Part 1: Food Waste in the Foodservice Industry

Team Eco-Eaters

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Problem Space

Food waste within the Food Service Industry, specifically pertaining to small businesses and restaurants.

Overview

Food waste is a growing issue in the United States, with over 40% of food being produced going to waste (NRDC, 2021). At the same time, one in eight Americans lacks a secure food supply, meaning that food is not only being overproduced but also improperly managed and wasted (NRDC, 2012). Food wastage occurs in every step of food production, from farming to the plating. Our focus for reducing food waste is in the foodservice industry, including restaurants, cafes, bars, and more.

Just as food waste occurs at every step of the food production process, food waste also occurs in every step of the food service process, from inventory to guest tables. Inadequate inventory management and improper food storage can cause food wastage before it is even prepared. Overly large portions, kitchen or employee mistakes, and confusing menus or ordering software also contribute to food wastage in the foodservice industry.

Controlling food waste is a challenge especially for business owners, as ingredients make a large majority of their budget. In most cases, food wasted directly equates with money wasted. For smaller businesses, saving money through reducing food waste could impact profits immensely. In order to avoid food waste and save, it is in business owners' best interest to maximize usage of ingredients and minimize food waste.

The main concern of food waste, in general, is the environmental concerns that it poses. The process of bringing food from the ground to the table through agriculture, transportation, and processing takes massive amounts of resources and energy, meaning overproduction of food wastes resources and energy. Food waste in landfills builds up methane gas, which largely contributes to greenhouse gases, which in turn contributes to global warming (NRDC, 2021).

Our target user group is food service employees, managers, and owners. Our goal is for the users to gain an understanding of the amount of food waste within the foodservice industry, as well as offer remedies to combat the issue. We also want to ensure that these remedies suit the economic interests of users.

Methodology

Our methodology includes interviews and surveys with stakeholders, as well as observations. The interviews and observations were effective in collecting useful information from a small number of stakeholders we were able to be in contact with. Through these stakeholders, we were able to obtain a substantial amount of qualitative data. We were able to collect substantial sources of information regarding their attributes, behaviors, preferences, feelings, attitudes, options, and knowledge about food waste in the foodservice industry. We also chose to hand out surveys and collect quantitative data to get information from a larger number of stakeholders to ensure more targeted results around food waste in the foodservice industry. Using a mixed-method for our research allowed us to gather both qualitative and quantitative data to draw purposeful data from the stakeholders.

Observations

To gather data, we contacted restaurant owners, managers, and employees and set up an interview. During our interview, we had the opportunity to observe the restaurant. We noticed that time-efficiency and customer satisfaction is the biggest priority of restaurants. Routines and procedures in restaurants, such as opening and closing the restaurant, are streamlined to be time-efficient. As a result, the issue of reducing food waste in restaurants is put on the back burner, and not given much priority.

It was also interesting to note that the COVID-19 pandemic has impacted the issue of food waste in restaurants. The pandemic resulted in food supply limitations as well as higher food prices. As a result, some restaurants would have certain menu items unavailable, shortening their menu. The pandemic also influenced how restaurants approach keeping inventory as well. Restaurants are more conscious of the amount of inventory because of the volatile nature of the pandemic. For example, within the first weeks of the pandemic, many restaurant owners had to discard spoiled ingredients as fewer customers ordered from restaurants.

Interviews

The first interview we conducted was with Herban Fix, a vegan restaurant in Midtown Atlanta specializing in plant-based fusion cuisines. We interviewed a manager at a family-owned business. It was interesting to hear from the perspective of a restaurant that is very conscious about the ingredients they use.

The interview was done in-person and on-site on June 9th through a semi-structured interview. We interviewed one of the managers, Annie, asking questions pertaining to food waste and the day-to-day life of the restaurant. Annie reports that there is minimal food waste at the restaurant, describing that less than 10% of food is left on the plates. The dishes at Herban Fix use recipes that are flexible, which allow for adaptability if they do not have enough ingredients or too much of a certain ingredient. For example, in their mushroom dishes, they are able to be flexible depending on the available inventory. They are able to use more of one type of mushroom depending on what is available. The COVID-19 pandemic significantly altered the restaurant's food waste policies by causing them to adapt and change their methods, such as shortening their menu. If there was any food waste that resulted from an employee accident, the server would be required to take it home and pay for it. In addition, the business does grocery shopping three times a week, so there is less of a chance to overestimate the amount of food needed in a week. These frequent trips allow for the restaurant to limit the amount of food waste they produce. In addition, culture plays a large role in how the staff runs their business. Growing up Buddhist, the owners are frugal with their spending and try their best to not waste ingredients. Economic factors also play a major role in the desire to limit food wastage.

Despite this, Annie mentions that overbuying food leads to some food waste at the restaurant. Oftentimes, there would be a huge sale at a local grocery store and her mother would overbuy. At first glance, this may seem like a good way to save money but in actuality, this is costly for the restaurant. Generally, extra ingredients are obtained, which means there is more to use but not enough time to use before they spoil and are tossed, causing economic losses. Herban Fix is a restaurant of mostly produce, such as fruits and vegetables, and will more likely spoil more quickly.

The second interview we conducted was with Youngok Cha, a former business owner of a Korean-fusion brunch cafe, GGrace, on June 9th. It was a semi-structured interview that was done in person.

Younggok mentions that she went grocery shopping for ingredients for the restaurant three times a week. This is an important part because grocery shopping for ingredients is one of the biggest components of the budget for the restaurant.

As the owner of her business, Youngok expressed that minimizing food waste was in her best interest. While avoiding food waste at home is motivated strongly by culture, the prime motivation for business was to save money. Her recommendation to avoid food waste was to make compensations for slower business days. Over-preparing or overestimating the amount of food

needed for a day could lead to substantial losses in profits due to food waste. She strongly emphasized the requirement for business owners to have awareness of factors, large and small, that may affect business. She also recommended proper inventory management to avoid over-buying when grocery shopping.

The third interview we conducted was with Your Pie with an employee named Sahana Saravanan, a second-year college student on June 12th. As a crew member of the restaurant, Sahana has experience with handling food. Her typical activities during a shift require her to set up the food materials in the front, heating up the brick oven, taking temperatures, as well as taking inventory by hand using a printed template that she hands to the manager. She detailed in questions regarding food waste that there is a significant amount by the end of the day, reporting that around 20% to 30% of the food is wasted on average. Most food waste at Your Pie occurs during in-store dining when some customers would leave food on their plates. In regards to leftover food at Your Pie, most customers do not use takeout boxes offered by the restaurant.

Food waste at the restaurant is also attributed to spoilage. For example, the dough for the pizza is kept out throughout the day for ready use, and the dough not used at the end of the day might end up crusting and become unusable. Sahana points out that one way to reduce food waste in restaurants would be to reduce the serving size. However, that proves to be a challenge since a majority of Your Pie customers enjoy the larger portions and manage to finish it, but not all. Decreasing portion sizes would lead to customer dissatisfaction, which may result in a decrease in business. To most restaurant owners, that issue is more important than reducing food waste.

Surveys

A survey was sent out to those who have worked or are currently working in the foodservice industry. The survey asked questions relating to survey-takers personal experiences and opinions relating to food waste within their workplace. The survey consisted of both open and close-ended questions through checkbox questions, Likert and ranking questions, and open responses. The purpose of the survey was to gather an understanding of the relationship between food service workers and food waste, as well as to narrow down the issue of food waste within the industry.

At the beginning of the survey, we asked questions about the individual, including age, job title, and typical activities. Next, we asked questions regarding personal opinions about food

waste in the foodservice industry. We then asked about any specific store policies. We closed the survey by asking for suggestions to reduce food waste within their workplace.

Of the survey participants, 81.3% worked front-end service, with 31.1% working or having worked as a server. 81.3% of participants agreed that food waste was a moderate to severe issue within the foodservice industry. Suggesting that food service employees are aware of the issue of food waste within the foodservice industry. 68.8% of participants express that their workplace's food reduction policies were either non-existent or inadequate and the same percentage of participants also answered that they have little to no power over implementing new policies. Overall, employees are aware of food wastage but are not given the proper knowledge, training, or resources to combat the issue.

User Characteristics

Primary Users

Primary users are users who directly interact with the system and are typically affected most by a given system. In our problem space, these users work directly with ingredient inventory whether that's through serving food to customers, cooking in the kitchen, and most importantly monitoring the current ingredient inventory. These users include restaurant owners and managers. The users play an instrumental role in the amount of food waste derived from the foodservice industry. Our primary users can be men or women between the ages of 20 and 40+ years old although a majority are within the 40+ category. (Zippia, 2021)

Primary Persona

Name: Rachel Johnson

Quote: "Family is not an important thing, it's everything."

Occupation: Rachel is the daughter of a successful small restaurant owner and she works as a manager. She works primarily with the front-end staff but is often tasked with taking ingredient inventory.

Demographics: 28 years old; Lives in Nashville, Tennessee; Lives at home with parents and a younger sister; Grew up in a low-income environment; Values family highly

Goals:

- Starting a family of her own

- Taking over her family's restaurant
- Pursuing a post-secondary education

Behaviors:

- Always on her feet
- Strictly stays on schedule, has no time for spontaneous activities
- Customer comes first
- Restaurant image is very important to her
- Very friendly with customers
- Worries more about her parents than herself

Pain Points:

- Is very busy working and managing the front end staff
- Dislikes when her co-workers make mistakes
- Is very organized, strongly dislikes when things are not done correctly
- Dislikes work that is slow-paced

Secondary Users

Secondary users are users who don't directly interact with the system but are indirectly affected by the system. In our problem space, these are the users that utilize restaurant ingredients and products but are not responsible for monitoring the ingredient inventory. Secondary users include but are not limited to other restaurant employees such as the waitstaff, hosts, and kitchen prep staff. Although these users do not interact with the inventory monitoring system, they indirectly affect it by selling and delivering orders to customers. Our secondary users can be men or women primarily between 20 and 30 years old. (Zippia, 2021)

Secondary Persona 1

Name: Larry Nguyen

Nick Name: Lazy Larry

Quote: "If it takes longer than 10 minutes, I'm out"

Occupation: Works part-time as a busboy at a local Chili's. Attends college at Georgia State University studying Computer Science. Also does gaming live-streams on the side.

Demographics: 19 years old; Lives in Roswell, Georgia; Lives in an apartment with 3 other roommates; Grew up in a middle-class family with divorced parents; Has a younger sister and two younger brothers

Goals:

- Hopes to become a popular streamer and make that his career
- Leave the Atlanta area and move to Los Angeles
- Wants a girlfriend
- Cares a lot about his younger siblings and wants to set a good example for them

Behaviors:

- Sleeps a lot
- Late-night gaming
- Tries to weasel his way out of extra work

Pain Points:

- Gets very frustrated while coding
- His least favorite thing in the world is debugging
- Absolutely despises mundane work that takes a large amount of time
- Having to wake up early
- Dislikes his job, is only doing it for the money

Secondary Persona 2

Name: Samantha Lee

Nick Name: Server Sam

Quote: "I wonder what I should eat for lunch break"

Occupation: Works part-time as a server at a sushi restaurant in Midtown near her college campus. College freshman at Georgia Tech, majoring in Business.

Demographics: 18 years old; Living on campus; Asian-American with strict parents who always emphasized good grades and discouraged activities outside of school.

Goals:

- Prove to parents that she can be independent and successful by balancing work, school, and social life
- Make enough money to pay for an apartment in Midtown for next year
- Work on social skills through front-end service work

- Make new friends in college

Behaviors:

- Social introvert that enjoys talking to people, but enjoys her alone time even more
- Foodie that loves to explore the Atlanta area for new, unique food and drink
- Perfectionist

Pain Points:

- Dislikes having to memorize many things
- Customers that come in last minute
- Anxious about making mistakes
- Bad handwriting
- Balancing school with work

Tertiary Users

Tertiary users are users who neither work directly or indirectly with the system but are able to affect the input and output of the system nonetheless. In our problem space, these are the users who order and purchase food from the restaurant. Tertiary users are restaurant customers. These users influence the system by determining the demand for certain items in a restaurant, this affects the restaurant ingredient inventory. Customer' demographics include all people of all ages.

Tertiary Persona 1

Name: Karen Winsington

Nick Name: Karen

Quote: "Can I speak to the manager?"

Occupation: Stay-at-home mom with 2 children. Spends a majority of her time doing art

Demographics: 38 years old; Lives in Seattle, Washington; Grew up and currently is a middle-upper class family; Has two children with ages 19 and 25; Husband works as a software engineer at Apple

Goals:

- Move to and retire in Southern Florida
- To give her children the best of the best

Behaviors:

- Will send food back if it is not perfect

- Very strong-headed about her opinions
- Stubborn
- “Never say no” parenting

Pain Points:

- Hates when people don’t follow her orders
- Dislikes when people have opposing opinions

Tertiary Persona 2

Name: Tom Gates

Nick Name: Techy Tom

Quote: “Hold on a sec … what was that?”

Occupation: Co-Founder of a Technology Start-Up working in Consulting

Demographics: 24 years old; Lives in New York City, New York; Grew up in an upper-class family as an only child; Single; Lives in an expensive studio apartment

Goals:

- Become the next Elon Musk
- Wants his Tech Start-Up to go global
- Become a millionaire

Behaviors:

- Goes to the most popular clubs in NYC
- Has no time to waste, is always moving on to the next thing
- Always has an earpiece in, those around him never know if he is talking to them or not
- Can come off as disrespectful to those around him

Pain Points:

- Hates when people take too long
- Hates “unnecessary” hassles in his day
- Dislikes it when people ask too many questions

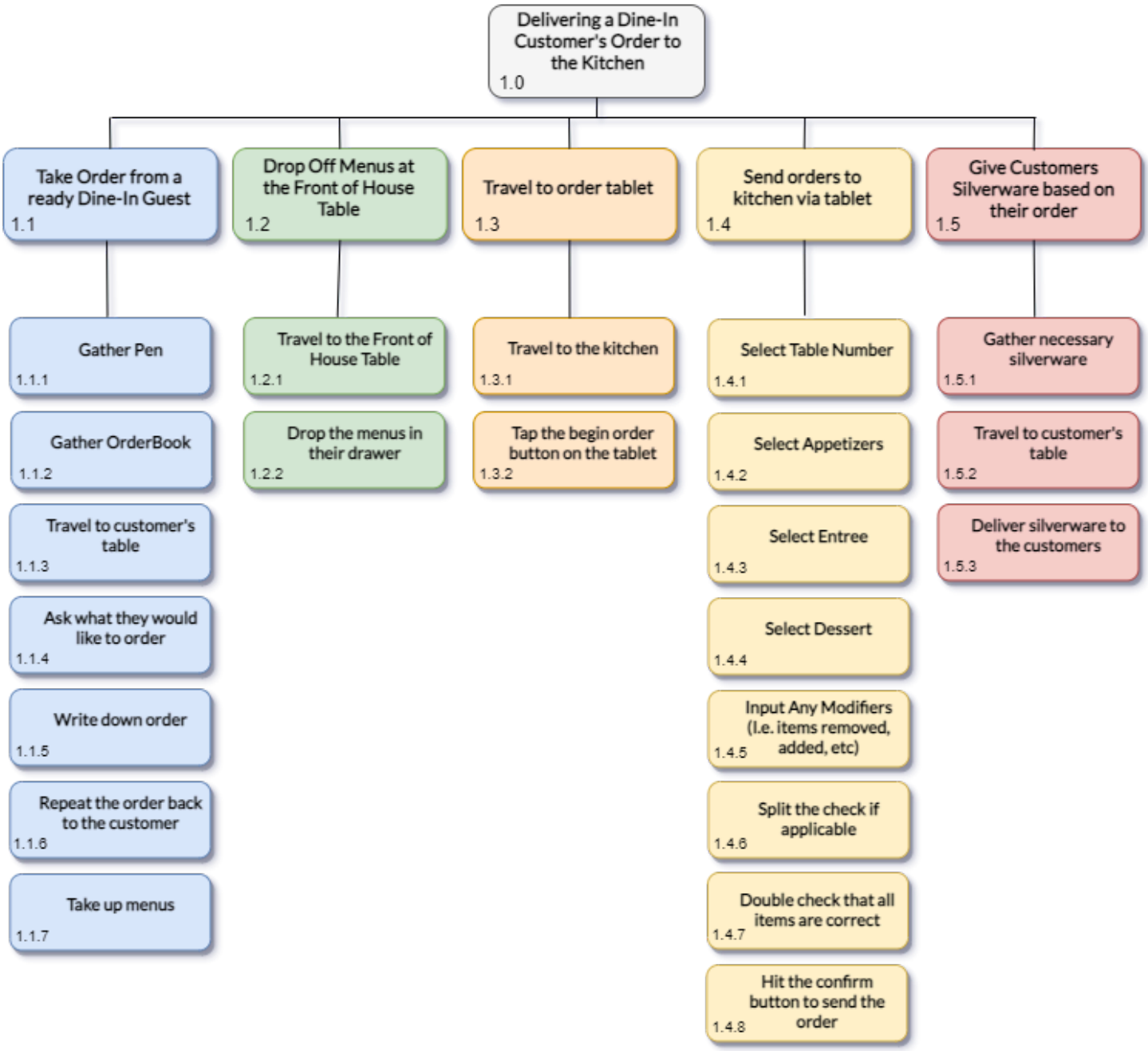
Task Analysis

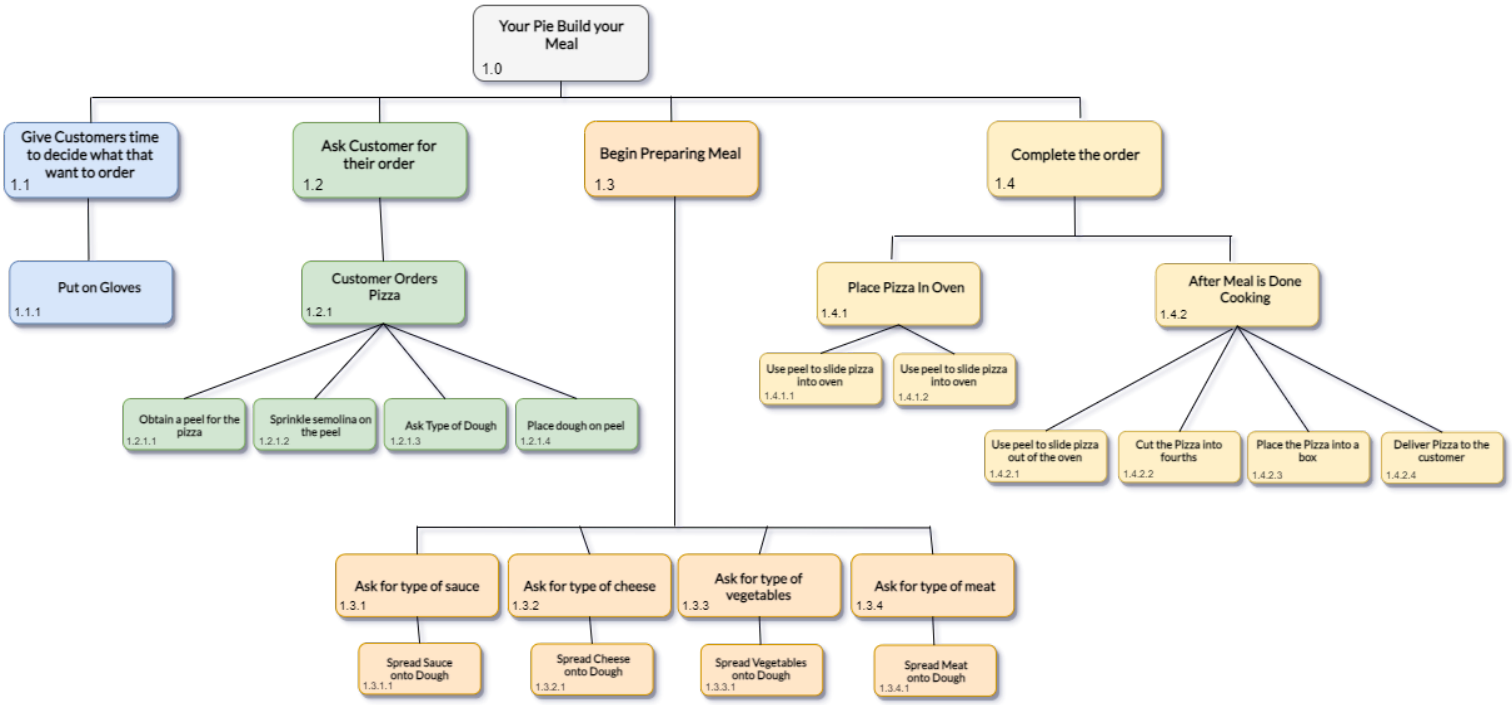
There are many unique tasks that happen within our system that contribute to food wastage. This report utilizes three distinct tasks that cover a majority of the types of situations our

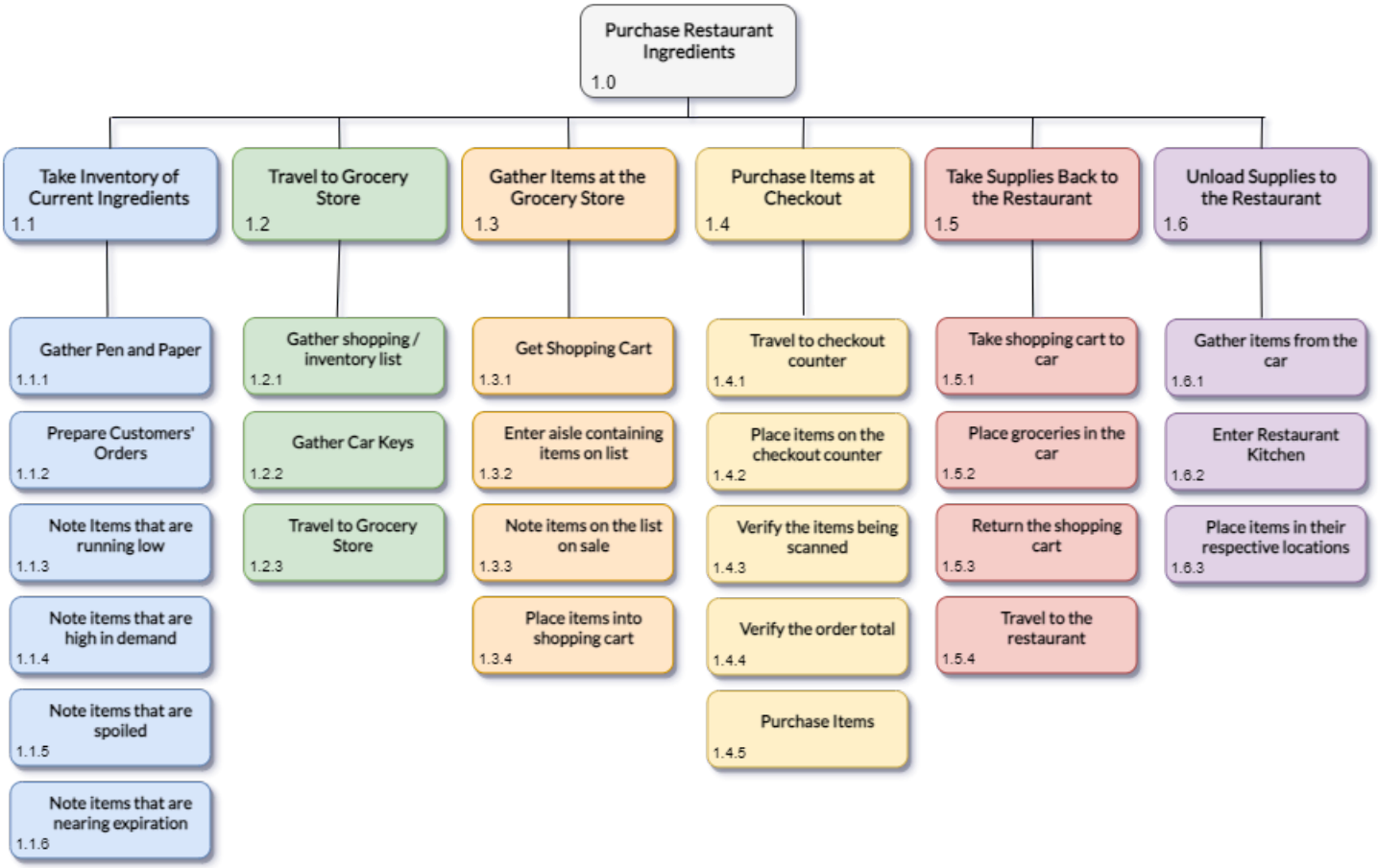
stakeholders can find themselves in. The major tasks chosen are the following: Purchasing Restaurant Ingredients, Building a Pizza at Your Pie and Delivering Dine-In Orders to the Restaurant Kitchen. These tasks are all relevant in our system because they cover the major situations that contribute to food waste from the staff's perspective. These tasks cover taking ingredient inventory, purchasing ingredients, cooking within a restaurant kitchen, and processing customers' orders correctly.

In order to properly understand the tasks that were chosen, it is important to grasp the environments in which these tasks are performed. Our first task, Purchasing Restaurant Ingredients, takes place in two distinct environments, the restaurant kitchen and the grocery store. Depending on the socio-economic status of the stakeholders involved, these settings can alter dramatically. For example, a stakeholder coming from a higher socio-economic status might purchase ingredients from a more expensive grocery store such as Whole Foods or Trader Joe's. In addition, these stakeholders may pay less attention to current in-store sales on relevant items. In another scenario, a restaurant may not even have access to fresh ingredients at their local grocery stores. It is important to consider all of these environments in our analysis of the problem space. Our second task, Building a Pizza at Your Pie, is a more specific and distinct task. We chose to use this task as a type of case study to explore potential risks for food waste within the cooking aspect of foodservice. The areas of potential food waste in this task come from stakeholder error through either spillage of pizza ingredients or incorrectly making orders. This situation can be applied to other restaurants of various socioeconomic statuses. For example, a chef may be more careful when working with more expensive ingredients in an effort to minimize waste. Our third task, Delivering Dine-In Orders to the Restaurant Kitchen, focuses on the front service aspect of our system. From interviews and research, we learned that food waste can arise from errors in the front-end. For example, a policy at Herban Fix, a restaurant we interviewed, has servers purchase the meal if they make a mistake with a customer's order. These policies pertaining to front-end mistakes can vary between restaurants but it is important to acknowledge this aspect of food wastage.

To view a full Hierarchical Task Analysis of each task, please refer to the upcoming pages.


Delivering a Dine-In Customer's Order to the Kitchen
1.0
Take Order from a ready Dine-In Guest
1.1
Drop Off Menus at the Front of House Table
1.2
Travel to order tablet
1.3
Send orders to kitchen via tablet
1.4
Give Customers Silverware based on their order
1.5
Gather Pen
1.1.1
Gather OrderBook
1.1.2
Travel to customer's table
1.1.3
Ask what they would like to order
1.1.4
Write down order
1.1.5
Repeat the order back to the customer
1.1.6
Take up menus
1.1.7
Travel to the Front of House Table
1.2.1
Drop the menus in their drawer
1.2.2
Travel to the kitchen
1.3.1
Tap the begin order button on the tablet
1.3.2
Select Table Number
1.4.1
Select Appetizers
1.4.2
Select Entree
1.4.3
Select Dessert
1.4.4
Input Any Modifiers (I.e. items removed, added, etc)
1.4.5
Split the check if applicable
1.4.6
Double check that all items are correct
1.4.7
Hit the confirm button to send the order
1.4.8
Gather necessary silverware
1.5.1
Travel to customer's table
1.5.2
Deliver silverware to the customers
1.5.3


Your Pie Build your Meal
1.0
Give Customers time to decide what that want to order
1.1
Ask Customer for their order
1.2
Begin Preparing Meal
1.3
Complete the order
1.4
Put on Gloves
1.1.1
Customer Orders Pizza
1.2.1
Obtain a peel for the pizza
1.2.1.1
Sprinkle semolina on the peel
1.2.1.2
Ask Type of Dough
1.2.1.3
Place dough on peel
1.2.1.4
Place Pizza In Oven
1.4.1
After Meal is Done Cooking
1.4.2
Use peel to slide pizza into oven
1.4.1.1
Use peel to slide pizza into oven
1.4.1.2
Use peel to slide pizza out of the oven
1.4.2.1
Cut the Pizza into fourths
1.4.2.2
Place the Pizza into a box
1.4.2.3
Deliver Pizza to the customer
1.4.2.4
Ask for type of sauce
1.3.1
Ask for type of cheese
1.3.2
Ask for type of vegetables
1.3.3
Ask for type of meat
1.3.4
Spread Sauce onto Dough
1.3.1.1
Spread Cheese onto Dough
1.3.2.1
Spread Vegetables onto Dough
1.3.3.1
Spread Meat onto Dough
1.3.4.1


Purchase Restaurant Ingredients
1.0
Take Inventory of Current Ingredients
1.1
Travel to Grocery Store
1.2
Gather Items at the Grocery Store
1.3
Purchase Items at Checkout
1.4
Take Supplies Back to the Restaurant
1.5
Unload Supplies to the Restaurant
1.6
Gather Pen and Paper
1.1.1
Prepare Customers' Orders
1.1.2
Note Items that are running low
1.1.3
Note items that are high in demand
1.1.4
Note items that are spoiled
1.1.5
Note items that are nearing expiration
1.1.6
Gather shopping / inventory list
1.2.1
Gather Car Keys
1.2.2
Travel to Grocery Store
1.2.3
Get Shopping Cart
1.3.1
Enter aisle containing items on list
1.3.2
Note items on the list on sale
1.3.3
Place items into shopping cart
1.3.4
Travel to checkout counter
1.4.1
Place items on the checkout counter
1.4.2
Verify the items being scanned
1.4.3
Verify the order total
1.4.4
Purchase Items
1.4.5
Take shopping cart to car
1.5.1
Place groceries in the car
1.5.2
Return the shopping cart
1.5.3
Travel to the restaurant
1.5.4
Gather items from the car
1.6.1
Enter Restaurant Kitchen
1.6.2
Place items in their respective locations
1.6.3

Usage Scenarios

Usage Scenario 1

Sale at the Grocery Store.

Greta is a 63-year-old restaurant owner located in Midtown Atlanta, Georgia. She is a first-generation immigrant from China hoping to be able to provide more opportunities for her children. Her daughter works as a manager at her restaurant and helps her work with and understand the technological aspects of the restaurant such as mobile ordering. On her weekly visit to the grocery store, she notices that the cucumbers are on sale for $1.25 a pound rather than $2.00 a pound. She realizes that the sale ends today. She decides to buy more cucumbers than normal without double-checking the current restaurant inventory system. Greta is excited as she believes that she saved money.

Usage Scenario 2

Kitchen staff utilizing software to take ingredient inventory.

Ethan is a 20-year-old student attending Georgia State University working part-time as a kitchen prep staff at a local family restaurant. Larry generally does not enjoy his job as it requires him to put in more effort than he is used to. Larry is tasked with taking inventory of the food supplies. This is unusual as the managers are generally tasked with this. It is late and Larry is the only employee left at the restaurant. The inventory tracking system located in the kitchen allows Larry to see each item's quantity and the nearest expiration date of that item. Larry sees that the system displays that the stock of meat is expiring in two days and decides to order a full shipment of meat without cross-checking the expiration dates on the containers. Larry leaves a message for the manager about the order and closes up the store. Larry is excited to get to go home and go to sleep.

Usage Scenario 3

Server at a sushi restaurant taking an order.

Server Sam, 19, is a freshman in college working a serving job at a sushi restaurant to save up money for tuition. Sam starts serving by approaching a table that the host assigned her. She

enthusiastically introduces herself and asks the table if they would like anything to drink. Before she leaves to get the drinks, she makes sure to notify the guests if they have any questions about the menu. The menu not only contains a wide variety of different fish and special rolls, but also other Japanese cuisines, like noodles and rice dishes. When Sam comes back with the drinks and straws to the table, she asks the table if they are ready to order. She must take every order by hand with pen and paper, so she has to write quickly and with abbreviations. After taking the table's order, she thoroughly reads back the guests' orders to ensure everything is correct. She then picks up the guests' menus and heads over to the computer to put the orders in.

Usage Scenario 4

Owner and manager of a small restaurant business, taking inventory.

Rachel, 28, is the owner and manager of a small restaurant. Tonight, she is closing and has to take inventory, as per usual. She grabs a clipboard with a chart of ingredients. She has to manually count and take note of every ingredient's quantity. Counting every item individually is time-consuming and tedious, so Rachel sometimes skims over some items, roughly counts, or estimates. She doesn't want to spend too much time closing, as she has to prepare dinner at home for her family. Rachel hates counting and was never good at math so she hopes to save enough money to one day be able to afford an inventory-taking software. After she finishes taking inventory, about ten minutes, she realizes that the next day is Saturday. With the current inventory, the ingredients wouldn't meet the demand of a busy weekend, so she rushes to the market to get more groceries.

Current UI Critiques

Lack of inventory software

Field visits to the interviewed restaurants revealed a lack of software and/or technology systems for taking inventory. When prompt interviewees about these findings, their response agreed that amid the statistical and documenting benefits of these systems, the old school 'paper and pen' worked just fine for what they needed. Among their causal reasons for their reluctance to use some form of software, they listed: pricing of software subscriptions, the restaurant's size, the

restaurant's frequency for ordering supplies, and overall discomfort with technology from the person in charge of inventory. To the pricing of software, they explained that the benefits failed to justify the additional spending since they could easily use inventory templates to note product' names and quantities. Additionally, the restaurant size along with the restaurant's frequency at ordering supplies implied inventory was not as complex to be done by hand, and thus, the need for a fancy system was not worth considering as of now. Lastly, people assigned to the inventory dutty confessed they already run into issues performing some functions with their phones. Adopting a new inventory system had no benefit worth the expense and/or additional hassle of training. These people's ages were in the range of 50-60 years old.

Revel POS

Revel POS is an iPad application that allows servers to take orders, send orders to the kitchen to be prepared, and make payments for orders. The software has several additional functions including seating customers, keeping track of total daily earnings, clocking employee hours, and more. The software's user interface is overall clean and basic usage is intuitive. Revel POS can be easily accessible on any iPad, allowing servers to take and send orders directly from the table that the order was taken from, making the ordering process faster.

The ordering page lists categories and subcategories in order to make finding menu items easier. However, the categories and items themselves are not in any order and some newer employees using Revel POS may struggle to find specific menu items. Quickly taking orders may take several days of training as servers familiarize themselves with the software.

A lack of certain features also requires servers to do certain tasks manually. Although Revel POS meets basic needs and is overall convenient, there are several challenges when it comes to customizing items. Certain features, like combo discounts, to-go items, and certain modifiers are not directly implemented. In order to get around these lack of features, extra steps are required that servers must remember. For example, to-go menu items are entirely different from dine-in, and in order to communicate correctly to the kitchen that an item is to-go, servers must complete three additional steps for each item. This is time-consuming, especially when taking orders over the phone, where customers may be on a time constraint. Additionally, after sending orders through Revel POS to the kitchen, it is difficult to modify them, making mistakes by servers more punishing.

Lack of food waste policies

One of the main things that we noticed throughout our field research was that practically all stakeholders agreed with the idea that food waste was an issue in the service industry and there needs to be some way to deal with that for restaurants. However, a lack of in-place policies for food waste management was just as universal. None of the three interviews we conducted had any type of written food waste reduction policy. Instead, employees stated that they just used their common sense about how to not waste food and went on with their basic routines. Another issue was that employees stated that they did not believe that they would have any impact on whether or not new policies for dealing with food waste would be implemented.

Any employees lacking knowledge on how to deal with food waste is an issue as this means that the restaurant is constantly bleeding money due to wasted ingredients and meals. This issue seems to be rather common and the scale that it could lead to is damaging both for restaurant owners and the environment. Our survey results were mostly made up of students in college and young adults who worked in restaurants as part-time jobs. If these employees were better educated and told to follow policies that were known to reduce the food waste in a restaurant, it would help both the environment and the owner.

Usability Goals

Our usability goals for our project are focused on making the system we create as simple and easy to implement as possible. The system should be capable of change and cover a wide variety of possibilities while also being cost-effective. With this in mind, our usability goals are **accessibility**, **speed**, **flexibility**, **cost-effectiveness**, and **transparency.**

Accessibility- Accessibility is the ease with which users can access and use the service that we implement for the food waste management system. The system should be usable with little to no training and should be able to stretch to varied restaurant settings. We would be able to test whether or not our system meets this goal through gathering client feedback from surveys as well as doing both, pre-and post-interviews to determine how easy it was for clients to adapt to the new system. This goal has a focus on Nielson's usability heuristics of "Recognition rather than Recall", "Aesthetic and Minimalist Design'' and "consistency and standards'' as these are directly bound to our product's learnability and potential for expansion.

Speed- Speed refers to the efficiency of the system at completing a particular set of tasks. As we are creating a system designed for restaurants, the system needs to be prepared to deal with the high-stress levels and quick pace of most restaurants. If the system cannot keep up with this need for speed, it will not be an effective system. Once again the best way to test whether or not the system meets this goal would be through survey feedback and interviews with stakeholders. Another possible way to verify whether this goal will be met could be through training. Since there should be a little bit of time put aside for the implementation of the system, employees could be trained on how to use the system as fast as possible and make it easy for customers to do the same thing. This goal has a focus on Nielson's usability heuristics of "Flexibility and Efficiency" and "User Control and Freedom" since they are directly concerned with the navigability of the system. The first, providing marked ways to interact with the system, while the second, providing shortcuts for more experienced users.

Flexibility - Flexibility is a necessity in terms of the implementation of this system. Since the system is meant to be employed on a large scale, it must be capable of working for multiple restaurants that each already have different ways of dealing with food waste. The system must be as flexible as possible so that instead of needing to rebuild the system for different clients, we can instead keep it consistent for ease of training and use. The best way to measure this usability goal would likely be by implementing the system in multiple locations and then calculating whether or not the food waste at each location went down by about the same percentage points. The percentage points would be calculated using our own set of heuristics based on secondary research. This goal has a focus on Nielson's usability heuristics of "Visibility of System Status" and "Error Prevention" since there is the innate necessity for users to be aware of they are correctly using the system along with minimizing the potential for misinterpreting the system's usage to a particular setting.

Cost-Effectiveness - Cost-effectiveness refers to how cost-effective it would be for the restaurant owners and investors to implement our new system. The system will be designed to reduce the amount of food wasted, but this should not cause a large expenditure for the stakeholders. Instead, there should be a net decrease in the total amount of money spent on food and waste management as more food is conserved and properly packaged. This goal can be checked via the bank books for the stakeholders after a month of the system being used. A month

is an adequate amount of time to determine if there has been any real change in expenditure due to the system and checking the cash flow statements will be crucial to this process. If there are any prevalent issues, looking at the bank statements could help us understand where they are and resolve them immediately. This usability goal has a focus on usability heuristic “help users recognize, diagnose, and recover from errors.” This is because this goal is meant to be a catch-all for any mistakes that were made in the implementation of the system and can be used by our team to make sure that the final submitted system is as cost-effective as can be.

Transparency - By transparency, we mean that all of our system’s operations should be easy to identify, and relate to the overall goal of reducing food waste. Transparency applies to all levels of stakeholders as it is important for employees to understand their roles in the system’s work and for customers to learn how they can contribute to this endeavor. This goal can be tested mainly through survey feedback as that would be the best way to get a wide variety of people’s opinions on whether they feel that the new system is comfortable and open to everyone. By getting survey feedback from both customers and employees, we will be able to rapidly improve the design of the project. This usability goal focuses on Nielson’s usability heuristics of “Help and Documentation” and “Visibility of System Status” since these provide all interested parties with knowledge of the system’s proper use, and expected behavior.

Constraints

Our constraints are built around the three sites where we conducted our interviews. Two of the restaurants were smaller and focused on a simple experience while the other was a fast food restaurant where you could build your meal. We decided that the best way to define our problem space and what constraints we would be operating under would be to analyze the places that we believed would cover the wide-area that our system should be able to cover in the future. By analyzing each of the three sites we would be able to generalize what the problem space and constraints should be, as well as being able to trim down the scope of our project.

Problem Space: Small-size, vegan, family-owned restaurant

Stakeholders: Manager, owner, chef, servers

Existing solutions & evidence: Write down on a notepad ingredients and other restaurant supplies that are running low while preparing meals

System Requirements:

Functional: The restaurant should avoid running out of ingredients that prevent them from selling items on the menu

Non-Functional: There should be enough restaurant's supplies to get through the day

Constraints: Because supplies are bought in an "as needed" fashion instead of systematic, there is a high frequency of trips to the store during the week

Problem Space: Food ordering at a casual-dining restaurant

Stakeholders: Manager, Server, Chef, Customer

Existing solutions and evidence: Upon verifying orders with customers, the server verifies order is inputted correctly on the restaurant's ordering system

System requirements:

Functional: Plates coming out of the kitchen should match the customer's order

Non-Functional: Restaurant's ordering system should provide fields to account for all kind of customer's specifications/ Communication between server and customer should be flawless

Constraints: Because restaurants are prone to noise, stress, and rush, there is room for orders to be taken wrong, particularly at lunch hour/ Because numerous orders are sent in a short time, people in charge of dispatching the orders occasionally mix orders

Problem Space: Food ordering at a fast-food restaurant (build your own plate style)

Stakeholders: Manager, Crew member, Customer

Existing solutions and evidence: the customer is prompt for order's ingredients/ specifications throughout the whole preparation process

System requirements:

Functional: The customer's order should have all ingredients specified along with quantities

Non-Functional: Communication between customer and crew member should be flawless

Constraints: Because restaurants are prone to noise, stress, and rush, there is room for orders to be taken wrong, particularly at lunch hour/ Ingredients might run out as customer requests them

Implications

Throughout our research, we learned a great deal about our potential users and the problems that they currently have with food waste management. We learned that many

restaurants either don't have software for keeping track of their inventory or they were not educated on how to use inventory tracking software. We also learned that for some restaurants food waste can be due to the restaurant not having enough traffic or could be due to customers not finishing their food and proceeding to not take it home. Food waste came from a variety of sources but it was agreed by the majority of workers that it was an important issue that should be addressed in the foodservice industry. Based on the results of our survey, all of the restaurant employees and managers that were surveyed believed that it was their responsibility to try and help solve this problem. Taking this into account and then understanding that we must build an efficient system that works for all ages, not just the range of 19-23 years old that made up our survey results, will be a very important task for the design of our project.

The biggest problem that we will face in our problem space is the lack of knowledge that many employees have about how to reduce food waste in a restaurant setting. During our field research, we questioned our interviewees on whether or not they felt there was a difference between food waste management at home and in the workplace and we received a resounding yes. However, many of these interviewees also responded that they had never learned any explicit policies on how to reduce food waste in the restaurant and instead just relied on common sense. This lack of proper policies coupled with a lack of software for inventory tracking has some important design implications as while the users are comfortable with the use of technology, they have not yet optimized their schedules to take advantage of this. By simply adding inventory-tracking software and written waste reduction policies, it is likely that the actions taken by staff to reduce food waste could increase significantly. These changes would have to be brought up with primary stakeholders, however, as the majority of our interviews and survey responses came from secondary stakeholders who felt that they would be able to change little about the restaurant policies. Since technology is such a vital part of streamlining the process in the kitchen, from keeping inventory to getting the order to the chef, we must also consider whether the system will be viable for all potential users. There is the chance that there will be users who will not be completely comfortable with technology which is a possibility that would have a significant impact on the design and implementation of our project.

In summary, we determined that the users of our food waste reduction system are likely to be the employees and owners of restaurants rather than the customers. While customers do have an impact on how much food is wasted in the industry, isolating our focus towards the employee side allows us to focus far more on the best possible design to most easily achieve and surpass our

goals for the system. We also identified our problem space and considered some of the possible issues that we would run into while attempting to implement the system. All of our findings are backed by our interviews and survey responses that covered a wide range of restaurant types to broaden the scope of our project. Thanks to the information we gathered, we will be better able to handle any potential issues that arise when building our system.

Limitations

As a group, we were able to gather data about food waste in the food industry mainly from the perspective of employees and food restaurant owners. We were also able to gain perspective into different restaurants ranging from a small family-owned business to a corporate chain. Despite this, we had some limitations in our research and the interaction with our stakeholders.

Due to time constraints as well as the pandemic, there were difficulties in obtaining copious amounts of field research. Many restaurant owners contacted were wary of allowing us to conduct interviews and observations. Because of this, it was difficult to obtain an adequate amount of interviews within the time constraints of this iteration of the design process. In addition, the impact of COVID-19 vaccinations and the urge to return to normalcy inhibited our ability to conduct field research. We found that currently restaurants are much busier, working to return their restaurant to a pre-pandemic state. Lastly, our desire to not encroach on sensitive topics about the food industry and the privacy of a restaurant business limited our ability to gather even more insightful data in the industry. Most restaurants were hesitant to give out certain information about their business, and understandably so.

Due to these limitations, our research had to be optimized to be time-efficient, insightful yet not intrusive, as well as open-minded. Nevertheless, we have gathered an adequate amount of research, field notes, and insightful data that can be utilized for our research project.

Reflections

It is interesting that everyone we have interviewed, and almost all the participants of our survey recognize the strong need to address the issue of food waste but cannot offer an ideal solution that is realistic.

One of our biggest challenges for the research was the stakeholder's lack of knowledge on food waste. This was reflected in customer attitudes towards leftover food during in-person dining. The lack of proper food reduction policies in many restaurants we interviewed also reflects this. A big reason for this is that restaurants prioritize business and customer satisfaction first. While it is more cost-effective to reduce food waste, that requires the sacrifice of time and customer satisfaction, or some other aspect of the business. Because of this, restaurant employees suffer from insufficient training for reducing food waste and restaurants lack large-scale food waste reduction practices.

Another aspect our group noticed is the effect of inventory on food waste in restaurants. This includes checking to make sure the restaurant has enough food in stock that is fresh, usable, or unspoiled for the day. This also includes minimizing ordering ingredients that are not in much use. Overbuying food correlates to an increase in food waste in restaurants as unused food spoils over time. It has become clear that managing inventory is quite complex and it is important for restaurants to have a proper inventory management system that could quantify food inventory as well as food waste in the restaurant. A more encompassing analysis of this is that restaurants have some amount of control in reducing food waste.

The most difficult part of this iteration of our design was finding eligible restaurants to observe and interview. Due to the COVID-19 pandemic, many restaurant owners are hesitant to run their businesses at full capacity, let alone allow for researchers to observe and interview their staff. In order for us to conduct interviews, we had to contact numerous people over a rather long time period. That being said, this iteration of our design would have benefited from the inclusion of more interviews. Nevertheless, the qualitative data we were able to obtain from the three interviews conducted is invaluable to this project. Without individual restaurant's perspectives on the issue of food waste, it would be very difficult to analyze our system properly.

This initial research has caused a shift in our project's intended scope. Identifying the primary users for our system shifted our goals and focus to encompass restaurant owners and employees. Our secondary, more indirect goal is to provide some knowledge about food waste to our stakeholders, in hopes of spreading more awareness of food waste and its long-term impact to create a more sustainable society.

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Appendix

Interview Guidelines

1. What made you choose this profession?
2. Could you walk me through a typical day in your role? What is your favorite part of the day?
3. Is there food waste within your business? Are you guys concerned with reducing food waste? What factors affect this decision and why?
4. Where does your restaurant get their food from? How frequently is new food received?
5. Does your restaurant utilize any third-party inventory tracking software? If so, which software?
6. If you had to give an estimated percentage to how much food is wasted within your operations, what would it be?
7. Is there a technique your restaurant uses to address food waste? If so, could you tell us more about it? To what extent are these policies and techniques enforced?
8. Are there any food reduction policies that you would like to enact in the future? Are there any policies that you did previously that you aren't doing anymore?
9. Are there any challenges to enacting food waste reduction policies?
10. How is reducing food waste at a restaurant setting different from reducing food waste at home?

Survey Questions

1. What is your job title?
    a. Waiter / Waitress
    b. Kitchen Staff
    c. Restaurant Manager
    d. Restaurant Owner
    e. Other...
2. What is your age?
    a. 18 and younger
    b. 19 - 23
    c. 24 - 30

   d. 30 - 39
   e. 40 - 49
   f. 50+
3. What activities are included in your day to day job? (Mark all that apply)
   a. [ ] Taking Inventory
   b. [ ] Order Ingredients / Food Supply
   c. [ ] Discarding Expired Food
   d. [ ] Cooking
   e. [ ] Front-End Service (ex. Waiting tables, taking orders, etc.)
   f. [ ] Other…
4. On a scale of 1-5, how adequate do you think your restaurant's portion sizes are?
   a. Likert-Type Scale ranging from 1 (Not Enough) to 5 (Too Much)
5. On a scale of 1-5, how serious of an issue do you think food waste is in the restaurant industry?
   a. Likert-Type Scale ranging from 1 (Not a Big Deal) to 5 (Very Serious)
6. If you think food waste is an issue in the restaurant industry, please state why or why not?
   a. Open-Response Answer
7. What are some reasons food gets wasted in your restaurant? (Mark all that apply)
   a. [ ] Customers not finishing their meals
   b. [ ] Food being returned to the kitchen
   c. [ ] Employee or Kitchen Mistake
   d. [ ] Ingredients going bad
   e. [ ] Other…
8. Of all the reasons that food is thrown out in your restaurant, which is the main reason?
   a. Customers not finishing their meals
   b. Food being returned to the kitchen
   c. Employee or Kitchen Mistake
   d. Ingredients going bad
   e. Other…
9. What do you think motivates people to avoid food waste? (Mark all that apply)
   a. [ ] Saving Money
   b. [ ] Environmental Concerns

   c. [ ] Cultural Reasons
   d. [ ] Moral Obligation
   e. [ ] Other…

10. On a scale of 1-5, how adequate do you think your restaurant's food waste reduction policies are?
    a. Likert-Type Scale ranging from 1 (Non-existent) to 5 (Very Adequate)
11. If your restaurant uses food waste reduction strategies, are there ways to make the implementation easier?
    a. Open-Response
12. If applicable, where do most of your food waste reduction practices take place?
    a. Open-Response
13. How often do you follow your restaurant's food waste reduction policies?
    a. Always
    b. Often
    c. Sometimes
    d. Rarely
    e. Never
    f. N/A
14. How often do your co-workers or employees follow your restaurant's food waste reduction policies?
    a. Always
    b. Often
    c. Sometimes
    d. Rarely
    e. Never
    f. N/A
15. On a scale of 1-5, how much power do you think you have over the amount of food being wasted in your restaurant?
    a. Likert-Type Scale ranging from 1 (Little to No Power) to 5 (A lot of Power)
16. On a scale of 1-5, how much power do you think you have over implementing a new policy to reduce food waste?
    a. Likert-Type Scale ranging from 1 (Non-existent) to 5 (Very Adequate)

17. Do you have any suggestions to reduce food waste in the food service industry? If so, please explain.
    a. Open-Response