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Creating an Information System with a Social Purpose

The Case of Re-Food

Leonor Vaz Keil Amaral

Project Work

presented as a partial requirement for obtaining the Master Degree Program in Statistics and Information Management

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CREATING AN INFORMATION SYSTEM WITH A SOCIAL PURPOSE

THE CASE OF RE-FOOD

By

Leonor Vaz Keil Amaral

Project Work presented as a partial requirement for obtaining the Master Degree in Statistics and Information Management, with a specialization in Information Management

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

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ABSTRACT

Nowadays, with the evolution of technology, the strategies of information management are constantly improving to create faster and more efficient methods of analyzing and displaying data. At the same time, the users, considering the amount of information they access every day, search for simpler, faster and cleaner ways to interact with information.

These strategies with simpler designs are important, now more than ever, to help social organizations, such as Re-Food, improve their work and show to communities that they impact directly and indirectly the importance of eco-sustainability and solidarity projects.

This project proposes to build an information system capable of structuring data from Re-Food resources, create faster and more efficient solutions to improve the centers' management and show to the rest of the community the impact this organization, and the ones alike have on society.

KEYWORDS

Food Waste; Social Impact; Information System; Software Architecture; Requirements Analysis

Sustainable Development Goals (SGD):

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LIST OF ABBREVIATIONS AND ACRONYMS

APN	Portuguese Association of Nutritionists
BI	Business Intelligence
BPMN	Business Process Model and Notation
CNCDA	National Commission to Combat Food Waste
DEMO	Design and Engineering Methodology for Organizations
DSRM	Design Science Research Methodology
ERD	Entity Relationship Diagram
ESS	Executive Support Systems
FAO	Food and Agriculture Organization of the United Nations
FS	Food Source
FSIN	Food Security Information Network
IFAD	International Fund for Agricultural Development
IPSS	Private Entity Serving the Public Good
NGO	Non-Governmental Organizations
TPS	Transaction Processing Systems
UCD	Use-Case Diagram
UN	United Nations Organization
UNEP	United Nations Environment Program
UNICEF	United Nations International Children's Emergency Fund
WFP	World Food Program
WHO	World Health Organization

1. INTRODUCTION

1.1. CONTEXT

Now more than ever, we are constantly analyzing our impact on the environment, in every sphere of our daily life, and searching for ways to diminish it. One of the problems that contribute to the decrease of resources available on the planet and that has a huge impact on our future is food waste. The present topic and study of mechanisms to reduce our impact on the environment are now gaining relevancy. In Portugal, one of the organizations that aim to minimize this problem is Re-Food. This organization collects surplus food and ensures that it is delivered to families in need.

Nevertheless, the food waste topic and the efforts to combat it still have a long way to go in terms of investigations, especially in the academic world. But more important than this, is the relevance of creating strategies to quantify a country or city's impact on the environment.

Therefore, this project aims to study and improve the work of one of the Portuguese organizations that is fighting food waste by helping vulnerable people. The purpose of this study is to analyze and design an information system capable of organizing Re-Food's resources to optimize its work. Consequently, this may increase its impact on society and the environment by upgrading its operational management with the creation of a mobile app capable of making the organization's daily tasks more efficient.

1.2. PROBLEM IDENTIFICATION AND OBJECTIVES

Considering the importance of initiatives such as Re-Food, not only looking from the food waste point of view but also, from the importance of society's participation in today's social and environmental initiatives, the main purpose of this project is to design the architecture of a software tool capable of improving the volunteers' tasks inside this organization.

Inside the organization, there are several situations where a lack of information or communication leads to negative outcomes, normally creating situations of delay, rework, or problems between partners, volunteers, or even the beneficiaries. By identifying these several issues, the project creates a tool capable of improving these communication flows, namely between volunteers and suppliers, of organizing the teams responsible for each task, and of optimizing food collection routes, through the assessment of its feasibility. All these steps aim to improve the organization's efficiency, allowing it to fulfill its primary goal: reduce food waste.

As some studies about the structure of NGOs or IPSS show us, the role played by technological tools is still very secondary. Not because it is not necessary, but mostly because sometimes there is a

lack of knowledge about which are the best tools for each work and/or the best ways to implement them (Esteves, 2020).

Creating this software architecture is critical. It analyzes every sphere of the work inside the organization, defines each step performed inside it, and identifies which processes could benefit from the use of this tool. It is also necessary to identify the volunteers' needs, the business's requirements, the available resources, and all the interactions, inside the organization and its partners and beneficiaries.

Thus, the objective of this project is to perform a requirement analysis with the purpose of creating an app (mobile and tablet) for Re-food, in order to organize and facilitate the work developed within the organization.

2. WORK PLAN

2.1. PHASES

As mentioned earlier, the main goal is to design a software system for a social organization, functioning as a collaborative platform that will help improve the organization's performance with the relocation and good management of resources. With this tool, the volunteers could enhance their work inside the institution by accessing the information needed to perform every activity more effectively, leading to more efficient results.

According to Geerts (2011), most of the studies about information systems are focused on understanding phenomena and finding why things work the way they do, and the papers written around this topic normally comprehend the following steps: problem definition, literature review, hypothesis development, data collection, analysis, results, and discussion. This "uniformity" can help not only with the paper's production but also with its presentation, making it easier for readers to evaluate it.

The development of this study comprehends the following phases:

- Literature Review Analysis Phase - Understand which development processes and methodologies are best to use on this project and how can a social organization improve its work by using them.
- Project Development Phase – This phase is the practical part of the project, and it is organized in a group of steps that will comprehend the first moment of interviews to collect other points of view about the work performed at Re-Food, to discuss and analyze the volunteers' needs and identify possible solutions and ways to improve the organization's work with the help of a software system. This phase will then be followed by the requirements' conceptualization and by the second phase of interviews. During this phase, the information gathered from the first interviews its conceptualized and then presented and discussed with the interviewers to understand their needs were captured. As a final step, the information from this feedback is analyzed and possible changes are made, the requirements will be defined and schematized, and the architectural design created.
- Final Review Phase – Finally, the last phase aims to analyze and understand the main contributions and limitations that the system can bring to the specific case of this organization.

Regarding the gathering of information from the volunteers' feedback about their work inside Re-Food, a general interview was written (Appendix 1). The interview methodology was chosen to better understand the difficulties felt by the volunteers when performing their tasks, and to discuss possible

solutions with them. Therefore, to be able to gather information about every task inside the organization, it's necessary to interview people who perform different activities and from different Re-Food cores around Portugal. The general screenplay for the interviews was written with open-ended questions so that the interviewer feels at ease to give his suggestions or opinions.

2.2. RESOURCES & STANDARDS

2.2.1. UML

Unified Modelling Language (UML) is a standardized language for building software schemas. UML can be used for visualization, specification, construction, and documentation of artifacts (Booch et al., 1999). This language is suitable for modelling systems, it allows you to define the design and structure of the project, addressing all the views needed to develop and deploy systems.

There are several important diagrams to represent the system and they can be organized into two major groups:

- **Structural Diagrams**
  - Class Diagram: Responsible for defining the different classes that the system contains, thereby defining all attributes for each class. This is considered the main building block of any solution.
  - Component Diagram: Describes and depicts the structural relationship of components of a software system, with communication being done through interfaces.
  - Deployment Diagram: represents the hardware and software within the system. It is useful when the deployment is made across multiple devices with each having a unique configuration.
  - Object Diagram: Like the Class Diagram, this diagram defines the relationship between objects, but in this case, it shows real examples. It is normally used to represent and explain complex relationships between objects.

- **Behavioral Diagrams**
  - Use Cases Diagram (UCD): Used to describe the interaction between the actors and the system, delineating the actions, relationships, and dependencies based on the system requirements. These are the best-known diagram types of the UML language and are considered the starting point for any project discussion.
  - Activity Diagram: Simplifies the interpretation of the logic within the system, allowing you to understand the sequence of existing actions and their connections. It is a graphical representation of business or operational workflows.

But considering the complexity of this system and data already collected by the organization, only some of these diagrams will be executed in this project.

2.2.2. Tools

- **Lucidchart**

In this project, since the UML notation will be used on most models/diagrams of system modeling, the *Lucidchart* tool was the one chosen to develop them. It is one of the most used platforms worldwide to develop UML diagrams since it is a very intuitive tool, based on a drag-and-drop user interface. This platform also has a group of shapes and templates available that allows to develop the work in a faster and easier process.

- **Adobe XD**

As for the interface definition, a series of prototypes of the app were developed to make it easier to demonstrate the usefulness of the system in the organization's day-to-day operations as a quick and easy solution. To develop this solution Adobe XD was used, which is also a user-friendly tool already known for belonging to the universe of Adobe's tools with which I was already familiar.

3. THEORETICAL FRAMEWORK

3.1. FOOD WASTE

3.1.1. Concepts

According to the Food and Agriculture Organization of the United Nations (FAO), food waste refers to the food loss in the subsequent stages of the food supply chain, from production to storage, processing, and distribution, retail to domestic consumption (Papaj, K. A., 2016; FAO et al., 2020).

This food loss can be related to many sources and can take place in the first stages of the supply chain, with situations of incorrect management of agriculture production, for example, situations of post-harvest, due to incorrect management on the logistic stage, related to lack of knowledge, infrastructures or technologies to storage, process and distribute food. Normally, this quantity of food loss is non-intentional or accidental, related to inefficiencies in the supply chain (Papaj, K. A., 2016, pp.3).

In the "Food Waste Index – 2021 Report" developed by the UN, food waste is defined as the food intended or not for human consumption that is removed from the human food supply chain mainly by the food/grocery retail, manufacturing of food products, food services and households' sectors (UNEP, 2021). As food, UNEP considers "any substance – whether processed, semi-processed or raw – that is intended for human consumption. "Food" includes drink and any substance that has been used in the manufacture, preparation, or treatment of food".

In 2015, the UN emitted seventeen Sustainable Development Goals for 2030, as a "call to action" to all countries to promote awareness of social problems such as health, education, social inequalities, economic growth, considering climate change, and planet protection (Esteves, 2020). This program was adopted by the 193 member states of the United Nations and was now adjusted to the actual conditions during the COVID-19 situation, with the creation of specific responses to each goal.

One of the social and economic objectives mentioned by the UN on this Agenda for 2030 - "*End hunger, achieve food security and nutrition and promote a sustainable agriculture*" - intends to create awareness for the 8.9% of the population worldwide in hunger conditions, a situation that has been getting worse with the COVID-19 situation, and the need to restructure the agricultural system, by increasing its productivity.

These values are shown in the study presented this year by FAO – *Food Security and Nutrition in the World* (FAO *et al*., 2020) – by the number of undernourished people in the world (Table 1), that is higher in countries in situations of conflict and insecurity, unbalanced economy or which experience difficult weather conditions frequently (FSIN, 2020).

Table I - Number of undernourished people in the world, 2005-2009 (FAO et al, 2020)

Number of undernourished (millions)								
	2005	**2010**	**2015**	**2016**	**2017**	**2018**	**2019[1]**	**2030[2]**
WORLD	**825.6**	**668.2**	**653.3**	**657.6**	**653.2**	**678.1**	**687.8**	**841.4**
AFRICA	**192.6**	**196.1**	**216.9**	**224.9**	**231.7**	**236.8**	**250.3**	**433.2**
Northern Africa	18.3	17.8	13.8	14.4	15.5	15.0	15.6	21.4
Sub-Saharan Africa	174.3	178.3	203.0	210.5	216.3	221.8	234.7	411.8
Eastern Africa	95.0	98.1	104.9	108.4	110.4	112.9	117.9	191.6
Middle Africa	39.7	40.0	43.5	45.8	47.2	49.1	51.9	90.5
Southern Africa	2.7	3.2	4.4	5.1	4.5	5.2	5.6	11.0
Western Africa	36.9	37.0	50.3	51.2	54.2	54.7	59.4	118.8
ASIA	**574.7**	**423.8**	**388.7**	**381.7**	**369.7**	**385.3**	**381.1**	**329.2**
Central Asia	6.5	4.8	2.1	2.1	2.2	2.1	2.0	n.r.[3]
Eastern Asia	118.6	60.6	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
South-eastern Asia	97.4	70.1	66.7	63.9	63.4	64.2	64.7	63.0
Southern Asia	328.0	264.0	263.1	256.2	245.7	261.0	257.3	203.6
Western Asia	24.3	24.2	27.6	29.2	29.5	30.4	30.8	42.1
Western Asia and Northern Africa	42.6	42.0	41.4	43.6	45.0	45.4	46.4	63.5
LATIN AMERICA AND THE CARIBBEAN	**48.6**	**39.6**	**38.8**	**42.4**	**43.5**	**46.6**	**47.7**	**66.9**
Caribbean	8.4	7.2	7.4	7.3	7.1	7.3	7.2	6.6
Latin America	40.1	32.4	31.4	35.1	36.3	39.3	40.5	60.3
Central America	11.8	12.4	13.4	14.7	14.4	14.7	16.6	24.5
South America	28.4	20.0	18.0	20.4	21.9	24.6	24.0	35.7
OCEANIA	**1.9**	**2.0**	**2.2**	**2.4**	**2.4**	**2.4**	**2.4**	**3.4**

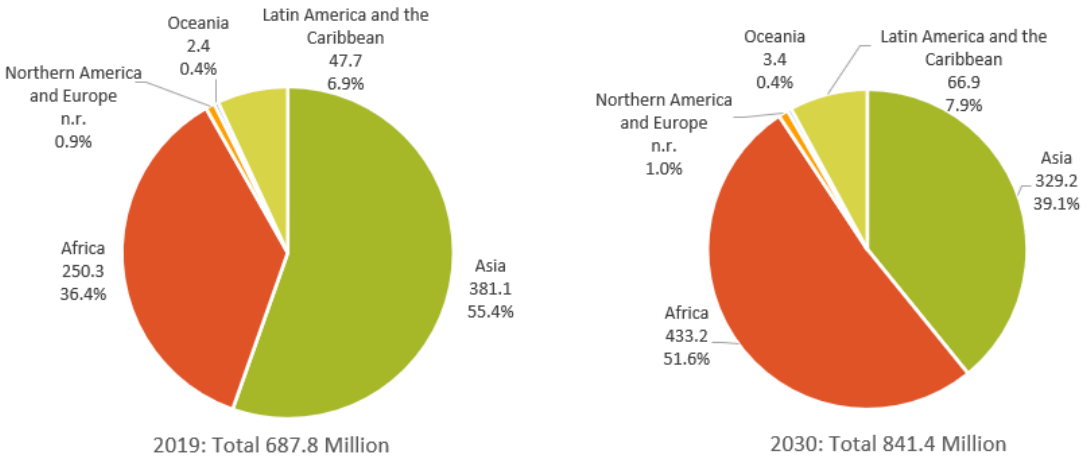


Figure I - Projection of the distribution of hunger in the world, 2019-2030 (FAO et al, 2020)

[1] Represent projected values.
[2] The projections for 2030 do not reflect the impact of COVID-19 pandemic.
[3] n.r. – not reported, the prevalence is less than 2.5 percent.

If we ignore the impacts caused by the COVID-19 pandemic and if the conditions and population's behaviors don't change, the projection for 2030 shows that the number of undernourished people will increase, making Africa the most affected continent (FAO *et al*., 2020). And when looking at the scenarios presented by FAO, now considering the COVID-19 situation, the numbers are even worse and, possibly, the number of undernourished people will be up to 860 million people in 2030 (FAO *et al*., 2020).

These values lead us to another goal listed on the UN's Agenda for 2030 - "*Ensure sustainable production and consumption patterns*" – which alerts the community to the waste of the world's resources and the need for more sustainable consumption (Jesus, 2017).

Once more, FAO's study – *Food Security and Nutrition in the World* – shows the existent inequalities of food access between countries and its impact on the nutrition of each country's population, for example, the lack of access to fruits, vegetables, and animal resources on the low-income countries.

And when analyzing the access possibilities to improve these countries' conditions, the main topic under discussion is, on one hand, the meal and products' cost, and on the other, which strategies would help to decrease it. One of the "cost drivers along the food supply chain" is food losses and waste (FAO *et al*., 2020, pp. 32).

3.1.2. Portugal Situation

In Europe, about 88 million tons of food are wasted annually, with an estimated cost of 143 billion euros. In Portugal, although there's no official data about this theme, it is estimated that 17% of food is wasted, equivalent to 1 million tons of food being thrown away, which would feed 360 thousand people in the country. However, a law was passed by the Assembly last year that mandates a national survey on food waste to get a realistic picture of the situation in the country[4].

The year 2016 was named the National Year of Combating Food Waste in Portugal, marked by the establishment of the National Commission to Combat Food Waste (CNCDA), whose mission is to promote food waste reduction, by creating a group of measures to raise awareness and reduce its impact on the community. Since this year this commission has already promoted a group of events to raise awareness of the food waste situation in Portugal and initiatives to combat it.

But with the aggravation of this situation in Portugal, during the period of crisis, mainly for the most disadvantaged classes, society tried to find a solution, and new initiatives related to social

[4] Law published on July 30, 2021 – Law nº 51/2021.

entrepreneurship were created. Today there are many national (Table 2) and international (Table 3) organizations that fight every day to end food waste and help vulnerable communities (Esteves,2020).

Table II - Portuguese organizations working to end Food Waste

Organization	Project
Dariacordar/Zero Desperdício	Three non-profit organizations that collect surplus food from several suppliers (restaurants, supermarkets, stores, hospitals, other organizations, and events) and deliver it to people in need.
Re-Food	
Fruta Feia	A project that partners with food producers and collects all the food that is not "presentable" to be sold in supermarkets or local stores and sells it on small markets by symbolic prices.
GoodAfter.com	An online store that sells products that are reaching their expiration date by half the price.
Muita Fruta	Project of a group of people that volunteered to take care of fruit trees around the city and deliver the fruits to people in need.
Banco Alimentar	Collects food from partners and people willing to help and give it for free to vulnerable people and institutions.
Movimento 2020	Movements associated with the Portuguese Association of Nutritionists (APN), that aim to raise awareness of the importance of balanced and nutritious food, by fighting food waste.
Dose Certa	

Table III - Other organizations working to end Food Waste

Organization	Project
ToGoodToGo	Apps that work with restaurants, cafes, and stores, and by a lower price, people can buy meals that would go to waste.
Phenix	
Fair Meals	

In these past few years, the large distribution chains in Portugal have also taken initiatives regarding food waste, creating projects to combat this problem. In this context, the LIFEFood Cycle project, co-financed by the European Union, and developed by Sonae in partnership with Phenix, stands out. Its objective is the creation of a digital platform for the management of losses and surpluses in its supermarkets/stores, to make the donation process more efficient.

In September 2020, on the International Day of Awareness on Food Loss and Waste, was also created the United Movement Against Waste. A movement brought together by the Portuguese Federation of Food Banks, composed of public and private companies and institutions, to facilitate the

use of surpluses, making the fight against food waste normalized, encouraging and facilitating the donation of leftovers, as well as promoting responsible consumption.

3.2. Software Development

3.2.1. Concepts

In the book *Software Engineering – A Practitioner's Approach*, Roger Pressman, one of the classic references in this area, starts by defining computer science as:

"The engine that drives business decision making. It serves as the basis for modern scientific investigation and engineering problem solving. It is a key factor that differentiates modern products and services. It is embedded in systems of all kinds: transportation, medical, telecommunications, military, industrial processes, entertainment, office products, . . . the list is almost endless. Software is virtually inescapable in a modern world. And as we move into the twenty-first century, it will become the driver for new advances in everything from elementary education to genetic engineering".

To better understand this area and recognize its presence in every aspect of our lives, in our everyday activities, it is important, as first base, to know more about its major concepts and comprehend how relevant computer science is, as the author says, as the "engine" for decision making (Pressman, 2001).

Speaking about Software Engineering as a group of theories, methodologies, and tools responsible for the creation of products, systems, or services capable of responding to the users' needs, bringing benefits to their everyday activities, one cannot ignore the major role they have on the evolution of technology. Over the years, the needs change, due to the transformation of the users' necessities, becoming even more important to conceptualize and implement equally evolved solutions for these needs (Guerreiro, 2015). This impact of software engineering is so profound in our society and our technological culture that one can foresee the need for industries and companies to adjust, and those who can not follow this evolution may be left behind (Pressman, 2001).

These technological aspects, methodologies, and tools that are part of Software Engineering are not the only aspects that must be considered when creating a software, it is also important to consider other factors. As Sérgio Guerreiro says in his book – *Introduction to Software Engineering* – it is necessary to account for "*the various social aspects with which it is related, the conceptualization of systems, the principles of databases and computer networks, the principles of management, team management, tests and production environments"* (Guerreiro, 2015, pp. 1).

As for Computer Software, it can be understood as a product created by Software Engineering, that has different conceptions for the engineer and the user. For the first, the product is represented by the program, data, or documents that are created, while for the user the final product is the information that comes from that program, data, or document, which will respond to a specific need.

Therefore, a software product results from a very complex process, which must lead to a high-quality outcome. For this, it must be considered the software products developed along the software engineering approach defined and the optimization measures for the procedure/activities under study.

Thus, following Roger Pressman, the main objective of a software product is to deliver information. Being an information system a set of interrelated components that collect, process, store, and deliver meaningful information to help with decision-making inside an organization. This system organizes raw data from events such as business transactions and transforms it into useful data for users.

According to James O'Brien and George Marakas (O'Brien & Marakas, 2010), there are three fundamental roles of business applications of information systems that support processes of operation and decision-making inside the organizations:

• Business Process and Operations Support refer to information systems as a recording tool, used to track and evaluate the processes' performance.

• Decision-Making Support: systems can support the decision-making inside the organization.

• Competitive Advantage Strategies Support: can help in gaining an advantage over the competitors by using new technological tools that work with the help of information systems.

3.2.2. Methodologies and Processes

When talking about **software development processes** it comprehends the complete procedure of its development, the intervening, the tasks that must be executed, and its management to create an efficient product, capable of responding to the client's needs (Guerreiro, 2015).

The development processes can be divided into two major groups:

- Classic Development Processes – used in situations where it is possible to identify all the client's necessities and to define a clear sequence of tasks.
- Agile Development Processes – this kind of procedure is assumed a constant and continuous evaluation of the process. For this development process, it's not mandatory to previously gather all the necessities/requirements from the client, this can be "adjusted" along the process building.

With the evolution of technologies, it has become increasingly difficult to answer to this rapid transformation and to the businesses' and users' needs, which are always changing. As so, the processes and methodologies to develop efficient, well-designed, and functional software need to be constantly improving. That being said, an Agile Development Process is more "flexible" and can better adjust to these new requirements.

3.2.2.1. Classic Development Processes

- **Linear Sequential Model (Waterfall)**

Sérgio Guerreiro in his book – *Introduction to Software Engineering* – adapts this model, initially proposed by Benington in 1983, by structuring it in five steps (Guerreiro, 2015):

1. Requirements Analysis: Refers to the phase of discussion between the user/client and the software development team about the requirements that need to be implemented.
2. Software System Definition: Analysis phase of the requirements discussed previously with the client on a conceptual perspective for the creation of a model.
3. Implementation: Codification of the software system and initially unitary tests to confirm if all the requirements defined are being answered.
4. Integration and system tests: This phase can also be called "Validation of the Software System" because it is in this step that the software design is tested by the client/user before its installation.
5. Operation and Maintenance: Corresponds to the installation moment and its configuration, already in a format that can be used by the final user. In this phase, some adjustments and corrections can be made to what was done along the process, which is considered the most important step of this model.

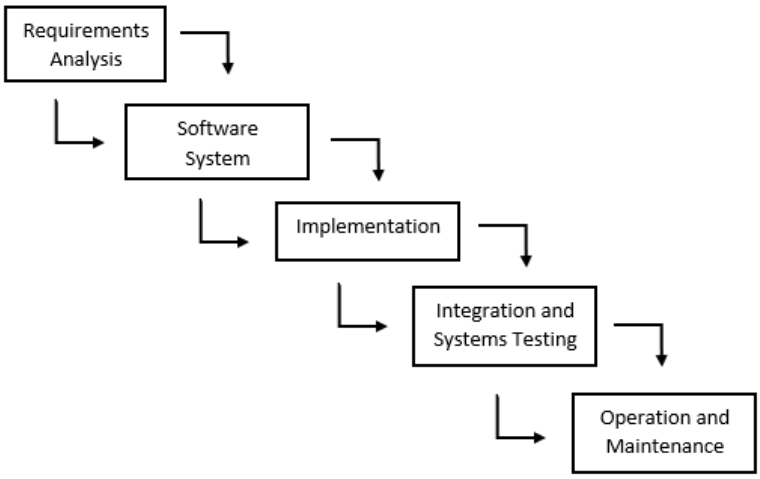


Figure II - Waterfall Software Development Process (Guerreiro, 2015)

In this project, it will only be discussed and implemented the first two steps: the requirements analysis and the software system definition.

3.2.3. Requirements Analysis

The requirements analysis is the first stage of any process of software development. Its goal is to identify and systematize the business needs of users/clients and find solutions to improve their work. The development necessities imposed and defined at this stage are named requirements and can be a client's current or future needs.

This phase is focused on the problem itself and not yet on the solution, but it is important, after defining the user's necessities, to define strategies that allow confirming if they are being fully answered by the software created (Guerreiro, 2015, pp.99).

For this author, to facilitate the identification of solutions for the established requirements, we should proceed with the following distinction:

- Functional Requirement – refers to a communication or production interaction between the software product and the business environment.
- Non-Functional Requirement – deals with the limitations of the software product, which can limit its implementation.
- Development Requirement – describes the limitations imposed by the development process, normally imposed by the technical team and not by the clients, which is the case of the other two requirements.

To identify the business's needs, and develop the users/clients' requirements, this phase can be organized into the following group of activities, schematized in the figure below (Figure 3):

i. Identify the requirements by discussing them with clients and final users.
ii. Analyze the identified requirements to guarantee its quality.
iii. Specify in detail the requirements in a consensual way between the intervening (business managers, clients and users, development process managers, software architects, and software product evaluators).
iv. Identify strategies, with the help of all intervenient, to confirm the quality of the requirements solutions implementation, which will be performed along the development process.

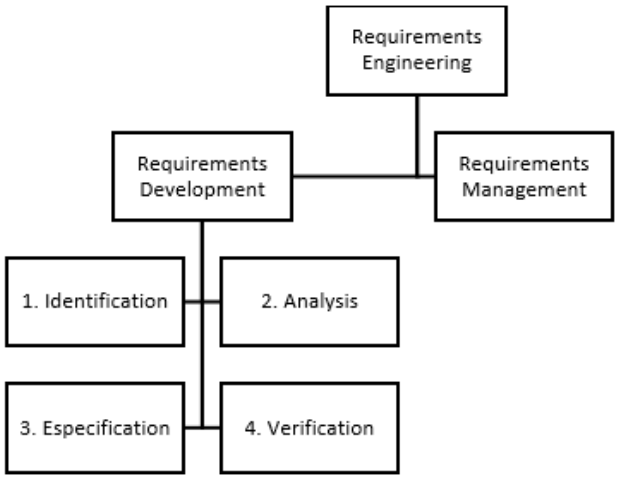


Figure III - Requirements engineering activities (Guerreiro, 2015, pp.101)

Therefore, for this phase is important to identify, for a certain business, which are the system features that must be improved to help the user to improve his work, ensure that these features correspond to the user's necessities established in the first place, and verify that the software systems produced satisfy or not these needs.

3.2.4. Software Design

It is, in this second phase of the software development software process, that the possible solutions established previously are designed and schematized. Through the specification of concepts and design of their relations, which will help further with the software codification, it is possible to narrow them and find more suitable paths.

As said previously, the requirement analysis is focused on the problem itself, searching for the "what", whereas the software design phase studies the "how", with the conceptualization and representation of concepts and how they relate. The information gathered in these first two steps will condition the following development phases, so it is important to create, in this phase, a complete and representative solution (Guerreiro, 2015, pp.121).

When looking for the primary methodology solutions for this phase, one must consider:

- Structured Analysis Model – model supported by programming languages, focused on the conceptualization of the fields: states, data flows, state transitions, and data dictionaries.
- Object-oriented Analysis Model – results from the application of concepts that come from programming language oriented to objects, for example, the languages C++, Java,

SmallTalk, and C#. This will allow the creation of a more automated tool that can better answer the client's needs.

Following these models, and the corresponding modeling language systems, this phase is focused on the creation of an architecture design, through the connection between concepts inside the process, to analyze the organization of a software system. It comes down to the definition of all components evolved and how they interact with each other.

Sérgio Guerreiro, in his book *Introduction to Software Engineering,* concludes that "*the architectural design of the software is concerned with understanding how a software system should be organized and designing its high-level structure*" (Guerreiro, 2015, pp.127).

4. PROJECT

4.1. METHODOLOGY

The decision of the development methodology to be used in this project started with the analysis of the traditional and agile methodologies presented previously, since it was necessary to evaluate the type of project and its characteristics. Since its development will only involve the requirement analysis and software design phases and not the implementation, coding, and testing phases, the development of this project was done based on a Classic Development Model.

Nevertheless, to create a system like this it is important to discuss step by step with the client, in this specific case the organization and its volunteers, which are their main difficulties and which improvements can be made for the centers' management. As so, the requirements analysis phase will comprehend a period of interviews to know more about other points of view on the work performed on Re-Food; then the analysis of the volunteers' needs and the discussion of possible solutions will be followed by its conceptualization; and lastly, the discussion and presentation of results.

Regarding the gathering of information about the volunteers' perspective on their work inside Re-Food, a screenplay was created for an interview that can be consulted in Appendix 1. The "interview" format was chosen instead of the "questionnaire" format to avoid null answers and to better understand the difficulties felt by the volunteers when performing their tasks, and to discuss possible solutions with them. So, to be able to gather this information, it was crucial to interview people who perform different tasks and from different Re-Food centers around Portugal. Consequently, in Appendix 1 there is a general screenplay for the interviews organized only with questions open to discussion so that the interviewee feels at ease to speak freely.

As presented by Hadar et.al. "requirements elicitation is the first activity on the requirements engineering process". This process includes information gathering from learnings and surfacing the organization's needs for the system. After its collection, the information needs to be interpreted, analyzed, modeled, and validated once more with the client before the requirements are fully completed and corrected (Hadar et al., 2011, pp. 1).

So, considering the information above, two phases of interviews were defined:

- Phase One: a general exploration of the organization's interests and needs, where the questionnaire described above was put into practice.
- Phase Two: phase of validation and discussion of the requirements gathered in the initial phase.

4.2. RE-FOOD ORGANIZATION OVERVIEW

Re-food is a non-profit independent organization (IPSS) composed entirely of volunteers that work with and for the community, to eliminate food waste and hunger. This food rescue movement began, in Portugal, in 2010, and consists of the collection of food surpluses from source partners in the neighborhood, that afterward are organized to be delivered to people in need. Today, this movement has 51 centers (Operation Centers) around the country that work independently, and one Core Center (situated in Lisbon).

The Re-Food movement is based on the idea of collecting food surplus from a certain area, involving the community in its collection. Despite the work developed in each center being independent, the movement values must always be respected, and the work structure similar and focused on three main steps:

- Collection – The volunteers are organized in collection rounds to pick up food from the food sources. These sources can be restaurants, supermarkets, or stores that contact Re-Food or the organization contacts them. The sources are interested in being part of the movement, to give a better destiny to the perfectly good food that, probably, without this option, was being thrown away.

When a volunteer joins the food collection shift, he or she is usually assigned to a particular collection route by the Volunteers Manager (placed according to its hourly availability and where it is needed), consisting of several restaurants/establishments. Normally, every center has several routes operating, with different pickup times or different geographical locations. The collection rounds can be done by foot, car, or any other transportation. The volunteers provide the containers to collect the food so they can ensure minimal inconvenience to the establishments, with zero costs and as sustainable as possible.

Before starting each collection, the volunteer consults the details from every food source from his/her route to check if there is any note to be considered before visiting the place and the supplies needed for the collection (example in Appendix C).

Once the restaurant/store is visited, the volunteers fill in the table (Appendix C), if whether they visited the site or not, and what was collected. If necessary, the table has a space to leave comments about the collection. When the collections are finished, the volunteers return to the operations center and a second team is responsible for evaluating the food's quality and preservation capacity, validating whether it can be delivered the next day, and storing it.

- Packaging – This stage is organized in two steps and two different teams. The first team operates in parallel with the collection teams - Once the food is collected, the collection and packaging teams (who remain at the center) meet at the Operation Center to organize the food and assure its conservation, following all the necessary steps, for example, confirm if it is in good conditions to be delivered.

If the food is in condition to be delivered, a label with the information about the collection (Appendix B) – including the name of the route, food source, type of food, date of collection, and signature of the volunteer receiving the food - is filled out and used to label the sealed containers, before being stored on the fridge to assure its longevity.

The second team operates in parallel with the distribution team, both at the center, and helps to prepare the containers that the distribution team will deliver to the beneficiaries and organize and clean the center for the entry of the collection team.

This second team is also responsible for assigning the boxes, once they are empty or when food is taken from it to the beneficiaries, for example, one box containing rice is delivered to the beneficiaries/families 2, 6, and 13. This information needs to be written on the box's label (Appendix B) and the labels stored. By the end of the shift, the information gathered from the labels on all the empty food boxes needs to be written on a table (Appendix E). This work has to be done so that the entire route taken by the food that enters the center is identified so that in case of food poisoning of a beneficiary, for example, the origin of the food can be identified and the food source warned.

- Distribution – The next day the food is delivered to the beneficiary families that in most cases come to the centers to collect it. Every center is also prepared to support people that may show up during the center's delivery moment but who are not registered as beneficiaries. Whenever possible the volunteers try to arrange something for them to eat and even in these situations the delivery should be registered. The food to be delivered is prepared considering the number of persons in the household and any special needs regarding the food (e.g. allergies).

Since the demand for these types of institutions and help has been increasing, the centers, besides asking for various documents from the beneficiaries when they apply to evaluate their professional and economic conditions, also evaluate their attendance later on. This is so that, in a situation where the beneficiaries do not show up to collect their meals, their place is "given" to a person/family who needs help the most. To this end, centers should fill out an attendance sheet every day, such as the one in Appendix D, and in case of a no-show, note whether the absence was justified or not.

- Management – The two shifts are run by a manager responsible for ensuring that there are enough volunteers to carry out all the day-to-day tasks of the center, help with whatever is needed, and at the end of the shift record any important notes that have an impact on the following shifts, on the remaining volunteers or matters to be dealt with by the portfolio managers. As such, in all shifts, a sheet like the one in Appendix F is filled in and later evaluated by the other managers.

Since most enrollment requests from volunteers, beneficiaries, or food sources come during shifts, the shift managers also have a follow-up role in these situations. The new elements need to fill in forms, such as those in Appendix G (e.g. Volunteers), which will later be evaluated by the respective managers (volunteer portfolio, food sources, or beneficiary).

4.3. SOFTWARE REQUIREMENTS

As described before, the requirements analysis is the first stage of any process of software development. After many conversations with members of the organization, it was possible to identify and systematize the main needs and solutions to improve everyday performed tasks. In this exercise, it was important not only to identify which problems the client wanted to solve but other hypothetical ideas that could improve the organization's everyday work and, of course, all the elements needed to be part of these solutions.

4.3.1. Requirements Collection

For the collection to be as complete as possible, from the point of view of tasks developed within the core, or even experiences from different centers and times as volunteers, various aspects were considered when selecting the interviewees. A total of 8 volunteers were selected and the following aspects were considered in this selection:

- Center's location: since the different centers have been created over time, this periodicity could have an impact on the way the centers are organized and on the day-to-day "problems" of the center.
- Time as Volunteer: considering the volunteers with more experience in the organization that might be able to easily detect the in-depth needs of the organization but also, the more recent volunteers that deal with the organization for the first time and might have other input to give.
- Function: since, as explained above, the system to be developed is intended to respond to the different activities developed in the core, it is important to have feedback from volunteers inserted in the different phases of the process.

- Age: considered because of the connection that today's younger people have with new technologies, namely with applications, but not devaluing the contact that older people also have with these because the goal is to create an intuitive system that is easily used by everyone.

After identifying the factors that ensure a greater diversity of volunteer experiences, 8 volunteers were selected who responded to these factors. Volunteers were selected from three different centers, from Lisbon (5), Leiria (2), and Vila Nova de Famalicão (1), two under 25 years old, four between 25 and 45, and the rest over 45 years old, only two of the 8 have been volunteers for less than 1 year, the rest have been part of Re-food for more than 2 years. As far as their functions are concerned, they are quite diverse, 2 are responsible for the nucleus (Leiria and Lisbon) as well as responsible for the portfolios' management along with 2 other volunteers (four in total), and three of them are part of the food collection team, two responsible for the food preparation and the others for the delivery to the beneficiaries.

The software must answer to more than one process from the organization. Since we are dealing with a circular process, which means, if the organization welcomes more beneficiaries, it will need more volunteers to collect food and if it manages to do so, it can contact more food sources and help more families and so on (schema shown in Figure V). Every process within the organization must work efficiently for the organization to do a better job and have a greater impact on its surroundings.

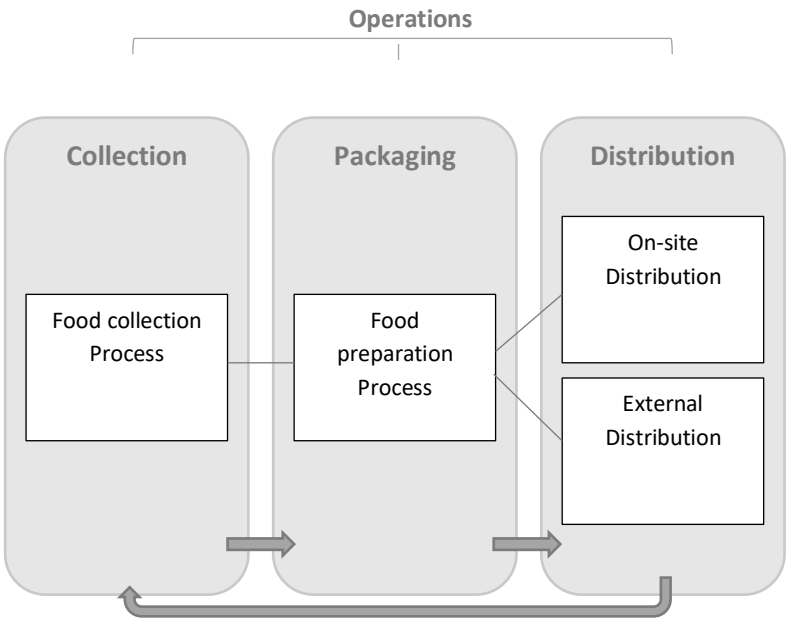


Figure IV - General Requirements Scheme

4.3.2. Requirements Definition

After some discussion, and according to the client's necessities, the software needs to answer to more than one process from the organization, so the requirements analysis, in an early stage, was done separately, process by process, for a more detailed description.

Table IV - Functional Requirements

Req. ID	Name	Description
FR.01	Login	Registered volunteers shall be able to Login with their username and password
FR.02	Attendance	The system sends all volunteers a notification where they need to confirm their presence on their following shift. The information will be available to the shift manager so he/she can manage the shift staff.
FR.03	Route Consultation	Access to all the information about the route – number of food sources, location (map), and means of transportation
FR.04	Check Food Sources' Availability	Shift Managers call restaurants/stores before the shift begins so that their collection volunteers can manage their routes more efficiently. Once checked they must update the source "availability" on the system
FR.05	Food Source Consultation	Consult existing food sources pages (name, address, schedule, collection specificities)
FR.06	Contact Food Source	Ability to contact, directly from the app, the food sources
FR.07	Access Food Source's Location	Ability to know more details about the food source's location from a map that can redirect to other maps apps in case of need to know more details
FR.08	Collected Food Registration	When a Food Source is visited, register if any food was collected, and if yes, register what was collected (select from a list) and the quantities. The system will automatically attribute a number to the collected box.
FR.09	Test Food Quality	Before attributing the number and storing the food it's important to confirm the food's quality (test smell, look, and taste). If it is not in condition, the box can be removed from the system
FR.10	Add comment	Shift volunteers may have the necessity to add a comment to a food source/beneficiaries/volunteers page to register important details for the other volunteers
FR.11	Consult Comments	Volunteers can have access to comments done by others
FR.12	Confirm food reception	Once the attribution of numbers to the boxes and the boxes arrive in the center, the volunteers need to store them. The volunteers will have access to information about the food that is about to arrive and the boxes that have already been processed by the center on that shift
FR.13	Collected Food Consultation	Access to all the information about the food available at the center to be delivered – organized by typology, entrance date, or box number
FR.14	Food Distribution	Register to which family was delivered a specific food/product and in which quantities.
FR.15	Family Attribution	Register which families came to collect their food.
FR.16	Beneficiaries Consultation	Access the information about the beneficiaries/families registered on the center (for data protection reasons, can only be available the main information such as the family ID, family composition, any special food conditions or allergies, ages, attendance record, and delivered meals).
FR.17	Resources Attendance	The volunteers will have access to information about the number of times the FS delivered food, the presence of the volunteers in the shifts, and the presence of the beneficiaries for collection

FR.18	Edit Rout	Possibility for the managers to edit routes – add new ones, add/edit food sources
FR.19	Edit Food Source Page	The ability of the manager to change the food source's details
FR.20	Edit Beneficiary Page	The ability for the manager to change/update the beneficiaries' details
FR.21	Edit Volunteer Page	Ability to change/update the volunteers' details. This change can be made by the volunteer himself (Profile view) or by the Volunteers Manager
FR.22	Edit Comments	Managers can edit comments done by others: edit information or delete it
FR.23	Material Consultation	Access the information about the materials (e.g.: boxes, bags, cleaning products) in the center.
FR.24	Edit Material List	Possibility to edit the material list when something is used or borrowed
FR.25	New Material Request	Add a request for a material that is no longer available at the center.
FR.26	Update Material List	As soon as the materials are replenished the list should be updated.
FR.27	Add New Food Source	Possibility to create applications for new food sources (to be analyzed and contacted later by the center's Food Sources Coordinator).
FR.28	Add New Beneficiary	Possibility to add new beneficiaries (to be analyzed and contacted later by the center's Beneficiaries Coordinator).
FR.29	Add New Volunteer	Possibility to create applications for new volunteers (to be analyzed and contacted later by the center's Volunteers Coordinator).
FR.30	Approve new entries	The process manager responsible for each department (volunteers, beneficiaries, and food sources) has the job of contacting each element and adding it to the system
FR.31	Notifications	The app has a notification system where a volunteer receives information about the shift, notes on their work, or information that he/she must know when performing their activities, future events, or training sessions. The notifications are created by the Managers.
FR.32	E-Learning	The system has a tab to access Re-Food's learning hub.
FR.33	Reporting	The system will allow all Process and Shift Managers to generate reports from their department – volunteers and beneficiaries' attendance, amount of food intake, and amount of food delivered.

Table V - Advanced Requirements

Req. ID	Name	Description
FR.34	Draw intelligent routes	Ability, based on the restaurants' availability (whether they have food or not) and their pick-up times, the system to suggest the fastest and most efficient pick-up route for the volunteers
FR.35	Food Sources Access	Similar to volunteers confirming their presence on shift, the system would allow food sources to confirm whether or not they have food to be picked up
FR.36	Built-In Chat	Possibility for the app to have a built-in chat for the contact between volunteers
FR.37	E-Mail	The ability of the app to redirect to the user's institutional email

Use Case Diagrams

The Use Case Diagram is intended to describe the functionalities that the system will require and its description. To this end, the set of actors who participate in the center's activities was defined:

- Volunteer - must log into the system but the interactions with it depend on his/her role within the organization. This role can be:
  - Shift Volunteers - volunteers who play a certain role on a shift - collection, food delivery, food preparation, cleaning/organizing the center, and receiving food.
  - Shift Managers - volunteers responsible for a given shift - coordinate team, allocation of tasks, mark volunteer absences, write off material, report incidents, and generate shift reports. They are the ones who coordinate the shift volunteers.
  - Process Managers - each center should have one or more people responsible for a process within the organization (related to the management pillars set by Re-Food), these being: Volunteers, Beneficiaries, Food Sources, Community Support, and Operations. These volunteers are responsible for raising and managing new volunteers, food sources, donations, integrating new volunteers, and ensuring the smooth running and logistical organization of the center. Other volunteers may also play this role, but the decision must always be approved by the process managers.
  - Center Manager - volunteer responsible for the center. Its role is to select and appoint the managers in the hub; to share information coming from the hub; to schedule meetings with the process managers.

The entire organization within the core, from shifts to logistical processes, is based on the following pillars - Volunteers, Beneficiaries, Food Sources, and Operations[5] - where the actors described above perform different activities on different work stages.

Since the volunteers from the collection and delivery stages have access to the packaging process for logistics reasons within the core (in case of a volunteer not being there, the collector may have to do the packing as well), the packaging process will be incorporated into these two tasks. As so the diagrams were grouped into three main processes to explain each one in detail. These processes are:

[5] The Community Center Process will not be considered since the tasks performed by this group include contact with the community and the search for, for example, for monetary support, sponsorships or material aid. As such, the role of the application is not, for the time being, considered fruitful.

- Collection Process – The process of collecting food from food sources that are part of a particular route and registration of the collected foods/meals. When the food is registered, the system assigns to each collected box a number. The role of the packing team is, already at the center, to check the quality of the food, assign the system number (the one generated by the system) to the box (stick a label on the box) and store it in the indicated place.
- Delivery Process – This process starts with box preparation. The packaging team, through the created system, can have access to all the food available to be delivered (the system can present info by entrance date, box number, and food typology) and starts the process of preparing the boxes. Once the box is prepared, it's necessary to identify what food has been delivered to each beneficiary/family. The delivery team also needs to identify which families/individuals were present that day to receive food (register attendance).
- Operational Processes – This process is common to all volunteers, and is where they can report a lack of material and create applications for new food sources, volunteers, or beneficiaries. Regarding the materials request, it is known that many materials are daily used in the center, so it becomes important to track their quantity/availability so that any constraints that might jeopardize the day-to-day work of the center may be avoided (for example boxes to collect food, boxes to deliver food, bags for transportation or to store food).
- Management Processes - Comprises all the processes of the management teams, both shift managers and process managers. In the case of shift managers, they can also access information about their team (voluntary and attendance data) and process managers can edit/delete information from the records.

- **Food Collection Process**

- Process Description – The volunteer by joining a food collection shift, has access to the route that was assigned to him/her – the number of establishments, pickup schedule, and means of transportation.

  Before starting each collection, the volunteer consults the details from every food source from his/her route, not only to check its availability (consult if it's open or if it has food to be delivered) but to see if there is any note to be considered before visiting the place. As so, there must be previous work done by the Shift Manager in which he/she updates the status of each source, that is, he/she calls the establishment and confirms whether it has food to deliver or not, and based on the answer the "availability status" must or not be updated (this assignment

works with a color system that also references situations like “contacted but no answer”, “contact again” or even reference to a comment done by the team from the previous shift).

This process also has the possibility of adding comments to the food source page (e.g., request for change of pick-up times or specific requests for the collection) which will then be evaluated by the Food Sources Manager as it may result in changing the collection details of the food source in question.

Once the restaurant/store is visited, the volunteers report on the system the food that was collected (type of food) and the number of boxes that were collected. Once the report is concluded, the system will attribute to each box a number, for example, from restaurant A was collected a box of rice and two of meat, once the volunteers “close” the report off the restaurant, the system will attribute to the box of rice the number 1, and for the meat, the numbers 2 and 3.

When all the restaurants/stores were visited and reported on the system, the volunteers return to the operations center and deliver the food to the packaging team that will evaluate the food’s condition and associate the system box number with the corresponding box. Considering the example above, the collection volunteers return from restaurant A with the three boxes, and they already reported on the system their collection, so the system already attributed numbers to the boxes (in this case the numbers 1, 2, and 3), so the packaging volunteers will have on their app/system the information that from that restaurant came 3 containers and the box 1 is rice and the 2 and 3 are meat. Therefore, they will have available at the center reusable cards with numbers and will stick those cards in their matching boxes. This operation is then repeated with the rest of the restaurants.

- Actors – Volunteer, Shift Manager, and Process Manager (Food Sources).

Table VI - Event Flow - Collection Process

Event Flow			
Req. ID	**Actor**	**Actor Actions**	**System Actions**
FR.03	Volunteer	Volunteers select the route that is about to perform and consults its foods sources and availability	The system gives the information about the upcoming routes the volunteer is on - route name, date, weekday, time, and transportation type. Once selected the route, the system gives information about food sources and their availability, the location (map), and the material needed for the collection.
FR.04	Shift Manager/Volunteer	Shift Manager updates food source availability status	The system permits to change the source’s availability status following a set of colors

FR.04	Volunteer	Volunteer check food source availability	The system gives information about location, material needed, schedule, collection specificities or any comment added previously
FR.05	Volunteer	Volunteer check food source page	The system gives more information about the food source and their delivery schedule and report collection
FR.10	Volunteer	Add comment to a food source page	Add information to the database and make it available to other volunteers. This feature will also alert the Food Sources Process Manager so he/she can evaluate the situation if needed
FR.11	Volunteer	Volunteers can read the comments left by other volunteers	The system displays the comments added by the process manager
FR.19	Food Sources' Manager	The Food Sources Manager updates the food sources details	The system permits to edit the food sources details
FR.06	Volunteer	Contact food sources directly from the app	By adding the contact details to each food source, the system can redirect to phone calls from the app
FR.07	Volunteer	Access to food source location by map	By adding the food source's address/location, the system displays a small map and if the user needs more details of the location, the app redirects to other maps apps
FR.08	Volunteer	Register if any food was collected and if yes, select, from a list, what was collected and how much quantity	The system allows you to report the food that was collected by picking from a list of food typology the number of boxes that was collected
FR.09	Volunteer	Already at the center, the volunteers need to confirm the condition/presentation of the food to assess if it is deliverable	The system can eliminate a box from the collection report and a list of reasons for the volunteer to choose the reason why for the elimination
FR.12	Volunteer	The volunteers will have access to information about the food that is about to arrive and the boxes that have already been processed by the center on that shift	The system informs the volunteer of the sources that have already been collected, the number of boxes collected, and the number assigned to each box
FR.13	Volunteer	Volunteers can have access to the overall information about the food available at the center to be delivered (type of food, quantity)	The system gives information about the food available – typology, entrance date, and quantity. This information was gathered by the volunteers during the collection process on the day before

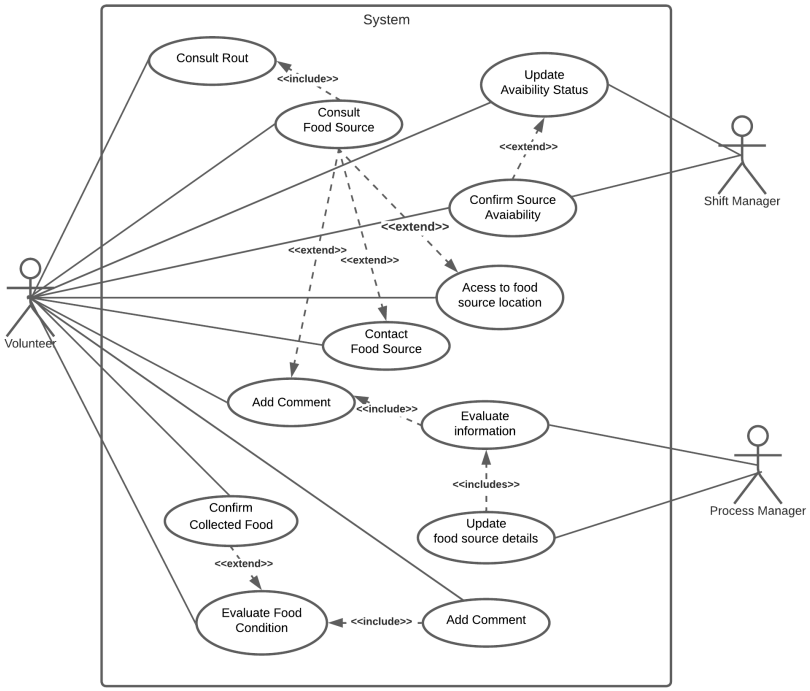


Figure V - Use Case Diagram – Food Collection Process

- **Food Distribution Process**

- Process Description – Once prepared, the meals are ready to be delivered to the beneficiaries. The volunteers responsible for the delivery, register the beneficiaries' attendance and deliver the prepared packages to them.

  During this shift, there is a specific team to prepare the meals based on the available food, the number of people, and any beneficiaries' special needs (allergies, dietary needs, etc.), generic information will be available for volunteers to consult on the beneficiaries' page. For this management to be done, the system will allow the team to consult the food available for delivery and any delivery conditions (expiration dates, for example) so that the process runs efficiently.
- Actor - Volunteer and Process Managers (Beneficiaries).

Table VII - Event Flow - Distribution Process

Event Flow			
Req. ID	**Actor**	**Actor Actions**	**System Actions**
FR.13	Volunteer	Volunteers can have access to the overall information about the food available at the center to be delivered (type of food, quantity)	The system gives information about the food available – typology, entrance date, and quantity. This information was gathered by the volunteers during the collection process on the day before
FR.14	Volunteer	When preparing the food to be delivered it is necessary, for control proposes, to identify to which family it was delivered	Inside the list of the food available, the system adds the possibility to assign it to one or more families/beneficiaries. This information will also be available on their page
FR.15	Volunteer	When delivering meals, the volunteer must report in the list of beneficiaries who showed up for the food pick-up	The system must make available the list of enrolled beneficiaries, from which the volunteer selects who was present on that day. This information (attendance) will also be available on the family/beneficiary page.
FR.16	Volunteer	Volunteers can have access to the overall information about the enrolled beneficiaries	The system gives information about the enrolled families – family composition, names, ages, contacts, specific needs, address, specific food condition, attendance record, and history of delivered meals
FR.10	Volunteer	Add comment to a beneficiary page	Add information to the database and make it available to other volunteers. This feature will also alert the Beneficiary Process Manager so he/she can evaluate the situation if needed
FR.11	Volunteer	Volunteers can read the comments left by other volunteers	The system displays the comments added by the process manager
FR.20	Beneficiaries' Manager	Process Manager updates beneficiaries' details	The system permits to edit the beneficiaries' details

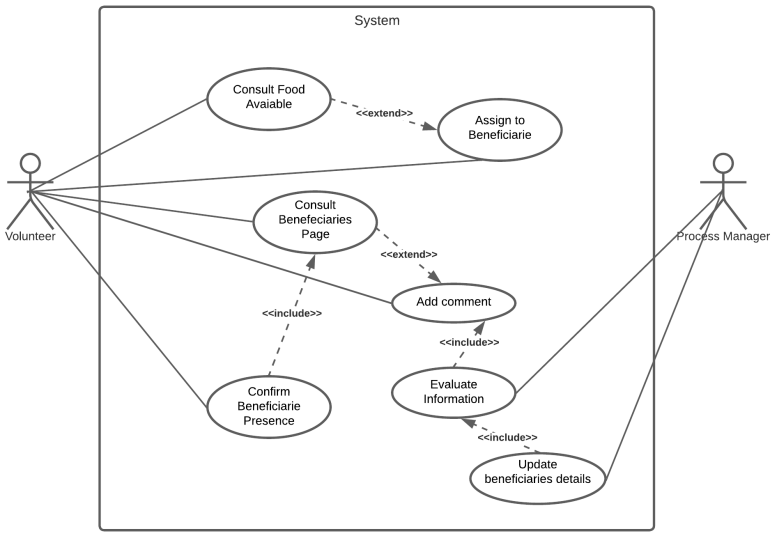


Figure VI - Use Case Diagram – Distribution Process

- **Operational Processes**

- Process Description – Unlike the collection and distribution processes, in which only the volunteers of those same shifts are involved, the operational processes are common to all volunteers, that is, they can be developed by any volunteer of the center. Within these processes we have: recruitment of new volunteers, recruitment of new food sources, requests for purchase of new materials, or entry of new beneficiaries.

  For the recruitment of new volunteers, beneficiaries, and food sources, the system will have specific forms for each case, where any volunteers can create new applications which will then be evaluated by the person responsible for each process.

  As for the request and controlling the use of materials within the center, it is known that several materials are used in the whole process of delivering and collecting food, so it becomes important to monitor what is used so that it does not create constraints on the following shifts. Thus, it is necessary that when a certain material is used it needs to be reported in the application, for the person in charge of the process to acquire more quantities of it in time.
- Actor - Volunteer and Process Manager (Volunteers, Food Sources, Beneficiaries, and Operations).

Table VIII - Event Flow - Operational Process

Event Flow			
Req. ID	**Actor**	**Actor Actions**	**System Actions**
FR.23	Volunteer	Volunteers can have access to the overall information about the materials available at the center	The system gives information about the materials available – typology, quantity
FR.24	Volunteer	Identify from a list of available materials, the ones used and the quantity, and update the list once something is used	The system shows the list of materials available and allows the user to select a product from the list and select which quantity was used. When the product reaches a "critical" quantity, the process manager receives a notification
FR.25	Volunteer	Volunteers can fill in a form for the application of new materials	The system displays an application form for new materials
FR.26	Operations Manager	When materials are replaced, the operations manager must update the list again	The system allows managers to update the material quantities and add new ones to the list
FR.27	Volunteer	Volunteers can fill in a form for the application for a new food source	The system displays an application form for a new food source
FR.28	Volunteer	Volunteers can fill in a form for the application of a new beneficiary	The system displays an application form for a new beneficiary
FR.29	Volunteer	Volunteers can fill in a form for the application for a new volunteer	The system displays an application form for a new volunteer
FR.30	Process Manager	The manager analyzes the new applications and adds them to the system	The ability of Volunteers – add them to new shifts and tasks; Beneficiaries – add them to the list and confirm any special needs to update the system; Food Sources – Insert them on a route.

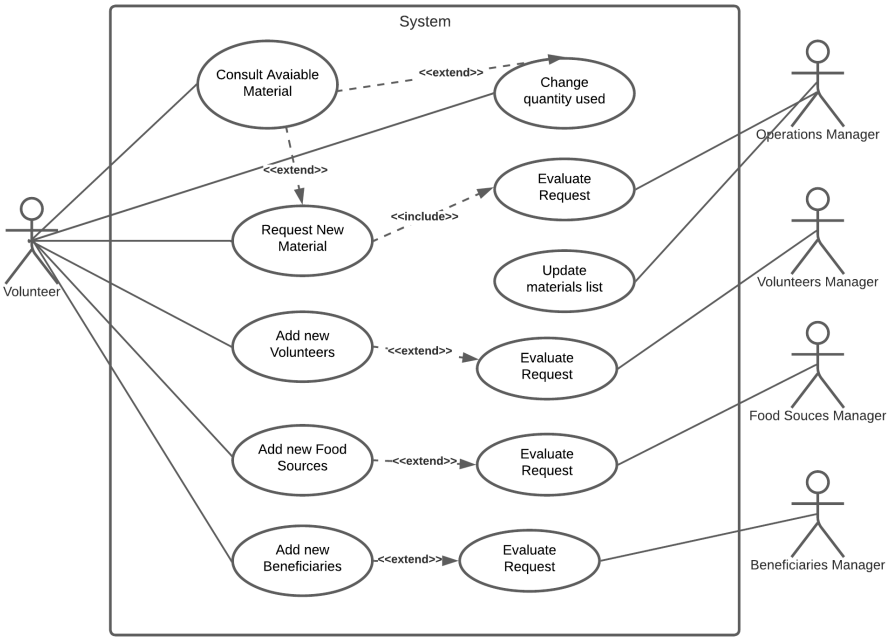


Figure VII - Use Case Diagram – Operational Process

Activity Diagrams

Some of the previous Use Case Scenarios, due to their complexity, are complemented below with the help of Activity Diagrams. With these diagrams, it is possible to visualize and understand how the entire flow within the system is carried out and how the different processes are interconnected.

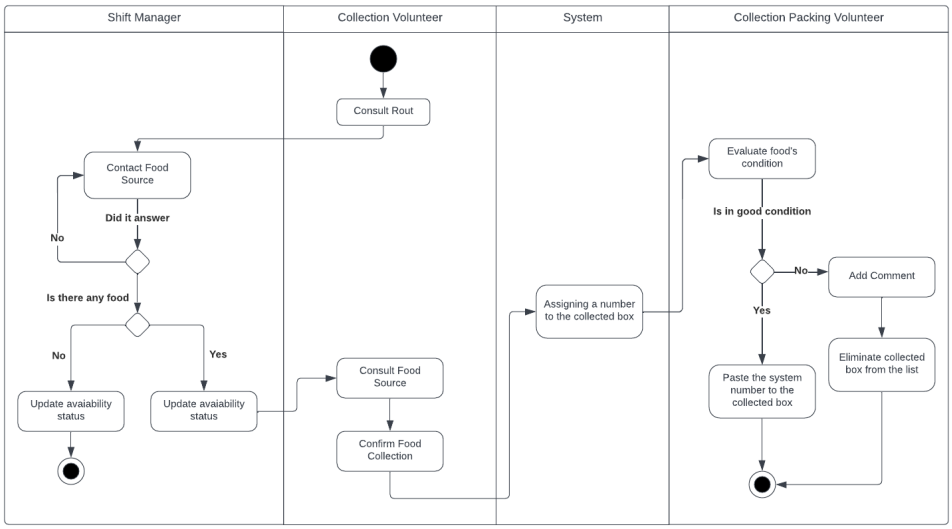


Figure VIII - Activity Diagram - Collection Process

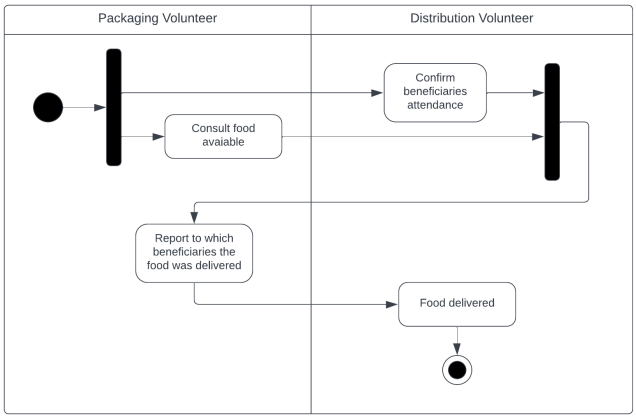


Figure IX - Activity Diagram - Distribution Process

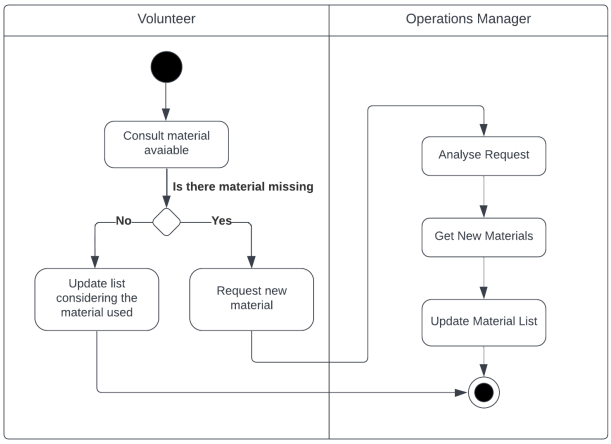


Figure X - Activity Diagram - Supplies Request Process

4.3.1. Requirements Validation

After the individual interviews and considering the volunteer experience of each one, the requirements in Table IV and V were then structured and later divided by the processes of - Collection, Distribution, and Operations.

Within the requirements collected and in the second phase of interviews it was agreed that these would be organized into two groups: the functional ones (Table IV) that represent the most urgent and useful requirements, and the advanced ones that represent less urgent and important requests/ideas for the system to have but that can be developed later when the system is already consistent and tested.

In this second phase, and as is expected to happen in this type of methodology of requirement analysis, more ideas emerge from the interviewees or new ways of visualizing the information already gathered. Some adjustments were made, but the main ideas received in this second moment were:

The possibility is that the app could not only be internal but could also be made available for Food Sources. This way, just like the volunteers who receive a notification to confirm their presence on shift, the food sources would also receive one, asking them to confirm whether they have food to deliver that day, and depending on the response, the system would automatically update their "availability status" for the collection, avoiding the need for volunteers to call before visiting the restaurant/store. This information could also be advantageous for the establishments themselves to count how much of their food is being delivered to families in need or to assess whether the partnership itself is still viable or not. However, it was agreed in the interview that this would only be an additional service and not mandatory since many food sources might not be available or receptive to having this service.

- Emphasis on the importance of reporting. Those interviewed who hold managerial positions explain that Re-Food's central office frequently asks for monthly/quarterly reports from the various cores to assess their viability. In this way, the possibility of developing a system capable of providing these types of analyses automatically was highly valued by all.

- The interviewees understand that one of the disadvantages of reporting is the inability to contemplate the financial and community support department of the center. The possibility that forms/spreadsheets could be developed further was discussed, which in this case could be filled in and uploaded into the app.

- For some centers, it would be important to also have a contact zone for situations of food overflow that cannot be disposed of. For these cases was discussed the solution of having a list of contacts of the center's "partners" that could be available to collect surplus food (like other Re-Food Centers for example).

4.4. Software Design

Once the requirements were gathered, the main processes within the organization were described, the actors and their interactions were identified, and the design and analysis of the IS started. To gradually increase in detail, the first step of the software architecture process was the development of a block diagram, followed by a class diagram, sequence diagrams for the more complex processes, the logical data model, and lastly the interface design with the use of mockups. This development allowed for a better understanding and served as a basis for the further development of the IS.

4.4.1. Software Architecture

The software architecture design started with the development of a block diagram to identify which are the main entities, concepts, and functions of the process under analysis.

As presented previously the work performed by the organization is based on three major processes – Collection, Distribution, and Operations. Each one of these processes operates an essential element in the work performed on Re-Food – collection operates with food sources, distribution with beneficiaries, and operations with supplies and assets. The three have in common the work performed by the volunteers but with different positions/hierarchies and tasks within the organization. The information system will gather the information from these three pillars and help gather it in databases that can help in inventorying, monitoring, and reporting processes.

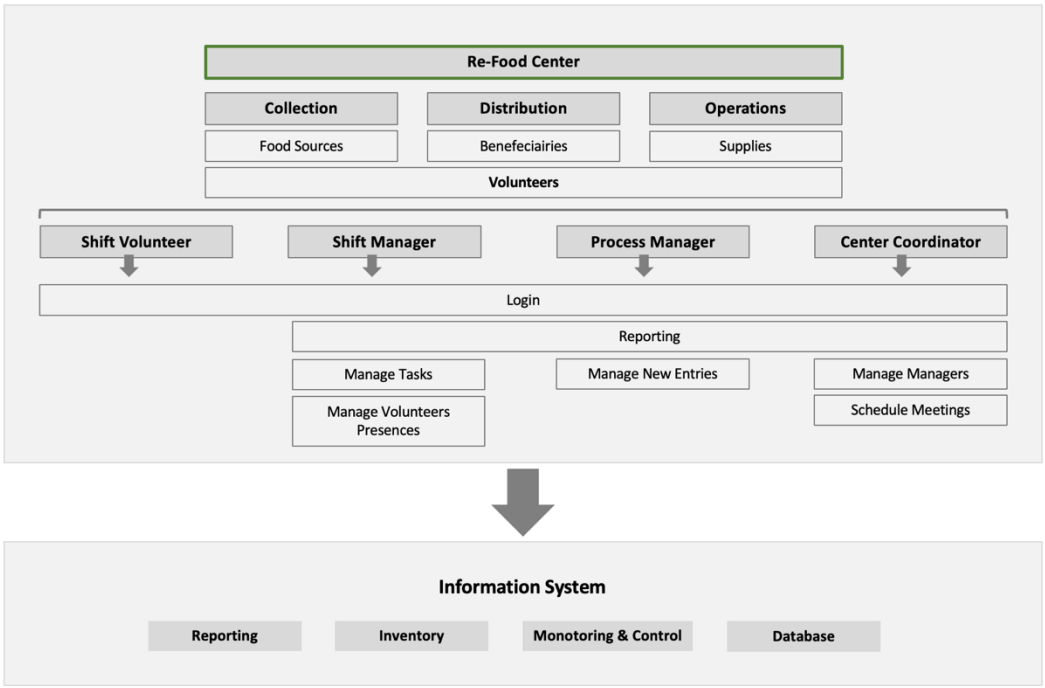


Figure XI – Block Diagram – Software Architecture

4.4.2. Software Specification

The next phase of the project is the software specification, where the specific system design stages are identified and how they are expected to perform. This phase began with the elaboration of the class diagram to describe the system structure, followed by the elaboration of the sequence diagram to detail the most complex processes and the interactions that arise from these processes, and by the entity relationship diagram to illustrate the logical design of the system.

From the information gathered in this phase, the design of interfaces began. First established the screens that would be created and then created their design in the form of mockups.

4.4.2.1. Class Diagram

The structure of the system is represented in the figure below in the form of a Class Diagram, allowing to map it simply and efficiently.

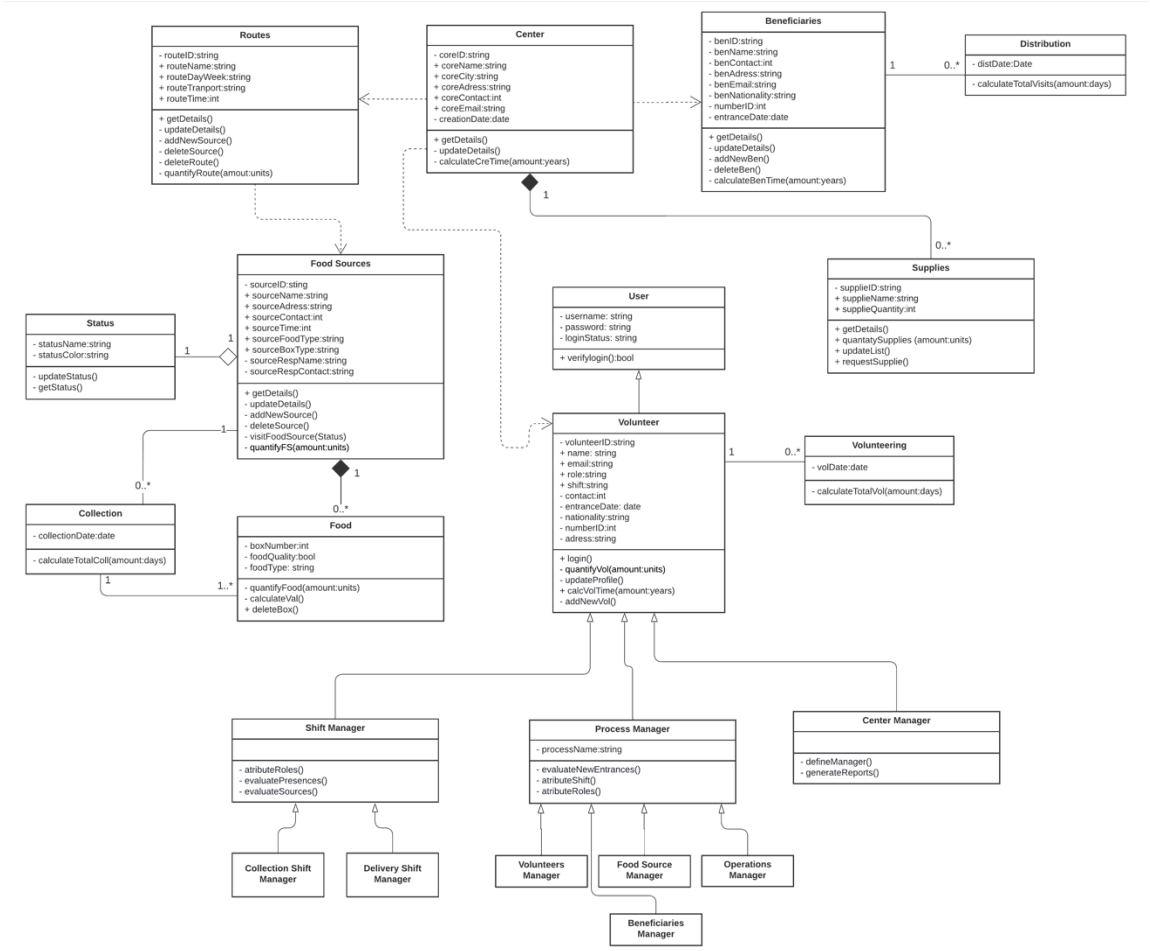


Figure XII - Class Diagram

4.4.2.2. Sequence Diagram

Once the objects that are part of the system are presented, it becomes important to describe how they work together. As so, a set of sequence diagrams were designed to better understand the functionality of a function or operation and how objects interact in a possible scenario.

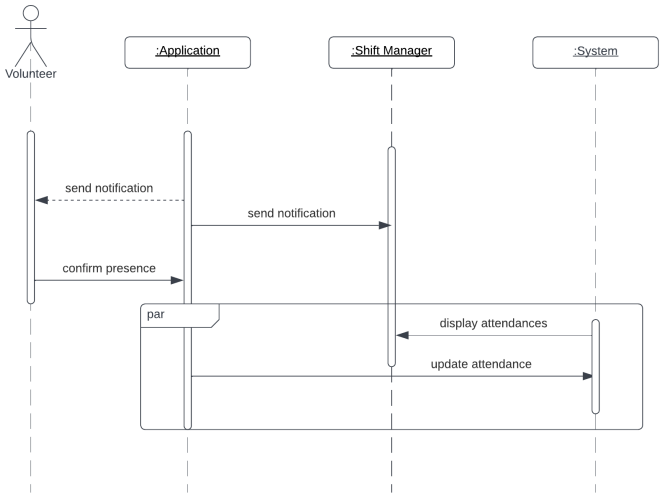


Figure XIII - Sequence Diagram - Attendance

The first selected process (Figure XIV) refers to the attendance confirmation procedure and the role that the various actors play in the action, in this case, the role of the volunteer and the shift manager. The volunteer, one day before his shift, receives a notification asking him/her to confirm his/her presence for the next day's shift. By confirming or refusing it he/she will notify the shift manager, who will have available in his/her app/system the information of the availability of all his volunteers and better manage his/her shift.

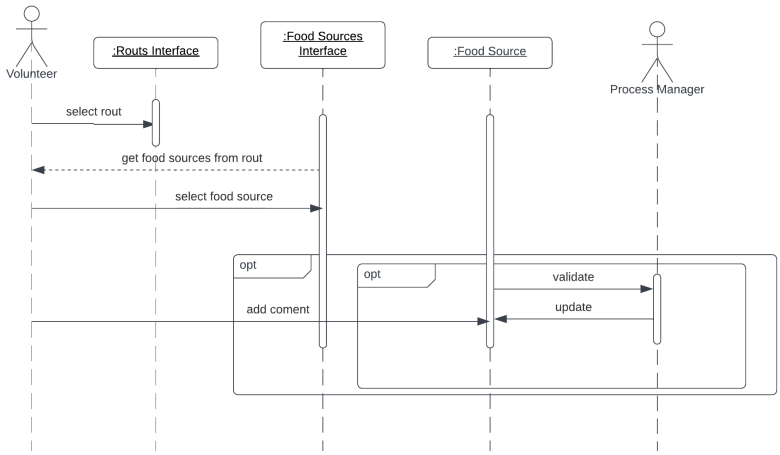


Figure XIV - Sequence Diagram - Add comment

Figure XV represents the process of being able to submit comments on the food sources page. Often while collecting surplus food, important situations arise to report to other volunteers, managers, or following shifts. This information can be reported through the platform and later evaluated by the food source manager.

4.4.2.3. Entity Relationship Diagram

To illustrate how the system's entities relate to each other was designed an Entity Relationship Diagram (ERD). By defining the entities, their attributes, and the relationship between them, it is possible to easily illustrate the logical structure from behind the system's database.

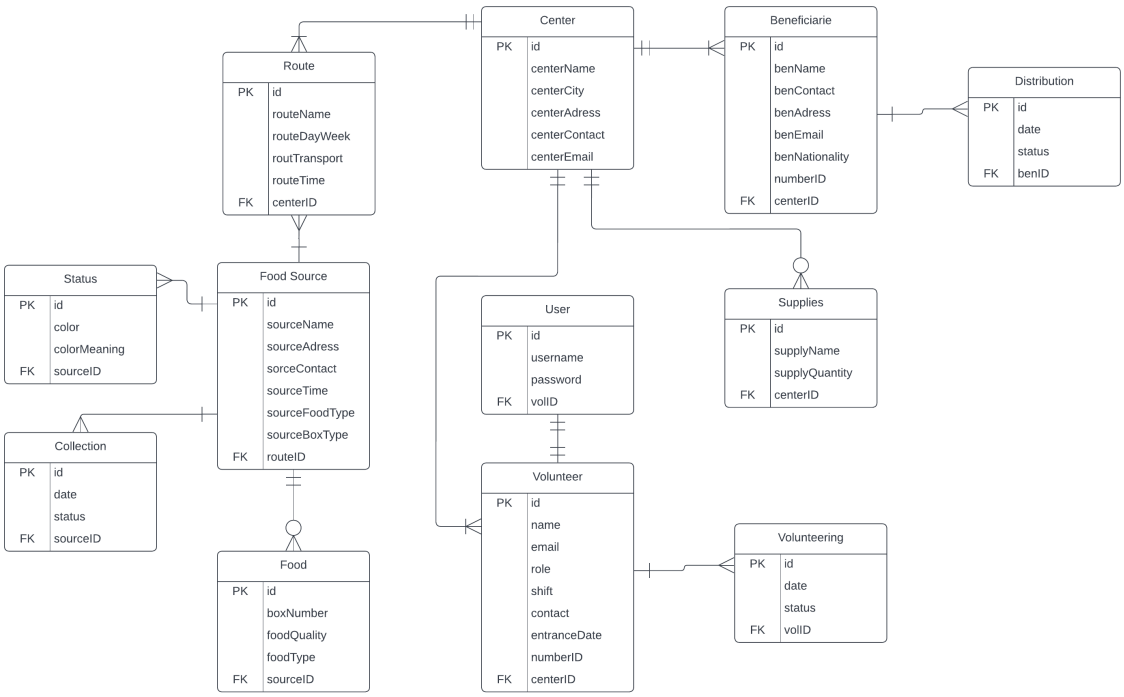


Figure XV - Entity Relationship Diagram

4.4.2.4. Interface Definition

To introduce the interface definition phase, first, the areas to be developed were defined to organize and understand how the screens and their connections would be developed.

Since sometimes, for management reasons (e.g. lack of volunteers, schedules) the volunteers from one shift have to perform different tasks throughout the day, they will have access both to the collection/distribution and/or organization/preparation of food. Considering the figure below, we will have, the screen *Recolhas* and *Embalamento* are part of the collection process and *Beneficiários* and *Entregas* belong to the distribution process. As for the *Operações*, it's a common screen for all volunteers (Figure XVI).

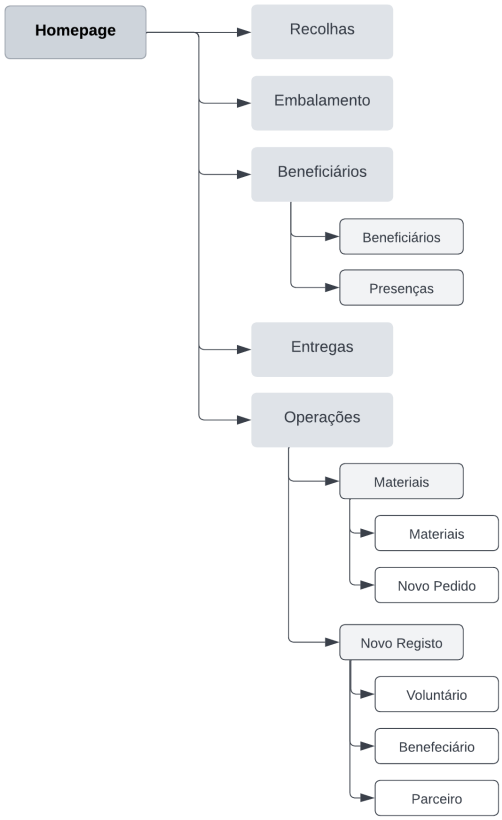


Figure XVI - System views organization

Once the views are defined, a series of mockups were designed to demonstrate in practice what the objective of the system is - to create a product that responds to the needs of the volunteers, that responds to the work that is currently done in the centers and that is easy to use.

- **Collection Process**

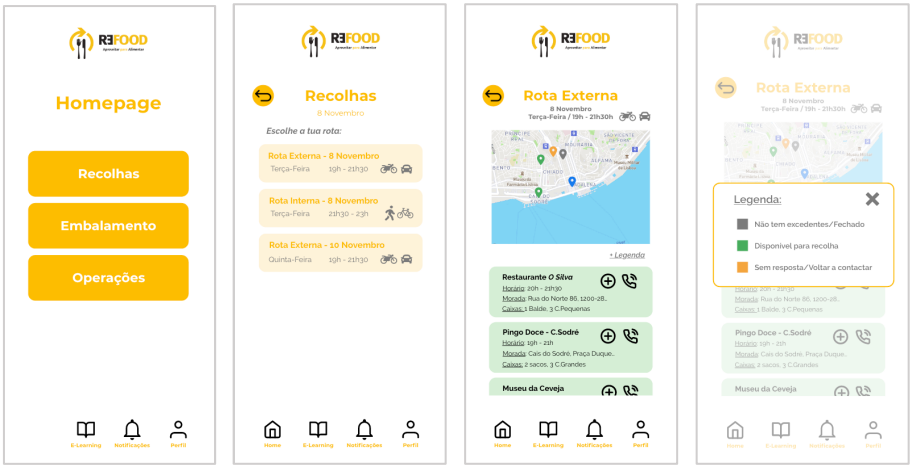


Figure XVII - Collection Process Mockup - Part I

Starting with the collection process (Figure XVII), volunteers will have access to the food sources process (”Recolhas”) and the reception process and organization upon arrival at the center (“Embalamento”).

Before starting the food surplus collection, volunteers can have access to information about the collection routes of which they are part, the food sources that are part of their route, their location, time of collection, supplies needed for the meals’ collection, and their availability to deliver surplus food. This last information is gathered by the shift manager before the collections start. Their role is to contact the food sources and find out if they have food to deliver or not. Based on this information the shift manager updates, through a color system, the "availability status" of the establishments – green means that the restaurant/store has surplus food to deliver, grey means that they don’t have any food to deliver, and orange means that it was not possible to speak with the food source.

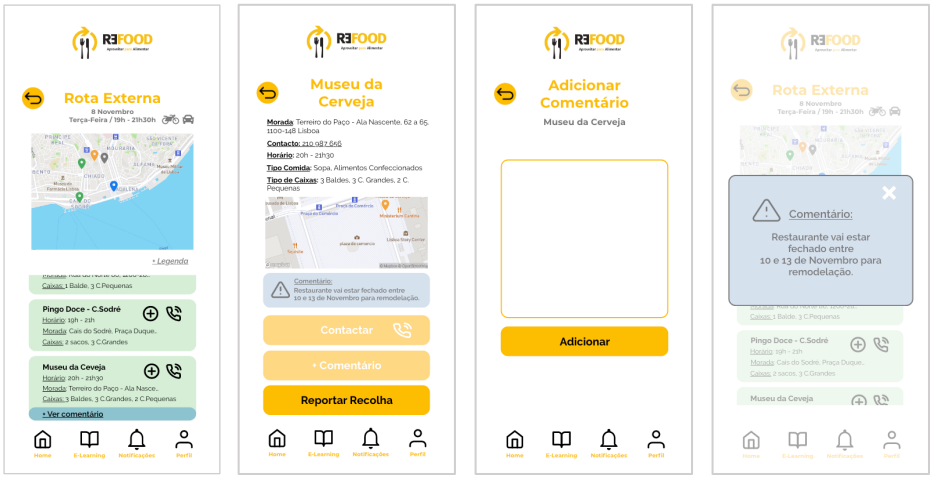


Figure XVIII - Collection Process Mockup - Part II

Through the system volunteers will also be able to have access to additional information about food sources, contact them directly through the app, and, if necessary, add comments about relevant information for future collections or other volunteers (Figure XVIII). Once the comment is added, it must be approved by the Food Source Manager, becoming then available to all volunteers (blue notes in the figures above).

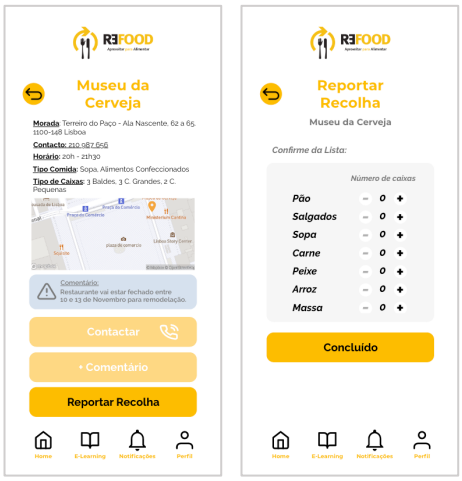


Figure XIX - Collection Process Mockup - Part III

By accessing the food source page, volunteers can start the collection process, selecting from a list of food types, the number of boxes collected from each one (Figure XIX).

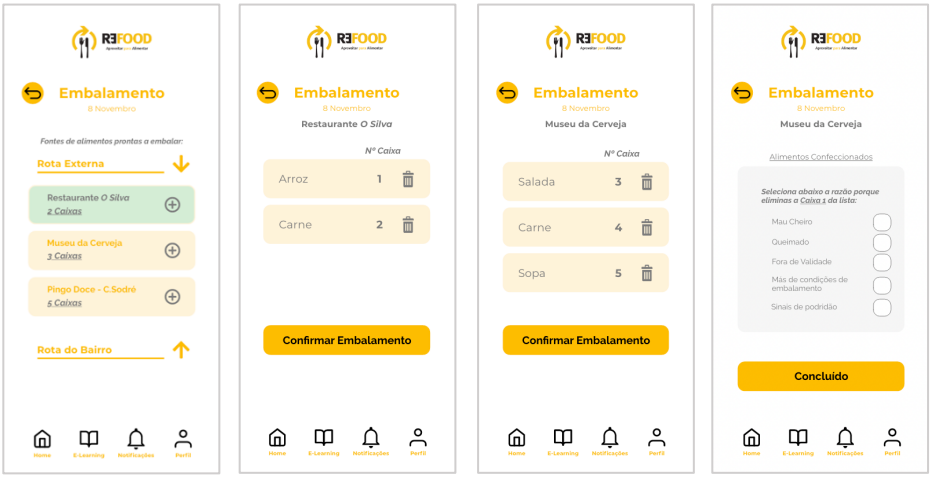


Figure XX - Collection Process Mockup - Part IV

When the collection information is submitted, the team at the center, responsible for receiving and organizing the collected food, will have access to the number of boxes and their contents per route and per establishment. The system will automatically assign a number to each box that will be stuck

to the box and stored in its proper place (refrigerators, cabinets). Taking the example of Figure XX we see that two boxes were collected from the *Restaurante O Silva*, one with rice which the system assigned the number 1, and another box with meat which was assigned the number 2. At the *Museu da Cerveja* three boxes were collected and assigned the numbers 3 (Salad), 4 (Meat), and 5 (Soup).

This system will replace the paper labeling of boxes, creating a more sustainable system. The labeling process remains since the boxes still need to be identified, but in this case, the process can be supported, for example, by a set of reusable labels (e.g., plasticized).

Already at the center, volunteers must also evaluate the food's quality. If the food is not in good condition, they can remove it from the list of collected boxes (the number assigned to the box will be available again) and justify why that decision was made.

Once the boxes have been labeled, the volunteer gives the process as finished and the food source will appear in the system in green so that the volunteer can have registered what has already entered the center.

- **Distribution Process**

As for the distribution team, volunteers will have access to general information about beneficiaries and their attendance ("Beneficiários") and the information about the food available at the center, ready to be delivered ("Entregas").

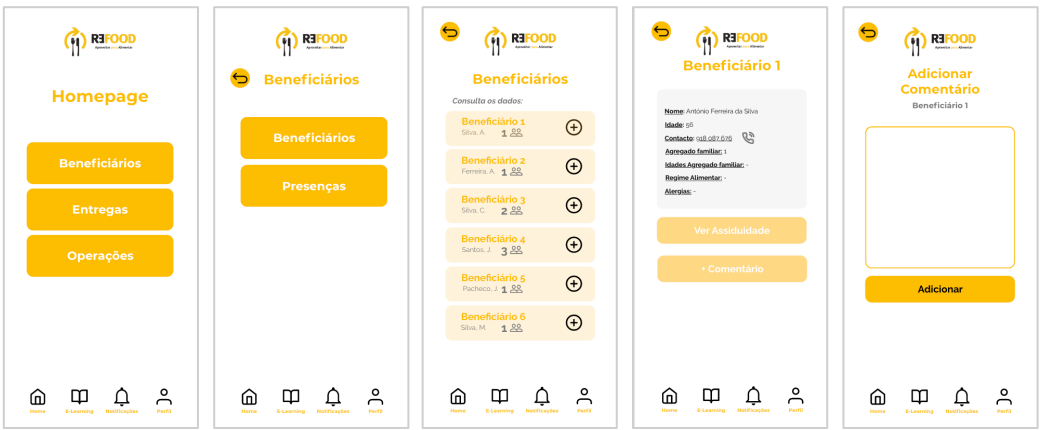


Figure XXI - Distribution Process Mockup - Part I

Starting with the beneficiary's component, users will be able to access general information about the beneficiaries/families and, as with the food sources, they can add in the comments section any kind of information that might be important to share with the rest of the team (Figure XXI).

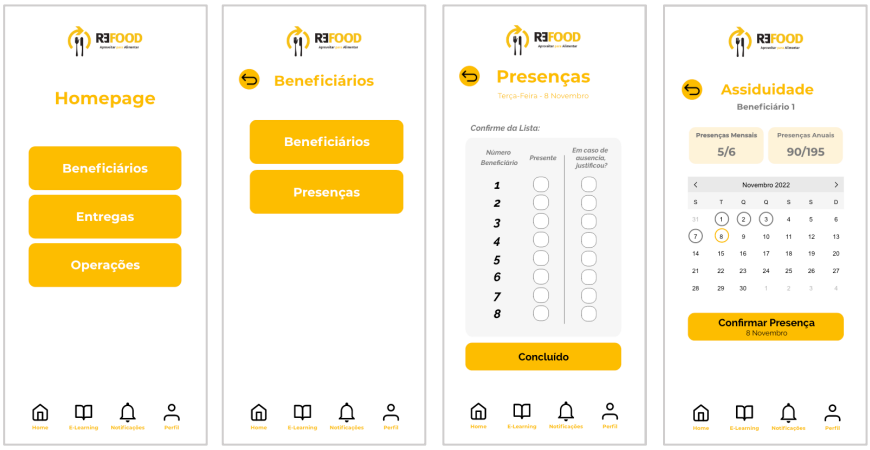


Figure XXII - Distribution Process Mockup - Part II

Volunteers will also be able to use the app to confirm the days on which beneficiaries have visited Re-Food to collect food (Figure XXII). Since the number of meal pick-ups by the beneficiaries has weight in their presence/stay at the center, this factor must be accounted for, even if their absences were justified or not.

In this case, the attendance register can be done through the main menu ("Presenças"), as well as directly from the beneficiaries' page, and in the latter, the volunteer can also consult the last visits made by the beneficiary (Figure XXII).

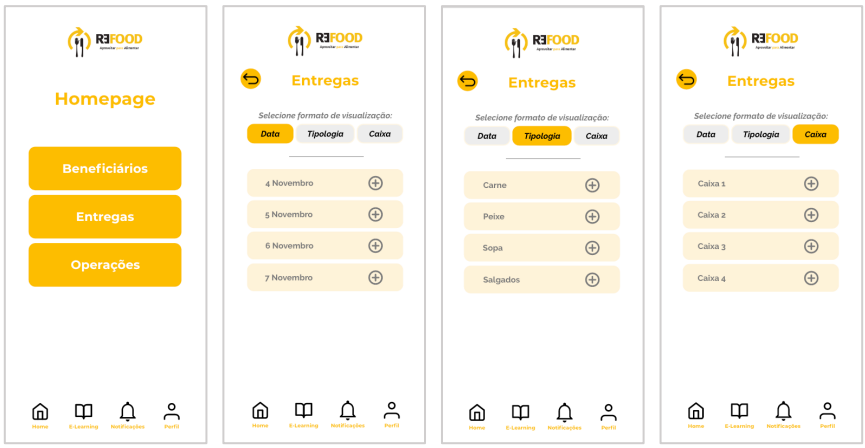


Figure XXIII - Distribution Process Mockup - Part III

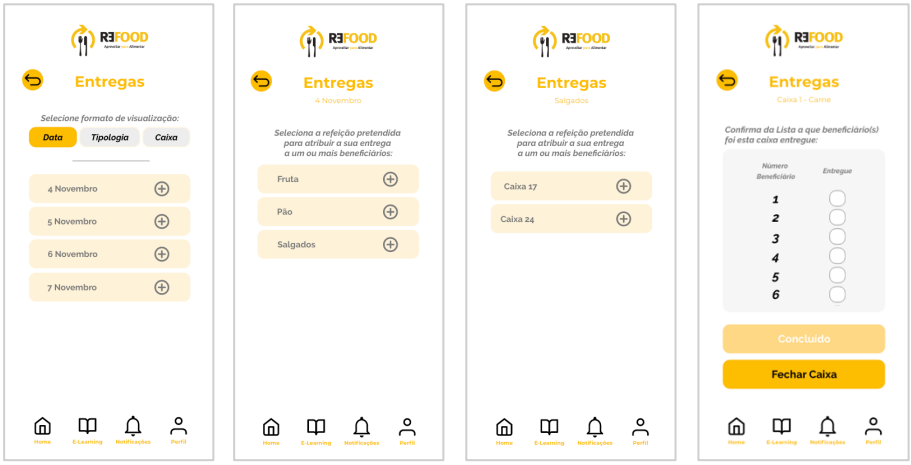


Figure XXIV - Distribution Process Mockup - Part IV

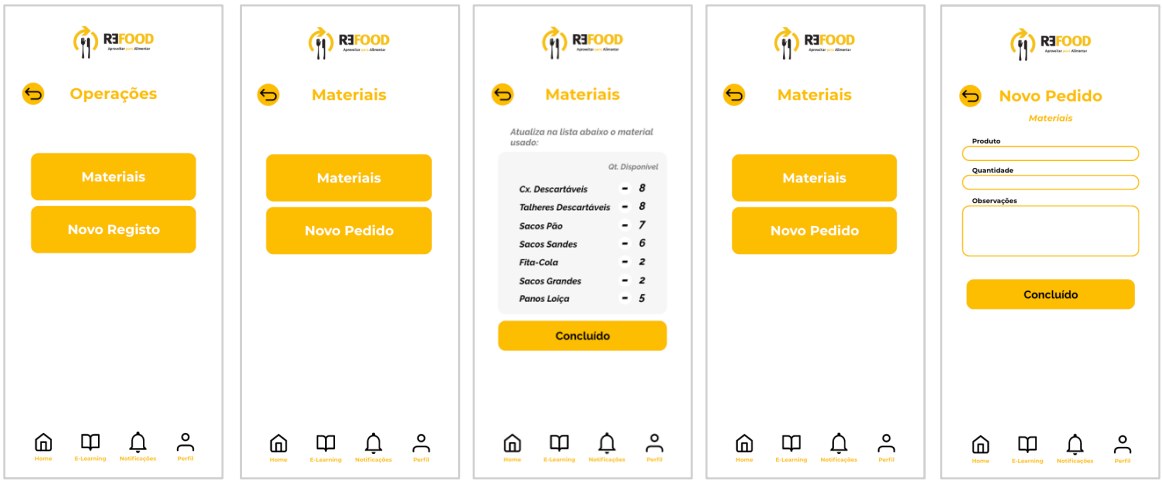
As far as the process of preparing meals to be delivered to the beneficiaries is concerned, the staff can use the system to access information about the food available in the center, and the search can be done by reception time (to see what has been in the center the longest), by type of food, or by box number.

Once the box is chosen, the volunteer will have to register to which beneficiaries its contents were delivered. For example, box 17 (Figure XXIV), which contains salty snacks, was delivered to beneficiaries with the numbers 2, 15, and 18. Have been registered all the beneficiaries to whom the contents of the box have been delivered, the volunteer can mark the box as "closed" and it will disappear from the system, in which case the box number will again be available for allocation in subsequent collections.

- **Operational Processes**

The Operational Processes within the organization are related to the request and management of supplies at the center and the request for new entries of volunteers, beneficiaries, and partners.

As for supply management, the material use report must be kept up to date so that there are no constraints on future shifts. As such, the system would offer a list of disposable and/or consumable materials available for use, which the volunteer would just have to keep up to date when used. Thus, the Operations Manager would be more easily aware of what is available and would have time to arrange new supplies if necessary. The system would also have the possibility to submit requests for materials that do not exist or are not available on the list (Figure XXV).



The other feature within the Operational Processes is the possibility to submit requests to become volunteers, beneficiaries, or partners. Often people go directly to centers to ask for membership information and it becomes easier, in case of interest, to submit the necessary data right away (to make it easier the system will have the center in which the app is being used pre-defined). This is done as soon as the registration is submitted, and the data will pass directly to the responsible manager (Figure XXVI).

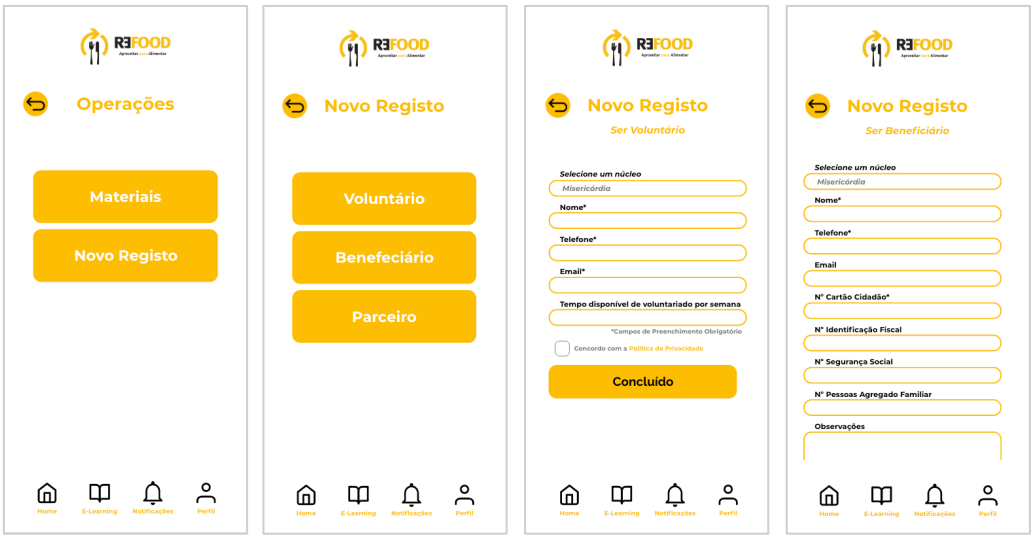


Figure XXVI - Operational Process Mockup - Part II

- **Process Managers Features**

Volunteers in management positions will have access - in addition to the above views, depending on the shift they are part of (collection or distribution processes) - to management fields for their shifts (in case of shift manager) or their portfolios (in case of portfolio manager). Regarding the features available, they will also have access to more information, for privacy reasons, than the other volunteers and they will have the ability to edit the available information.

Upon registration, as required by Re-food's policy, the beneficiaries are asked to present a set of information and supporting documents (proof of address, employment center, identification documents, etc.). In this case, the beneficiary manager will be able to submit the beneficiary's files through the app and consult this information if necessary.

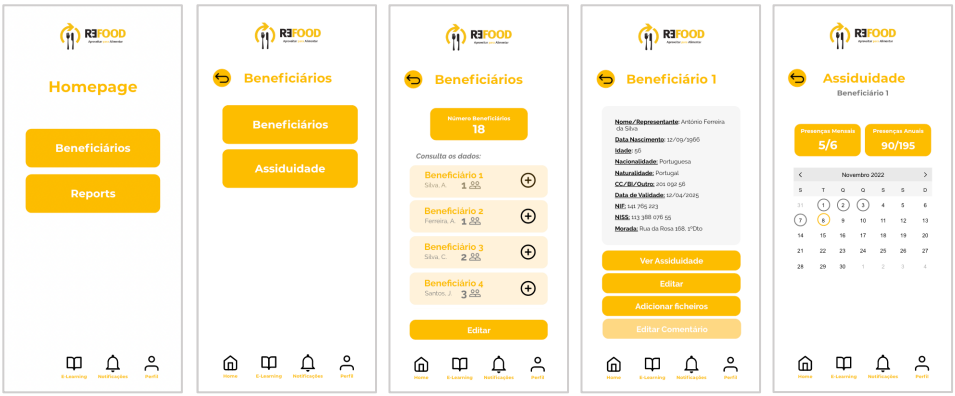


Figure XXVII - Process Manager Features Mockups - Part I

As for the Managers, he/she will also have portfolios' general information – routes, number of beneficiaries, number of food sources and volunteers, their attendance, and weekly, monthly and annual deliveries. They will also be able to add and remove beneficiaries/volunteers and food sources from the list, edit its data, or approve and edit comments made by other volunteers.

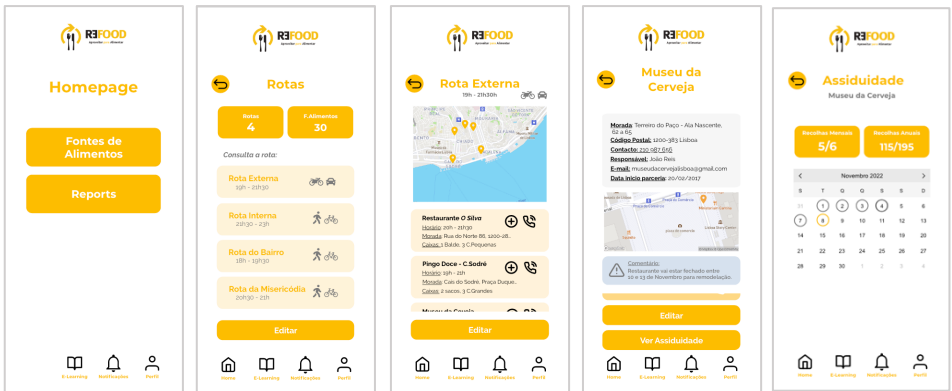


Figure XXVIII - Process Manager Features Mockups - Part II

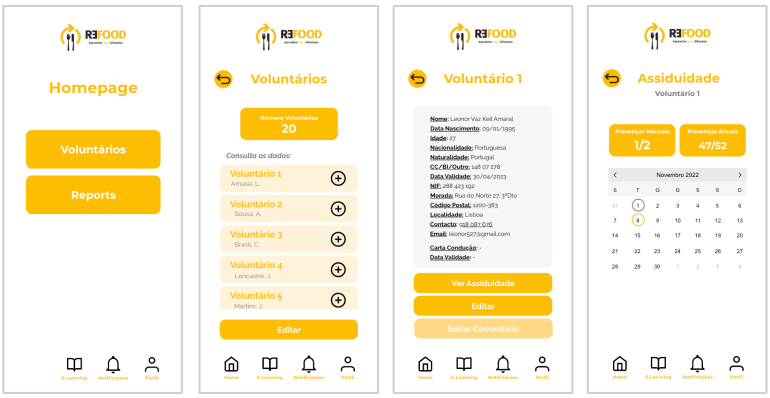


Figure XXIX - Process Manager Features Mockups - Part III

Managers will also be able to prepare reports from their management areas, which can be customized. Through the reports area, they can export general data from their areas, export the complete personal data of beneficiaries and volunteers, for example, or export the number and dates of the food collected by the establishment, collection by the beneficiaries, or working hours of the volunteers.

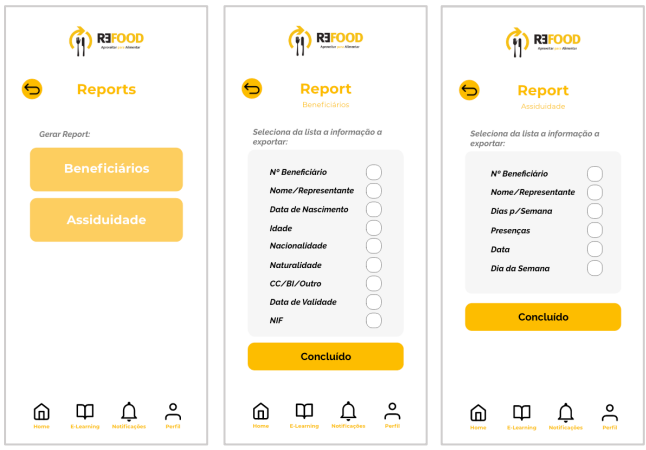


Figure XXX - Reporting Process Mockup

- **Shift Managers Features**

As Shift Manager, he/she will have access to information about the volunteers who are part of the shift and the tasks they perform, contact them, and consult their presence throughout the month/year.

As volunteers confirm their attendance at the shift (explained below), the system will automatically update, the manager will receive a notification, and the information will be available

according to a color system (green means that the volunteer will attend the shift, gray means that he/she will not be there, and orange means that he/she has not yet confirmed) (Figure XXXI).

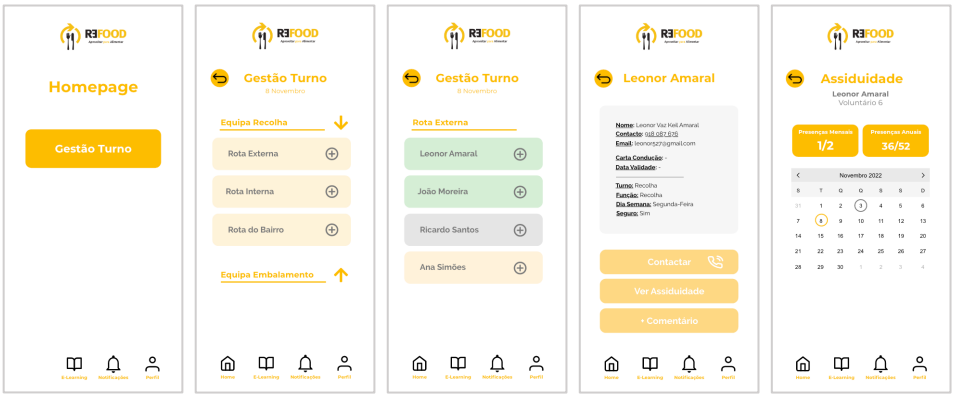


Figure XXXI - Shift Manager Features Mockups

The process explained above, performed by the Shift Manager, in which he/she contacts the food sources before the collection starts and assigns them a color based on the positive/negative response, was designed as a simple process like the one above, using the "swipe left" for assigning the colors (Figure XXXII).

The manager will have access to the list of food sources by collection route, be able to contact the establishment directly from the app, and assign the color to it. If necessary, they can also access more information about the source and add comments, like the other volunteers.

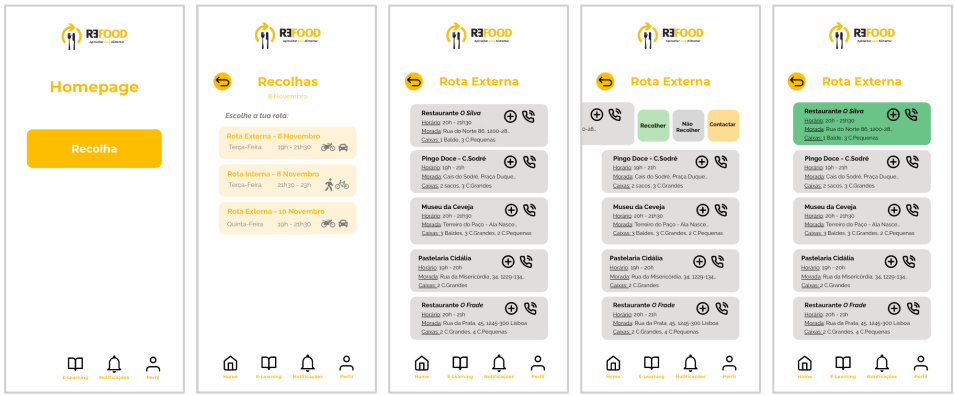


Figure XXXII - Collection Shift Manager Features Mockups

- **Other General Features**

When a new volunteer joins Re-Food, an email is created for him/her, which will allow him/her to access the application. When this access is done, by default, a notification will appear asking the

volunteer to confirm his/her presence on the following shift in case he/she has not confirmed it via notification.

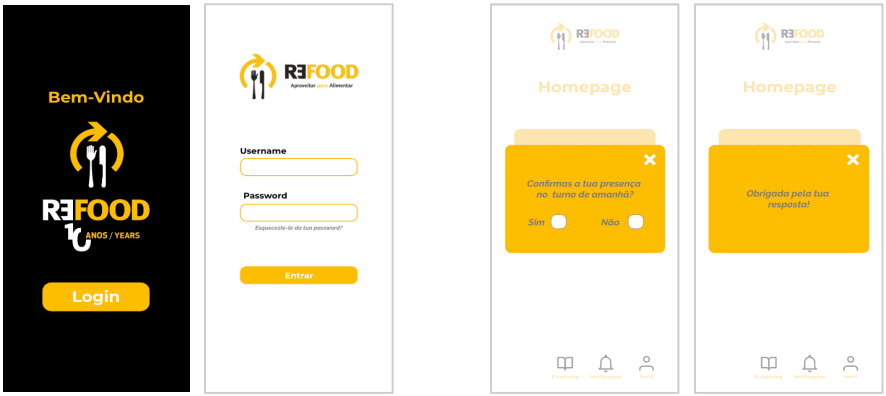


Figure XXXIII - Login & Notification System Mockups

The system will allow (menu at the bottom of the screen) access to the e-learning space where important documents and Re-Food training will be available, to the notifications page where, for example, you will receive invitations to events or requests for availability for other shifts and, finally, to your profile page where you can change your data (Figure XXXIV).

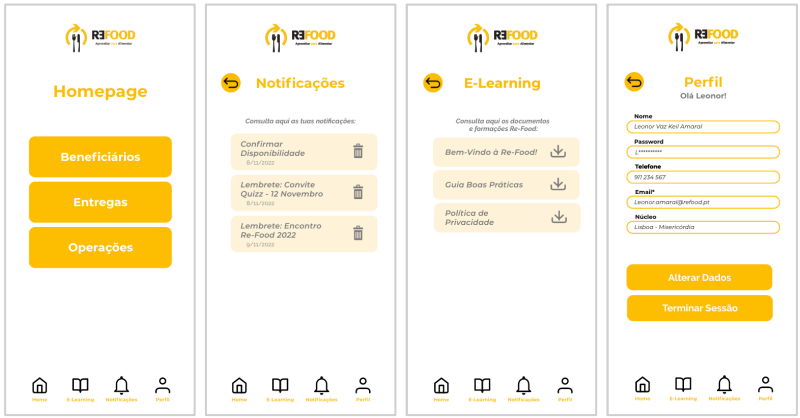


Figure XXXIV - General Features Mockups

5. CONCLUSIONS

5.1. SYNTHESIS OF THE DEVELOPED WORK

Digitalization and innovation in community-based social action projects (i.e. created by citizens for citizens) are themes that have been discussed and have gained relevance over the past years. The development of work dynamics within the institutions that allow for optimization of the processes of volunteer projects, where no one is paid, has become increasingly valued. These are activities that must be coordinated with the life/jobs of volunteers, who want to invest more time in effectively relevant tasks focused on Re-Food's core values - collecting surplus food and distributing it to people in need.

It was the work that I developed during several years on Re-Food that made me choose this institution for this project. My participation started as a volunteer on the food collection shift, but over time I had the opportunity to be part of other shifts, work with multiple teams, and later, lead my team and help with different portfolios management. This work allowed me to understand the workflows within the organization and their failures. But it was only with the help and contact with other volunteers and managers from different centers and different positions, and when working on this project, that I have been able to deconstruct the pre-defined ideas and volunteer work experience I had and to find and understand the usefulness of this project.

The goal was to develop a system that would help in the daily tasks of the Re-Food centers. Every day the volunteers deal with situations of communication failures, loss of information, and overprocessing. The idea was to develop a system for the institution's daily use that would help to aggregate all the information and make the tasks more efficient.

This way, a prototype of a mobile application was designed, to be used in the daily tasks of each Re-Food center. This app considers, on one hand, the two main tasks of Re-Food - food surplus collection and local distribution of these surpluses to families in need - and that, despite being distinct and easily differentiated in the center's daily tasks, the information collected in one influences the other and, therefore, the app must consider this intercommunicability.

Besides daily tasks, the designed system considers the figures of volunteer and volunteer manager and therefore, the different tasks performed by both, and considers the different portfolios that support the structure of each core, which can be easily manageable with the use of an app (Volunteers, Beneficiaries and Food Sources).

This way, this prototype was developed in a way that seeks to simplify registration processes, centralize information, and facilitate communication routes between volunteers. This centralization and processing of information/data besides allowing for a reliable report to be made to Refood's

"central services", allows the center itself to analyze its results and adapt processes/tasks, to ensure that its purpose is achieved in the best possible way.

Although this project focuses on the implementation of a new work methodology, associated with its digitalization, it is important to understand that the sustainability of the project should not only be about fighting food waste. All the activities of the center should also be guided by zero waste principles: the digitalization of the processes will allow the reduction of the use of paper and other economical materials.

In summary, the main goal of this project is to create a practical, sustainable, and easily customizable solution that allows each core to perform a more efficient job and consequently allows the institution to have a greater impact on our community.

5.2. LIMITATIONS

When considering the main limitations of this project we must look firstly for the main constraints in creating an app. And the main limitation is to base the daily tasks of an institution on an application. We all know that this can be a facilitating factor but at the same time, it can bring several constraints. And understand that creating it and implementing it, if it happens, is time-consuming and laborious and that, even if implemented 100%, each core should always have a Plan B of action (for example, having the forms on paper, in case the app fails).

Must also be considered, besides the importance of constant app maintenance, the managers of each core initial time investment, to insert in the app all the relevant information of that specific core (routes, restaurants, beneficiaries, e.g.) and assign specific skills/tasks to each volunteer profile.

Other limitations that can arise are cultural and generational issues. Changing processes already ingrained in the culture of each core takes time and work - either because people are used to paper or because the average age of Re-food's volunteers is relatively high, which means they are less digitally literate. This implies a big effort in awareness and training, especially during the app's launch but also in the long-term teaching/learning.

And speaking about the era of digitalization, from a more technical point of view, this app was designed having cell phones and tablets in mind which implies that for volunteers to be able to perform their tasks concretely, they must have access to at least one of these devices, which in itself can be a limitation.

Last but not least, if we want to move forward with the development and implementation of a system like this, we must always consider that development (building the app using programming for example) is a time time-consuming process. Since we are dealing with an IPSS, sometimes the financing for this type of project can be difficult to obtain, consequently making the idea difficult to materialize.

Not to mention that we know that some centers may have a different work dynamic, which implies more time and money in creating a new system, applicable to the necessities of the work.

5.3. Future Work

The fact that Re-Food is distributed, so to speak, over several poles, implies that the daily organization/management may have, at times, different daily operations. Although the core values of their work are the same, volunteers, their learning and ways/dynamics of working can be quite different. In this way, it is important that this system can not only respond to the needs of each center but can also adapt and customize itself to the interests and limitations of all.

For greater receptivity by all, this must remain a simple, sustainable, intuitive system, easily adaptable to different circumstances, and, above all, easy to maintain. By the end of the day, one must not forget that this is an organization of volunteers who dedicate 3/4h a week of their free time to help their community.

Regarding the development and creation of the app and considering what was discussed above regarding the costs of this type of development, it could be interesting, at an early stage, to see if this work could be done internally, with Re-Food's human resources. If not, if this work needs to be developed by a third party/company would be important to form a team of volunteers so that they would be responsible for maintaining the app, for example, or appoint a person responsible for each center, for its maintenance.

Another important point is application access. This process would imply that each core had at least one tablet available for common access or thinking about creating an online format (computer) for internal access, and in the occasional case of total lack of access, the center would work as it currently works, using paper tables.

We must also not forget that this work will only be possible after all the cores work to gather and centralize all the information of their day-to-day work. And this is the most important point of this project - taking that information and finding a way to work with it in a way that is beneficial to the center and the well-being of the volunteers.

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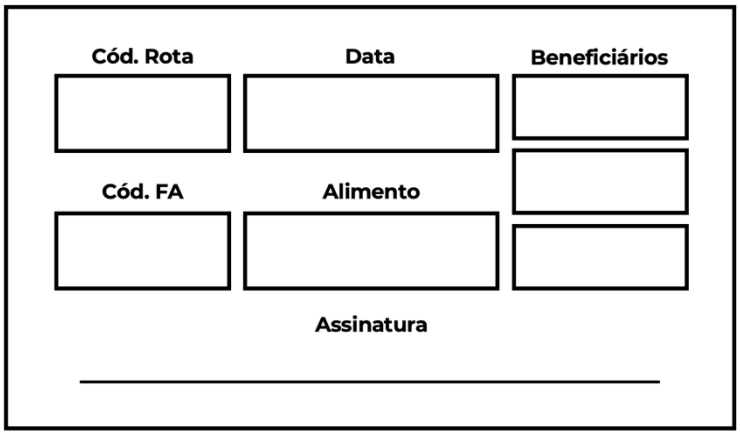
APPENDIX A

Screenplay for interview

1. For how long have you been volunteering for Re-Food?
2. Why did you start working with Re-Food?
3. What tasks do you perform at Re-Food?
4. Do you think Re-food has a big impact on your community? By reducing the impact of food waste and helping people in need?
5. Do you think that the time you spend on Re-Food is time well spent?
6. Do you think that your work can improve somehow?
7. Do you think that there is a lack of information about other volunteers/food sources/beneficiaries that somehow affect your performance in the organization? In which situations? In your opinion, how could you solve it?
8. Do you think that your work or the organization's work can improve with the use of an app? If yes, how?
9. In which steps do you spend most of your time during your shift?
10. What is your least favorite part/more difficult part of your shift?
11. What's your opinion of the communication with food sources/volunteers?
12. (If interviewing a Center Manager) What are the main issues discussed between managers?
13. (If interviewing a Center Manager) What can be done to simplify Manager's meetings?

APPENDIX B

Collected Food Tag - Example



APPENDIX C

Collection Route - Example

Semana XX a XX

Rota EXTERNA (carro)

	ESTABELECIMENTO - Hora Recolha	2ª FEIRA						3ª FEIRA						4ª FEIRA						5ª FEIRA					
		Visitado (S/N)	Género (x):					Visitado (S/N)	Género (x):					Visitado (S/N)	Género (x):					Visitado (S/N)	Género (x):				
			Sopa	Prato	Pão / Bolos	Outros	Amanhã é outro dia...		Sopa	Prato	Pão / Bolos	Outros	Amanhã é outro dia...		Sopa	Prato	Pão / Bolos	Outros	Amanhã é outro dia...		Sopa	Prato	Pão / Bolos	Outros	Amanhã é outro dia...
	HORA DE INÍCIO DA RECOLHA -------->	___:___h						___:___h						___:___h						___:___h					
1	**TAVERNA IMPERIAL - 22h30** Praça Restauradores 16 (2 sopas diferentes, Bolos e Comida) João Rodrigues / 965 528 019 ou 213 468 491																								
2	**MUSEU DA CERVEJA - 22h40** Praça do Comércio 62 a 65 (lado esquerdo de quem está de frente para o rio). Entrada c/ tapete que diz "Porta de Serviço". (comida feita) António Carlos / 210 987 656																								
3	**PADARIA PORTUGUESA (Av. 24 Julho) - 23h00** Avenida 24 de Julho 1B e 1C (sopa, pão, bolos, salgados sandes e saladas) Aelita / Loja: 926 797 955																								
	HORA DE FIM DA RECOLHA -------->	___:___h						___:___h						___:___h						___:___h					

Para a PADARIA PORTUGUESA levar apenas 2 sacos etiquetados / o tabuleiro salmão / 2 caixas para salada e/ou sopa

OBSERVAÇÕES	2ª FEIRA	
	3ª FEIRA	
	4ª FEIRA	
	5ª FEIRA	

APPENDIX D

Attendance Register - Example

Folha de Presenças

Beneficiários	Segunda	Terça	Quarta	Quinta	Sexta	Sábado	Domingo
	--/--/--	--/--/--	--/--/--	--/--/--	--/--/--	--/--/--	--/--/--
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

APPENDIX E

Food Intake Log - Example

Rastreamento

Data Recolha	Cód. Rota	Cód. FA	Alimento	Data Entrega	Beneficiários

APPENDIX F

End-of-Shift Notes

Data: _____ **Dia da Semana**: _____

Turno: _____ **Gestor**: _____

Observações de fim de turno:

Data: _____ **Dia da Semana**: _____

Turno: _____ **Gestor**:_____

Observações de fim de turno:

APPENDIX G

Volunteers Registration Form – Example

INDICAÇÃO DO TURNO	
DIA DA SEMANA	
TURNO	

FICHA VOLUNTÁRIO

DADOS	
NOME COMPLETO / FULL NAME:	
MORADA / ADDRESS:	
COD. POSTAL – LOCALIDADE / ZIP CODE - LOCALITY:	
NACIONALIDADE / NATIONALITY:	NATURALIDADE / PLACE OF BIRTH:
NIF / TAX IDENTIFICATION NUMBER:	CARTA CONDUÇÃO /DRIVER'S LICENSE:
BI/CC / PASSPORT NUMBER:	VALIDADE BI/CC/PASSPORT / VALIDITY PASSPORT:
TELEFONE / PHONE:	CONTACTO EMERGÊNCIA / EMERGENCY CONTACT:
DATA NASCIMENTO / BIRTH DATE:	
EMAIL:	
FUNÇÃO DE TURNO / SHIFT FUNCTION:	

Lisboa, _____ de _____ de_____

Assinatura _____

APPENDIX H

Volunteers Report - Format Example