Lab 1 – Refill.Me: Package-Free-Shopper Product Description

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1 Introduction

It will pose a great difficulty if someone asks to pick a loose package-free item from the grocery store. While it seems like a very easy task, it becomes very challenging when the loose items are taken into close inspection. There will be a trace of it regardless of how minuscule loose products will have some form of packaging: plastic sticker (ex. apples, peppers) or a wire that attaches the product with its description tag (ex. pineapples), to list a few. Regardless of how big or small the package is – all end up as waste: food as compost waste, plastic on trash' mount. As it said in 'The Environmental Impact of Food Packaging' article, "almost all food that we buy, especially processed food comes packaged" as well as "the trouble with food packaging begins at its creation." (2018). However, that would be an ideal order, while in majority time, both end up in the trash mount pile due to the lack of spending time on the system that is in place that regardless of sorting sent to the trash mount facility. The United States, apart from other countries, does not worry about the limited land availability or its water boundaries; thus, many states are designated to trash mounts. "In January of 2016, the Washington Post published an article with the headline, by 2050, there will be more plastic than fish in the world's oceans, study says." (VanRemoortel, 2018). The author also states, "150 tonnes of plastic in the ocean today [May 2018]". Furthermore, the author states that "each year at least 8 million tonnes of plastics are leaked into the ocean" (VanRemoortel, 2018).

According to the EPA"Container packaging…" article, the USA accounts for 28.1% of global trash waste generated for 2018. (2022). Additionally, in 2018 packaging waste mounted to 82.2 million tons of waste (EPA, "Containers and packaging…", 2022). This is a difficult to

grasp; and, for illustration purposes, an example with World Trade Center was used to show that the building that almost anyone can imagine with closed eyes weighs about 500,000 tons. Thus, if to put 160 times the building weight or easier: 160 copies of World Trade Center buildings together, that will be the size and the weight amount that is the more measurable representation of how much waste in the US alone was produced in 2018. (EPA "National Overview", 2022). Even though recycling has increased in popularity over the years, it is still not the solution to the problem of packaging waste. Figure 1-1 shows that a large percentage of the materials that could be recycled are not recycled (EPA, "National Overview…", 2022). Furthermore, with COVID, it became even more. FDA is focusing on freshness and the appeal for shopper to buy; thus, it has become out of control nowadays: ex.: coconuts sold sealed individually placed on a plastic tray and wrapped with saran wrap. What use is that? Coconut is not exposed to air or gets easily bruised. Thus, it tends to escalate immensely, especially if to remember that most single-use packaging items weigh only a few ounces.

The issue with the trash is partially on users; however, they also are to blame for adding items to enormous trash mounts. However, it is more due to the lead managing organizations and poor communication between product' options from restaurants and supermarkets to farmer's markets. Unfortunately, many stores are set that the package-free or "on a go" products are set closer to the entrances and registers, which are full of suitable packaging materials. Thus, users are forced to venture further into the aisles in search of loose products. Also, due to the bulk section taking so much place, many bulks, unless Costco or Sam's club, focus on selling bulk items online only to keep shelves for smaller, more eye-appealing products. While some remain in the dark about package-free options, others who are aware of these options are in a constant battle ranging from lack of information to lack of transparency between the potential shoppers

and food vendors. Please see, Figure 1-2 for key problem areas that were identified. (Claim*: all the Figures presented in this Product Description are taken from the team' Design presentation, only the background and text font are adjusted*) As Katie Denis lists in her poll with the sample of 1530 adults aged 18+ (Denis, 2021), she points out in 'The Future is Bright for American Recycling' poll blog that "consumers are increasingly taking matters into their own hands to make conscientious choices. If given the option to buy products with recyclable or compostable packaging where 47% of Americans opt for recyclable products as their first choice, and 20% prefer compostable products" (Denis, 2021). In her article, the author remarks that some mega companies like Proctor & Gamble, Palmolive, Colgate are already taking "baby-steps" in becoming more environmentally friendly packaging material product companies. While some might consider the poll as bias, the data shows that "eight-in ten responded that they're worry about the environment and the issues that plastic and the packaging waste is causing" (Denis, 2021). At the same time, some shoppers who are aware of alternative, bulk, or package-free items tend to fall into a puzzle of how to store the items properly from getting stale products. Lastly, there is no place where this group described above could socialize freely to form a network a foundation for the overdue change in the market.

The mobile application, Refill.Me will resolve this and other questions; it will be the hub that provides up-to-date information on package-free goods in the neighborhoods where the users reside. It will enhance novice and experienced shoppers with a new, more organized method of shopping. If, in the past, the user had to browse the website, look at the weekly ads, create a manual shopping list, think of the containers/bags, and then go to the store to find out that the item is out of the sale, Refill.Me will eliminate the majority of this chaotic experience with the endless hours of package-free shopping preparations by connecting the stores with the shoppers:

from unit price to the available items to what containers to bring automatically upon placing the item in the shopping list. There are just the obstacles that will be resolved for the users. In addition, it will help supermarkets track which items are more desirable for package-free shopping, track seasonal demand changes, and religious and holiday meal preparation shopping.

1.1 Problem Background

While trying to see the problem, let's dive in into what is happening inside the trash' mount. There are tons and tons of plastic, metal, glass and rotting products laying in the mounts that produce all ton of fumes and leakage from the soil of broken-down particles to the chemical reactions with the acidic rains. Depending on the access to air, both anaerobic and aerobic bacteria form that emit a wide range of fumes from sulfur, nitrogen, and carbon dioxide to methane and other unpleasant fumes. With both bacteria present, the hot and cold compost forms regardless of if it's sealed from the air or exposed to the air content. In sealed bags, the cold compost forms and anaerobic bacteria forms which semi-stable but produce methane to the already high concentration of green gases. On the other hand, if it's exposed to the air, with aerobic bacteria, healthy compost is formed, which is beneficial for soil and air, but it's a hot compost that requires constant rotation as it tends to hit up with the organic breakdowns, for this reason, often time dozers are seen on the piles that rotate the trash to avoid spontaneous combustible burning.

Furthermore, the media also is at fault for the landfill' problem as it created a myth that now has a mental linkage between global warming and packaging materials in general. However, it is not only plastic that pollutes the environment. Another aspect that also poses a problem that must be taken into consideration is whether to take how much the production of green gases are

produced during the plastic and aluminum packaging released into the atmosphere. According to "(Micro)plastic crisis" article posted in 'Journal of Cleaner Production', "rapid plastic production expansion and emission growth will exacerbate the climate crisis." (Shen, 2020), which in the end, adds to already escalating global warming issue. In addition, many know that microplastics are becoming an enormous problem for our oceans and the soil. Shen raises the concern that microplastics and nano plastics damage ecosystem and thus, human health, "new evidence has emerged that microplastics not only accumulate in the environment, but also in our food … and water supplies… even our bodies." (*ellipses are in place for omitted references that are present in the sentence*).

Now let's analyze how many times the items on the trash mounts can be recycled. Mrs. Sinai, in her article, 'How Many Times Can Recyclables Be Recycled?' states, "if you really want to live a greener lifestyle, buy recyclable materials that can be recycled an unlimited number of times" (Sinai, 2017). Furthermore, she states: that "plastic can be recycled once or twice before they're downcycled into something with lesser value," ex.: cloths, fleece, and lumber. Also, she points out once the material is downcycled, it cannot be recycled any further. Paper is recycled as long as its building blocks; fibers are intact. According to Sinai, "the shorter and shorter the fibers the harder it is to recycle…this material [paper] can usually only be recycled about five to seven times." (Sinai, 2017). Once it has reached the max amount of recycling – paper downcycled into newspapers and cartons for the eggs. As Sinai states, glass is great for recycling; however, in Fairfax County, new purple color bins are placed at specific locations for collection. With the busy lifestyle and lack of desire to travel the extra mile to glass, to the purple containers, many dump glass into the regular trash thus ending the cycle of recycling for the glass. 'How many…' article also states that aluminum and some metals as steel,

can be recycled over and over (Sinai, 2017); and this as long as its sorted according to not to be placed into regular trash to end up at the landfill but correctly placed in the recycling bin. The last point from the article that it is more energy efficient in the author's view to recycle metal rather than to start a process from the start for the new batch. Something that the US has not focused on, as with many, seems 'endless' for many resources; it is easier to remove the forest and make the farmland rather than reuse the already existing land; the same goes for reusing aluminum, metal in general, and glass.

Alternatively, another aspect needs to be reviewed as, in many places; the metal is not used by itself, ex.: aluminum is very soft and easily bent with hand material. So to make the drinking can as sturdy as that can be dropped and thrown without getting any leaks, an alloy is used (mixture of materials). After that, the surface is covered with a non-corrosive layer to prevent rusting the cans when it contains acidic coke, for example. The other surface is painted with toxic/metallic paint to adhere to the surface. As anyone can imagine, in this can of coke example – when it goes back to recycling, it needs to undergo an extensive process to become presentable and drinkable once again. There are known references like "Overview of known plastic packaging-associated chemicals and their hazards" by a group of scientists who lists the database of chemicals associated with the plastic packaging (CPPdb) who are well aware of the chemicals that are leak into the food supply (Groh, 2019). According to the article, those leaks cause health and toxic risks to rewriting human genes. The article starts from the most common terms: "The five polymers most commonly applied in plastic packaging include polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polystyrene (PS), and PVC" to "The major families of plastics additives (listed in order of decreasing total tonnage) are fillers, plasticizers, flame retardants, colorants, stabilizers, lubricants, foaming agents, and antistatic

agents. Stabilizers can be further divided into several groups with more specific functions, including antioxidants, antiozonants, heat stabilizers, UV stabilizers, and biostabilizer (biocides)" (Groh, 2019). It should be enough to prove that it is not good and, thus, better not to dive in so as not to damage someone's views on packaged goods permanently.

There is a new trend coming in the United States with a zero-waste packaging market which is on the rise in the United States because it is a good source for investors. "Zero waste packaging is hailed as a fresh industrial revolution" (Precedence Research, 2022). At this point, it is early to speculate as it is only in its initial phases, but it is already happening in several countries: Singapore, India, Brazil, and others worldwide. Since it is in the early phases, we need to wait longer to see what the "sharks" will do with this market. Hopefully it will follow as the article predicts: "to increase [zero-waste packaging market] significantly as a result of the strict regulatory environment, the worldwide environmental crisis, and other factors" after all "over 200 million tonnes of plastic are being produced each year and landfilled" (Precedence Research, 2022).

This raises another aspect, 'Amazonification', a term that defines access to anything with the click of a button. As Amanda Hoover states in 'These influencers, live trash-free in a garbage world' that are with each day gets more and more addictive for people to have "everything shipped quickly in disposable plastic and cardboards, in favor of a mindful lifestyle…a lifestyle around shunning waste." (Hoover, 2022).

1.2 Problem Description

Thus, if people would stop using reusable containers like tote bags, glass or plastic containers, and reusable bags to refill with the product, it would reduce the waste and decrease the damage to the environment and thus decrease the environmental footprint. Even one who skipped the visit to the restaurant will save all the trash associated with the condiments alone. However, even after introducing a fee for the usage of plastic bags general public retaliates against the idea of using reusable produce bags or any improvements towards environmentally friendly shopping.

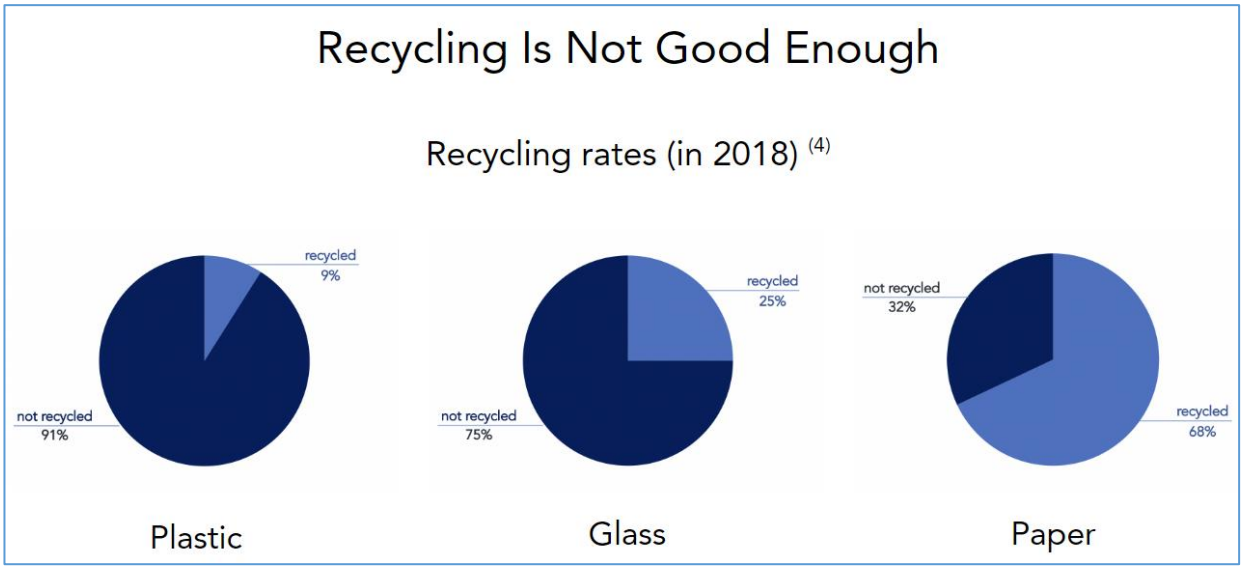

Figure 1-1: Recycling is Not Good Enough

As shown in Figure 1-1, due to fast technology and people's lack of sorting items rather than going to recycling, products end up in landfills instead. Thus, although recycling has increased in popularity, it is still not entirely up to speed to keep up with the demands. Furthermore, many believe that paper is a good alternative to plastic and other packaging materials; however, it is only partially true. Paper can only be "recycled seven times" before it decommissions into another product as the wood fibers get shorter and shorter (Sinai, 2017). If nothing changes, the waterways known now, soil, and air, creatures from small to large will all

be polluted, which in the end will lead to environmental degradation. All this depends on the problem that is leading to a climate catastrophe. And what about cross-contamination when with the hot composting and heavy dozers? It would be nice to know what packaging items are in the landfill and use them as possible ingredients in the chemical reaction pool. However, even Groh, with his group of scientists, is unable to answer, "currently, no publicly available information source exists that offers a one-stop, easily accessible overview of all chemicals associated with plastic packaging" (2019).

Thankfully, more and more people wake up from the trance and realize the issue that package items pose. More and more forums demands come for the government to start to take action to ban single-use plastic items, like plastic straws and shopping bags. However, it's not consistent from store to store, from state to state. While plastic straws are stopped in many restaurants, it is still sold in supermarkets. Some countries are more successful than others in this attempt to eradicate package materials.

Up to this point, the main focus was the landfills, and it's time to focus more on the area that is truly the problem that is the core problem for this product description paper. As was briefly mentioned in the earlier sections, mainstream grocery shopping damages the ecosystem. However, the waste that it generates: is from cans, glass, cardboard, plastic straps, and cerin wraps to stabilize the pallets to wooden crates. The mainstream is too stubborn to change and unable to adapt quickly to the ever-changing shopping clientele. Yet, shoppers who are interested in reducing waste and doing package-free shopping lack detailed information, such as product and unit price listings for the loose products that is available for purchase in neighborhood' stores It also lacks information on what container to use for storage once the shopper purchases

the package-free item. The shoppers need a platform that provides this and other information to make ecological shopping less confusing and frightening.

Package-free shopping is “sustainable consumption” that introduces the idea that the shopper has to bring their container for purchasing products that they would like to purchase. The containers can be anything from tote bags to glass or plastic bottles or boxes to produce bags. It even can be something spontaneous and creative, ex.: a cone out of paper for the sunflower seeds, a seeping cup for some fresh berries’ blueberries, raspberries, etc.

Once package-free shopping is clarified, now is an excellent time to define the shoppers’ eagerness for package-free shopping, an ecological environment shopping. By now, anyone might wonder who they are that struggle to find ways. It is ordinary folks who have a goal in mind to reduce packaging waste and decrease the emission related to transportation. Moreover, those people want to consume produce with pleasure, knowing that they made a difference by purchasing package-free items. Package-free shopping is more relaxed, less stressed on time or energy to be in and out, but to stroll a conversation with the stranger, patiently fill the container, thus, making shopping a whole new experience. As Hoover’ remarked: on Lauren Singer’s experience with cutting waste, saying, “Everybody can be zero waste. It is whether or not you try or you want to try” (2022). According to Singer’s experience, “awakening happened in 2012 when she [Singer] noticed the amount of trash produced by something as simple as her groceries” (Hoover, 2022).

In 2021, a Consumer Brands poll surveyed a group of adults in the USA and found that the following age categories as well as defined which group is more susceptible towards the packaging waste: “Boomers have the highest level of concern about packaging waste with 87% reporting concern, compared to Generation X (79%), Millennials (83%) and Gen Z (85%).

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A politician, John Lewis, once said: “If not us, then who? If not now, then when?” Because of the vast range of ages, there is also an income diversity between the Baby Boomers, generation X, Millennials, and Generation Z folks. The younger generations would strive more toward the average earners, while many Baby Boomers are quite affluent. According to ‘Incentives, Demographics, and Biases of Ethical Consumption: Observation of Modern Ethical Consumers’ article, “older population are generally more engaged with ethical consumption, given that ethical purchases involve the knowledge and the bandwidth to purchase more expensive things” (Kim, 2018). It is also wise to assume that many of the target group audience is educated and well-versed in environmental issues.

Once the target group for package free is identified, the topic can be moved to the targeted market. Mainstream grocery shopping has caused severe damage to the ecosystems with all of its accumulated waste generated from packaging materials. Many shoppers are angry by this grandalas amount of trash that accumulates from shopping venues. These shoppers are eager to try something different but meet roadblocks due to limited options. One of the primary reasons

for the roadblock is the lack of information on package-free shopping that is not easily accessible. Another roadblock is that the price listing for the loose products needs to be included or completed, and it is hard to sway the myth concept that lose items cost more. Lastly, it would benefit the shoppers if there was information on package-free options in their areas.

Currently, right now unfortunately, many obstacles make package-free shopping challenging to plan. As it listed in Figure 1-2: Current Process Flow, shoppers experience a lot of frustration as information about stores that sell package-free goods and the prices of those goods is not readily available. Additionally, it is a struggle for shoppers as they need to run from one store to the next in finding and completing their shopping for package-free items. Moreover,

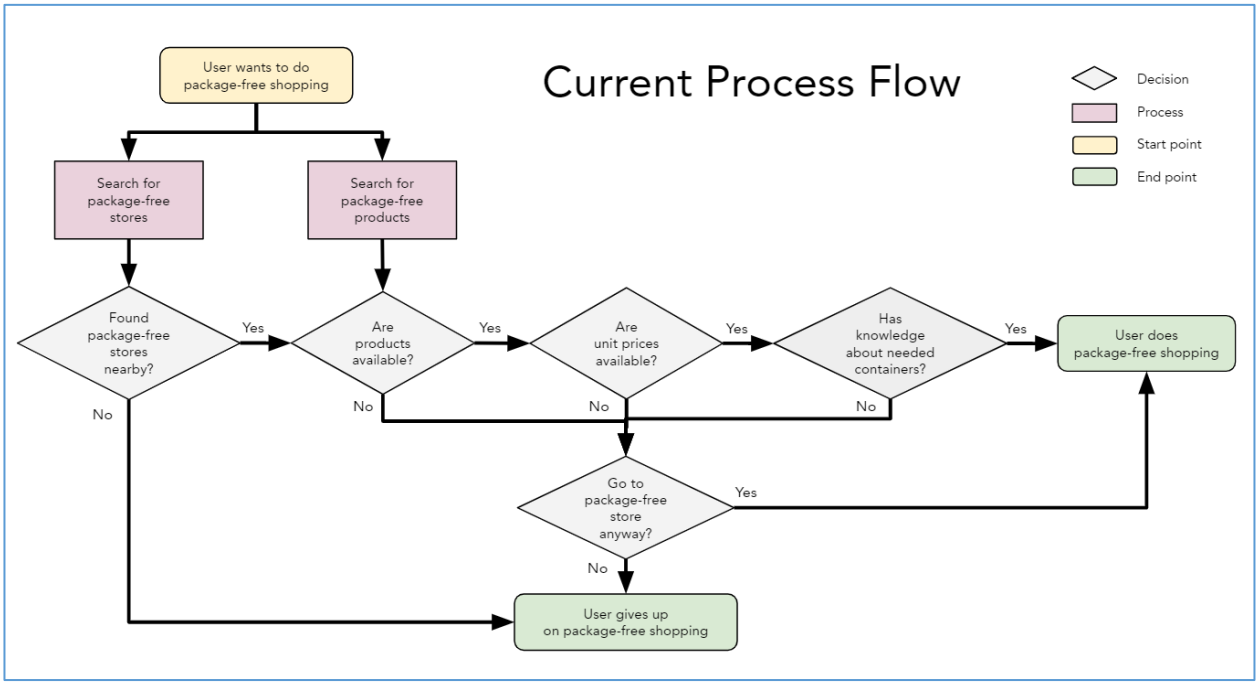

Figure 1-2: Current Process Flow

it is hard to track which store offers what and where the shopper can benefit because it is pretty challenging to find the listings of the products stores sell. In addition, weekly ads are not great for this task. This makes many very discontented and discouraged. Also, many people are unfamiliar with the containers that could be used. Lastly, currently, the apps and websites that

provide some features for searching for stores and products are not efficient and often are not up to date.

Figure 1-3 summarizes the excruciating daily experiences shoppers must undergo daily. As the chart shows, unfortunately, several steps will most likely set shoppers to give up on the package-free shopping experience altogether. Plausible examples: if there are no stores nearby; no product listing is available; no unit prices are available; no information on the necessary containers. All of these are significant obstacles that cannot be overcome by many.

1.3 Solution Description

To overcome the problem description and to prevent shoppers from turning away from package-free shopping, Refill.Me an information-hub mobile application, will be implemented that will provide relevant and up-to-date information regarding package-free shopping goods. It is going to fill a void in the market. The application would aim to help the novice as well as experienced package-free shoppers through their transition into package-free shopping. In addition, Refill.Me, will be saving time for package-free shopping and supporting local businesses while reducing package waste materials. It will significantly reduce package waste by supporting package-free shopping.

The app will use the shopper's location to locate the nearby stores and provide items that can be purchased as package-free items. It will also allow the user to select the items sold in their areas by comparing the unit price and adding the desired item to the shopping list. The list will then automatically adjust with the recommendation for the specific item in mind—a Reward.Me a reward system would be created to keep shoppers enthusiasm going for package-free shopping and, in return, rewards them with the points that shoppers accumulate for uploading the receipts that could convert into discounts (certain benefits depending on the store). It will also have

container guides to provide as basic as specific for the item assistance. Figure 1-3 summarizes this and other Refill.Me' features.

Figure 1-3: Solution Characteristics

Now, if to look at the proposed solution flow, the shoppers have less chance of giving up and have more opportunities to do a successful package-free shopping experience. It is expected that some users will have to overcome the application use challenge per the customer range mentioned earlier. However, the intuitive interface will not cause much trouble. Once the shopper gets used to the app, it will boost confidence and provide a more positive experience. The app will have several options for the search for products and stores selling package-free items and an option to scan the product. For detailed references, please refer to Figure 2-1: Solution Process Flow.

Its benefits would be the planning package-free shopping would be possible to plan and buy in one place. It will be easy to make by comparing unit prices of the same products in different locations, so it will finally be easy for the shoppers to make. The app will embark on

several roles, so its features will be focused not only on shopper-oriented but store-owners-oriented as well. The application should provide the necessary publicity to the shoppers and increase the stores' revenue. The biggest goal is that the app would benefit the environment by allowing shoppers to buy the amount that the shoppers need, which would lead to less food waste and wrapping waste. Furthermore, by purchasing package-free items, customers will have less exposure to chemicals that would otherwise leak into the food from packaging materials.

2 Product Description

2.1 Overview

Refill.Me application will be available on mobile for shoppers and on the web or tablet for store owners, testers, and admins to maintain, as it will take much work to do the same features from the mobile display. As was mentioned before: Refill.Me will have several builds features that would boost the positive experience and save time on a task that would in the past take a whole day to do in a few hours. Refill.Me is going to eliminate the lack that many shoppers experience when they plan to go shopping: what are the prices in this or that store? This will not be a secret anymore: unit prices will be listed for all the package-free items offered by the store. Shoppers will no longer need to travel far to shop, as the application will allow them to search stores in their neighborhoods, compare items and prices, and provide the feature to build a shopping list with intuitive container recommendations for the selected product. Another unique feature of the app is that it will allow shoppers to search products using several methods: search stores and then search for the item or look directly for the item. The last feature for the search would be to scan the barcode for an alternative. By following Figure 2-1, the shopper path is laid out. Shoppers can avoid having a bad experience of getting their high hopes crushed by going to

a vendor who happened to run out of the desired product. To be clear, there is no guarantee that the listed information will be 100% accurate at all times; but the application staff will try to keep up with it. The diagram below shows the access after opening and logging in to Refill.Me as a shopper. As illustrated user will have three options to choose from as well as three options to

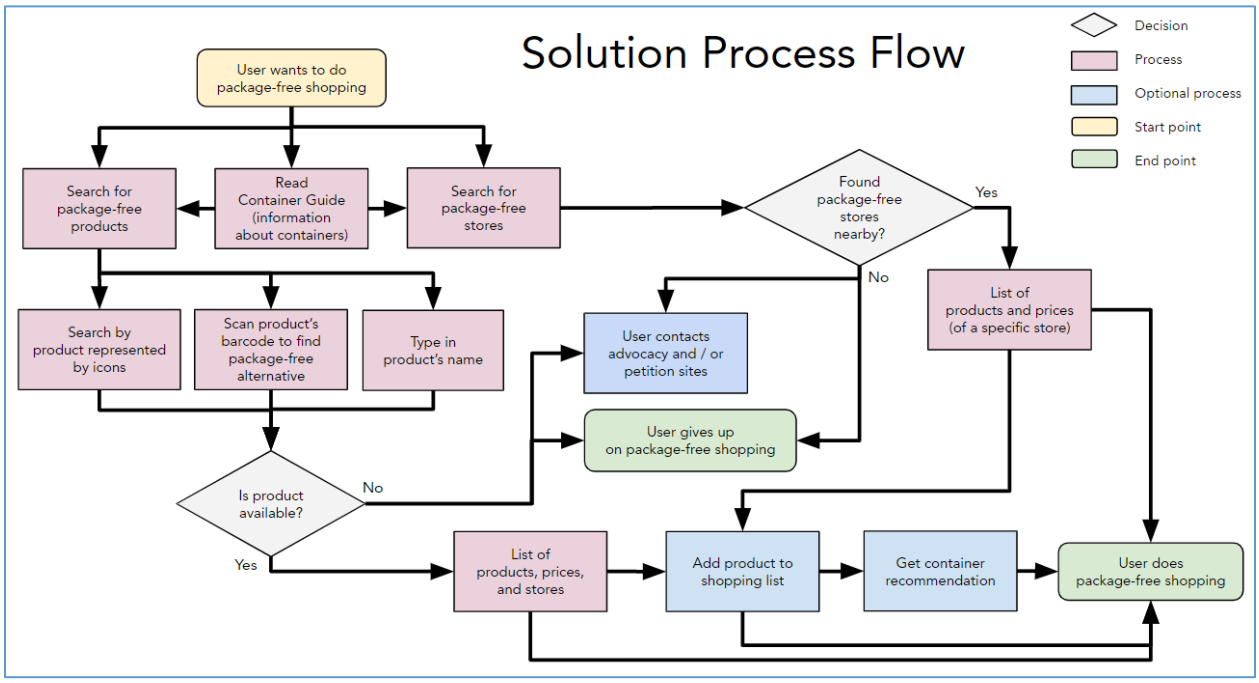

Figure 2-1: Solution Process Flow

search a product in three different ways (outlined in pink boxes). Upon successful search, a detailed product listing with the unit price and the store location where the product is available will display. Suppose the user is planning to purchase the item. In that case, the user can add the item to the shopping list, and based on the added item, and a customizable container recommendation option will be available. Providing the container gives the shopper more confidence to fulfill their package-free shopping spree.

2.2 Key Product Features and Capabilities

The mobile app will have the following significant features: ‘Home’ to access every app feature, such as ‘Store Search’ with three options for search, ‘Product Search’ with three options for search, ‘Shopping List’, and ‘Profile’ with Reward.Me feature. A search will only work accurately if Location is enabled. When turned on will provide a detailed store listing of nearby stores: supermarkets with bulk sections and farmer’s markets locations. The home tab will have quick navigation to speed up the familiarization time so shoppers will start using the app sooner. It will also support any possible questions/inquiries or concerns and resources (social media, network, etc.), to preview possible crowdsourcing information. The profile will provide the user with the option to update profile information; preview shopping lists history, and store list history, as well as keep track of the accumulated points and rewards. Note: The points do not expire on the app, but discounts do. The ‘Reward.Me’ will require shoppers to scan their receipts, and it will scan and assign a preselected number of points for each receipt that shoppers upload. ‘Reward.Me’ feature is unavailable to guests, store owners, and farmers markets. Please refer to Figures 2.3 – 2.5 for more details. There also would be static and automatic container guide pages, first for general knowledge of what kind of containers are available for usage when doing package-free shopping and automatic. The “smart” container recommendation guide

provides customizable input based on the item in the shopping list.

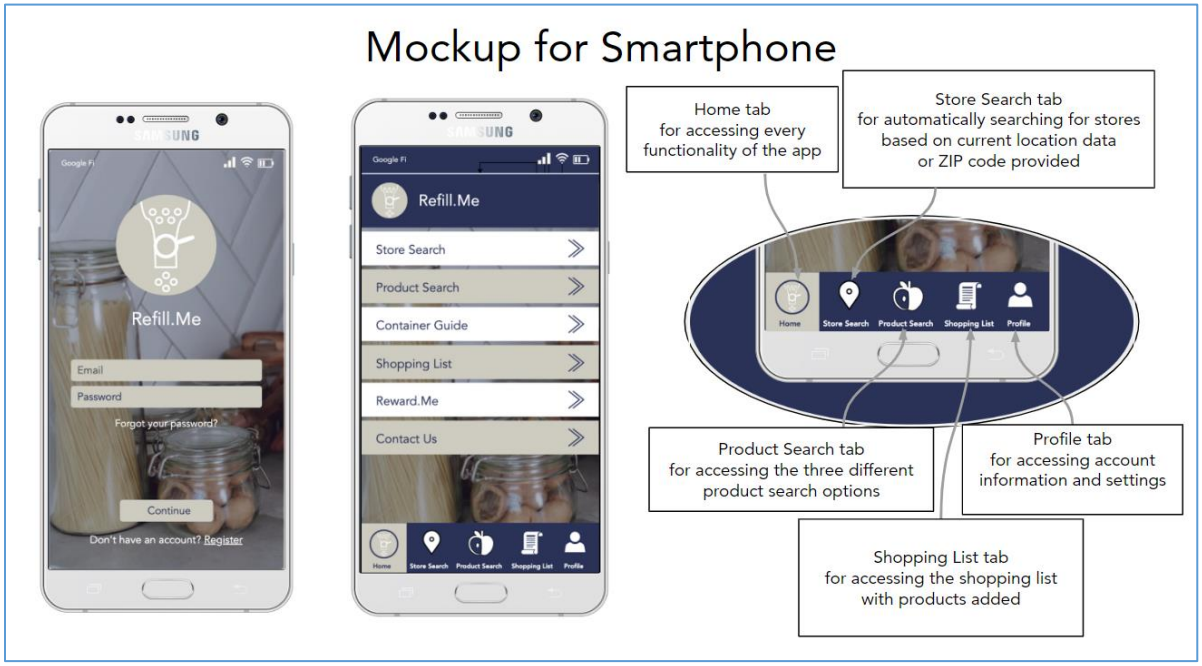

Figure 2-2: Mockup for Smartphone 1

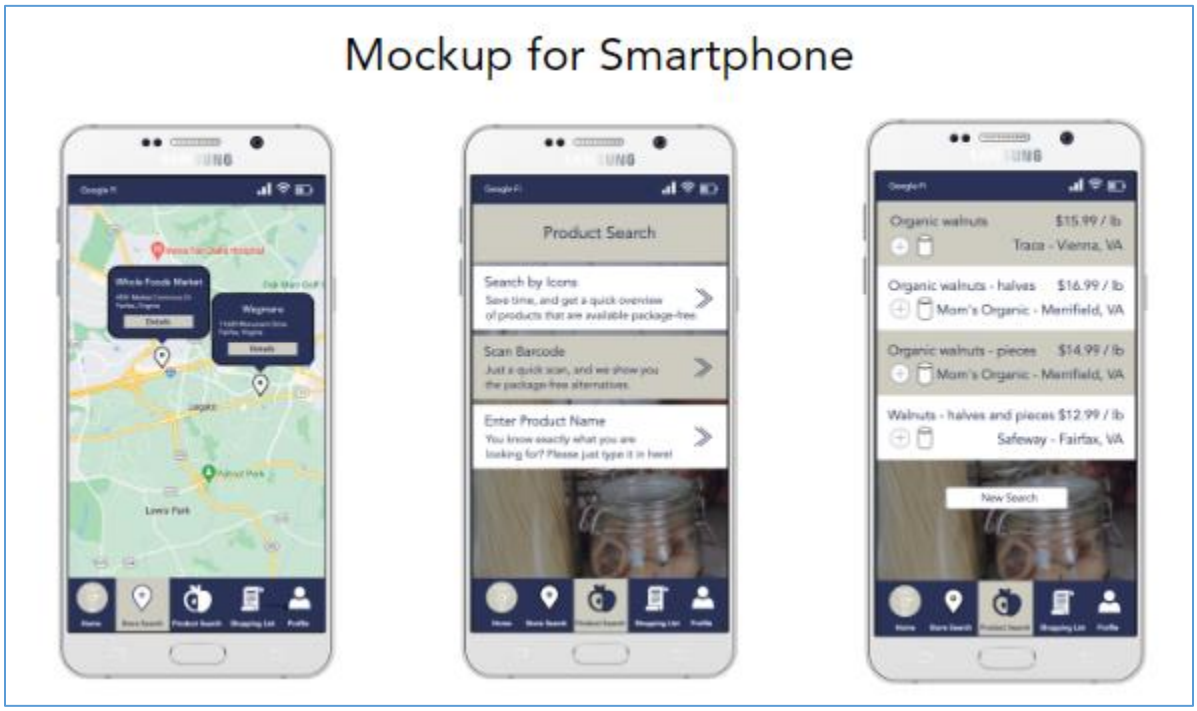

Figure 2-3: Mockup for Smartphone 2

Figure 2-4: Mockup for Smartphone 3

The web or table version will have an additional feature that is hidden from shoppers; it will have ‘products & prices’, ‘reward point conversion,’ ‘coupons,’ and ‘store analytics’ features. In ‘products & prices,’ store owners/farmer markets could update/delete their inventory records of the items they carry and are available for package-free shopping. The ‘reward point conversion’ would allow farmer markets, store owners, and the maintenance team to set/update parameters on how the points are converted to discounts. Again, the points that shoppers accumulate have no expiration date, but the discount has an expiration date. Also, all roles except for guests and shoppers will have access to personal ‘store ratings’ where they can review and track the rating for the store. In ‘store analytics’, store owners can generate data for desired store/inventory analyses: ex.: based on search product, found the item that the shoppers were searching for, product availability in the store. Store owners can contact administrative staff for a

specific report, but it will require admin assistance. Refer to Figures: 2.5 – 2.7 for more details.

Figure 2-5: Mockup for Tablet 1

Figure 2-6: Mockup for Tablet 2

Figure 2-7: Mockup for Tablet 3

Regardless of if the user connects to Refill.Me using their phone or tablet, the app supports four roles: administrator, package-free shoppers (later shoppers), store owners or employees (later store owners), and guest. The roles on the app or tablet allow overlap so the same user can be a store owner and the shopper account but not at the same time; consequently, two accounts for the same user. Refill.Me will provide free and premium subscriptions; free subscription at first and then a choice of either individual or family premium user access.

In the beginning, the biggest support for Refill.Me will be coming from the stakeholders while the network of the supermarkets is formed in the form of non-governmental environmental organizations or from individual investors from private or government sectors focused on sustainable investing, for example, ESG environmental and social governance groups.

The main customers for Refill.Me application will be for supermarkets offering bulk sections, package-free stores, and farmer's markets. It would be the core to inform and market their products to potential shoppers through the app. Furthermore, to encourage the adoption to

Refill.Me a free introductory period would be offered to the supermarkets, stores, and farmer's markets. However, after a specific time, the application would force the user to log in using premium, paid credentials.

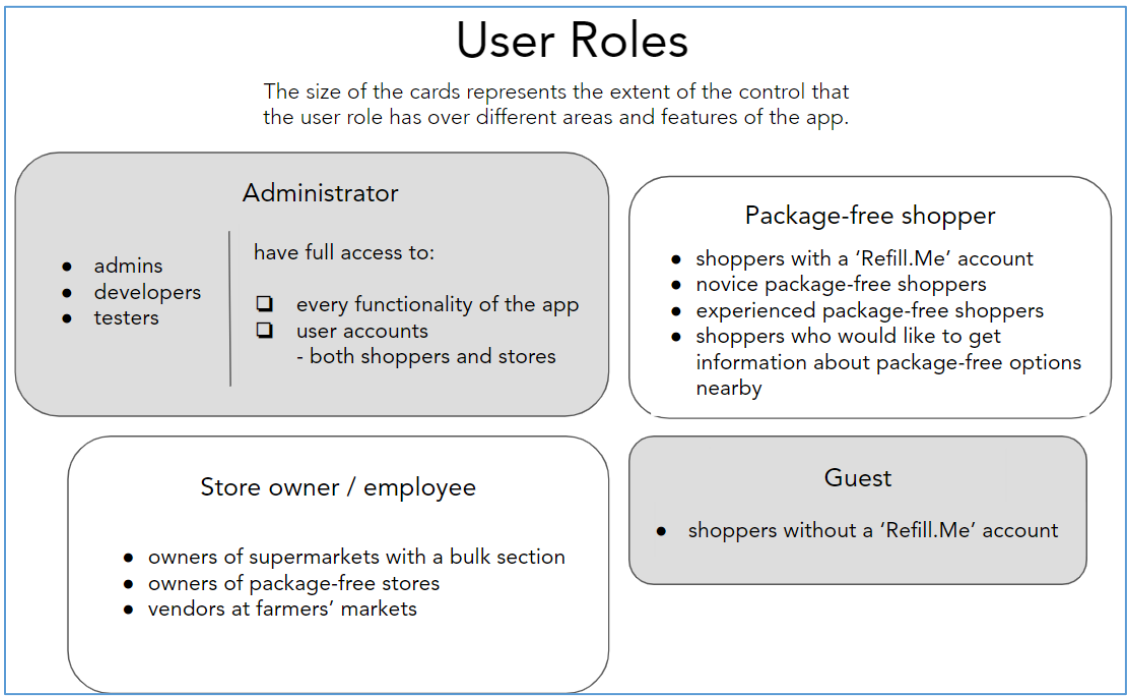

Figure 2-8: User Roles

The app's customers will be supermarkets with bulk sections, package-free stores, and farmer's markets. It will be the core of the app to inform and market to potential buyers on the app. This approach can minimize the number of users who would give up on package-free shopping. The app's benefits for the users will be easy to plan package-free shopping based on store and product information. It will attract the hidden-in-the-dark target audience for shops and farmers' markets. Lastly, it will lead to less trash. The goal will be that the shopping is performed using just one app rather than doing google maps, then looking at stores' weekly ads, etc. The users will be informed based on the provided data with price transparency, and to encourage adaption, as mentioned before, the free introductory trial will be introduced.

Before wrapping this section, it is essential to declare what Refill.Me application will not do: it will not be a webtop where the app would allow users to place an order as it's a relatively new concept, and packaging/sending package-free goods have not been readily available. Thus, in the end, it will only defeat the original purpose of eliminating package materials. Furthermore, with many educational apps, Refill.Me will not be one of them. It is specifically designed to improve the package-free shopping experience rather than to teach what package-free shopping is all about. If anyone is interested, they are more than welcome to browse on their own to better understand the core of the Refill.Me app.

Now, after discussing the roles and the MFCD, it is a good time to talk about the features and which role has access. Something that wasn't mentioned before, shoppers will also have access to creating and managing the account. Guest can barely access Refill.Me, only store the search feature if a location is enabled and the static container guide page. The store owners will

Features Table

Category	Features	Guest	Registered Shopper	Registered Store Owner	Administrator
Account Management	Login / Authentication		✓	✓	✓
	Location usage	✓	✓	✓	✓
	Account Creation / Deletion		✓	✓	✓
Mobile App Features	Search by Store	✓	✓	✓	✓
	Search by Product		✓	✓	✓
	Container Guide	✓	✓		✓
	Container Recommendation		✓	✓	✓
	Shopping List		✓		✓
	Reward.Me		✓		✓
	Product and Price Dashboard			✓	✓
	Reward Point Conversion Dashboard			✓	✓
	Coupon Dashboard			✓	✓
	Store Rating Dashboard			✓	✓
	Search Information Dashboard			✓	✓
Data Management	Data Analytics				✓
	Trend Reports				✓
	Search Information Analysis				✓
	Tags				✓

Figure 2-9: Feature Table

have access to several stores' related administrative pages such as: 'product and price,' 'reward point conversion,' and 'store rating.' On the other hand, administrators will have access to all features for operational and maintenance purposes. It will include all the features that guests have and finish with all the features that the store's owner has, plus the additional scoop on system settings, data analytics, back-end scripts, and store procedures.

2.3 Major Components (Hardware/Software)

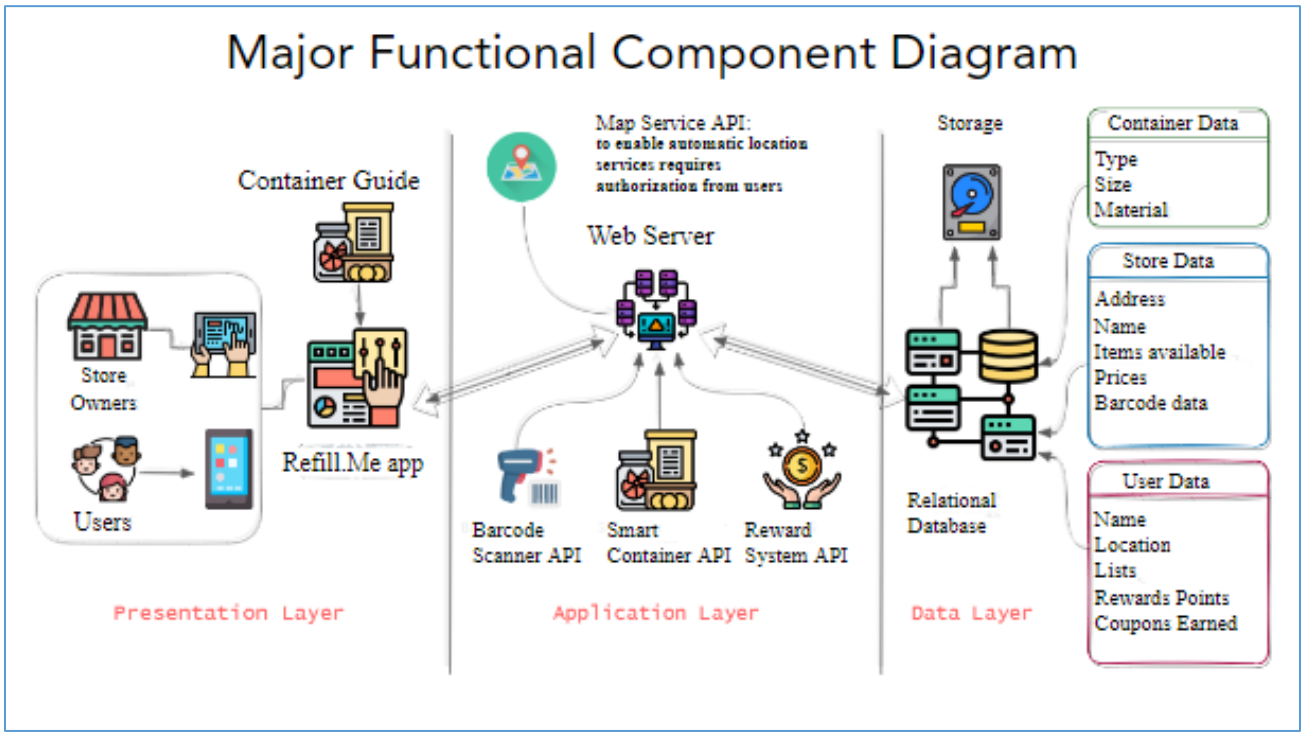

Figure 2-10: Major Functional Components Diagram

The major Functional Component Diagram (MFCD) will be set in three-tier architectural system layers: Presentation Layer (front-end or UI), application layer (the integrations, "logical" and linked to APIs components), and last Data Layer (back-end and DB access). Each Layer represents its own challenges: a user interface where users interact with Refill.Me application.

The logical tier is where the brain of the application resides, as it houses the design and algorithms: barcode scanner, brilliant container, and reward system. Lastly, the data tier, where the data associated with the application is stored and managed using a relational database. The reasoning behind going with a three-tier architecture is scalability concerns. If the data infrastructure needs to be upgraded, then the logic tier and user interface will not be affected. As it was mentioned earlier, the app will work on both mobile and the web. Shoppers rely heavily on mobile while store owners and admins rely heavily on the web or tablet.

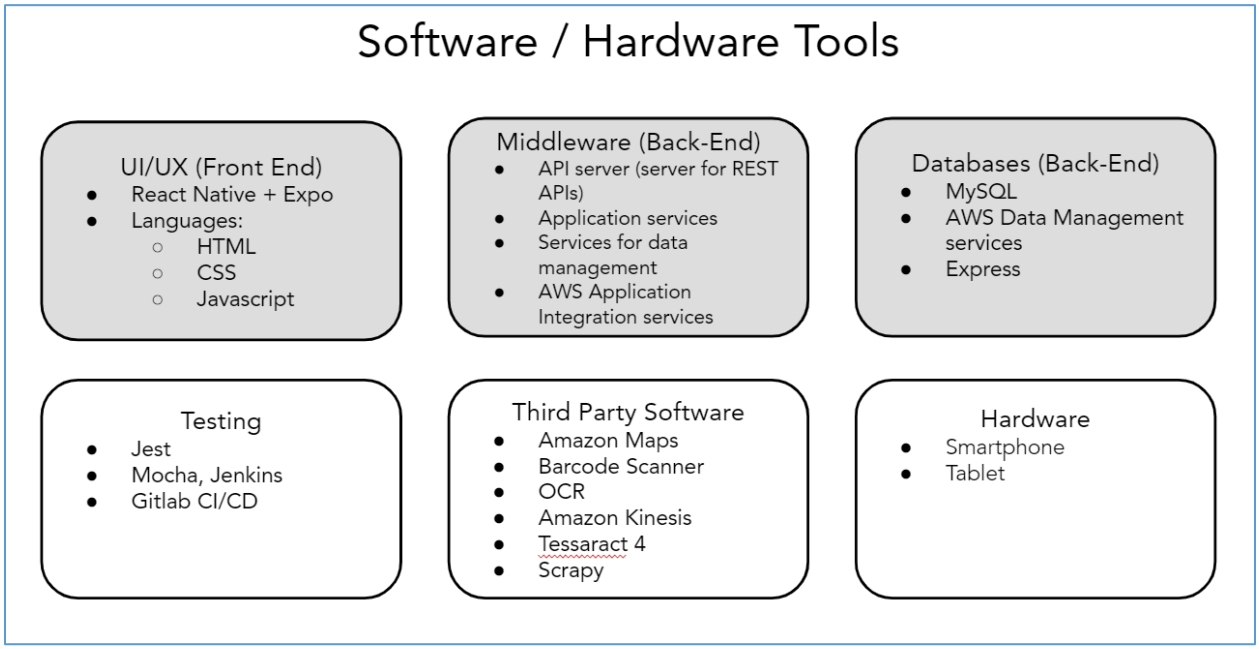

Figure 2-11: Software / Hardware Tools

Hardware:

- Desktop computer
  - Keyboard
  - Mouse
- Tablet
- Mobile phone (android/iOS)

Software:

- Languages
  - Web Programming: HTML, CSS, Javascript, React Native
  - Database: MySQL
- Libraries:
  - Test Library: JUnit, Jest, Mocha
- Third party software:
  - IDE: Visual Studio Code
  - Database: Amazon RDS, Amazon Map, Amazon Kinesis
  - Flask or Django

- Code Repository & Version control: GitLab
- Project Management: Trello
- Testing: Gitlab CI/CD
- Group Collaboration: Discord/Zoom

3 Identification of Case Study

3.1 Who is Refill.Me for?

With this infrastructure, some might speculate that competitors already have similar designs or structures. It cannot be that no one else thought about it; or think about it, but when similar in-nature apps are considered, none will incorporate all of it. It is an environmentally friendly shopper platform that brings closer the vendors: stores, farmer markets with eco-conscious clientele, and shoppers interested in package-free shopping. The app removes the frustration and ambiguity for unit prices and container recommendations without Refill.Me would be very challenging. As mentioned earlier, the clientele is mostly women from 4 different age groups, from baby boomers to generation Z, that mainly reside in urban cities on the east and west coasts of the United States. These women-clientele come from diverse income levels, are typically highly educated, and, most importantly, are passionate about the environment and the changes happening.

The app will be used by the facilities that sell bulk, lose, or package-free items and farmer's markets. It is a way to advertise something that weekly ads fail to do. First, some ads have not been reviewed in some time and thus fail to attract shoppers. Many still follow the unhealthy habit of posting meat all over the ads, as if the United States is not the #1 country for heart attacks or high cholesterol levels. Another reason is that each time the ads are made for the store – a good amount of resources is used (from trees to all of the exothermic reactions).

Refill.Me is a digital advertisement – where stores come to the platform to update the products and their prices (unit prices) for conscious shoppers to decide without guessing if the item is available today to is this is the right place to buy the type of produce. Refill.Me removes the mystery out of the process – brings transparency to shoppers and lucrative investment opportunities for vendors. Refill.Me creates a symbiotic relationship between the stores and their customers.

The United States likes to set up sectors that do things in a monopolistic way: ex. farmers must cut meat in the following way: chefs, on the other hand, who cook and prepare the meat cannot go to the farmer and ask to have it sliced differently as it typically happens in other countries, where the artisan sets the rules. Thus, most markets rely on packaging for freshness and sanitation, but it is only sometimes valid. The sealed meat packages sometimes mean the meat stays fresh, as well as fruits, regardless of whether any packaging needs washing, even if it is suitable from the bag, which defeats the purpose; other packages are even worse and more cumbersome, ex.: Asian pears typically come in a padded box with an individual plastic wrapper that prevents bruising, and then the fruit is wrapped in foil. Thus, the desire to consume is gone by the time the fruit is ready for consumption.

3.2 Who is Refill.Me will be used for?

As defined, the primary key previously for the app's success is to have supermarkets, stores, and farmer's markets facilities willing to sell loose or package-free items. The users of this platform will be shoppers, women, as was earlier mentioned, ages from baby boomers to generation Z. These women not only purchase goods for daily necessities but also try to make a change in their communities. They also hope to inspire or share the tactic with someone else who

can join the package-free movement. COVID-19 was bad for the environment when everyone was locked indoors, and the top-selling items were “on the go” items with a ton of packaging materials. It is also to raise awareness and to help build mental cues for store information locations, for which items can be sold loose or bulk to containers that would be acceptable for storage. Thus, no one likes to see the infestation due to poor storage. Lastly, the app allows users to create a shopping list, another virtual list that would assist shoppers with ensuring that all desired items are purchased.

Crowdsourcing information would be shared to keep shoppers motivated with the app, from please rate the store to advertisements on the platform that this or that loose item is on sale this week. This will also help with shopper networking. For shopper input and support, Refill.Me is going to have a Reward.Me options, where shoppers could upload their receipt for points. Once a lump sum of points is accumulated, the shoppers can change it to a discount of some sort, as it most likely will be the case that the “reward” will vary from vender to vender: in some cases free item or a discount from the regular price, etc.

What would store owners gain by the extra work of putting prices and available items on the who-knows-what app? The app will provide limited analytical records that would assist shoppers in the long run by reducing waste; more in-depth analysis can still be gathered upon request using the Support/Contact Us page.

3.3 Who might use Refill.Me in the future?

Anyone can use the app, from the DoorDash to BlueApron service. It provides an open door access when an ingredient is needed in an emergency. It would be the first-of-its-kind app

that would give others to tweak it to make it better or to be able to buy the loose product from the trucks.

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4 Refill.Me Prototype Description

1. Prototype Architecture (Hardware/Software)
    1. Hardware
    2. Software
2. Prototype Features and Capabilities
3. Prototype Development Challenges

4.1 Prototype Development Challenges

- Describe the expected challenges to be encountered while completing the prototype – e.g., knowledge missing, capability missing, supporting technology issues.

5 Glossary

Biodegrade: to decompose and become incorporated back into the environment;

Bulk section: an aisle where products are available in dispensers or bins, and the shoppers can buy the exact amount they desire;

BYOC (Bring Your Own Container): an initiative to encourage shoppers to bring their own containers with them to the store in order to avoid creating packaging waste;

Compostable: breaks down into organic matter and does not produce any chemicals during that process;

Container: tote bags, produce bags, glass or plastic jars, glass or plastic boxes, glass or plastic bottles that can be used for package-free shopping;

Container Guide: a small lexicon providing an overview of different types of containers and the types of products that could be stored in them;

Container Recommendation Feature: a feature of Refill.Me that suggests specific containers for products based on the type of product such as liquid or solid;

Experienced package-free shopper: a shopper who has experience, and thus, knowledge of package-free shopping;

Farmers' market: a market where local farmers sell their products directly to consumers;

Greenhouse gas emissions: gasses that trap heat in the earth's atmosphere such as carbon dioxide and methane, and thus directly contribute to climate change, predominantly emitted through human activities;

Loose product: product sold without any packaging;

Mainstream grocery shopping: grocery shopping that does not follow sustainable practices, thus, it entails buying packaged items, using plastic, not considering environmental aspects;

Microplastics: tiny plastic particles that are less than five millimeters long and are created when larger plastic pieces breaks down;

Novice package-free shopper: a shopper who has no experience, and thus, no knowledge of package-free shopping;

Package-free: without any packaging materials such as plastic, paper, cardboard, aluminum, or glass;

Package-free store (in the context of our application): supermarkets with a bulk section, stores exclusively selling loose products, and vendors at farmers' markets;

Package-free shopper: a shopper who prefers to buy loose products by filling them into their own containers;

Package-free shopping: shopping using one's own containers, thus, shopping without creating packaging waste;

Packaging: material used to protect a product from any damage during transportation;

Produce bag: a reusable bag usually with a window and tare weight label that is used for buying fruits / vegetables;

Single-use: designed to be used only once, and then to be discarded;

Tare weight: the weight of an empty container that should not be included when the price of the product is calculated;

Tote bag: a large bag, often made of cotton, used to carry many items;

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