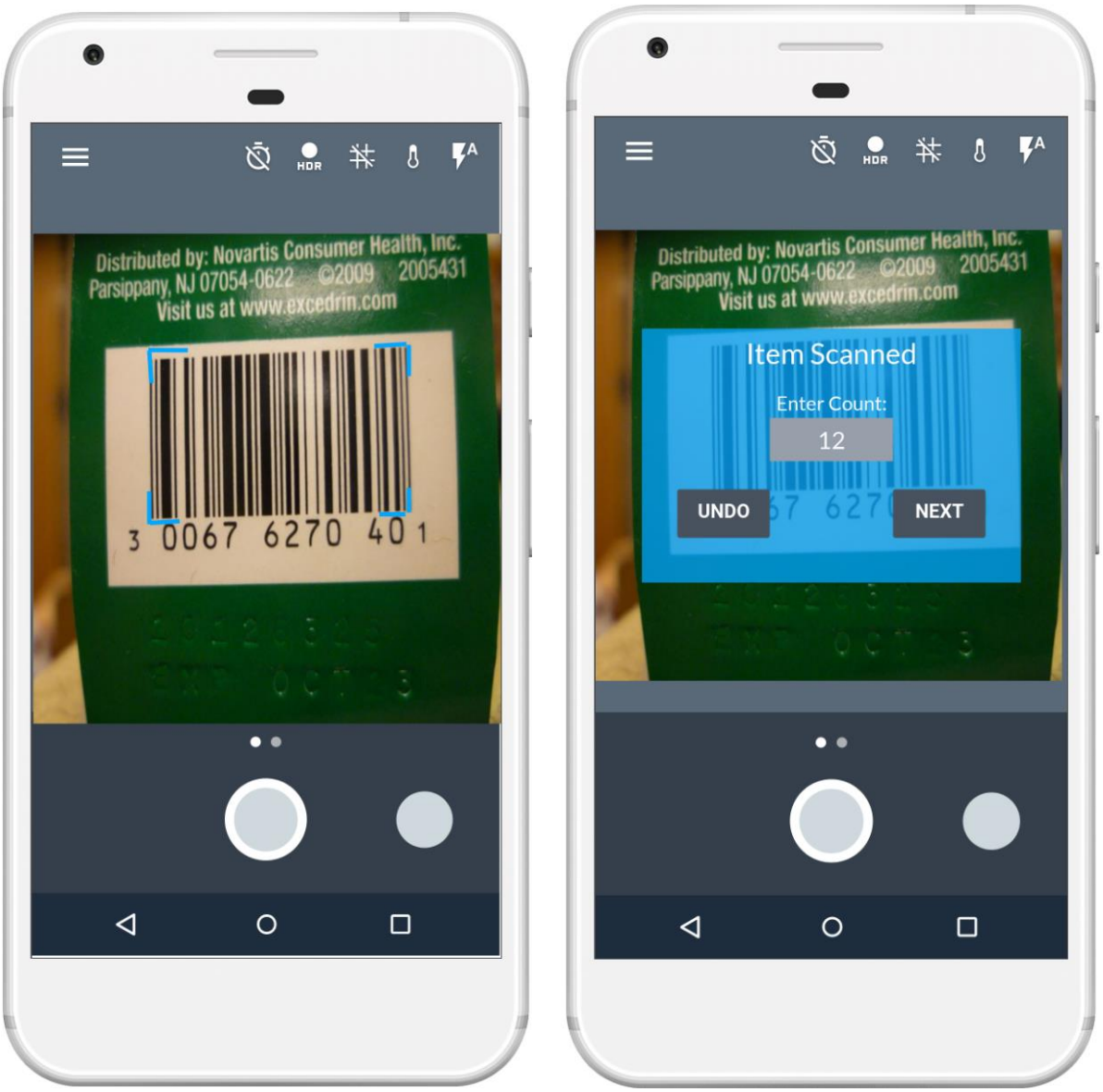


Figure 10 - Auto focus and barcode detection (left) and Item Scanned confirmation screen after producer enters the number of units in the package (right).

The scanning functionality displayed in Figure 10 was a key design decision for our team. We wanted to simplify and improve the existing manual process of picking up donated items, but at the same time, we didn't want to introduce a complex and time intensive process that the drivers must follow in an environment with both physical and time constraints. For this reason, we leveraged existing image recognition to detect the barcode and a simple interface to input the number of items, confirm the scan, and move onto the next item (similar to the volunteer scanning functionality). In our prototype, the next item is a second image that can be scanned and logged to inventory.

Although this functionality is not shown in Figure 10 (but available in the prototype), the driver can manually enter the item code to initiate the scanning process. This functionality was added to ensure that if the camera had any trouble identifying the barcode, the driver would still be able to scan the item. This type of error prevention functionality allows the app to be error tolerant and more effective, aligning with our usability goals. Furthermore, the simple scanning process meets our design goals by allowing the quick collection of inventory data and streamlining the existing manual process.

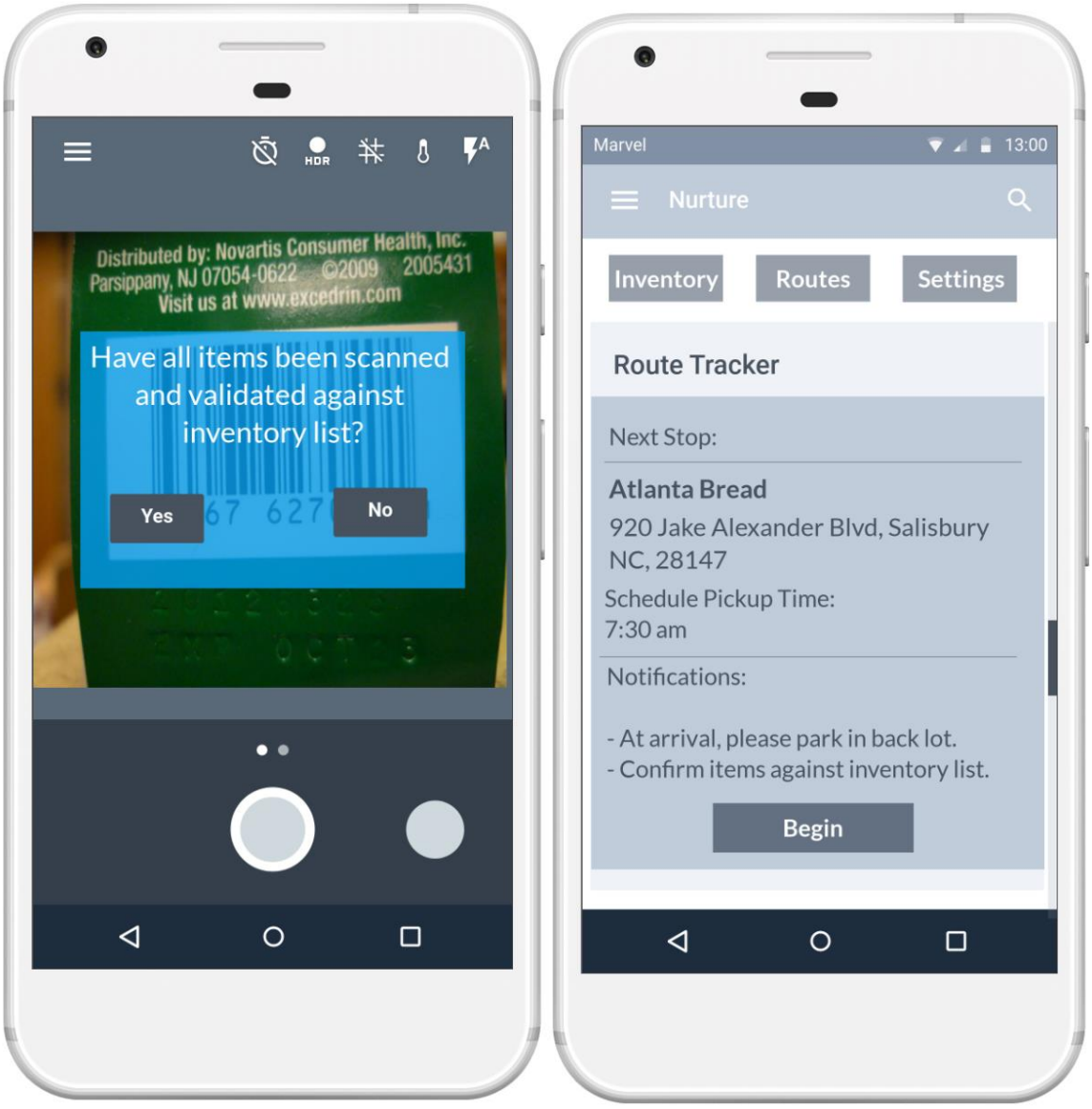


Figure 11 - Confirmation after all items completed at a stop (left), followed by the loading of the next stop details (right)

Once the driver scans all of the inventory at the specific destination on the route, they can select "Complete Scan" (not shown in Figure 10) on the main page of the camera to initiate the process

to end the inventory scan at that location. Once “Complete Scan” is selected, the driver receives an alert asking them to confirm if all items have been scanned and validated verse the inventory list for that location (Figure 11). At this point, the driver can select No and to go back and make sure all items have been scanned and validated, or the driver can select yes to complete the scanning process and move on to the next location. Figure 11 also shows the Route Tracker, updated to reflect the next location’s details and notifications, after the driver has completed the scan at their current location.

App Features Summary

Overall, the design of the volunteer and driver app incorporates features and functionalities that allow it to meet our design goals, as well as specific elements of interaction design to meet our usability goals. All of these component sit in a clear and consistent layout, designed with simplicity and leverage proximity, whitespace, and alignment to make it easy and enjoyable to use.

Web Portal

For the dashboard, we had a diverse set of options that we could use to develop the prototype. However, we decided to code the prototype using advanced technologies such as Bootstrap, HTML, CSS, JavaScript and jQuery with an open-source dashboard template. We wanted to make sure to give the users the look and feel of the final product. The team recognizes that a high-fidelity prototype might makes the users think this is a complete system and, therefore, the users were explicitly informed that this is only a prototype with limited functionality. The following table shows the functionality supported by the dashboard prototype:

Inventory	**Volunteers**	**Suppliers**	**Drivers**	**Agencies**	**Reports**
View/Edit Items	View Today’s Volunteers	Add Suppliers	Add Drivers	Add Agencies	Daily Reports
View/Edit Locations	Approve/Reject Volunteering Request	View/Edit Suppliers	View/Edit Drivers	View/Edit Agencies	Monthly Reports
View Current Inventory	View Volunteers Database		Track Drivers		Yearly Reports
Search for Inventory Items	View Volunteers Calendar				

During the design of the dashboard prototype, different usability goals and principles were taken into consideration. For example - in all the modules of the dashboard prototype, the users can search for an entity using a few characters in any of the descriptive columns for the entity (they can search “Lion” and “Tryon” for Food Lion on N Tryon Blvd). This way, the users do not need to remember exactly what they are looking for and the system is going to show them results that contain the keywords they entered. This functionality supports recognition over recall as well as the easy-to-use and easy-to-learn usability goals. Another example of usability consideration is that the dashboard prototype helps the users minimize errors. For example, in any given page where a form exists, form validation is used to validate the user’s input. For example - if a form requires the user to enter an email address, a client-side script is used to validate that the user input was a valid email address. This is also used to validate that when the user confirms an email address, the two email addresses match. This functionality was implemented to help solve the need of accurate contact information, which we had identified at the foodbank during our needfinding activities.

The team also recognizes that feedback is an essential aspect of any usable interface. The users should always know that the action they want to perform is performed and their goal is achieved. Therefore, we designed the dashboard in a way that will always keep the users informed of what the system does. For example, when a user deletes an item, a success message is displayed with the name of the deleted item. If the system is not able to perform any requested action for any reason, an error message will be displayed to the user with information regarding the error. Moreover, we designed the dashboard prototype in way that helps the users recover from their mistakes. For example, when a user deletes a driver, they can undo the action immediately. During the design, we used typical conventions in our design decisions to improve the effectiveness of the dashboard prototype. For example, a success message is displayed in Green while an error message is displayed in Red. In addition, we used icons that should match with the user’s mental model of different things such as shopping carts. Figure 12 shows some of the icons used and the functionality that they are associated with.

	Drivers Management
	Suppliers Management
	Volunteers Management
	Reports

Figure 12 - A few types of icons outlined alongside the functionality they represent.

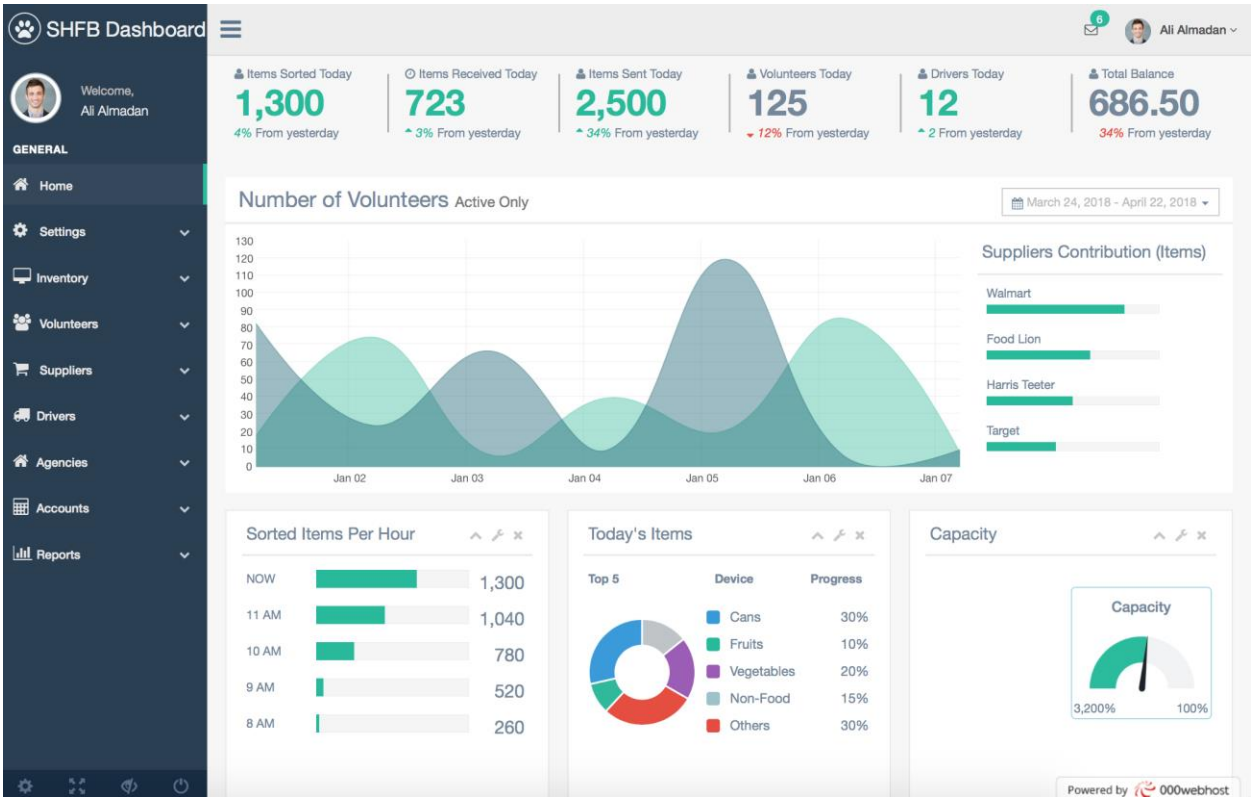


Figure 13: Dashboard home page

In Figure 13, the users can see real-time data about the major activities taking place at the food bank - this allows for live insights into the donation and distribution processes. For example, they will be able to see the number of items sorted today, received today, and sent today. They can also track the number of volunteers and truck drivers. Furthermore, the dashboard gives the users the ability to compare today's performance with yesterday's for example. What makes the dashboard efficient is its ability to aggregate and visualize all the collected data in an organized and consumable way, allowing the management to make real-time decisions.

In terms of design, the dashboard uses a consistent and cohesive layout across all of its pages. The main difference between the dashboard and the rest of the management functionality is that the dashboard relies on whitespace to separate the various visualizations and blocks of information, while the core management functionalities accessed through the menu bar on the left use a more tabular design (Figure 14). This design decision was done on purpose, as the management team is used to spreadsheets for processing and viewing information. Since we wanted this to be easy to adopt, we decided to incorporate some of the visuals that they were used to seeing, but in a more modern and digital approach.

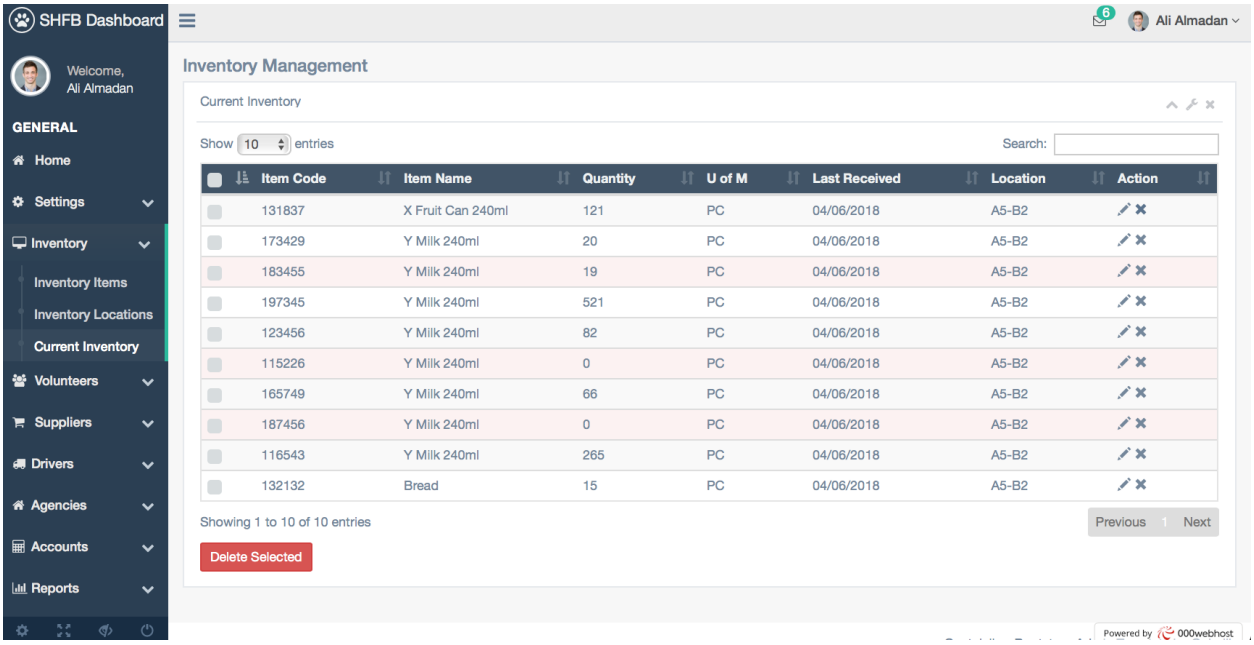


Figure 14: Current inventory view

Figure 14 shows the current inventory of the food bank. For each item, the users will be able to see the item code, name, quantity, unit of measure, last received, and location. The users can also modify the information or delete them. To make the dashboard more efficient, we decided to have a quantity threshold, and the item will be highlighted in light red if the quantity drops below the threshold. The page also allows the users to sort by any column. It might be helpful for the food bank management to sort the inventory list based on the quantity to see which items are not currently available. An example of action they might take based on this kind of information is finding more suppliers for a certain item.

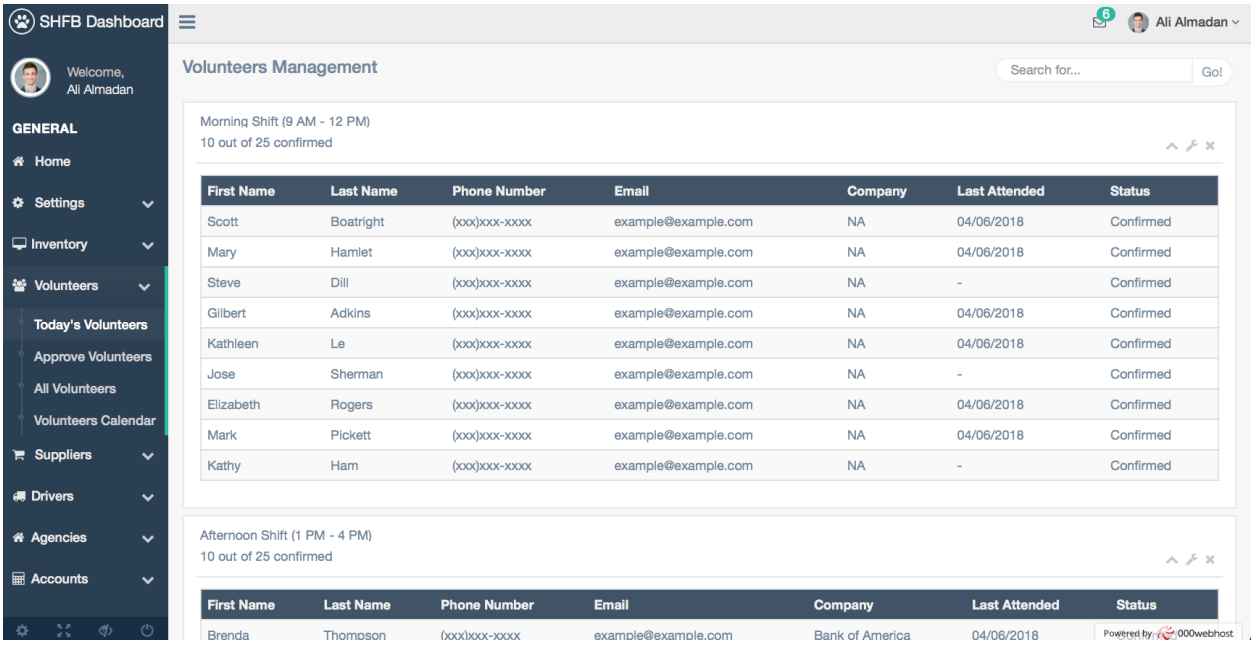


Figure 15: Today's volunteers

Figure 15 shows a list of the volunteers that are coming today during the morning and afternoon shifts. The users will be able to see volunteers information such as name, phone number, email address, company, last attended date, and the status. The the status might be confirmed or pending. The page also shows the number of volunteers coming today. In this example, we have 10 out of 25 who were confirmed. This means, we are accepting more volunteers and we have 15 more available.

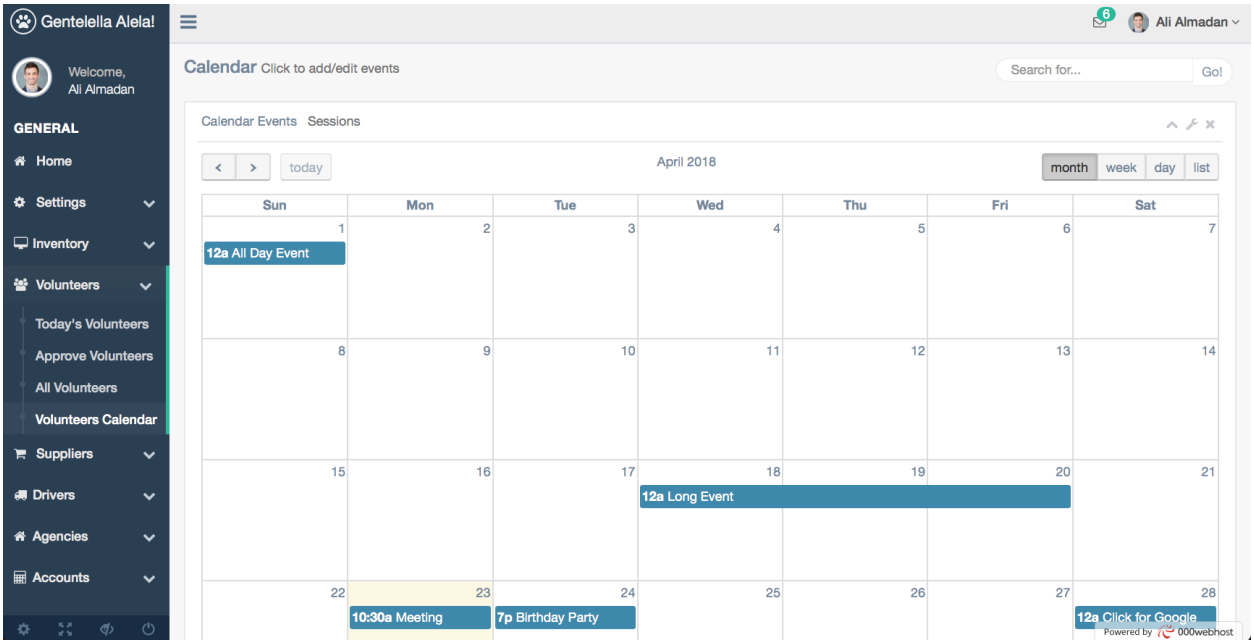


Figure 16: Volunteers calendar

Figure 16 shows the volunteers calendar. The calendar shows any important event regarding the volunteers. For example, if the food bank is not accepting volunteers for one day, this will be shown in calendar. It is also linked to the page were the users approve/reject volunteers. Organizing the volunteering sessions in a calendar helps the food bank decides if they will need to send out emails to have more volunteers for a specific day for example.

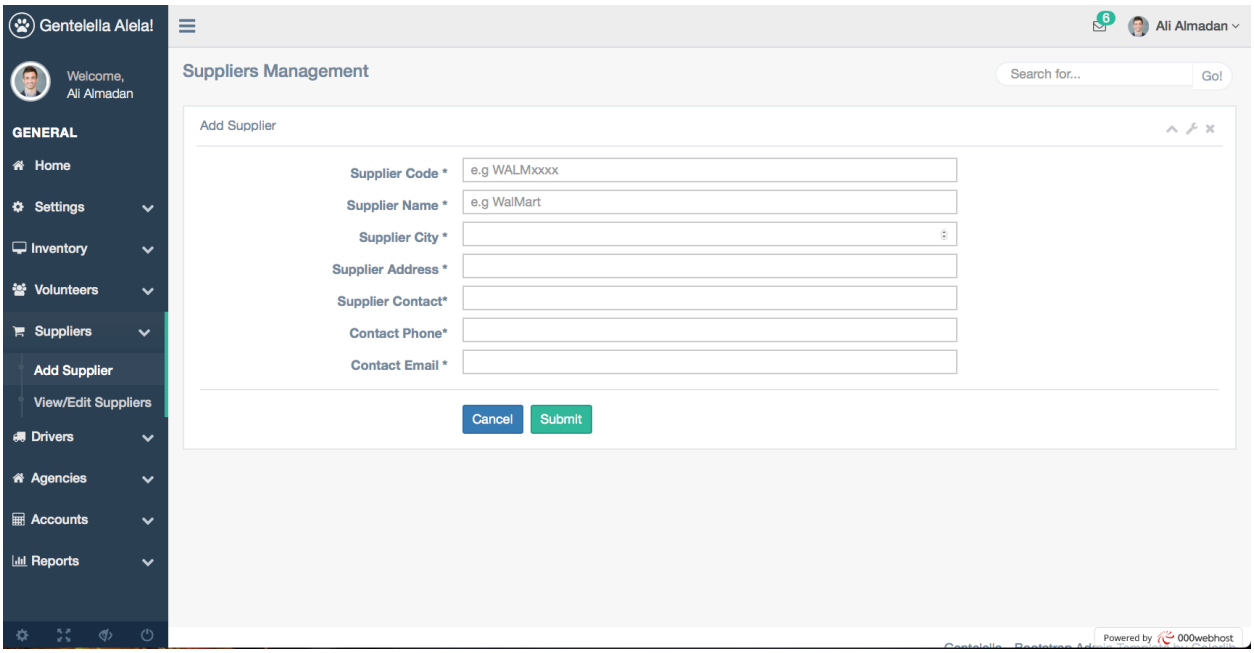


Figure 17: Add a new supplier.

In Figure 17, the users will be able to add any new supplier to the food bank. The supplier information includes the supplier code, supplier name, supplier city, supplier contact, contact phone, and contact email. We also made sure to put examples in the field placeholders. This helps that users know what they should enter to help minimize errors. In suppliers, we use the supplier code to be the primary key and it is a unique identifier. When the user tries to enter a new supplier where a supplier code matches another existing supplier's code, an error message will be displayed notifying the user that the supplier code exists.

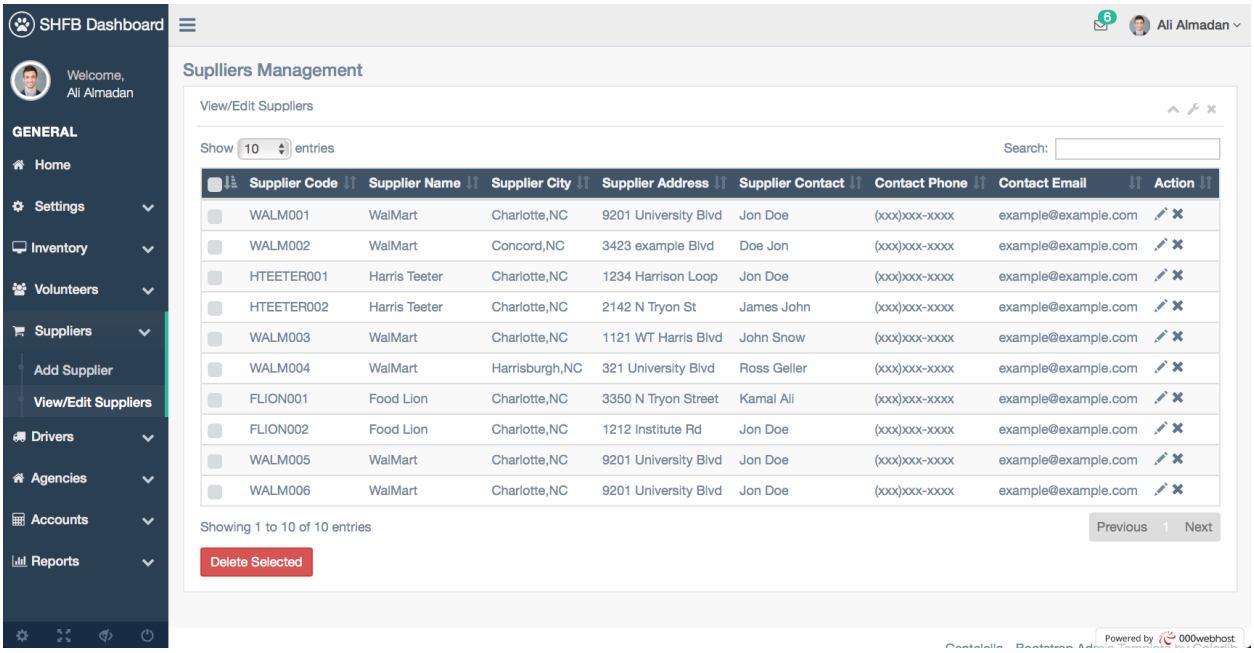


Figure 18: View and edit current supplier

Figure 18 shows the current suppliers we have in the system. For convenience, the users can sort the data on any column. They can simply click on the name of the column and they can sort the data in ascending/descending order. They also have the option to edit and delete the suppliers information.

The users have two ways to delete suppliers. They can delete specific ones, or they can delete multiple ones. To minimize error, a confirmation message will be shown to the users when they try to delete a supplier.

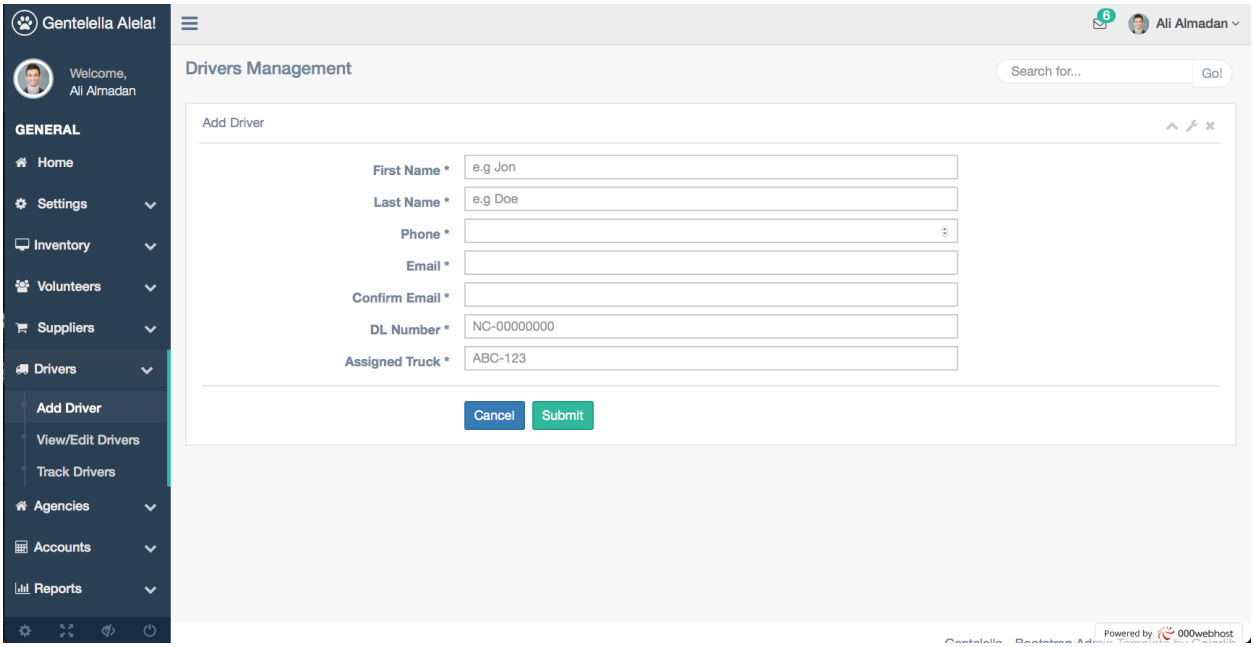


Figure 19: Add a new driver.

Figure 19 shows the page for adding a new driver to the system. The users need to enter name of the driver, phone number, email address, driving license number, and the plate number for the truck he/she is driving. To improve usability, we designed a page which uses form validation. For example, the page ensures that the phone number follows a valid phone number format. In addition, if the confirmation email doesn't match the original email, an error message will be displayed and the user will not be able to process. To perform the validation, we are using client-side scripts. The advantage of using a client-side script over a server-side script is that the validation takes place immediately. It is more efficient that the user doesn't have to submit the form to receive an error message. In addition, Figure 20 shows how the management can view and edit the list of existing volunteers.

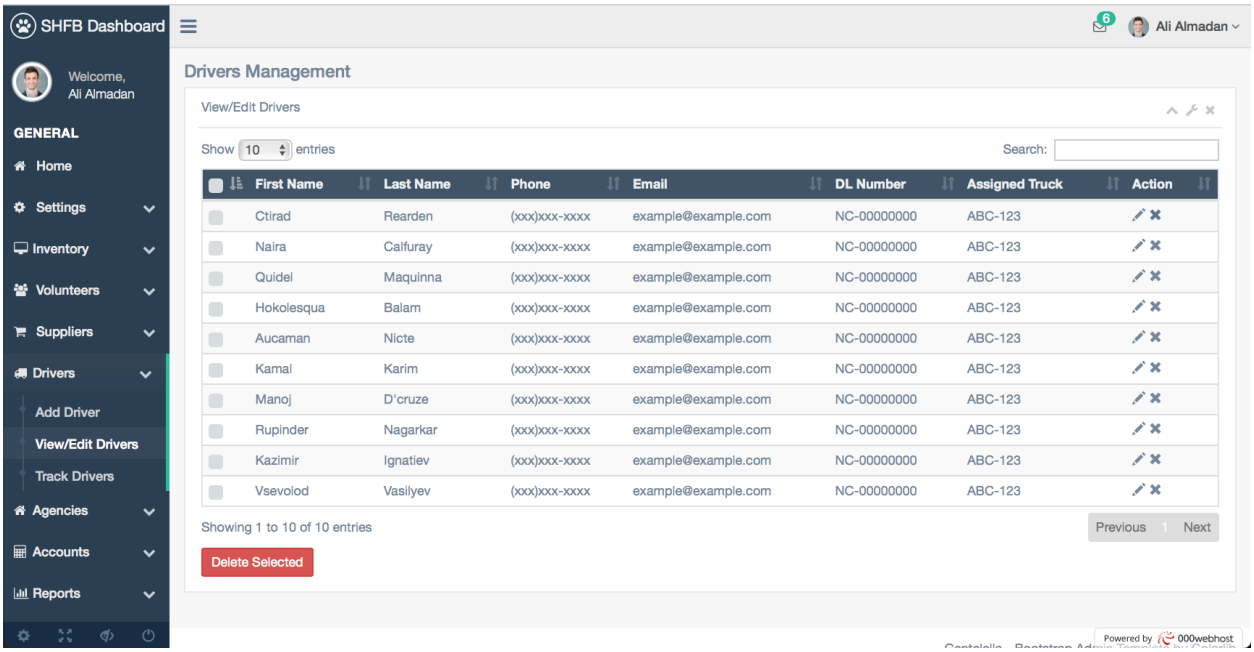


Figure 20: View and edit current drivers. Search for driver is also available

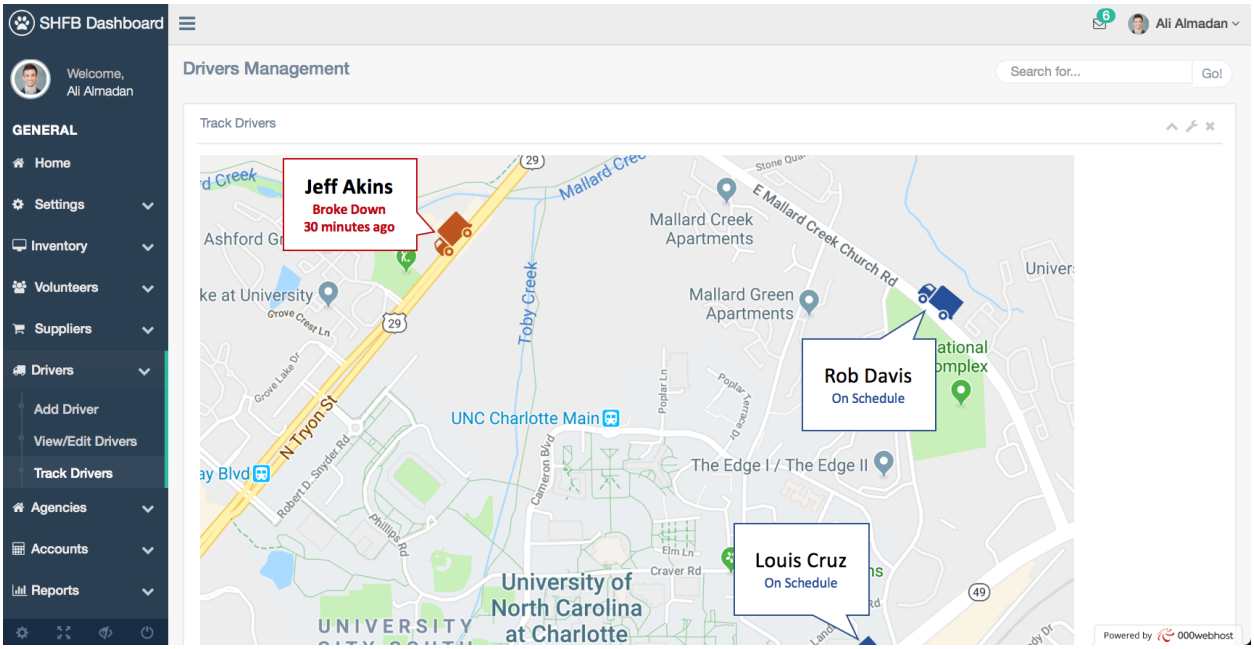


Figure 21: Tracking drivers helps the users locate any of the available drivers on route.

Figure 21 shows one of the most important features the food bank needs. Even though the food bank has limited number of truck drivers, tracking them is problematic. The dashboard allows the management to track the different drivers on a map. They can see who is on schedule and who is not. It also helps the management see if a driver is not on route. Since the drivers are using an app, the app feeds the geospatial data to track their location.

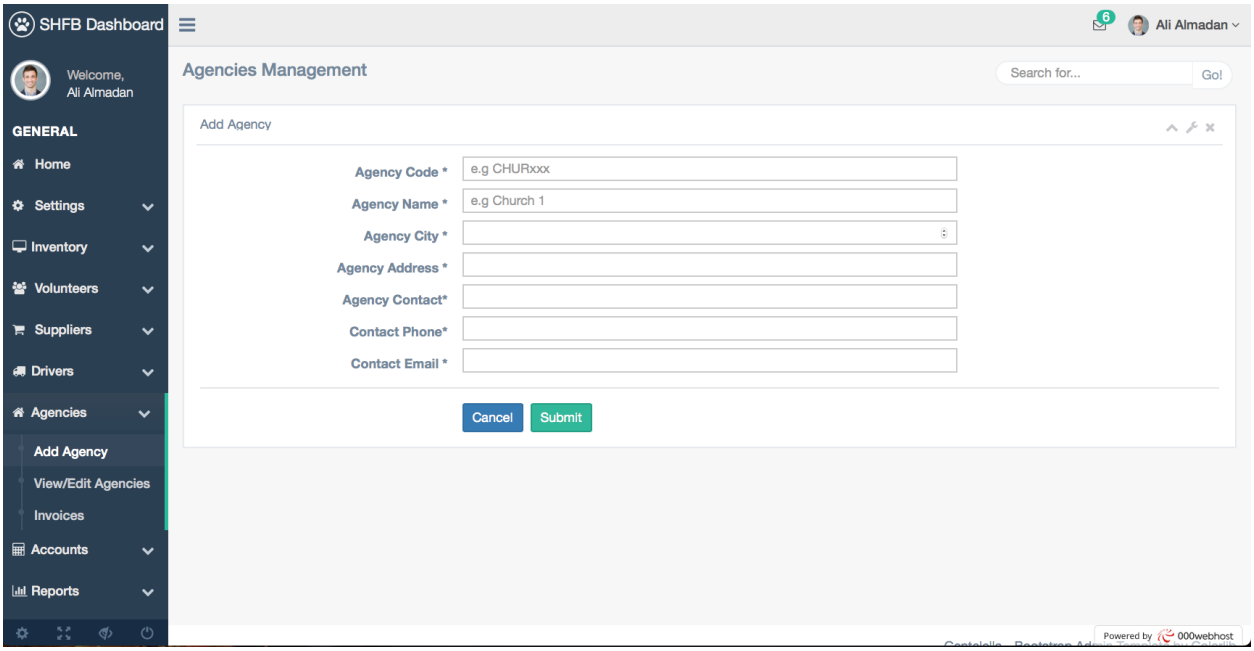


Figure 22: Add a new agency. This includes form validate to ensure what the user enters is valid and to prevent errors.

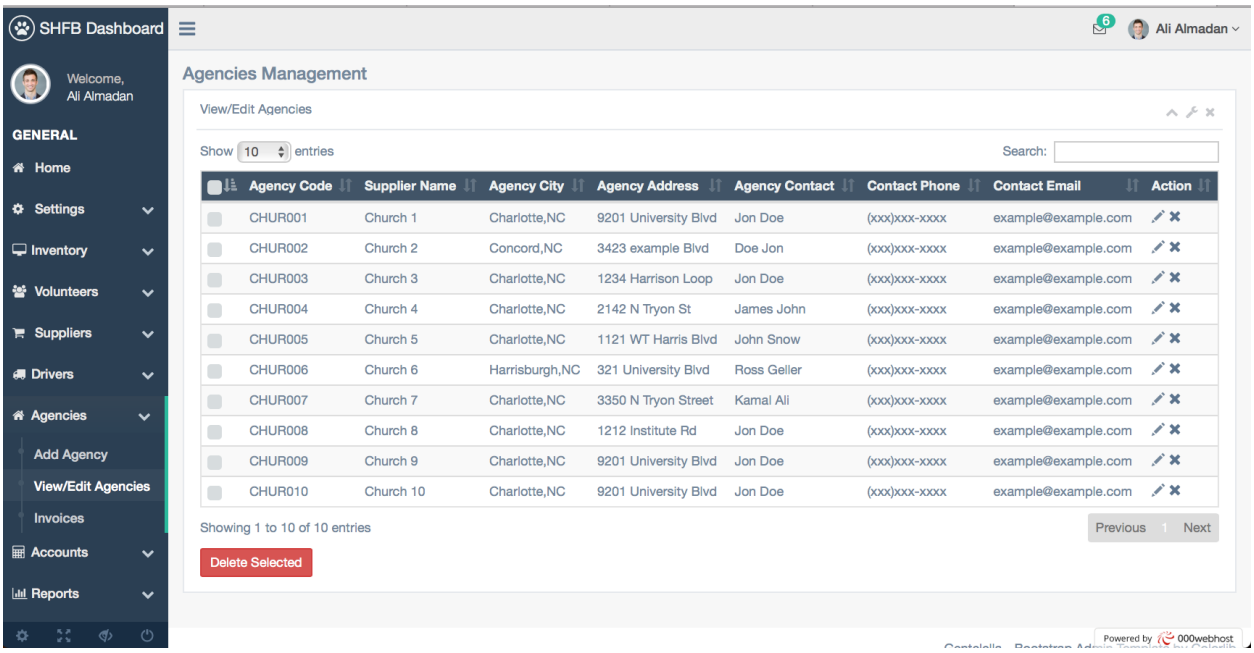


Figure 23: View and edit current agencies. Search is also available

Figures 22 and 23 show how the management portal also supports the tracking and management of the agencies that the food bank deals with. This was another need identified during our needfinding activities, since the foodbank wasn't accurately tracking the downstream agency

data. This led to difficulties in managing the payments and balances that the agencies owed to the food bank. Thus, this type of new functionality provides the food bank with more control around their agency relationships.

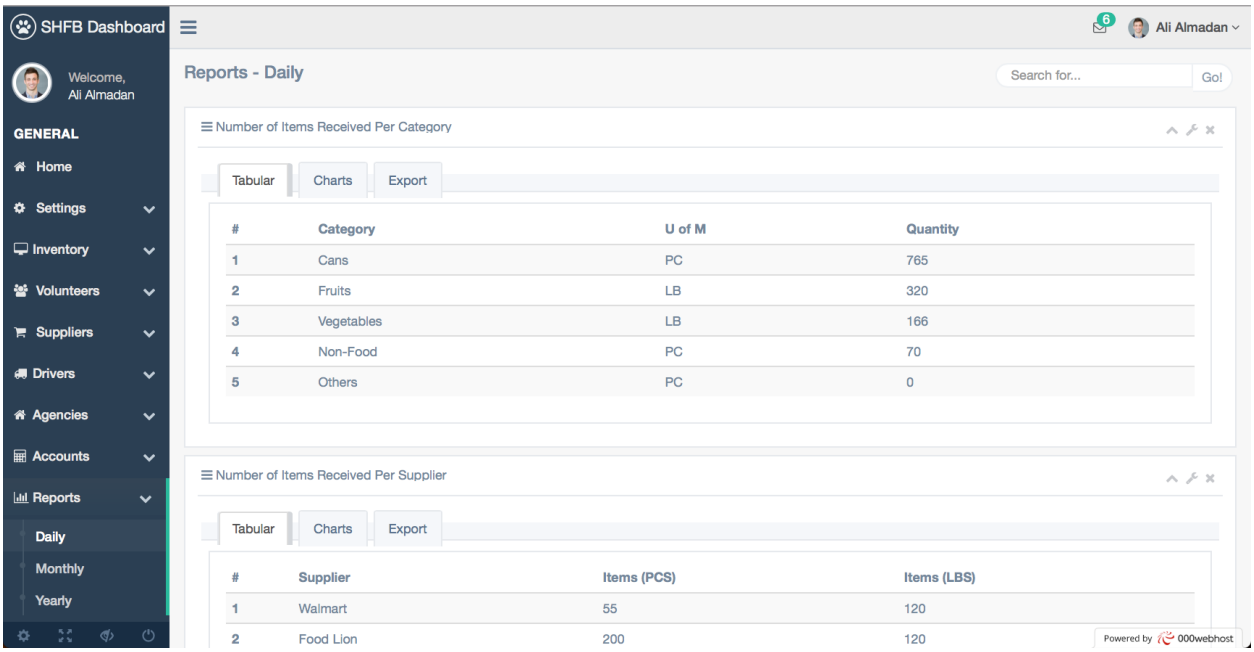


Figure 24: Generating reports.

Figure 24 shows the reports the dashboard can generate for the users. The users can see different reports such as number of items received per category and per supplier. They can also see the number of volunteers per company. The dashboard provides the users with daily, monthly, and yearly reports. The reports can be viewed as tabular data or charts. Furthermore, the dashboard allows the users to export the data as PDF or CSV for further analysis. It is also important to mention that the food bank is currently using spreadsheets to keep track of their data. Therefore, we decided to have a tabular representation in our design to help them understand the data. Moreover, we provided them with a chart tab to visualize the tabular data. This type of data would significantly help the management during their weekly meetings with the food bank executives, as well as creating funding requests.

Live Prototypes

The following links can be used to access the live prototypes of the App and Dashboard.

Mobile App:

Volunteer - Link: https://marvelapp.com/157eh95g (links to Truck Driver pages when Truck Driver login is selected)

Truck Driver - Link: https://marvelapp.com/5136dhh

Dashboard:

Management - Link: goo.gl/K5m8N3

Evaluation Methodology

Hypothesis for Evaluation

After completing our initial solution prototype, but prior to taking it through any type of structured evaluation activities, we drafted a set of hypotheses (one for the mobile app, one for the management dashboard). This would allow us to keep our evaluations and resulting design changes closely tied to the usability and design goals that we had identified. This is an important dependency for our team - to ensure that this solution would be adoptable and provides value for the food donation ecosystem, it must be able to deliver on the usability and design goals that came out of our needfinding activities.

For the mobile application, the hypothesis is:
Leveraging a simplistic design with quick interfaces and intuitive interactions will improve the overall efficiency and productivity of the food bank volunteers.

For the management portal and dashboard, the hypothesis is:
Designing a management system with a focus on familiarity and similarity will drive the extraction of meaningful business insights and grow the rate of adoption.

Given these two hypotheses, we were able to structure a three-phased evaluation approach (discount, pilot, user) to drive valuable results and maintain consistency with our targeted need.

Discount Evaluation

For the first phase of evaluation, our research team conducted a set of discount evaluations to better understand the design and usability issues within our solution. We decided it was critical that we evaluate our design and functionalities against a defined heuristic and cognitive

framework, before we roll it out for the pilot study. This ensures that we identify the design flaws that impact usability up front, allowing us to correct them before we ask our potential users to evaluate the solution.

The two discount evaluation techniques we utilized are cognitive walkthrough and heuristic evaluation:

Cognitive Walkthrough:

The first type of discount evaluation that the research team performed was the Cognitive Walkthrough on the mobile application. To facilitate the walkthrough, we identified 3 tasks to evaluate from the perspective of the user, as well as a set of questions to answer related to each task:

Task 1: Complete the required training

Will the user know what to do to achieve the task?

Yes. In the home page, there is a button that is is clearly marked as "Training". The user will know that they need to tap the training button to access the required training.

Will the user notice that the correct action is available? Do they see a button or menu item that they should use for the next action?

Yes. A list of checkboxes shows the completed training modules, and the modules the users need to finish in order to take the quiz. The checkbox that is left unchecked is easily noticeable and the user can select it for their next action.

Once found, will they know it is the right one for the desired effects?

Yes. The user will know it is the right one since it is the only one that is marked with an open checkbox (all of the other training modules are checked. In addition, there is an alert on the top that says please complete the (Specific Module) before taking the certification quiz.

Will the user associate and interpret the response from the action correctly? Will users know from the feedback that they have made a correct or incorrect choice of action?

Yes. When the user finishes the training module, they would see a check mark next to the module. This lets them know that they performed the correct choice of action.

Task 2: View the number of hours the volunteer served in the profile

Will the user know what to do to achieve the task?

Yes. The users will know to check the profile as it is part of the task, and will immediately find the number of hours on the profile.

Will the user notice that the correct action is available? Does they see button or menu item that they should use for next action?

Yes. There is a button titled “Profile” that is shown on the home screen.

Once found, will they know it is the right one for the desired effects?

Yes. The user will know it is the right action since they will see the volunteer hours in the center of the profile.

Will the user associate and interpret the response from the action correctly? Will users know from the feedback that they have made a correct or incorrect choice of action?

Yes. The user will recognize that they made the correct choice of action when they land on the profile page and view the “Hours Served” metric. This is exactly what they were looking for.

Task 3: Donate an item and discard an item

Will the user know what to do to achieve the task?

Initially no, the user might not know what to do upfront because there was nothing to indicate how then can start scanning items. After a brief experience with the system, the user knew to complete the check-in first to be able to scan the items. After the check-in was completed, it was obvious that the user could start scanning items because the camera opened immediately.

Will the user notice that the correct action is available? Does they see button or menu item that they should use for next action?

Yes. After check-in, it was clear, but since all functionality wasn’t implemented at the time of evaluation, the users didn’t know which was or which wasn’t implemented. This caused some confusion. Once the scanning process was initiated, it was natural, since this is how the user typically uses the phone (center / focus and then tap the camera). To get to donate and discard, the feedback and messaging was clear. The buttons were all available.

Once found, will they know it is the right one for the desired effects?

Yes. It was known because that is how they naturally user their camera. After scanning, they were given the options that they expected, which were donate or discard, and then given the aisle or the bin instructions afterwards. Overall, the user knew that what they were doing was the right action to produce desired effect of donating/discarding.

Will the user associate and interpret the response from the action correctly? Will users know from the feedback that they have made a correct or incorrect choice of action?

Yes. Each step provided direct feedback that they were making the correct choice of action. From the camera immediately coming up to the expected/intuitive menu items, the user was able to recognize that they were on the right path. The process utilized limited and direct functionality to guide the user.

Heuristic Evaluation:

After the cognitive walkthrough, the research team performed the heuristic evaluation. The following heuristic evaluation provides the selected heuristic, and the flaws identified that relate to it. In addition, we labeled each flaw to be managed and tracked - D indicates dashboard flaw, A indicates mobile app flaw.

1.) Visibility of system status

- D1: No successful message when a driver is deleted. (Fixed)
- D2: No successful message when an entity is added. (Fixed)
- A1: An alert is not presented when the training is not complete. Rather, the user was expected to recognize their "Pending" status and complete the training. (Fixed)

2.) Match between system and the real world

- D3: The modules icons on the left do not match what the users might have in mind regarding each module. (Fixed)

3.) User control and freedom

- A2: Multiple screens identified on the app that did not allow the user to exit if the screen was selected in error. These screens resulted in a dead in for the user. (Fixed)

4.) Consistency and standards

- A3: The driver's interface is not consistent with the volunteers interface. For example, when a volunteer logs in, a home page is displayed. However, there is no home page when a driver logs in. (Fixed)
- D5: Agency icon is the same as home icon in the left menu. (Fixed)

5.) Error prevention

- D6: No confirmation message (Are you sure you want to ….) when a user taps on "delete". (Fixed)
- D7: No form validation. (Fixed)
- A4: No confirmation message when user selects discard delete. It is important to confirm that the user followed the guidelines when discarding inventory. (Fixed)

6.) Recognition rather than recall

- D8: The user has to remember the exact name to search. (Fixed)
- A5: The driver doesn't have a way to quickly access navigation details, rather, has to remember them. (Fixed)

7.) Flexibility and efficiency of use

- D9: When deleting a driver for example, only bulk actions is available. This is, the user has to "check" the driver he/she wants to delete and then they tap on "Delete Selected". This is two taps for deleting only one driver. (Fixed)

8.) Aesthetic and minimalist design

- D10: The initial dashboard was overcrowded and contained material that does not merit a position on the dashboard. (Fixed)

- A6: The initial version of the home page had lines separating the various sections of information, instead of white space, which would have been a better design. (Fixed)

9.) Help users recognize, diagnose, and recover from errors

- D11: The user cannot undo an action. (Fixed)
- A7: When a user attempted to tap the training quiz before completing all of the required training modules, nothing would happen. Instead, an alert should pop up allowing the user to recognize the error and recover from it. (Fixed)
- A8: Users cannot use the back button in all screens. (Fixed)

10.) Help and documentation

- D12: There is no help or documentation.
- A9: Although the app has a built in help function (regarding the sorting process), it doesn't have a general help function to enable overall usability..

Organizing the Feedback for the Heuristic Evaluation:

To better understand the results of the heuristic evaluation, our team leveraged the following rating map to score each of the flaws we identified in the table below:

Rating map:

1. Not a problem
2. Cosmetic Issue
3. Major usability problem, low priority
4. Major usability problem, high priority
5. Usability catastrophe, must be fixed

The following table outlines the identified flaws and ratings:

Problem	Rating
Visibility of System Status	
D1: No successful message when a driver is deleted	4
D2: No successful message when an entity is added	4
A1: The quiz button is grayed out, but that's confusing – it should have an error message pop up and tell you to do the training first	3
Match Between User and Real World	

D3: The modules icons on the left do not match what the users might have in mind regarding each module	5
User control and freedom	
A2: Multiple screens identified on the app that did not allow the user to exit if the screen was selected in error. These screens resulted in a dead in for the user.	5
Consistency and standards	
D4: The driver's interface is not consistent with the volunteers interface. For example, when a volunteer logs in, a home page is displayed. However, there is no home page when a driver logs in	5
D5: Agency icon is the same as home icon in the left menu	3
A3: The volunteer's interface is not consistent with the driver's interface	5
Error prevention	
D6: No confirmation message (Are you sure you want to ….) when a user taps on "delete".	5
D7: No form validation	4
A4: Confirmation screens are not used	4
Recognition rather than recall	
D8: The user has to remember the exact name to search	4
A5: The driver doesn't have a way to quickly access navigation details, rather, has to remember them	3
Flexibility and efficiency of use	
D9: When deleting an a driver for example, only bulk actions is available. This is, the user has to "check" the driver he/she wants to delete and then they tap on "Delete Selected". This is two taps for deleting only one driver.	2
Aesthetic and minimalist design	

D10: The initial dashboard was overcrowded and contained material that does not merit a position on the dashboard	3
A6: The initial version of the home page had lines separating the various sections of information, making it seem very dense	2
Help users recognize, diagnose, and recover from errors	
D11: The user cannot undo a delete action	5
A7: When a user attempted to tap the training quiz before completing all of the required training modules, nothing would happen. Instead, an alert should pop up allowing the user to recognize the error and recover from it.	3
A8: Users cannot use the back button in all screens	5
Help and documentation	
D12: No help available	1
A9: The app doesn't have "help" to show how the app works. However, there is a help button that helps the volunteers decide when they should discard an item	1

Changes Incorporated after Discount Evaluation

The discount evaluation provided the research team with an opportunity to take the role of the users and analyze the interface. Through this activity, we identified multiple usability problems outlined in the table and descriptions, above that had to be fixed before extending the evaluations to the actual users.

Participant Evaluation Methodology

After completing the discount evaluation and incorporating all of the design changes for the usability problems uncovered during those activities, the research team was ready to initiate the user evaluations. In addition to the discount evaluation, our evaluation methodology consisted of two more phases - Phase 0 and Phase 1. Phase 0 consisted of a quick pilot study on a small number of users, where we analyzed their performance and feedback afterwards and decided on a set of minor design changes to the app. After these design changes were integrated, we initiated Phase 1 where we conducted our user study across a larger group of users. Both the mobile app and the management portal were evaluated in these additional two evaluation phases.

Given the phased structure of the evaluation, we then outlined our evaluation goals by starting with our hypotheses and our defined usability and design goals. We wanted to make sure that the evaluation results can be tied back to our usability and design goals, regardless of how we were evaluating the solution. This would allow us to demonstrate the value and utility of the solution. In addition, we wanted to keep the evaluation goals simple to ensure that they do not introduce any confusion or complexity into the analysis of the solution. Therefore, our evaluation goals were focused on evaluating the ease of use and simplicity of the interface, the learnability and error tolerance of the interactions, the effectiveness and desirability of the functionality, as well as the overall design and experience of the solution. If the evaluation shows positive results across these goals, we would be able to justify our proposal to embed this type of solution into the food donation ecosystem, and ultimately, bring us closer to closing the gap we identified during needfinding.

To successfully measure our solution against these evaluation goals, we had to identify the users for the evaluation, the specifics tasks they would need to execute, the key performance indicators, and the medium we would use to administer the evaluation. To identify the users, we used a mix of actual users (at Second Harvest Food Bank) and potential users for both the dashboard and mobile application evaluation. The users included the actual food bank management and volunteers, as well as college students and employed adults that fit the persona of a typical volunteer. We decided that we should use college students and employed adults since most volunteers fall under one of those categories, and we could use them to accurately represent a volunteer at the food bank. Since we weren't able to meet with the food bank management team in person, our communication and recruitment of these participants occurred over email. Aside from the team at the food bank, we were able to engage with our other users through face-to-face interaction, providing us with more control of the evaluation scenario. For the pilot study, we had identified 9 users, but only 6 were able to complete the evaluation. For the participant study, we had evaluated 17 users and all of them were able to complete the evaluation.

To evaluate these users, we used a mix of controlled setting and natural setting evaluations. For example, the food bank employees performed the evaluation in their natural setting at the food bank, while the other volunteers performed the evaluation in a controlled face-to-face setting. To accommodate for these differences, we had to conduct the user studies using multiple formats and mediums. For the users that we could not evaluate in a face-to-face setting, we created a questionnaire on google forms that guided them through the evaluation of the dashboard and presented them with the evaluation questions at the end of each task.

Link to Google Forms Dashboard: https://docs.google.com/forms/d/e/1FAIpQLSeKaz90uurd-uNh_wvdFMWiz2LDdneZz8WUJkDszJJSnMOjQw/viewform

The 6 tasks that the participants were required to perform were:

1.) Inventory Management - Search for bread in Current Inventory
2.) Volunteer Management - Lookup today's volunteer in the Volunteer module (Morning and Evening shift)
3.) Edit Truck Drivers - Delete Ctirad Rearden from the list of truck drivers in the Drivers module
4.) Supplier Management - Search for "Lion Tryon" in the Suppliers Module
5.) Generate Report - Generate the tabular Monthly Report using the Reports Module
6.) Dashboard - Open the home page and view the dashboard

These 6 tasks were carefully design to tie back to some of the major functionalities that the dashboard must be able to support. We couldn't include all of the functionality in the evaluation, or else it would have been too time consuming and difficult for the participants to complete, especially since we were not face-to-face with them.

Then, for each task, the following questions were asked:

1.) Given the action steps, how would you rate how easy and clear it was to complete the goal? : High / Medium / Low
2.) Given the action steps, how would you rate how quick and efficient it was to complete the goal? : Quick and Efficient / Medium / Slow and Complicated
3.) Were you able to identify the correct action at each step in the process? : Yes / No
4.) Did all of the action contribute to achieving the goal?: Strongly Agree / Agree / Disagree / Strongly-disagree
5.) How many areas of possible confusion did you encounter? : None / Between 1 and 2 / 3 or More
6.) Were you able to accomplish the goal? : Yes / No
7.) A specific question related to the type of data they had to collect or analyze for each task (For example, how much bread is currently in the inventory) - we asked this to make sure they were focused on the survey

For the last task (Dashboard overview), the participants were asked a different set of questions. We wanted this task to be more open ended and help us get an understanding of how the users really feel about the landing page dashboard functionality. The questions are:

1.) How effective is the display of information on the dashboard (logical, organized,...etc)?
2.) Would this type of real-time information improve the operations of the food bank?
3.) How would you describe the dashboard in 3 words?

For the user studies that we were able to perform in person, we utilized a hybrid interview and participant observation methodology where we instructed the user to perform certain tasks, followed by a series of open and closed-ended questions. We then aggregated their user metrics (time, clicks, error rate). In addition, we asked the users to think out-loud while performing the chosen tasks, giving us the ability to gain more understanding as to how the users were

comprehending and processing the information presented to them and making task related decisions while interacting with the interface. We also videotaped a smaller subset of users with the goal of going back and studying their interaction behaviors. Since all of the mobile application evaluations were done in person, we were able to leverage this framework across all participants.

The 5 tasks that the participants were required to perform for testing the mobile application were:

1.) Login and view the volunteer session details (determine the date/time of today's session)
2.) View your profile and determine the number of items you have scanned at the food bank
3.) Complete all required training and the certification quiz before volunteering
4.) Check-in, scan the item, and select donate
5.) Scan the item, select discard, and determine reason for discarding the item

For each of these tasks, we measured the time and the number of taps it took to complete it. We also measured their incorrect interactions and selections to calculate an error rate metric (represents the ratio of users that performed at least 1 error). In addition to this quantitative data, we asked the participants a set of questions. First, we discussed the overall experience with the participant and took note of they liked and didn't like. We asked open ended questions around the usability and design goals - for ex: if they felt they had visibility into what the app was doing, if they felt in control, if they believed it was a natural and effective way to scan inventory. We also asked their opinion on how this solution compares to manually sorting food items, and received their feedback on what functionality or interface they would improve.

After the open ended questions, we asked the following scale-based questions:

1.) On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use?
2.) On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use?
3.) On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn?
4.) On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks?

Evaluation Results and Implications

The results from our three phased evaluation approach revealed to us the areas that the solution does well in, in terms of functionality and interaction, and areas in which the solution needed improvement. Starting with the discount evaluation, both the cognitive and heuristic evaluation

methodologies allowed us to pinpoint very specific changes that needed to be made in the solution to improve the usability and better align it with our design goals. We specifically found the heuristic evaluation extremely useful, since the heuristics we were evaluating against are very closely tied to our desired goals. We were able to step through each heuristic principle and compare it to the overall solution. This allowed us to recognize design flaws related to the lack of visibility, error prevention, lack of user control, aesthetic design, recognition over recall, and consistency. The specific flaws discovered are outlined alongside their severity rating in the Heuristic Evaluation table (pg 34 - 36). We were able to quickly remedy these flaws in both the application and dashboard, improving the usability of the solution before rolling out to the users for evaluation.

The results of the pilot and full participant evaluation were not as easy to obtain as the discount evaluation, since there were many other factors involved in contacting the participants, facilitating the evaluation, collecting the data, and analyzing the results. We decided not to limit ourselves to just quantitative results, since the descriptions of what our participants love plus what they hate in our solution would provide us with added insights for our redesign.

Starting with the quantitative measurements and key performance indicators, **Figure 25** below outlines the time and taps for each task evaluated for the mobile application. Overall, the figures are very impressive as the users are able to complete major tasks with a minimal number of steps.

Task #	Description	Avg Taps	Median Taps	Avg Time	Median Time	Error Rate
1	Login / View Volunteer Session Details (Date/Time)	2	2	15	9	5.8%
2	View profile and determine number of scanned items	2	1	6	5	0%
3	Complete training modules before initiating volunteering	8	7	30	29	41.1%
4	Check in, scan item, donate item	8	7	21	21	29.4%
5	Check in, scan item, discard item	7	7	15	13	0%

Figure 25 - Mobile app metrics and results. Note: Error Rate = (Users who performed at least 1 error) / (Total # of Users)

Once we calculated the error rate across the user population, two functionalities stood out as severely flawed in terms of usability. These two tasks are focused on the training (Task 3) and scanning (Task 4) functionalities of the app. This was not a surprise though, since we saw and heard the struggles that the participants faced when executing these tasks during our face-to-face evaluations. For Task 3 - Completing the training modules - the participants kept trying to tap on

the checkbox to initiate the training module, while we only had the name of the module linked as as a potential selection. We realized that this could be confusing for a user since they might assume they should tap on the unchecked box to complete the requirements, since all of the other modules were checked. This was a simple change in our interface to expand the selectable area to both the name and the checkbox for the training modules. For Task 4 - check in and scan item - the users did not notice the small notification at the top of the page instructing them to tap anywhere on the screen to autofocus on the bar code. Instead, they kept trying to tap the capture button on the camera, but nothing would happen. In terms of design, we realized this wasn't the best placement for a critical notification, and moved it to the center of the screen during our redesign to make it more visible. Task 5 indicates that once the participants go through the scanning process for the first time, they do not make the same error twice (since the discard and donate action follows the same initial process).

In addition to those user metrics, we also analyzed the answers for the scale based questions, where 1 is worst and 5 is best.:

- **Rating for Easy to Use:**
    - Median = 4; Average = 4.00
- **Rating for Effective and Efficient:**
    - Median = 4; Average = 4.27
- **Rating for Easy to Learn:**
    - Median = 5; Average = 4.4
- **Rating for Visibility:**
    - Median = 4; Average = 3.6

Overall, these user ratings strongly support the performance of the solution with respect to the usability and design goals, especially since this is just an initial design. Similar to the usage metrics, the one area that didn't perform as well was the visibility area, with an average score of 3.6. This is also due to the low visibility issues identified for the scanning notification and the training checkbox, which was corrected after the evaluation in the redesign.

For the dashboard, our metrics and visualizations were automatically generated by the tool (Google Forms) we used to evaluate our participants. Figure 26 outlines the performance against two specific metrics that we selected for the dashboard - although these visualizations are just for 2 specific tasks, they represent the general feedback we got for the dashboard. For the full evaluation of detailed metrics across each Task, please refer to the Appendix.

Figure 26 - Dashboard evaluation for two out of the six tasks.

For the qualitative data, we collected all of the feedback that the participants provided us for analysis. In addition to providing us with a different perspective on the solution, using this type of analysis for our results was extremely helpful in measuring the performance of the dashboard, since most of our feedback was survey based. To create a single representation of what kind of feedback we received, we created the word cloud in Figure 27. Overall, the descriptions that the participants provided were very well aligned with our usability and design goals. In addition to the other numerical and scale-based questions provided on the survey, this type of data helped us create a single view of what our participants thought of our solution.

Figure 27: Word cloud based on the feedback from the participants

Evaluation Conclusion and Next Steps

The analysis that we have done on the evaluation results strongly supports the hypotheses that we developed before starting the evaluation. The analysis presented for the overall solutions shows that a simplistic design, with intuitive interactions, based on familiarity and a functional similarity to the existing process, can improve the efficiency of the food bank and provide a way to improve their capabilities and bring them forward into the digital age. In conclusion, Figure 28 outlines the usability goals and design goals that we started with, as well as the level of support that the solution is able to provide.

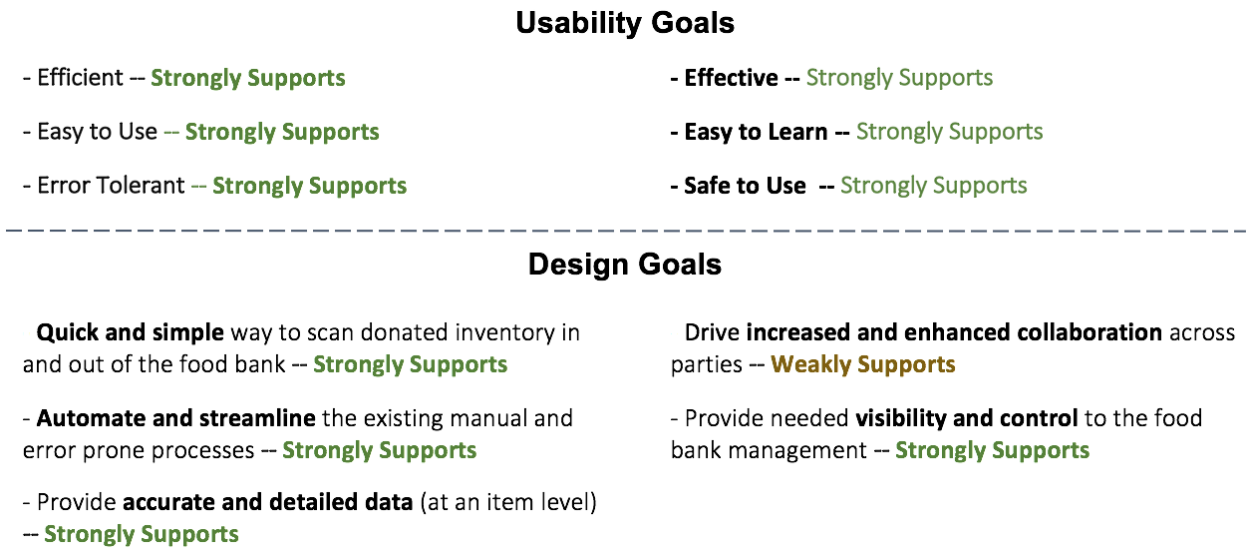


Figure 28 - Usability and design goals

The evaluation results strongly support our usability and design goals (Figure 28). The only design goal that is weakly supported is "Drive increased and enhanced collaboration across parties". We had developed a profile functionality in anticipation of building out a community base for the foodbank, but since this social functionality was not nearly as high-impact as the other functionality that we developed, we just stopped at the profile page. We have this identified as a potential area for new functionality in the future, along with a couple of other ideas our research team had thought of, like machine learning to automatically classify an item with damaged packaging as a discard item.

In addition to this new functionality, we are planning on re-evaluating the app with the updated design which was targeted to improve visibility. If our visibility metrics are still lagging in comparison to the other metrics, we are planning to further improve the visibility and prevent errors by creating notifications when the user attempts to perform an incorrect option. This type of functionality would only apply to novice users though, since we realized that once the participants went through the process for the first time, they quickly learned the steps and did not commit the same error twice.

In conclusion, our evaluation results and observation activities strongly support the utility and value that our solution provides, when measured against our defined goals. We believe that this solution could drastically change the level at which Second Harvest Food Bank and other food banks across the United States can serve their community.

Appendix

Mobile App Participant Evaluation:

User Study Process:

1) Ask users to perform the 5 tasks below and think out loud. capture their comments, and time and number of taps for each task (record like in the table below). If you can video record, better.
2) Ask open ended questions around usability and design goals. For example, ask them if the app provided them with visibility and control, if they felt it was a natural and effective way to scan inventory, how much better is this experience compared to manually sorting items? ..etc Ask what they would improve. Capture responses.

Ask the following Questions:

3) On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use?
4) On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use?
5) On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn?
6) On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks?

Data Collected for Mobile App Evaluation

User 1

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	1	8
view profile and determine number of scanned items	1	11
complete training before volunteering	9	39
Check-in, scan item, donate	6	23
scan item and discard	6	21

User 2

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	1	7
view profile and determine number of scanned items	1	13
complete training before volunteering	6	20
Check-in, scan item, donate	6	21
scan item and discard	5	17

Comments Captured:

- 20,583 items doesn't clearly indicate these are the scanned items. It would be better if it says "Items scanned: 20,583" changed it to say items scanned

- The user kept tapping the check box beside “sorting” instead of the word “sorting” .. this increased both numbers of taps and time.
- Participants tried to tap the circle for taking picture without tapping the barcode .. and it took them time to figure out then need to tap the barcode. This this for the first item. added instruction to scanner saying tap image to focus on barcode.

User 3

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	1	10
view profile and determine number of scanned items	1	4
complete training before volunteering	10 (3 taps in error)	55
Check-in, scan item, donate	6	25
scan item and discard	7	24

Comments Captured:

- she was looking for the date and time and it was correctly displayed up front
- training was confusing, didn’t read the instructions at the top
- the user indicates that the scanning process is natural and straightforward
- open discussion: visibility and control definitely, users thinks is is a convenient and fast way to scan barcode (instead of doing it manually) and believes it would save a lot of time, the users believes the flow of the process was natural and allowed her to effectively explain her task. user indicated that we did not properly explain the app at first (didn’t give an introduction to what it was and why we are doing it). the user thinks this is a much better experience than doing it manually bc faster, more efficient, and more in control - she stresses that it is more systematic so less room for error
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? **5**
- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? **5**
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? **5**
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? **4**

User 4

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	1	7
view profile and determine number of scanned items	1	4
complete training before volunteering	9 (3 in error)	29
Check-in, scan item, donate	7 (1 in error)	12
scan item and discard	7	12

Comments Captured:

- first task is easy because the information is displayed up front

- for the training session, she thought to tap on the box, but instead had to tap on the word (kept trying to tap on the sorting box, 3 taps)
- for the check in and scan, the user tried to take a picture before auto capturing the barcode
- open discussion: overall feedback is that it's "not too hard to use" and "intuitive". The user feels she is in control and has visibility. The user thinks this is much more time efficient than doing it manually. the user indicated that the process steps were also intuitive and made sense in each progression. The user also commented that this would reduce the number of errors, unless you had "fat thumbs".
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? **3 (got confused with the dispose.. why are we disposing it?)**
- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? **4**
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? **5**
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? **4**

User 5

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	1	24
view profile and determine number of scanned items	1	4
complete training before volunteering	9 (2 in error)	36
Check-in, scan item, donate	6	18
scan item and discard	7	13

Comments Captured:

- first task - user started to give the time of the next session, not today's. had to remind the user to look at today's.
- for the training session, the user also tried to check the box (2 taps) and said you usally always check the box, not the word.
- for the check in and scan, the user wasn't able to see the instructions - she said the location of being at the top isn't good and it should be moved towards the center so that the user can immediately pick it up.
- open discussion: overall feedback is that it requires training. the first time you need someone to walk you through, but the second time it becomes intuitive and easy / quick. The user feels she is in control and has visibility, since she knows what she is supposed to do to achieve her goal. the user says this is much easier than doing it manually since you have to remember why you must discard, vs using the app to help. the overall process was intuitive. she also questioned why she had to check in twice (this is due to how the app screens are linked).
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? **4**
- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? **5**

- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? **5**
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? **4 (comments that first time it was lower visibility)**

User 6

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	2	9
view profile and determine number of scanned items	1	3
complete training before volunteering	8 (1 in error)	25
Check-in, scan item, donate	10 (4 in error)	20
scan item and discard	7	10

Comments Captured:

- first and second task - easy because info was immediately displayed
- for the training session, the user said she was thinking she would check in first then do training (which is possible).
- for the check in and scan, the user was focused on tapping the camera button, instead of reading the instructions to auto focus on bar code. she tried to swipe up on help multiple times, and finally got the focus to work.
- open discussion: overall feedback is that it is overall easy, but the instructions at the top of the camera are bad - no one will look up there.. the user thinks it is intuitive and easy to use and would speed up the process compared to manual processing. The user feels she had visibility at each step and was in control.
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? **5**
- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? **3 (didn't like on screen instructions, but app was effective)**
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? **5**
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? **3 (low visibility due to on screen instructions)**

User 7

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	2	9
view profile and determine number of scanned items	1	5
complete training before volunteering	9	21
Check-in, scan item, donate	10	15
scan item and discard	7	10

instruction are not visible on camera page, tapped the shutter button multiple times before understanding instructions

too much content/info to read/understand in order to complete tasks

1. On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use?
   1: very had to use
2. On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use?
   5: effective
3. On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn?
   1: hard to learn
4. On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks?
   2: not very visible

Usability/design: design was not good and very hard to use
usability/control: didn't feel in control and instructions were not visible
natural/effective: app did not feel natural to use but it was effective
experience compared to manually sorting: more efficient

User 8

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	2	5
view profile and determine number of scanned items	1	3
complete training before volunteering	4	12
Check-in, scan item, donate	7	15
scan item and discard	8	8

easy to use but app looks boring

On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use?
5: very easy to use
On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use?
5: very effective
On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn?
5: very easy to learn
On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks?
5: very visible

Usability/design: easy to use but design could be better
usability/control: felt in control, everything was visible
natural/effective: felt natural to use and it was effective
experience compared to manually sorting: more efficient way to sort items

User 9

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	3	22
view profile and determine number of scanned items	1	5
complete training before volunteering	5	26
Check-in, scan item, donate	10	9
scan item and discard	8	10

autofocus command at top of camera was confusing at first

On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use?

4: easy to use

On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use?

4: effective

On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn?

4: easy to learn

On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks?

5: very visible

Usability/design: easy to use but design is ugly
usability/control: very in control and easy for user to use
natural/effective: felt natural to use and it was effective
experience compared to manually sorting: easier way to sort items

User 10

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	**1(confused with the landing page)**	**16**
view profile and determine number of scanned items	**1**	**6**
complete training before volunteering	**9(3 taps in error)**	**43**
Check-in, scan item, donate	**6(including back)**	**24**
scan item and discard	**7**	**22**

Comments Captured:

- The user got confused with the landing page
- She took a while to understand the structure of the page, she stopped and glanced at the UI to understand that the information being displayed is about the session details.
- She indicates her confusion over the presence of training data clubbed together with profile, training and settings on the same screen.
- Thereafter, She is able to check-in smoothly.
- Scanning flow: she erroneously taps on the back and capture icons, indicates it is not clear that one has to tap on the screen with the QR scan to capture the scan.
- Discussion: User likes the flow for each feature and feels it is quite streamlined and natural. Although, she feels an opening introductory exercise outlining all the features would have helped her and would have enabled her to do tasks faster. (She was able to the tasks faster the second time around). She likes the control and flow of information in the app, feels one thing leads to another seamlessly. She believes this is much more effective than the manual process of scanning and collecting information using different interfaces/devices.
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? 5
- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? 5
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? 4
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? 4

User 11

Task	Number of taps from home page	Time in seconds

login and view volunteer session details (determine date/time)	**1**	**8**
view profile and determine number of scanned items	**1**	**6**
complete training before volunteering	**11 (4 taps in error)**	**48**
Check-in, scan item, donate	**6**	**23**
scan item and discard	**7**	**24**

Comments Captured:

- Check-in is clear to him, he is able to do it efficiently.
- Scanned items details and time/date he finds missing details. Needs explanation. Since when the data is given as this only mentions a figure.
- Training has check boxes that does not make sense to him.
- Training module check box leads to a training video which according to him is not a natural flow.
- Scan : he erroneously taps a number of times on the Big circle icon, not on the scan/QR code screen.
- This poses a big problem and he takes time to understand the bar code has to be tapped, he suggests an autofocus/tap feedback is not clear at first after the tap.
- It should autofocus automatically and not on tap event.
- open discussion:

Training module he feels that the use of check-boxes does not feel natural. He adds, tap on checkbox leads to training video does not seem natural. He feels once a training is done it should become green or give completed feedback, and the remaining should be other icon/color. For scanning he suggests an autofocus/tap feedback is not clear at first after the tap. A more clear feedback that the autofocus has been selected or an autofocus without the need of a tap would be more smooth.

- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? 4
- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? 3
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? 5
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? 4

User 12

Task	Number of taps from home page	Time in seconds
Login and view volunteer session details (determine date/time)	5	41
View profile and determine number of scanned items	1	5
Complete training before volunteering	6	29
Check-in, scan item, donate	6	26
Scan item and discard	7	19

Questions:
1. Easy to use?
3 – too many words on the screen, easy to get confused.
2. Effective and Efficient?
4 – very effective and efficient
3. Easy to learn?
5 – would be easy to learn if someone were guiding you through it
4. Visibility?
2 – features don't stick out enough
Design: would not change appearance
Control: did not feel in control; the application is not very intuitive
Effective: Yes
Better than manual sorting: Could be better than manually sorting items

User 13

Task	Number of taps from home page	Time in seconds
Login and view volunteer session details (determine date/time)	2	33
View profile and determine number of scanned items	1	4.3

Complete training before volunteering	4	27.5
Check-in, scan item, donate	7	20.5
Scan item and discard	7	13

Questions:

1. Easy to use?

5 – wasn't too difficult.

2. Effective and Efficient?

5 – didn't run into any issues and can tell the app isn't supposed to be fully implemented so it is effective and efficient as it stands.

3. Easy to learn?

5

4. Visibility?

3 – not very intuitive, descriptions are hard to read to figure out how to complete tasks.
Design: would make some text bigger (autofocus) but other than that the app looks good –

aesthetically pleasing.
Control: Yes
Effective: Much more effective than writing down inventory.
Better than manual sorting: More efficient than manually sorting items

User 14

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	**2**	**12**
view profile and determine number of scanned items	**2**	**7**
complete training before volunteering	**5(confused with the sorting checkbox)**	**30**
Check-in, scan item, donate	**15(The scan button in the camera does not yield any action)**	**45**
scan item and discard	**5**	**10**

Comments captured:

Login, checking the sessions details, determining the number of scanned items was easier to do.

The training module was little confusing for the user, as there are few checkboxes checked user tried to check it, which did not give her any result.
While scanning items, user tried tapping on the scan option,i.e Big white circle rather than tapping on the QR code.
As the colour of the option 'Tap to autofocus on code' is same as the colour of the background, user is unable to view that option and tried tapping on the big circle.
After completing the scan process once, it was easier to scan it again and discard.

- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? 4
- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? 4
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? 4
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? 3

User 15

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	**2**	**9**
view profile and determine number of scanned items	**1**	**3**
complete training before volunteering	**4**	**15**
Check-in, scan item, donate	**6**	**9**
scan item and discard	**5**	**6**

Comments captured:

Login and determining the number of scanned items was easier to do.
In the training module this user did not face any issue.
The only issue faced by this user is while scanning the item, user tried to tap on the big circle instead of the QR code.

- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? 4

- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? 4
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? 4
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? 3

User 16

Task	Number of taps from home page	Time in seconds
login and view volunteer session details (determine date/time)	**2**	**8**
view profile and determine number of scanned items	**1**	**3**
complete training before volunteering	**5**	**23**
Check-in, scan item, donate	**7**	**30**
scan item and discard	**5**	**8**

Comments captured:

As explained above only the user faced problems with the check box for sorting in the training module and the scan option was confusing as well.

- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy was the app to use? 3
- On a scale of 1-5, with 1 being the least effective and 5 being the most effective, how efficient and effective was the app to use? 3
- On a scale of 1-5, with 1 being the hardest and 5 being the easiest, how easy is the app to learn? 5
- On a scale of 1-5, with 1 being the least visible and 5 being the most visible, how visible and clear were the features required to complete the tasks? 3

User 17

Task	Number of taps from home page	Time in seconds
Login and view volunteer session details (determine date/time)	3	7.7
View profile and determine number of scanned items	1	3.75
Complete training before volunteering	4	21.83
Check-in, scan item, donate	6	15.2
Scan item and discard	7	10.83

Questions:

1. Easy to use?

5 – Yes, it “literally” tells you what to do.

2. Effective and Efficient?

5 – very efficient at doing its job.

3. Easy to learn?

5 – very simple

4. Visibility?

5 – features were “quite” visible.

Design: would not change appearance

Control: felt that the application was very intuitive.

Effective/Efficient: Yes

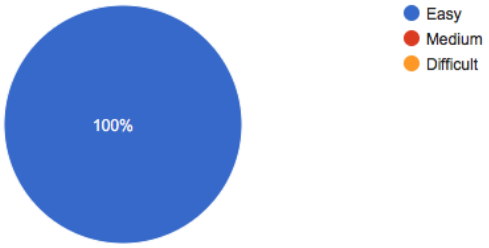
Better than manual sorting: Yes, “Lord have mercy, writing things down? Who thought of something SO terrible?” Much better than manual sorting.

Dashboard Feedback (from Google Forms):

Goal: Search for Bread in current inventory

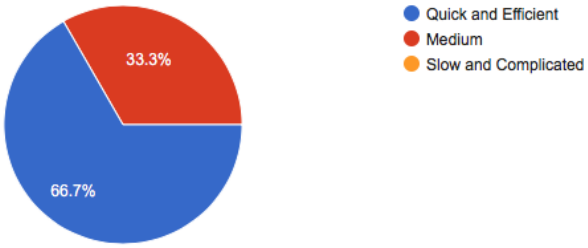
Given the action steps, how would you rate how easy and clear it was to complete the goal?

6 responses



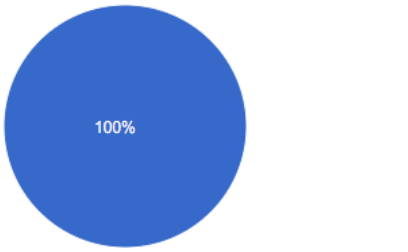
Given the action steps, how would you rate how quick and efficient it was to complete the goal?

6 responses



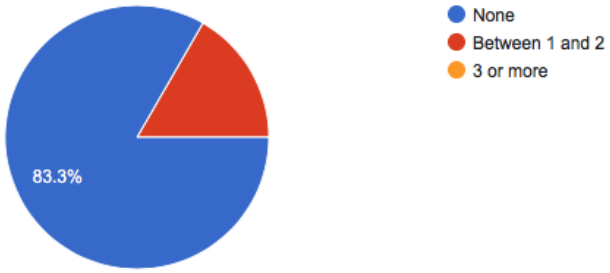
Were you able to identify the correct action at each step in the process?

6 responses



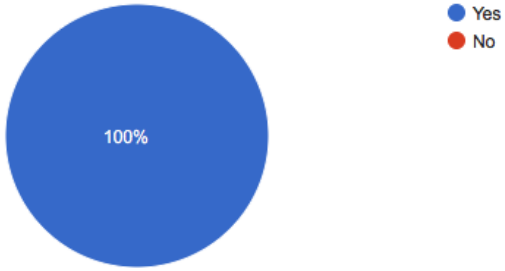
How many areas of possible confusion did you encounter?

6 responses



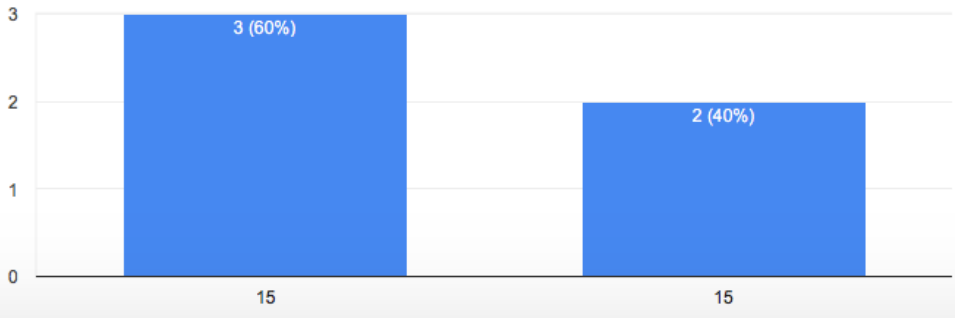
Were you able to accomplish the goal?

6 responses



How much bread was available in current inventory?

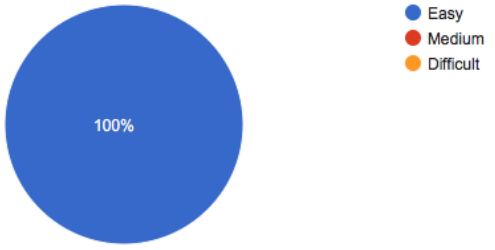
5 responses



Goal: Lookup today's volunteer in the Volunteer module (Morning and Evening shift)

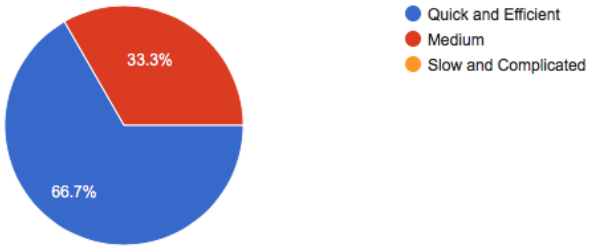
Given the action steps, how would you rate how easy and clear it was to complete the goal?

6 responses



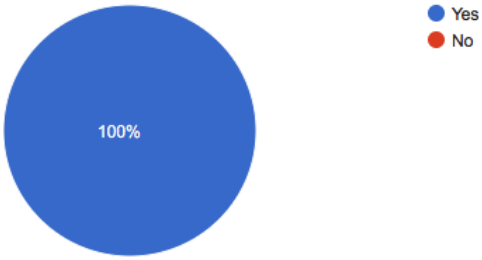
Given the action steps, how would you rate how quick and efficient it was to complete the goal?

6 responses



Were you able to identify the correct action at each step in the process?

6 responses

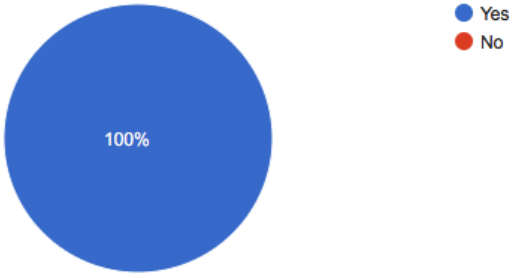


How many areas of possible confusion did you encounter?

6 responses

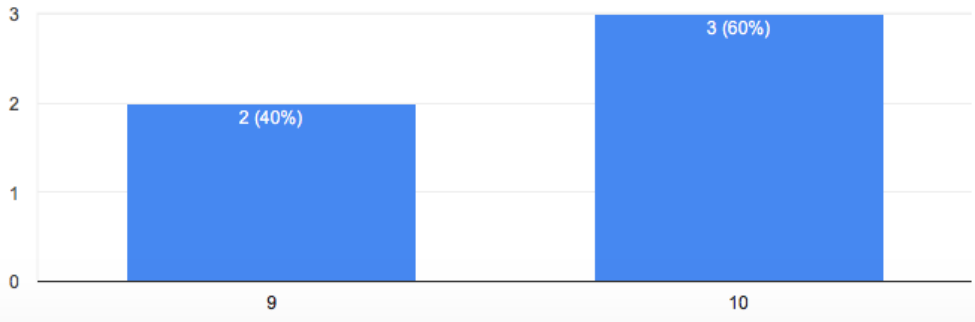
Were you able to accomplish the goal?

6 responses



How many volunteer are confirmed for the morning shift?

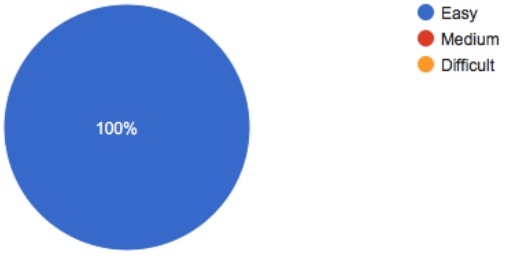
5 responses



Goal: Lookup today's volunteer in the Volunteer module (Morning and Evening shift)

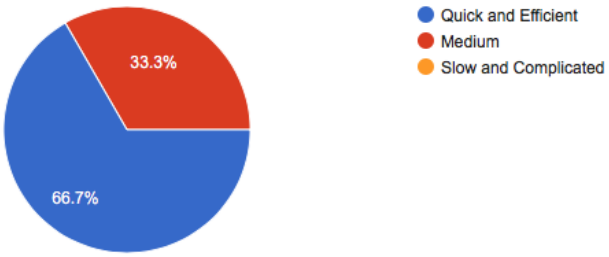
Given the action steps, how would you rate how easy and clear it was to complete the goal?

6 responses



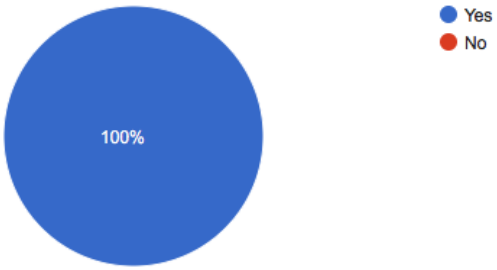
Given the action steps, how would you rate how quick and efficient it was to complete the goal?

6 responses



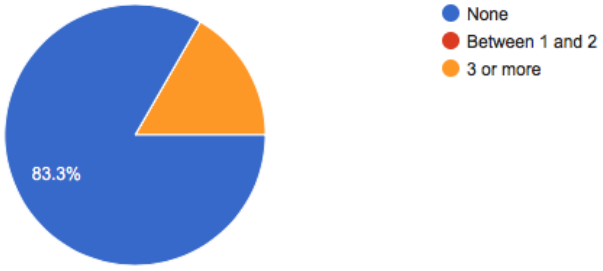
Were you able to identify the correct action at each step in the process?

6 responses



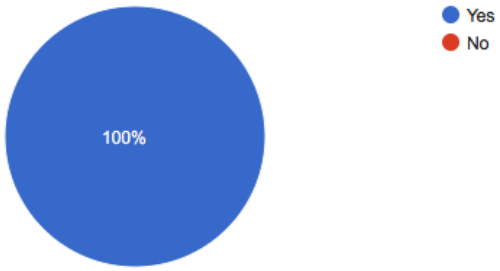
How many areas of possible confusion did you encounter?

6 responses



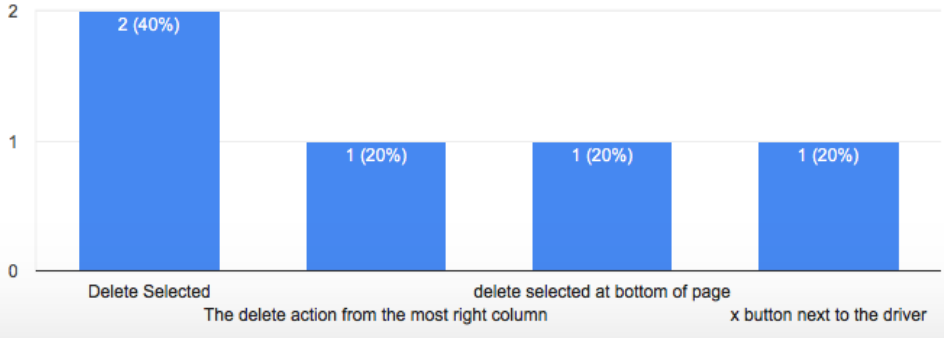
Were you able to accomplish the goal?

6 responses



Which button did you use to delete Ctirad Rearden from the list of drivers?

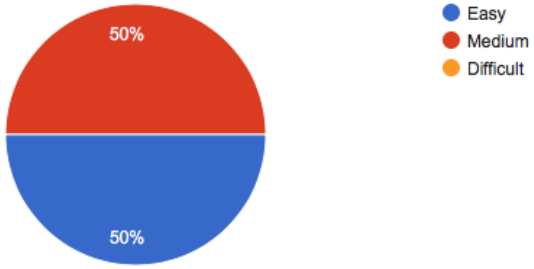
5 responses



Goal: Search for "Lion Tryon" in the Suppliers Module

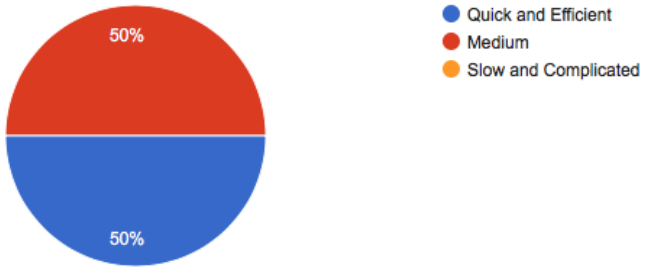
Given the action steps, how would you rate how easy and clear it was to complete the goal?

6 responses



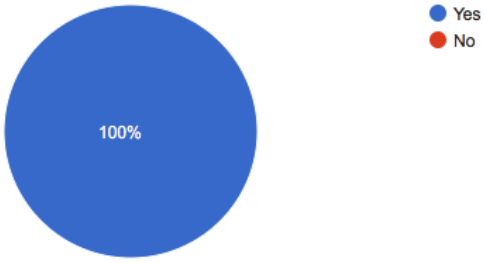
Given the action steps, how would you rate how quick and efficient it was to complete the goal?

6 responses



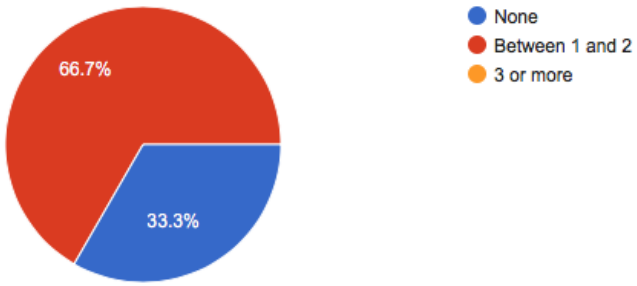
Were you able to identify the correct action at each step in the process?

6 responses



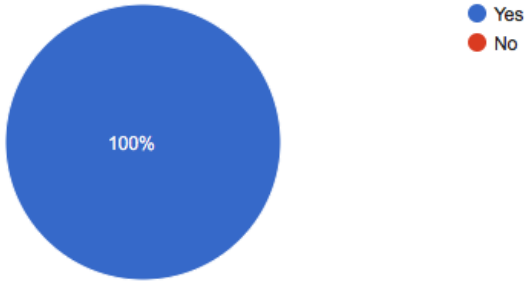
How many areas of possible confusion did you encounter?

6 responses



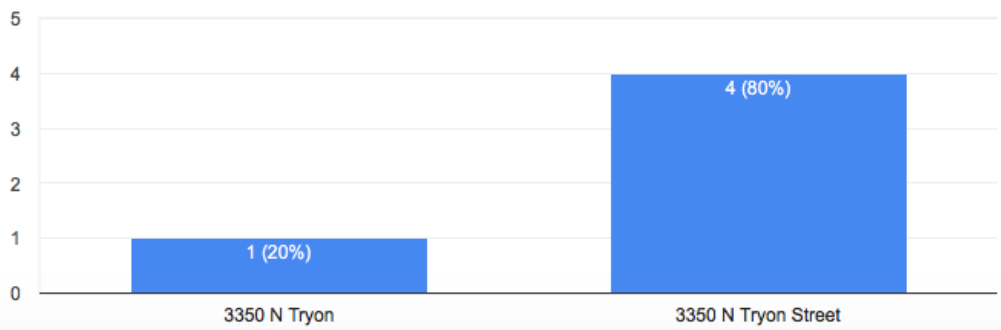
Were you able to accomplish the goal?

6 responses



What is the address for Food Lion on Tryon St?

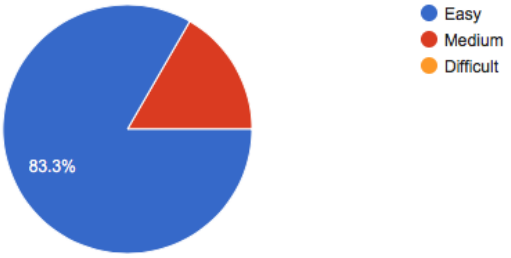
5 responses



Goal: Generate the tabular Monthly Report using the Reports Module

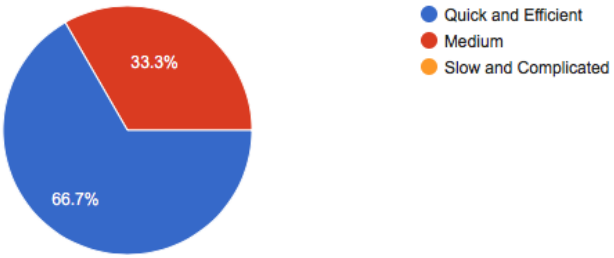
Given the action steps, how would you rate how easy and clear it was to complete the goal?

6 responses



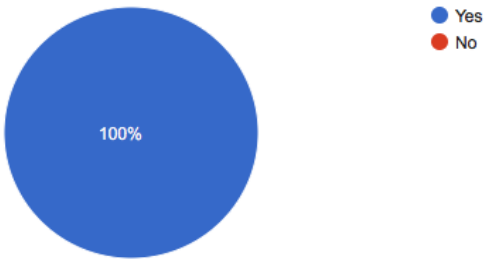
Given the action steps, how would you rate how quick and efficient it was to complete the goal?

6 responses



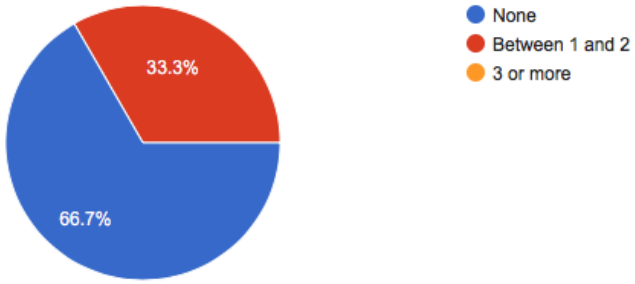
Were you able to identify the correct action at each step in the process?

6 responses



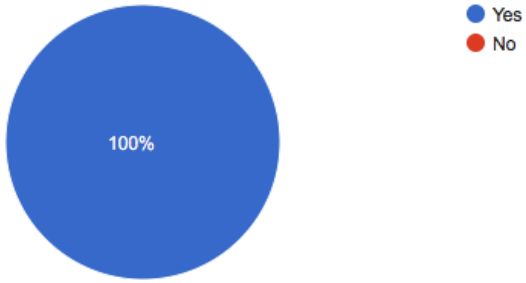
How many areas of possible confusion did you encounter?

6 responses



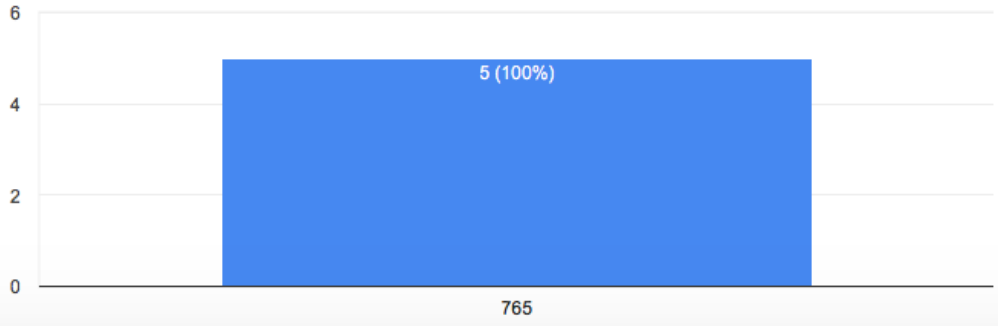
Were you able to accomplish the goal?

6 responses



What is the quantity of cans that we received this month?

5 responses



How effective is the display of information on the dashboard (logical, organized,...etc)?

5 responses

Very organized and logical
information is organized well - great way to see activities in one place
logical and organized
easy to see and interpret
Logical, well-sorted, aesthetic, easy to follow and use

Would this type of real-time information improve the operations of the f bank?

5 responses

Yes (3)
yes
Yes, easy access

How would you describe the dashboard in 3 words?

5 responses

Organized! Smart! Technical!
organized informational tiles
professional easy nice
well-designed impressive useful
efficient, organized, visualized