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Fostering Organic Composting: A Service Design Approach

Carolina Trindade Salgueiro Pereira de Almeida

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Supervisors at FEUP: Prof. Jorge Grenha, Prof. Vera Miguéis



Abstract

Rising population and urbanization are leading to a rise in municipal organic waste, a pressing environmental and public health concern. Organic waste constitutes over half of municipal solid waste, making it imperative to manage this problem.

Composting offers a sustainable solution to this challenge, as it enables the biodegradation of organic waste into a nutrient-rich product that can enrich soils while reducing landfill pressure.

Although composting is a sustainable practice that brings benefits to the soil and citizens alike, this is still an under-adopted practice. With its positive environmental impact, it is essential to design effective interventions that can promote this sustainable behaviour.

Grounded in the service design framework, this project aimed to design a service to help raise the adoption of composting as an organic waste management practice. Guided by the integration of design science and design thinking, the study employed a qualitative approach based on interviews with two key stakeholder groups, i.e., experts and citizens, to explore expert insights and citizens' perceptions of composting.

The analysis of the interviews resulted in an understanding of the barriers and motivations behind the adoption and loyalty of composting. Based on these findings, the project proposes a set of customer experience requirements for the adoption of composting.

The insights gathered from the interviews were also used to develop a citizen journey. This journey describes the core phases in the adoption and practice of composting, with the respective motivations, barriers, and context. Furthermore, the citizen journey also identifies desired processes of composting.

Based on these insights, a service prototype was developed in the form of a smartphone application. The design incorporates gamification elements, including a point-based rewards system and competitions, alongside information on the environmental impact of composting.

This project resulted not only in a design of a service but also in a set of recommendations for future service providers. The most significant recommendation being the need for a holistic, multi-stakeholder approach that integrates diverse solutions into a single, encompassing composting service. This project thereby highlights the potential of service design and multi-stakeholder approaches to generate actionable insights for sustainability challenges.

Keywords: Service Design; Composting; Adoption; Municipal Solid Waste; Food Waste Management; Customer Journey

Sumário

O aumento da população e da taxa de urbanização têm contribuído para o crescimento da produção de resíduos orgânicos municipais, uma preocupação ambiental e de saúde pública urgente. Os resíduos orgânicos constituem mais de metade dos resíduos sólidos urbanos, tornando imperativa a gestão deste problema.

A compostagem surge como uma solução sustentável para este problema, visto que permite a biodegradação de resíduos orgânicos, resultando num produto final rico em nutrientes, capaz de enriquecer os solos e reduzir a pressão sobre os aterros.

Apesar de a compostagem ser uma prática sustentável que traz benefícios para os solos e para os cidadãos, continua a ser uma prática pouco adotada. Dado o seu impacto ambiental positivo, torna-se essencial compreender como aumentar a sua adoção e como promovê-la.

Orientado pela integração de design science e design thinking, o projeto recorreu a uma abordagem qualitativa, baseada em entrevistas a dois grupos principais de stakeholders (p. ex., especialistas e cidadãos), para explorar as perspetivas dos especialistas e as perceções dos cidadãos sobre a compostagem.

A análise das entrevistas resultou na identificação das barreiras e motivações subjacentes à adoção da compostagem. O projeto apresenta ainda uma lista de requisitos à experiência do consumidor para a adoção e retenção da compostagem.

Com base nos dados recolhidos nas entrevistas, foi desenhada uma jornada do cidadão. Esta jornada descreve as fases principais da adoção e prática da compostagem, com as respetivas motivações, barreiras e contexto. Adicionalmente, a jornada do cidadão identifica também os processos desejados para a prática da compostagem.

Com base nestes resultados, foi desenvolvido um protótipo de serviço sob a forma de uma aplicação para smartphone. O desenho incorpora elementos de gamificação, incluindo um sistema de recompensas baseado em pontos e competições, bem como informações sobre o impacto ambiental da compostagem.

Este projeto resultou não só no desenho de um serviço, mas também num conjunto de recomendações para futuros prestadores de serviços. A recomendação mais relevante sendo a necessidade de uma abordagem holística, que integre diversas soluções num único serviço de compostagem. O projeto evidencia assim o potencial do desenho de serviços e das abordagens de multi-stakeholders para gerar soluções aplicáveis aos desafios da sustentabilidade.

Palavras-Chave: Design de Serviços, Compostagem, Adoção, Resíduos Sólidos Municipais, Gestão de Resíduos Alimentares, Jornada do Cliente

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Table of Contents

Abstract	ii
Sumário	iii
Table of Contents	v
List of Figures	vi
List of Tables	vii
1 Introduction	2
1.1 Problem Description	2
1.2 Project background	3
1.3 Research Objectives	3
1.4 Report outline	4
2 Literature Review	5
2.1 Organic Waste Management Motivations and Barriers	5
2.2 Literature Gap	8
3 Problem Characterization	9
4 Methodology	11
4.1 Methodology Selection	11
4.2 Methods used	11
4.3 Exploration Stage	11
4.4 Ideation Stage	15
5 Results	17
5.1 Expert Interviews Results	17
5.2 Citizen Interview Results	21
6 Recommendations	32
6.1 Service Design	32
6.2 Recommendations	36
7 Conclusion and Limitations	38
8 References	40
9 Sustainable Development Goals	46
10 Appendix A- Expert Interview Script	47
11 Appendix B- Citizen Interview Script	48
12 Appendix C- Informed Consent Experts	50
13 Appendix D- Informed Consent Citizens	54
14 Appendix E- Declaration of Generative AI Usage	56

List of Figures

[FIGURE 1- CITIZEN JOURNEY](#) 21

[FIGURE 2- STORYBOARD](#) 33

[FIGURE 3- SERVICE SYSTEM](#) 34

[FIGURE 4- BLUEPRINT](#)..... 35

List of Tables

[TABLE 1- CITIZEN DATA](#) 14

[TABLE 2- EXPERT INTERVIEW DATA STRUCTURE](#)..... 18

[TABLE 3- PRE SERVICE DATA STRUCTURE](#) 23

[TABLE 4- COMPLEMENTARY SERVICES DATA STRUCTURE](#) 25

[TABLE 5- SERVICE DATA STRUCTURE](#) 27

[TABLE 6- POST SERVICE DATA STRUCTURE](#)..... 30

[TABLE 7- SUSTAINABLE DEVELOPMENT GOALS](#) 46

List of abbreviations

MSW- Municipal Solid Waste

HC- Home Composting

FWM- Food Waste Management

FW- Food Waste

CC- Community Composting

PAYT- Pay as you throw

SAYT- Save as you throw

SDGs- Sustainable Development Goals

APA- Portuguese Environment Agency

1 Introduction

1.1 Problem Description

With the rising global concerns surrounding the environment, waste management has become a concern for all nations. Municipal Solid Waste (MSW) is the combination of the solid waste generated in urban and rural areas, which can include a wide range of fractions, such as kitchen scraps and garden waste (Cao et al., 2023). Worldwide, MSW can be disposed of using four main methods: landfilling, composting, recycling, and reusing (Cao et al., 2023). Out of these methods, landfilling proves to be the biggest potentiator of global warming (Costa et al., 2026).

Within the fractions that make up MSW, the majority corresponds to organic waste (Wang et al., 2023), of which food waste (FW) is an example. Food waste corresponds to 60% of Municipal Organic Waste, with garden scraps and other waste corresponding to 35% and 5%, respectively (European Environment Agency, 2020).

Food waste can be classified into two main categories: avoidable and unavoidable. Avoidable food waste corresponds to FW that is edible prior to its disposal, while unavoidable food waste corresponds to FW that was disposed of as it was not safe for human consumption (Nguyen et al., 2023).

In the European Union (EU), food waste is a pressing issue, with over 58 million tonnes of food being wasted per year, of which households are responsible for 53% of this amount (Eurostat, 2025). In Portugal, 2023 food waste totalled 1,932,893 tons, or approximately 182.7 kg per inhabitant (Statistics Portugal, 2025, 2025b).

The amount of food waste observed in Portugal and the EU in general fails to reach the targets set by the EU in the Sustainable Development Goals (SDG). Particularly, SDG 12, which targets Responsible Consumption and Production by aiming to halve food waste and reduce waste generation (United Nations, n.d.).

Pre-emptive measures regarding the reduction of food waste have already been implemented and tested, such as shopping (Stefan et al., 2013) and meal planning (Romani et al., 2018). However, these are still not enough, as food waste remains a problem.

As can be seen by the goals set by different organisations, it is imperative to resolve this issue, which is why many authors have set out to research more about home composting (HC). Home composting is the act of aerobic biodegradation of organic waste and is a way of recycling from home (Loan et al., 2019). As mentioned above, FW is an example of organic waste, making HC a viable way of managing this waste.

The adoption of home composting can help reduce landfill pressure, minimise waste collection as well as transportation costs, all the while improving soil structure (Loan et al., 2019). Landfills require expansive land usage over prolonged periods of time and pose a burden to the environment due to the emissions produced (Tian et al., 2025). Composting is an effective way to resolve issues regarding Municipal Solid Waste (MSW), as well as providing an organic fertilizer (Tian et al., 2025). Home composting has also been highlighted as the most effective method for managing household waste (Loan et al., 2019).

Complementarily, Community Composting (CC) is a method of enhancing urban biodiversity and can include HC with neighbour contributions as well as community-led group composting in public or private urban spaces (Rice et al., 2025). Adoption of both practices can benefit not

only communities but households as well by providing a sustainable way to manage organic waste.

Composting organic waste has been increasingly framed as a social demand (Lapeyre et al., 2025), which can explain the growing research interest in the study of the citizen perceptions of this practice.

1.2 Project background

This research was developed as part of the CircularTech Project and focuses on the city of Porto. Porto is the second-largest city in Portugal, with a population of around 1.3 million inhabitants. In Portugal, it is the only city, besides Lisbon, to be considered a global city, and it has the country's second-largest urban area (World Population Review, 2026). Porto is home to home and community composting initiatives as well as urban gardens. This is largely due to LIPOR's operations, the primary waste management organization overseeing waste processing in the region.

LIPOR is the main promoter of composting initiatives in the Porto area, providing citizens with free resources (composting bins) and training. In the Maia municipality, this promotion is done alongside Maiambiente, who works closely with the municipality's citizens to foster sustainability.

As a result of LIPOR's initiatives, Porto has garnered attention for its high percentage of selective biowaste collection, as highlighted in the *Relatório Anual De Resíduos Urbanos* (2025). Given its population and status as a global city, and the composting initiatives implemented by LIPOR, Porto is presented as an adequate setting for the project. The findings obtained in this project will be valuable to other countries with similar urban characteristics, thereby facilitating the adoption of the solutions proposed later in this work.

1.3 Research Objectives

This project aims to design a service that increases the adoption rate of home composting and improves the customer experience. Service design is a field of study that combines service science and design thinking to achieve a holistic solution for service offerings (Fisk et al., 2013). The design will be grounded in an investigation of the motivations and barriers influencing composting adoption.

To this aim, we have defined a set of research objectives to guide the data collection and analysis.

- O1:** To understand the motivations behind the adoption and continued practice of composting.
- O2:** To understand the barriers hindering the adoption and sustained practice of composting.
- O3:** To identify initiatives that could increase adoption rates and foster long-term loyalty to composting.

The service designed will aim to mitigate the barriers experienced by individuals and leverage the motivating factors identified. Furthermore, the design will be informed by citizens' own suggestions for what they would like to see implemented.

Data will be gathered using a qualitative approach, where interviews will be conducted with employees from two organisations, LIPOR and Maiambiente, as well as citizens. These

organisations were chosen for their work in home composting initiatives. Expert opinions such as this will provide richer insights into the current environment surrounding composting in Porto.

Citizens were also interviewed, as they can provide a richer look into the barriers and motivations behind the adoption of composting. Two distinct groups of citizens will be interviewed: composters and non-composters. The distinction is relevant as both groups will provide different insights, aiding in the design of the service.

This project will thus propose a solution to the current issue surrounding organic waste generation through increased composting. Through the design of a new service, the goal is to raise the adoption of composting and normalise its usage for managing organic waste.

1.4 Report outline

This project is initiated by a review of the literature surrounding service design, MSW, FW, and composting. As the goal of the project is to design a service that raises the adoption of composting, it is necessary to understand what has been found by other research, especially with regard to the motivations and barriers. The review includes barriers and motivations to the adoption of food waste and municipal solid waste management practices, as these share behavioural and contextual similarities with home composting (Nguyen et al., 2022).

Subsequent to the literature review chapter is a characterization of the problem this project is aiming to resolve. The section aims to delve deeply into the intricacies of the issue that this project seeks to address, providing a nuanced understanding of its various dimensions.

The problem characterization chapter is followed by the methodology section, where the methods used in this project are described and how they help reach the end goal.

The data collected using the described methodology is then analysed in the results chapter. The analysis of the citizen interviews is done based on a citizen journey designed as a way of organizing the data into easier-to-understand sections. This is then followed by the service design and recommendations chapter, where the data analysis is compiled into the solution that this project aims to develop.

Lastly, the project is finalised through a conclusion and limitation chapter, where the main results of this project are summarised, and opportunities for future researchers are discussed.

2 Literature Review

This chapter is based on the analysis of the existing literature through a service design lens. Service design provides research with holistic and more human solutions, which are especially essential in resolving sustainability problems with their complex natures (Karpen et al., 2023). This dynamic perspective is thus valuable in MSW management.

This chapter is organised into two main sections: synthesis of organic waste management motivations and organic waste management barriers, with a focus on home composting. Finally, gaps in the literature are identified, including methodological limitations and the absence of comparative stakeholder perspectives, which the present project seeks to address.

The management of MSW is a multifaceted challenge encompassing environmental and public health dimensions (Sondh et al., 2023). In response to this challenge, guidelines have been implemented. In Europe, since the revised Waste Framework Directive (WFD) was introduced, it was established that organic waste must either be separated and recycled at source or separately collected to not be mixed with other sorts of waste (*Bio-Waste in Europe-Turning Challenges into Opportunities*, 2020).

With these new directives, there have already been some solutions put into place. For the collection of sorted waste, a popular initiative is the Pay-As-You-Throw (PAYT) system. For source separation and disposal, composting surges as a solution.

The PAYT system is a system where, as the name implies, individuals must pay in proportion to the waste they produce (Costa et al., 2022). This system was designed with the aim of correcting the attitudes regarding waste management (Costa et al. 2022). Complementarily, the Save-As-You-Throw (SAYT) system is a system where users can receive rewards based on their ability to dispose of their household waste properly (Vorobeva et al., 2022).

In Portugal, authors have studied the acceptance of the PAYT system, which revealed that, while the whole population might not find it fair, the acceptance rate is still significant (Costa et al., 2022). However, another study in Portugal found that, although the majority of citizens support waste management practices, this is not directly translated into practicing them (Celestino et al., 2025).

With regards to the PAYT system, a study found that, even with this system put into place, there is still a need for waste reduction promotion (Shan et al., 2024). Another solution implemented for selective waste collection is door-to-door collection, of which the curb-side double-bin is an example of a system. A study found that, through this system, not only is there a rise in sorting, but there is also a rise in the generation of waste. This means that although convenience might increase participation in sustainable practices, it may also intentionally encourage overconsumption (Maró & Ráti, 2026).

Despite its recognised benefits, the adoption rate of HC is still not as significant as expected, which highlights the importance of studying the barriers and motivations behind the adoption.

2.1 Organic Waste Management Motivations and Barriers

MSW has been considered one of the most prejudicial global environmental issues since the rise of urbanization (Sandhi & Rosenlund, 2024). There are different methods of disposing of organic waste, the greater part of MSW; however, they often drain resources and worsen environmental issues, as is the case with landfilling (Kharola et al., 2022).

Home composting can be a useful tool to relieve pressure from landfills, being a sustainable way to recycle from home, and enrich the soil structure (Loan et al., 2019). However, although composting organic waste has been framed as a social demand (Lapeyre et al., 2025), it is still not a widely adopted practice. Understanding this low adoption rate requires analysing both the motivations behind the participation and the barriers that stop it.

Organic Waste Management Motivations

With regards to food waste management participation, it was found that citizens who self-identify as environmentally-conscious are not only more likely to adopt environmentally friendly behaviours in general, but are also more likely to choose HC over alternative FWM practices (Loan et al., 2019). The same environmentally conscious behaviour was observed in those who partake in home composting.

Moreover, across multiple studies, those who compost appear to display some similar characteristics, with environmental concern emerging as one of the most consistent predictors of home composting (Fernando, 2020; Rice et al., 2025). This connection is reinforced by Loan et al. (2019), who found that citizens engaged in other environmentally responsible behaviours, such as reusing plastic bags, are also more likely to compost at home. This, combined with the findings from FWM adoption, indicates that environmental concern is a key motivational factor for home composting, particularly among individuals who are already attentive to the environmental consequences of their daily actions.

Governmental incentives can also positively affect the adoption of HC among citizens. Different types of incentives, such as free compost bins and gardens for composting, were effective in getting citizens to home compost (Kunszabó et al., 2022).

Other authors, like Rice et al. (2025), explored this further and found that preferences for incentives vary among individuals. Some residents valued financial incentives, while others preferred resource-based incentives, such as composting tools. Moreover, a portion of participants in their study did not view financial incentives as essential, with some even considering composting to be a community effort rather than an individual responsibility.

Together, these findings suggest that a one-size-fits-all approach to incentives may not be effective. Instead, offering a combination of financial and resource-based incentives, tailored to different citizen profiles, may be more successful in promoting composting adoption.

Awareness also surges as a way to motivate citizens to start composting. This can be achieved through campaigns, which raise citizens' interest in composting, making them more likely to participate (Rahman et al., 2025). By gaining awareness, citizens also become more likely to be able to demystify certain pre-set beliefs, such as the fear of bad smells (Rice et al., 2025).

Additionally, knowledge about HC practices can also positively impact the adoption of HC by individuals. It was observed that those who had greater knowledge of composting (such as compostable materials and compost readiness) were also more likely to adopt the practice and promote it to others (Loan et al., 2019). The authors also highlight that building up this knowledge should be the first step when trying to capture residents' attention and participation in HC.

As was observed by different authors, both awareness and knowledge are simultaneous motivational factors (Pierini et al., 2021; Fernando, 2020; and Kunszabó et al., 2022). As such, these factors can be combined in campaigns that explain composting's functioning and benefits, both to the environment and the individual (Celestino et al., 2025). Additionally, through these

educational campaigns, citizens might understand the possible uses of composting, which, according to Nguyen et al., 2022, makes citizens more likely to dispose of their FW this way.

Regarding the practice of community composting, one notable advantage is its social nature. This characteristic also serves as a motivational factor (Rice et al., 2025), as social norms can play a significant role in encouraging the adoption of this practice.

Organic Waste Management Barriers

A study on the participation of MSW management practices found that citizens highlighted barriers to the adoption of sustainable management practices, including a lack of time, laziness, and a lack of understanding of waste separation (Alimoradiyan et al., 2024).

With regards to FWM, it was found that the presence of a tool in the kitchen (such as a kitchen caddy) could lead to higher rates of FW being managed in a sustainable manner, such as composting (Nguyen et al. 2022).

The perceived lack of time can be a detriment to the rate at which home composting is adopted by people, as seen in Wu et al. (2019). In their study, the authors found that it was not the actual time constraints that reduced people's participation in curb-side composting. Instead, they realised that residents simply perceived their time as not enough to compost. This highlights once more the importance of education regarding the HC practice and how it is not necessarily time-consuming.

The lack of adequate space, such as a home garden, is also a frequently identified barrier. The lack of a garden is a difficult barrier to overcome, as not everyone is able to have a personal garden (Kunszabó et al., 2022). However, community composting can be a possible solution as it increases convenience, which will then improve the chances of adoption of composting (Rice et al. 2025). This is validated by other authors who have found that, when setting up a home composting system, residents point out that adequate space to conduct the practice is also a problem, and would rather have a simpler option, such as FW collection service (Oehman et al., 2022). Moreover, it has been found that citizens with garden spaces are more likely to understand the benefits that HC provides (Loan et al., 2019).

Additionally, previous research indicates that in the existence of a substitute solution, such as door-to-door collection, individuals will prefer the alternative rather than HC (Rahman et al., 2025). This hints that convenience might be more appealing than the benefits that home composting may bring to a homeowner.

When attempting to home compost, there is a surge in needs regarding the appropriate tools and resources, which also serves as a barrier (Fernando, 2020; Loan et al., 2019; and Rice et al., 2025). Rice et al. (2025) observed that the availability of these tools and resources was an enabling factor, which then made the inverse true as well. The authors then recommend facilitating access to such tools together with legal recognition to enhance participation.

Due to the nature of home composting, where organic waste is decomposed, there are some smells that come with the practice. In a study in Switzerland with a focus on PPV (P'tite Poubelle Verte, French for small green bin), which is a recycling bin for kitchen scraps, the authors found that, even with the proper equipment, residents still found that the smells stood as a barrier to the adoption of this sustainable practice (Moussaoui et al., 2022). This barrier regarding smells has also been highlighted by other authors who have found that smells associated with FW also stopped residents from managing it sustainably (Oehman et al., 2022). This suggests that addressing this sanitation issue can be done through composting education,

which can teach citizens to take preventive measures, could be an effective way to overcome this barrier.

2.2 Literature Gap

After analysing the existing literature regarding MSW management, FWM, and composting (HC and CC), a list of motivations and barriers to try to overcome has been compiled. However, even though the literature is rich in these factors, there are still several gaps that this project seeks to address.

While the existing literature focuses on motivations and barriers, the analysis conducted discovered that it lacks actionable solutions. As was pointed out by other authors (Karpen et al., 2023), service design offers a framework for overcoming the barriers found in the literature. This project aims to bridge this gap by not only identifying barriers and motivations but also using these findings as the foundation for a designed service intervention.

Service design is a holistic and customer-centric approach that is essential to service innovation (Fisk et al., 2013). However, there are still very few studies that use service design as a way to develop sustainable solutions (Karpen et al., 2023). This reinforces once more the relevance and importance of this project.

A study found that the service design principle of co-creation can aid citizen engagement in managing this waste. This study found that, through gamification, citizens are also more likely to engage in MSW management, even if they do not receive any reward from it (Mersico et al., 2025).

Additionally, the majority of the studies analysed have been quantitative studies that focus on identifying and measuring the motivations and barriers to the adoption of the practice. A qualitative approach, by contrast, enables a deeper understanding of the perceptions and experiences of those studied (Agius, 2013). This project, by using a qualitative approach, aims to find richer explanations of the barriers and motivations to composting.

Complementarily, building on a service design approach, this project will also analyse different stakeholder perspectives, something that is not prevalent in the literature. By studying both experts and citizens, the present study obtains more thorough results due to these two perspectives. With this analysis, the project is able to strengthen the validity of findings and produce insights that are relevant not only to academic understanding but also to the practical design of composting services.

The present project addresses the gaps found by employing a qualitative, service design-informed methodology to explore barriers and motivations among both experts and citizens, with the ultimate goal of designing a service that can raise home composting adoption rates.

3 Problem Characterization

In this chapter, the problems surrounding the low adoption rate of composting are synthesised, as identified in the literature review. Additionally, the unique circumstances of the place where this project is conducted will be described and analysed.

As discovered in earlier chapters, organic waste corresponds to half of Municipal Solid Waste, which causes not only environmental but also health issues, making it a global problem that many countries are trying to resolve. Composting has been identified as a sustainable and effective management method (Cao et al., 2023; Loan et al., 2018), offering not only pollution reduction but also the generation of valuable end-products such as compost (Chen et al., 2020). However, despite its many benefits, composting adoption remains low.

This low adoption rate can be partially due to technological shortcomings and social issues (Al Mamun et al., 2023). However, it was found through the analysis of the literature that one of the biggest barriers to this adoption is the lack of knowledge regarding the benefits and the composting process. Complementary, weak incentives and inefficient regulations have also been found to be a reason for this low adoption rate (Chen et al., 2020).

As observed, there are already some solutions to the collection of separated waste; however, they are still not fully effective and have their own barriers. One issue with this collection is that, unlike composting, there is no full circularity of waste generation and management.

In Portugal, policies regarding the environment are defined by the Portuguese Environment Agency (APA). Within their work, this agency has defined the PERSU 2030, the strategic plan for urban waste (APA, 2024). This plan focuses on waste prevention and selective collection while putting emphasis on different types of waste, one of them being organic waste.

The PESRU 2030 plan has defined a set of goals for the years 2025, 2030, and 2035. Concerning organic waste, a goal was set for a 50% increase in recycling at the source, achieved through home or community composting (APA, 2021).

Another goal set in PERSU 2030 was to reduce urban waste in landfills to a maximum of 10% of total urban waste (APA, 2021). As organic waste can often be found at landfills, the rise of composting adoption can be a way to reach this goal.

LIPOR and Maiambiente have thus set their strategies to fall into line with the guidelines set by APA. This can be seen through LIPOR's initiatives in composting. Moreover, Maiambiente has also begun implementing the PAYT system in the Maia municipality.

With their composting initiative, LIPOR provides both training and composting bins for free. Currently, the training is fully online, with citizens simply needing to sign up. This change was made after the COVID-19 pandemic and was kept as the standard, as citizens prefer it over in-person training. The existence of free training and composting bins is a very important factor in the context of this project, as it might mean some barriers, such as a lack of knowledge or resources, might not be as prevalent among the citizens.

Within their service area, LIPOR has also implemented residential door-to-door collection, which is also an important factor to take into account. Authors have found that the existence of this door-to-door collection might have a negative impact on the adoption of home composting (Rahman et al., 2025).

Considering the fact that these services have already been implemented in the area where the project is being conducted, we once more highlight the need for a service design approach. With

its holistic approach, service design is the ideal framework to design a solution that takes all these factors into account.

Innovative services are a means of changing an individual's thinking, participation, and capabilities to create and realise value (Fisk et al., 2013). This project's focus is on designing a service that can help raise the adoption rate of composting. As was found through the study of the literature, changing the citizens' mindset and willingness to participate will be essential to raising the adoption, showing once more why service design is the ideal tool to generate a solution.

The study of motivations and barriers behind the adoption of composting is a necessary part of this project, as it will allow a better understanding of the citizens. This is a way of complementing and validating what has been analysed in the literature. This study will be done with both citizens and experts, as service design incentivizes a deeper understanding of all stakeholders and their impact on the study environment.

4 Methodology

In this chapter, we will explain the methodology employed in this project and its relevance to the work conducted. This chapter focuses on explaining the methods used and the reasoning behind each of them, and how they contribute to our goal of designing a service that aims to raise the adoption of composting.

4.1 Methodology Selection

The goal for this project is to design a service, employing a qualitative analysis of stakeholders, grounded in the service design framework. Service design is a field that combines design thinking and service science, resulting in a service offering based on customer co-creation. This framework relies on understanding the customer experience, and interviews provide researchers with an understanding of customer needs that they can verbalise (Fisk et al., 2013).

Through the analysis of the literature, it was found that the majority of studies focused on finding barriers and motivations through a quantitative approach. Moreover, most of these quantitative studies used surveys to gather data as they are a way to reach a greater population at once, gathering a bigger sample size. However, this means that the literature is lacking a more personal perspective, which is something necessary when studying adoption rates and the motives behind them.

While quantitative data allows for a greater reach and a broader range of data, it is not suited for an in-depth understanding of the customer experience. Quantitative studies are also more prevalent in the literature. As such, a qualitative study is a way of complementing the existing literature. Moreover, qualitative methods align intrinsically with the service design framework, as it prioritises the customer (or in this case, citizen) perspective (Fisk et al., 2013).

The following sections detail the specific methods employed, including the interview structure, participant selection, data analysis procedures, and the subsequent stages of the service design framework.

4.2 Methods used

As established, this project is built upon the service design framework, with the main goal of designing a service, thus achieving a more thorough solution to the composting adoption issue.

This framework follows four stages: problem framing; exploration, ideation, and reflection (Fisk et al., 2013). The problem framing is described in the beginning of this document through the Literature Review and Problem Characterisation chapters. The exploration stage focused on two sequential rounds of interviews with different stakeholder groups. Firstly, experts were interviewed and, afterwards, residents. In both rounds, we conducted semi-structured interviews. The ideation stage corresponds to the analysis of the results obtained, supporting the subsequent design of the service. Finally, the reflection stage consists of evaluating the strong and weak points of the design.

4.3 Exploration Stage

This stage is based on the understanding of the stakeholders, which, in this project, are the experts and the citizens. For both interview rounds, we conducted semi-structured interviews, although with different goals.

Alongside the study of motivations and barriers to the adoption of home composting, this project aims to understand what can be done to boost composting adoption. This adoption process was inquired about with both experts in the field and citizens.

The comparison of perspectives of both experts and citizens is an essential part of designing a service that can meet the needs and wants of both stakeholders, ultimately raising the adoption rate of the practice. To conduct this project, a qualitative study was conducted, which, by nature, studies a smaller sample size. However, in qualitative analysis, sample size is not as relevant as the characteristics of the sample, which must be selected based on theoretical relevance to the study (Agius, 2013). The sample was therefore appropriate for the project's objectives: the experts interviewed were knowledgeable about composting and waste management initiatives, while the citizen sample included a wide variety of participants, comprising both composters and non-composters.

CONTEXT DESCRIPTION

The expert interviews were conducted with experts from two organizations: LIPOR and Maiambiente.

LIPOR is an organization that has led the composting initiatives in the greater Porto area, with its scope being up to 8 municipalities (Espinho, Gondomar, Maia, Matosinhos, Porto, Póvoa de Varzim, Valongo, Vila do Conde).

LIPOR offers sustainable options ranging from recycling to waste treatment and solutions that aid composting. Homeowners with green spaces (such as gardens, land, or similar spaces) are eligible to receive a composting bin as well as training on how to compost properly. Additionally, LIPOR provides community composting bins where individuals can dispose of their organic waste after completing the required training. Community composting is especially beneficial for those who lack sufficient space to compost at home. Some of these community composting bins are found in community gardens, which are another initiative that promotes not only composting but also biodiversity and agricultural practices. To participate in this project, citizens must also compost, either in an individual or community composting bin.

Understanding LIPOR's perspective on why citizens do or do not compost is essential for the design of the service, as they are the ones who manage the composting initiatives in Porto, meaning they have the most practical experience. Additionally, their perspective on possible initiatives that might boost adoption is also a way of brainstorming service ideas.

Maiambiente provides urban waste management and cleaning services, such as waste collection. While the management of the composting initiatives is LIPOR's responsibility, Maiambiente works under them and helps them establish said initiatives in the Maia municipality. Maiambiente, because of its exclusivity to the municipality of Maia, can also provide a deeper insight into the needs of homeowners, as they are closer in the supply chain to citizens compared to LIPOR.

Both of these organizations have become the standard in the community when it comes to composting initiatives, which is one of the reasons why they were chosen to interview for this project. We believe that their vast experience and knowledge of the community we are studying and designing for is essential for this project.

EXPERT INTERVIEWS

With these interviews, the goal was to understand what they have found to be the main motivations and barriers to the adoption of composting. This project also aimed to better

understand their current offerings and residents' reactions to them. Finally, we aimed to gather their perspective on potential services we could implement and how residents might react to different ideas.

The first round of interviews was conducted with experts from the main waste management companies in Porto, LIPOR, and Maiambiente, the main waste collection organization in Maia. Complementarily, their initiatives in home composting as well as community composting make both organizations relevant to interview.

We conducted three interviews with experts, two from LIPOR and one from Maiambiente. The interviewees from LIPOR were directly involved with the composting initiatives of the organizations, which led to rich results from the interviews. The average time of the three interviews conducted was 58 minutes.

This round of interviews was conducted before any citizen was interviewed. The decision to interview the experts before the citizens was made so that there was a deeper understanding of the context beforehand. Complementarily, this is also a way to help prepare the script for the citizen interviews, especially regarding possible solutions to the low adoption rate.

In the script for these expert interviews, there is an innovation section (Appendix A). This section has the aim of questioning the experts regarding any initiatives that they wished could be implemented and possible solutions they had already theorised but not implemented. It is also a way of understanding if other initiatives were also put into place before the current ones and understanding why they might have failed.

CITIZEN INTERVIEWS

For this round of interviews, two groups of citizens were interviewed: those who compost and those who do not. The decision to interview these two types of citizens was made due to their different experiences, which might provide essential information for the design of the service.

For this round of interviews, the sample was narrowed down to those who reside in the LIPOR area, meaning the following municipalities: Espinho, Gondomar, Maia, Matosinhos, Porto, Póvoa de Varzim, Valongo, and Vila do Conde. The sample was restricted to citizens within the LIPOR area, as LIPOR provides access to composting bins and training. This delimitation ensures that the barriers identified are not simply due to a lack of resources or awareness, but rather other factors influencing adoption.

This round of interviews had the same goal as the one with the experts: to understand the barriers and motivations behind the adoption of composting, as well as opinions about possible services (Appendix B).

The majority of the data from the citizen interviews was placed in the citizen journey aggregated dimension. In here, the journey was divided into three stages: Pre-Service, Service, and Post-Service. Each stage was thus divided into current and desired, as a way to compare how the citizens report the journey is at the present time and how they wish it were.

While the goal for both interview rounds might be the same, it was still relevant to interview citizens, as they will be the end users for the service. This citizen perspective is essential for the customer-centric service design framework.

To summarise the personal data gathered from the citizens, a table was developed (Table 1) to help visualise the amount and characteristics of the interviewees.

Table 1- Citizen Data

Data	Composts (n=15)	Does not Compost (n=9)	Total (n=24)
Age Range			
21-30	0	6	6
31-40	1	1	2
41-50	3	0	3
51-60	7	1	8
61-70	2	1	3
Number of Household Members			
1	1	1	2
2	3	0	3
3	3	2	5
4	4	5	9
5	2	0	2
6	0	1	1
Type of House			
Apartment without outside space	0	2	2
Apartment with outside space	5	3	8
House with garden	8	4	12
Occupation			
Employed	11	4	15
Unemployed	1	0	1
Retired	1	0	1
Student	0	5	5

During this round, 7 interviews were with those who do not compost, as well as a focus group with two citizens, making it a total of 9 interviewees. In this sample, one of the interviewees was from Gaia, which is outside of this project's scope. However, an exception was made because this resident used to have a composting bin in their school, meaning they had some experience and knowledge regarding composting practices.

Alongside the interviews with those who do not compost, citizens who took part in one or more of the composting initiatives LIPOR has available were also interviewed. Within this sample, we completed 11 interviews as well as 2 focus groups made up of two residents each, making it a total of 15 interviewees of citizens who adopt composting. Within this group, we conducted 3 interviews with those participating in the urban garden project, with the two focus groups part of this number. Within this sample, we also interviewed one resident who was a teacher and, while they didn't take part in any initiative, they composted at the school where they taught.

The following data was collected from citizens: Age, Occupation, Type of House, and Number of Household Members (Table 1).

The analysis of this data did not reveal any clear correlation between these factors and participation in composting. However, some observations emerged, such as the fact that in order to have a composting bin on the property, citizens must have enough space, such as a garden, to place it. Yet, some of the citizens living in apartments participated in the urban gardens project. This means that, for those who wish to do so, household type is not a barrier.

Regarding the age of the interviewees, there was no correlation between those who compost and those who do not. The only exception was younger interviewees, who cited living with others as a barrier, either parents or roommates.

The average interviewing time of the citizen interviews was 43 minutes. This interviewing time, combined with the variety of citizens, provides a wide range of results, which is essential for this exploration stage.

DATA ANALYSIS

To analyse the results gathered from the two interview rounds, we used the NVIVO software. The analysis was done based on the interview rounds, meaning we analysed the expert interviews together and then the citizen interviews.

The expert interview analysis was done through an inductive coding approach. This means that the coding structure was built as the interview was analysed. This structure is represented by three main dimensions: (1) available services, corresponding to the current services these organizations offer; (2) current offering, corresponding to the customer journey and regulations; (3) innovation, corresponding to initiatives that could be implemented to resolve the problem being studied.

To analyse the citizens' interviews, the analysis was structured based on the customer experience modelling framework (Teixeira et al., 2012). This was an abductive analysis, where the codes were formatted into three main dimensions: (1) Activity, which is the collection of actions taken with a goal in mind; (2) Context, which encompasses all artifacts, systems, and actors interacting with the citizen or the citizen themselves; (3) Customer Experience Requirements, which are the perceived attributes that contribute to the satisfaction and usage of a service.

The code structure was built into three main dimensions: (1) Complementary services, corresponding to services that work alongside the current offering; (2) Customer Journey, where the main stages of the citizens' journey are analysed; (3) Citizen Data, where the data gathered from the citizens was grouped and analysed. Each dimension was then analysed individually due to the vast amount of subcodes presented in each one. Except for the citizen data dimension, the codes were further organised into the 'Current' and 'Desired' subcodes to differentiate between what the citizens experience at the moment of the interview and what they wished was put into place.

The usage of the customer experience modelling framework was done so that it became easier to understand how different stakeholders interact within the service and what citizens value the most in the service experience. Moreover, this aids the design of the citizen journey. be easier to organise the citizen journey. This is especially relevant to the next stage of the service design framework, the ideation stage.

4.4 Ideation Stage

The ideation stage is where, after the initial interview analysis, new ideas are generated that may lead to the design of a service (Fisk et al., 2013). It is in this stage that the specifications of the service designed for this project are outlined.

This stage was initialised through the design of the citizen journey. This journey was based on the citizen interviews and had three main stages: Pre-service, Service, and Post-Service. Just as

analysed in NVIVO, it also had the distinction between the current citizen journey and the desired citizen journey.

This was the starting point to the design of the service that, together with the codes in NVIVO, allowed for the design of the service system. In order to design the service system, a storyboard was initially designed as a way of visualizing the process of the new service (Fisk et al., 2013).

Following the storyboard, the service system was then designed, which is a visual representation of the interactions within the system (Fisk et al., 2013). This tool displays the various contact points and interactions among the different stakeholders, ensuring a holistic integration of all actors.

Finally, once the service system had been developed, one service blueprint was designed. Service blueprinting allows for a more in-depth look at the interactions that occur in a service (Patrício et al., 2011).

Complementary, this tool also allows for better understanding of the service, such as learning where possible fail and waiting points might occur. This in-depth analysis is essential for ensuring the satisfaction of the citizen when interacting with the service, as it allows for the creation of preventive measures.

The ideation stage constituted the final stage of the service design methodology completed for this project. Although the framework includes a reflection stage, it was beyond the scope of this study. This stage is therefore recommended for future research to test and evaluate the service designed.

5 Results

This chapter presents the results obtained from the two interview rounds with experts and citizens. The results were analysed using the NVIVO software and will be presented using the Gioia data structure. In this structure, results are represented in three dimensions: Aggregate Dimension, First-order Themes, and Second-order Themes (Gioia et al., 2013). To this structure, the number of times a first-order theme was referenced was also added in the column titled 'References'.

The data structure for the citizens' interviews was more complex, meaning the aggregate dimension column was replaced by first-order themes, and so on until third-order themes. In this data structure, the number of times the third-order themes were referenced appears separately by those who compost (C References) and those who do not (NC References).

The analysis of the citizen interviews is complemented by a figure (Figure 2) that displays the citizen journey, both the current and desired. This journey is a global representation of the citizen data that will be analysed individually through the three stages: Pre-Service, Service, and Post-Service.

5.1 Expert Interviews Results

The analysis of the expert interviews was conducted using the NVIVO software and organised in an inductive way (Table 2). From this analysis, data regarding the experts' perspective of the citizens was gathered.

One aspect of the data gathered that is not represented in Table 2 is the available services. This corresponds to the initiatives LIPOR has put into place, such as Home Composting, Community Composting, Selective Collection, Vermicomposting, and an Electric Composting Bin. This dimension was created with the aim of cross-referencing the codes on the other two dimensions (Current Offering and Innovation).

Table 2- Expert Interview Data Structure

Aggregate Dimension	Second-order themes	First-order themes	References	Quotes
Current Offering	Advantages	Serves Large Number of People	1	"...community composting can serve a larger number of people. The idea is that there will be no collection of bio-waste in the area; instead, there will be local treatment where disposal does not leave the place where it is produced, and we also have the advantage of producing compost that can be used on-site as well."
	Citizen Journey	Adoption	3	"...we are not able to capture the interest of others because, right away, we have a prerequisite that implies effort from the individual and that, for the majority of people, is a barrier."
		Awareness	3	"Those who like the environment, adhere to these things, but for those who don't care, it's very difficult."
		Continuous Use	3	"At first, it was mostly word-of-mouth promotion from one parish to another, so it was limited to the local area."
		Stops Using	3	"But at first, they reached out quite often because there were so many questions at the start of the project, and people really felt comfortable doing so. I think these days it's more of an occasional thing."
	Monitoring	KPIs	2	"In areas where bio-waste collection services are currently available—whether through selective door-to-door collection or community drop-off points—many of these people have given up on composting"
		Strategies	3	"We essentially have three metrics: service scope, which refers to where the service is currently available; adoption, which refers to who has actively agreed to receive the content...; and participation, which tracks who did and did not participate over a given period."
	Performance	Gains	3	"...First, LIPOR used to make site visits. Now, they're relying on phone calls..."
		Pains	3	"It seems to me that there was an initial wave of support from those who are most attentive, who are already concerned about these issues, and who therefore also sought out these initiatives to some extent as they were launched."
	Regulatory frameworks	PERSU	2	"In other words, once they find an easier and more convenient service, they no longer compost."
Innovation	Communication	Knowledge	3	"Municipalities have set targets in their PAPERSU plans..., a target for bio-waste, which is then broken down into a target for separation and a target for composting, in this case, for treatment at the source."
		Special	3	"At the same time, we are continuing to offer online composting courses. For those who want to join, for new participants."
	Economic	PAYT	3	"Home composting is currently intended for those who have a house with a garden; we provide the training and supply the composting bin, and they use it on their own for their family."
		Reward System	3	"But the commitment to environmental education that we've made over the years, right? And perhaps starting with the younger generations often yields some degree of success."
	Equipment	Composting Bin Characteristics	1	"Most people tell us that they don't even feel responsible for the waste. And so, changing this mindset is a bit tricky."
		Dehydrator	2	"People are asking us to strengthen enforcement and incentive measures so that those who aren't complying will start to do so. And I think this is proof that there is broad support among the majority of the population."
		Vermicomposter	1	"Now, how would I make a composting service appealing enough for people to want to use it? Honestly, I don't see how that could happen without other tools, financial incentives, or other types of rewards that might encourage people to participate more."
	International Standards	Belgium	1	"But keep in mind, when we were designing the composter, we also took the type of equipment into consideration. We wanted equipment that was eco-friendly, that would look good in gardens, and that was enclosed to keep out pests. So even when choosing the equipment, we thought about maintenance—ensuring it had good aeration so people wouldn't have to go in there and turn it over so often. So, we take the choice of equipment into account to make it convenient for those who compost, right?"
		Catalunya	1	"We are dehydrating food waste in schools because they have cafeterias, and because this equipment is large enough to require a continuous supply of waste in sufficient volume to make it worthwhile—they are large-scale systems."
		Italy	1	"Vermicomposting was intended for people who did not have access to soil; in other words, it was primarily designed for apartments or homes without outdoor space."
		Switzerland	1	"Culture and society are used to this model—it's nothing new, is it? We're in the midst of a transformation, a shift, but not there; the generations that grew up with this are adults now, so we're talking about a very different context."
	Planning	Region Specific Initiatives	2	"Catalunya is also a good example, at the European level, of different approaches to waste management, and they are quite well organized."
				"There was a clear incentive to remove waste from landfills in order to save money, because, essentially, treatment was so expensive that a huge gamble was taken."
	Policies			"And so, if people really start to realize—as is the case in Switzerland and other countries—that I pay for waste that has a greater impact. That's just how it is; producing waste is inherent to our activities. It will always be there."
				"Because I think there has to be a system that is tailored to the area and its residents. I can't implement a PAYT system in an extremely rural area where I don't have the collection capacity I need, I don't have the necessary infrastructure, and yet still expect people to pay for it. The service must then meet the expectations that are created and align with the taxation system that is established."

CITIZEN JOURNEY

One of the main results taken from these interviews was regarding the citizen journey, namely the awareness stage. It is in this stage that the experts' perspectives on what motivates and stops citizens from composting were placed. Their perspective falls in line with what was found in the literature.

One of the factors experts perceived as the biggest hindrance to the adoption of composting was the amount of effort it took. From their experience, if a sustainable act takes too much effort, citizens are less likely to take it up. One of the experts claimed, *"Everyone is very keen on the environment and sustainability – unless it involves a bit of effort,"* showing how even if citizens are conscious of environmental issues, the effort might be too big a hindrance.

The experts argued that this unwillingness to put in extra work, combined with the existence of a more convenient alternative, was the main reason behind the low adoption in Porto. While analysing the literature, it was also found that the existence of a door-to-door collection service could be a barrier to the composting adoption. Thus, the data gathered from the expert interviews corroborates some of the findings present in the literature (Rahman et al., 2025).

Another barrier identified in the literature and reported by the experts studied is the presence of pests or sanitation issues (Rice et al., 2025). The experts explained that the disgust of dealing with compostables is enough of a barrier to stop citizens from attempting it.

Finally, just as found by other authors, the lack of awareness and of composting knowledge are both mentioned in the interviews (Pierini et al., 2021; Fernando, 2020; and Kunszabó et al., 2022). The lack of composting knowledge was mentioned by two of the interviewees, highlighting the importance of educating citizens in order to raise the adoption.

"And when we look at the questions that are asked, we can see that there are significant shortcomings in terms of technical expertise and knowledge within our local authorities."

Regarding what might motivate the citizens to compost, the consensus was that environmental concerns are the biggest motivators, which was also verified in the literature by Loan et al., (2019). Two of the interviewees agreed that these concerns are the main motivations behind composting: *"This rapid adoption came from those people who are, naturally, most interested in these topics"*. Environmental concerns were also highlighted as being the reason for the fast initial adoption of the composting initiatives.

CURRENT OFFERING PERFORMANCE

As part of the final goal of designing a service, the experts were also inquired on the ongoing performance of their offerings and how they monitored it.

The monitoring of services is done based on three KPIs: Adoption Rate, Service Adherence, and Service Scope. Although the inquiry into KPIs is not something other authors in the literature have sought to know, it is relevant to the goal of this project. By defining and questioning these KPIs, this research provides the foundation for evaluating service success, guiding implementation, and ensuring that the service is designed to achieve measurable outcomes. These measurable and actionable guidelines are something that are not very prevalent in the literature, a gap that this project aims to address.

Through the interview with one of the LIPOR experts, it was also found that, as a way to monitor the continuity of participation in composting, there are some strategies being implemented. The two main strategies being utilised are door-to-door visits and, as of the present, phone calls. Door-to-door visits were found to be more accurate; however, it was highlighted that this strategy is highly labour-intensive.

Through these strategies, the experts were able to give a general description of the current performance of the service offering. One of the main issues found is cannibalization, as the selective collection service is gathering more participation than adoption. This once more proves the results found in the study of barriers, also found in the literature, that with a more convenient option, composting adoption lowers.

“We’re currently in a bit of a state of uncertainty, trying to work out where home composting will fit in now that an organic waste collection service is available.”

The cannibalization can also be explained through another factor discovered through the interviewing process. Two of the experts highlighted the need for initiative planning, something necessary as regulations have been changing, as seen in the European bio-waste report (*Bio-Waste in Europe-Turning Challenges into Opportunities*, 2020). From one of the interviews, one solution proposed by the expert was a geographical planning of initiatives: *“So we’re making the same mistake too, because there’s no proper planning here where we specify, for example, that people living on one street only have waste collection, whilst those on another only have home composting.”*

Another relevant finding is related to the channels used to conduct the mandatory training needed to participate in any composting initiative. The experts discovered that citizen satisfaction rose once training became asynchronous, mostly due to complaints regarding a lack of time. This finding exemplifies once more how convenience is a strong motivational factor for composting adoption.

INNOVATION

The inquiry of the experts’ perspective regarding innovative measures to raise composting adoption is one of the essential findings of this project.

With regards to incentivising adoption, economic incentives were the most frequently referenced ones. The PAYT system was mentioned as a possible way to incentivise through a more punitive approach, with the need for monitoring being mentioned as well. Through the interview with Maiambiente, it was also found that in Maia, where this system is being implemented, the overall citizen reaction has been positive. The interviewee from Maiambiente stated, *“But here, we feel that people generally have a positive view.”*

Within the economic incentives, all the experts agreed that a reward system could be implemented. These rewards could range from different prizes; however, discounts and monetary incentives were the most agreed upon. The discount initiative would be combined with the PAYT system by providing those who compost with a discount in the water bill.

“Right, we haven’t looked into anything yet; ... considering introducing a PAYT scheme into its charges – in other words, offering a discount to residents who have a compost bin.”

Lastly, two final suggestions that can work complementary are the need for planning and policies. Planning with regard to where each initiative should be implemented, so as to avoid

the cannibalization highlighted. And policies as a way of defining how much should be invested in each initiative, and defining protocols for composting.

5.2 Citizen Interview Results

The majority of the data was gathered from the citizen interviews, due to both the number of interviewees and the variety of the sample. As outlined previously, the data was compiled into three dimensions: Citizen Data, Complementary Services, and Citizen Journey.

The citizen data dimension was analysed in the previous methodology chapter, as there were no correlations behind the data collected and composting adoption.

CITIZEN JOURNEY

The majority of the data from the citizen interviews was placed in the citizen journey dimension. This dimension is also seen in Figure 1, which provides a visual synthesis of this journey, distilling the key codes into a diagram that illustrates the current and desired experiences across the Pre-Service, Service, and Post-Service stages. Each stage was thus divided into current, represented through three of the subcodes (barriers, motivations, and context), and desired, as a way to compare how the citizens report the journey is at the present time and how they wish it were.

Figure 1- Citizen Journey

Composting Types: Home Composting; Community Composting; Urban Garden Composting; Informal Composting; School Composting						
	Pre-Service			Service		Post-Service
Barriers	Awareness	Training	Obtaining the Composting Bin	Bin Size Lack of Composting Knowledge Community Bin Selective Collection Training is not specialized enough		Lack of Composting Bin
	Lack of Composting Knowledge	Online Training	Lack of Space Need more bins			Lack of Time
	Do not care Too much Work Lack of Time Lack of Compost Disposal Place					No longer having a garden
Motivations	Benefits the Community			Interest in Composting Using the Compost		
	Personal Benefits Managing Waste Being from the Countryside Environmental Concerns					
Context	Actors	Artifacts	Systems	Actors	Artifacts	Artifacts
	Service Provider	Composting Bin Garden	Training	Citizens Schools Service Providers	Composting bin Compost Waste	Garden Composting Bin
Desired	Communication Schools Municipality Social Media Environmental Impact of Composting Transparency of Compost Usage		Economic Incentives Discount in Water Bill PAYT	Community Activities More Green Spaces or Community Composting Bins		Wants to Compost Again
	Convenience Composting Bin Distance		Initiative Planning Pro-Composting Education Starts Composting	Gamification Point System Plants and Seeds Produce		Composts over Selective Collection

In the figure above, the different stages of the journey, as well as the current and desired journey, can be visualised. In the Pre-Service step of the journey, the barriers are divided into three stages of the step: awareness, training, and obtaining the composting bin. This was done in the barriers subcode, as there were barriers related to these stages. The same cannot be seen in the motivations subcode, as no relevant motivations were identified with these stages.

In the context subcode, all three steps of the citizen journey display what elements of the context are associated with them: actors, artifacts, or systems.

In the desired section, there are three blocks color-coded. These colours correspond to the components represented in the service system (Figure 3), presented in the Service Design chapter of this project.

The first block, coded green, corresponds to the Communication section in the Pre-Service step. This relates to the Environmental Impact of Composting section of the service system.

The second block, orange, corresponds to the Community Activities code from the citizens' interviews. In the service system, this connects to the competition component of the service.

Finally, the Gamification code represented by the blue block, which corresponds to the Point-Based Reward System of the Service System, later analysed in chapter 6.

PRE-SERVICE

The first stage of the citizen journey corresponds to the pre-service, which is where the citizen has the first contact with the service (Table 3). It is in this stage that the citizens described what motivates or stops them from composting.

Table 3- Pre Service Data Structure

First-order themes	Second-order themes	Third-order themes	C References	NC References	Quotes
Current	Barriers	Knowledge-Behavioural Barriers	7	7	"And I spend some time sorting things out, so if people aren't willing to do that, it still takes us some time. "
		No need for compost	1	2	"Because if people really don't need fertilizer, making compost at home is kind of pointless, isn't it?"
		Operational Barriers	4	6	"To be perfectly honest, I think it was really the extra work it would entail—that is, the extra care needed to sort things properly, put them in the right place, or have the right container, and then figure out what I was going to do with it all."
		Pests and Sanitation	8	5	"I don't like having trash in the house. And if I could, I'd take the trash out almost every day... If not, it starts to smell bad, I don't like it."
	Motivations	Resource Limitations	12	9	"So, it's just a matter of seeing if I have time, and maybe one of these days I'll get back to doing that."
		Community	10	5	"But if I knew that doing this would benefit the municipality, I wouldn't mind doing it at the community composting site."
	Context	Individual	14	8	"I think for the sake of the environment, I think for our sake, for everyone's sake, for the sake of planet Earth—I think we should do it." "But I don't think people would want to compost if they didn't see any benefit in it for themselves, right?"
		Actors	0	2	"I'd say a letter or a flyer or something like that in the mailbox"
		Artifacts	7	2	"If we had a house with a garden, we'd probably already be doing it on our own. We'd set it up and do it there, for sure, right?"
	Stages	Systems	0	2	"Well, if I received the proper training and also had the means to do so."
Desired	Awareness	Obtaining the composting bin	3	0	"And then I'd also heard about it—I'd heard of Lipor back then—and that was it; we decided to buy a composter so we could have that convenience at home too."
		Training	14	0	"Lipor organized a series of courses on composting and organic farming."
	Convenience	Awareness	14	9	"I've been familiar with the urban garden project for a long time; in fact, I think I even knew about it before LIPOR was established." "LIPOR also visits schools and encourages students, and this initiative was carried out by LIPOR as part of its school program."
		Communication	13	9	"But for example, one thing that might be interesting is for LIPOR itself to offer to provide schools—perhaps through the local municipalities—with compost bins and to promote composting"
	Incentives	Pro-Composting Education	12	7	"Perhaps more publicity—not through flyers, but through social media." "...raising awareness of what it is, why it exists, and the benefits it offers—whether environmental, such as preventing waste from ending up in landfills or being incinerated, or simply using it to plant some potted plants."
		Compost Collection	1	0	"...extending this practice might encourage people even more, since they wouldn't have to leave the house—they could just leave it at the door on the designated days."
		Composting Bin Distance	9	8	"I think there always needs to be easy access to composting bins. If it's something that causes inconvenience in people's daily lives, they won't use it."
	Initiative Planning	Waste Separation	1	0	"You don't have to sort anything, do you? Because recycling also includes bones and processed food scraps, and maybe that's why."
		Composting Bin Offer	3	4	"...I think that giving someone a compost bin is already half the battle, isn't it? "
	Monitoring	Economic Incentives	15	9	"If someone living in a house composts at home and can prove they're doing so, and if they get a discount—even if it's just one euro a month on their water bill—because they're producing less waste, they'll do it."
		Waste Bin Offer	2	0	"...if they didn't give them the bucket, they wouldn't bring it. When the bucket broke because they didn't give him a new one, he stopped doing it."
	Starts Composting	—	6	3	"And in areas where it's already clear that people have been encouraged to compost at home or take their organic waste to a community composting site, so to speak, perhaps in those areas we could start to scale back at-home waste sorting or selective collection."
	Starts Composting	Identification of Waste to the Individual	2	0	"So you'd know that that customer was composting, right? And that customer would get a discount on their bill, for example."
		—	1	6	"Maybe, but once I saw some tiny compost bins—I don't remember where, in some store or another. And it would be interesting to make them. Because it makes perfect sense."

Current Journey

Within the barriers, citizens put special emphasis on time and space limitations. Citizens claimed that a busy lifestyle can be a hindrance to composting, as they believe composting would take a significant part of their day, especially in the case of community composting. One citizen explained that living in an urban area, it is difficult to have proper space by claiming: *“Well, here in the city it’s a bit tricky too, isn’t it? Because, I mean, most people live in flats, so there’s no way around it, is there? There’s just no way.”* Just as having a proper space to place the composting bin is a requirement set by LIPOR for those who wish to compost, citizens also see this as a prerequisite to adoption. Both these barriers confirm what was found in the literature regarding the lack of time and space (Wu et al., 2019; Kunszabó et al., 2022).

Just as shown in the literature and perceived by experts, sanitation issues also arise among citizens (Rice et al., 2025). The main barrier being the expected smells, as citizens understand the decomposing of organic waste as a process with unpleasant smells.

These barriers, together with the fact that citizens claimed that composting was too much work, show once more the importance of composting education. As seen in the literature and from the experts’ interviews, the lack of composting knowledge serves as an umbrella barrier that encompasses others (such as perceived lack of time and amount of work (Loan et al., 2019)

Concerning the motivation behind the adoption of composting, there are two main dimensions: Community-based motivations and individual-based motivations.

Through the interviews with citizens, it was found that some took up or would take up composting if it meant it could bring a sense of community. Some citizens who currently do not compost affirmed that they would consider starting if their compost could somehow benefit the community (e.g., being used in public parks).

“But if I knew that doing this would benefit the local council, I wouldn’t mind doing it at the community compost bin”

The creation of a community through composting was also mentioned in various interviews. Citizens believe the community could create a sense of accountability, while also motivating them to participate. The creation of a composting community also helps overcome knowledge barriers, as some might be more well-versed in composting than others.

The individual-based motivations are all the ones that are exclusive to the individual. The main motivations associated with this section are related to environmental concerns and waste management. One of the citizens stated that environmental concerns are something that should be generalised: *“I’ve always been interested in environmental issues. And I think these are things we really ought to do”*.

Environmental interest is a motivation that is not only mentioned in the literature but also in the experts' interviews. This highlights the importance of this motivation, which so far proves to be the biggest incentive to compost.

The existence of a garden and making use of the compost produced also surge together as motivational factors. This also falls in line with a desired complementary service (Table 4), which is the compost collection service: *“Or then again, I suppose, seeing someone who would collect that compost we produce in some way, I don’t know”*. This means citizens wish for two options: either using the compost in their personal garden and gathering benefits from it, or having their compost used somewhere else that can benefit the community.

Table 4- Complementary Services Data Structure

Aggregate Dimension	Second-order themes	First-order themes	C References	NC References	Quotes
Complementary Services	Current	Recycling	6	1	"I usually sort all my trash anyway, so the only thing left is food waste"
		Selective Collection	11	7	"As the daily collection comes around, I see that every house has trash bins out front, which means that everyone—in one way or another, for better or worse—is sorting their trash. In other words, it's become a more widespread practice here in the neighborhood."
	Desired	Composting Bin Delivery Service	0	1	" At my house, it was nice to have it delivered. It was great not having to go out and worry about it—that would be a real plus."
		Compost Collection Service	2	2	"If someone from LIPOR comes here to pick it up or uses it for X amount of time... I think it would be a win-win—in other words, I'd be able to get rid of what I produce at home, knowing that it would be beneficial to another place."
		Compost Building Service	0	2	"Because of the order—I don't know what—you just sort them out, and then someone else puts them in the right place "
		ShareWaste	1	1	"...because there used to be a very interesting platform called ShareWaste, but it has since shut down...Through the platform, people could get in touch with those who had compost bins to decide whether or not to share their organic waste."

The majority of those interviewed, both citizens who compost and those who do not, were also aware of the existence of composting as a sustainable organic waste management practice. This awareness mostly came from LIPOR's communication effort, especially in schools. Most of those who already compost had also learned about composting through the urban gardens project. This interest in the projects shows that, once more, if there is a usage of compost, and citizens can gather benefits from it, they are more likely to adopt it.

Just as many citizens got their knowledge about composting from the urban gardens project, many also knew about it from living in the countryside. Quite a few citizens who were or had family from the countryside were familiar with informal composting, where the waste is placed in a pile and left out to decompose outside. This goes to show that environmental education in childhood, either in school or through family, may lead to higher adoption rates.

Desired Journey

Raising the awareness of composting as a sustainable organic waste management method was the most referred desire from the citizens. The interviewees put special emphasis on educating the population on the process and benefits of composting, as was found in the literature (Nguyen et al., 2022). This emphasis can be seen with a quote from one of the interviewees who believes education is more important than incentives: *"I think that, at the very least, information should come before incentives"*. Regarding the channels for this communication, social media was the most mentioned due to its wide reach and appeal. In terms of who should conduct this education, the main actors mentioned were schools and municipalities, highlighting the need for education when younger and the responsibility governments have when educating the population.

From the interviews, it was found that even those who live in apartments would consider composting if it were in a community bin. However, they emphasize the convenience factor, especially regarding the distance of the composting bin to their home.

Finally, another factor citizens mentioned often for raising the initial adoption of composting was the need for incentives, especially economic based ones. Just as it was found through the interviews with the experts, the PAYT system serves as a possible incentive through the punishment of those who do not compost. Complementarily, discounts on the water bill are also referred to as possible motivators to start composting

"If there were a reduction, for those who have a compost bin and compost regularly, I think such a reduction in these charges might eventually be of some help."

Possible discounts in businesses to those who compost was also mentioned as a possible incentive, as the reduction of the water bill might not be a significant value. From the interviews, quite a few citizens were interested in discounts in supermarkets, as these products are the most practical. This type of partnership would have to be further studied by the service providers.

SERVICE

The second stage of the citizen journey corresponds to the service stage, where the citizens interact with the service offerings (Table 5). In this stage, the citizens described what motivated them to keep composting or the pains they experienced, as well as how the composting process was carried out.

Table 5- Service Data Structure

First-order themes	Second-order themes	Third-order themes	C References	NC References	Quotes
Current	Barriers	Composting	5	0	"...but no one ever asked me what could be changed or what I thought could be improved."
		Selective Collection	1	0	"The thing is, sometimes they go a whole month without getting any trash picked up. And things start to decompost inside."
		Training	3	0	"And perhaps that aspect could be explored further in this training, with a more hands-on component. Or maybe we could provide case studies and examples to show that, while this works well in theory, it might need some adjustments in practice."
		Urban Garden	5	0	"In the past, LIPOR encouraged the use of compost bins in every garden. Right now, they're moving away from that policy, and I don't know why."
	Motivations	Interest in Composting	2		"And then I think it's really cool how we toss the vegetables and scraps of raw food in there, toss them in, and after a while, soil starts coming up."
		Using the Compost	7	0	"The fact that I enjoy gardening. And I really make good use of the compost to improve the quality of my potted plants here, as well as the vegetable garden and the little plants we have over there."
	Context	Actors	10	1	"Well, there's always that initial adjustment period, because sometimes the dry ones aren't... We're figuring things out as we go, aren't we? You have to use a certain amount of the dry ones."
		Artifacts	13	7	"Now that there's a collection service for green waste, for example, I don't even put that kind of thing in the composter anymore."
	Stages	Composting	15	9	"I try to do it as often as possible, because that's what I was taught back then. I try to do it... If not every day, then every other day."
Desired	Community Activities	Expand the Urban Gardens Project	5	2	"There would be more urban gardens, and then one thing would lead to another, wouldn't it? If people had a small plot in their garden, that would encourage them to try this kind of composting, or else they could use those community compost bins and then benefit from them as well."
		More Green Spaces or Community Compost Bins	9	6	"So, I think the infrastructure itself needs to be in place to facilitate the service—whether through community composting initiatives, like the one I was just mentioning, which I think makes perfect sense—but also so that people can put it to good use."
		Neighborhood Leader	1	0	"This idea of a neighborhood leader might be an interesting concept for cities—I'm not sure. And it could fit in with the task of maintaining a community compost bin and putting it to good use, right? "
		Public Garden Composting	2	0	"...only if there were compost bins in some gardens... and then the media reporting that there's a compost bin in Garden X."
		Street Cleaning	1	0	"A few years ago, I saw a news report about Portuguese people around the world. It featured a Portuguese man living in Japan who said that the street was kept clean by the people who owned shops there or lived along that street."
	Gamification	Point System	11	9	"Maybe keeping track of how much compost is produced each month or year—and sometimes there could even be prizes for those who compost the most, I don't know. Yeah, some kind of competition" "Either that, or perhaps the municipality could have a market or a store where these discounts could be applied and made available by the municipality" "The points could also be—as long as they were things—they'd have to be something really worthwhile, right? Something people would actually think is worth it, right?"
	School Activities	School Gardening Club	1	0	"So I think clubs generally operate in a more informal way, and I think they're usually a good way—at least to get kids started in certain areas."

Current Journey

One of the main pains described by citizens was from those who composted in the urban garden. They expressed discontent over the fact that the garden they frequented had a community composting bin rather than individual ones. With this complaint, it is possible to see a distinction between different citizens, those who prefer community composting and those who prefer to do it individually.

Additionally, some citizens commented on how, at first, they had some issues when they started composting. One citizen explained that the initial starting period had some trial and errors: *“Right, there’s always that initial settling-in period, because sometimes the dry ones aren’t... We’re finding things out as we go along, aren’t we?”*.

The interviewees advanced that they perceived the current training as lacking in the practical aspect, which led to these difficulties. Within the composting process, there were also some pains surrounding the composting bin design and how it has not changed recently.

Regarding the motivations to keep composting, citizens stated two main motivators: interest in composting and making use of the final compost product. Once more, having a final destination for the compost is mentioned, highlighting the importance of this motivation. This goes to show how education regarding composting benefits and destinations can help raise the adoption and maintain citizens' loyalty to composting.

“And I save money because I don’t buy fertilizer. I make my own. Now, if I didn’t have a back garden and a vegetable patch, I wouldn’t make compost. That’s for sure.”

Within the composting process, many interviewees claimed the ability to adapt when composting so as to maintain a certain compost quality standard. Citizens claimed to be able to separate the greens and browns¹ to put in the composting bin, and separating the organic waste at home before putting it in the composting bin. Finally, the most common use for compost is either in the citizens’ personal garden or the urban garden, showing they understand the benefit of natural fertilizers and enjoy the produce that results from the process.

Desired Journey

Within the desired section of the service stage, citizens expressed a desire for two main initiatives: community activities and gamification.

For the community activities, the most referenced one was the expansion of the community composting initiative: *“I think the community aspect is much more fun, because you end up interacting with people and building a certain rapport with them”*. This was especially common among the citizens who live in apartments, showing once more how, even without an appropriate space, they are willing to compost. The request for this expansion was so that there would be more community composting bins within the city. This expansion also emphasises

¹ Waste placed in the composting bin needs to be alternated between carbon-rich waste (browns) and nitrogen-rich waste(greens)

the impact convenience has on composting adoption. Once more, a shorter distance from the composting bin may motivate citizens to start composting, for the simple reason that the bin is available and close to their home.

Finally, the other initiative that gathered the interest of citizens was gamification. Through this gamification, interviewees suggested the existence of a point system that would allow them to exchange points for rewards.

The rewards citizens wish to get fall into two main categories: either discounts in businesses and events, or receiving organic produce and gardening essentials. The discounts in businesses are the most widely requested rewards as they are more practical and have greater usability: *“General discounts, for example, if we’re talking about, say, supermarket chains, for instance, I think it would have a greater impact if it were supermarkets”*. The produce and gardening rewards were mostly requested by those citizens who enjoy gardening and prefer more natural benefits.

Within the gamification initiative, some citizens also expressed interest in being informed of how their composting is benefiting the environment. This reminder of the actual impact composting can have on the environment, together with the point system, is a way to not only get citizens to adopt composting but to stay loyal and consistent.

POST-SERVICE

This stage in the citizen journey corresponds to what the citizens do once they stop interacting with the service (Table 6).

Table 6- Post Service Data Structure

First-order themes	Second-order themes	Third-order themes	C References	NC References	Quotes
Current	Stop Composting	Lack of Composting Bin	1	0	"And then that (compost bin) ended up breaking, and I wasn't really in the habit of using it."
		Lack of Time	1	0	"But then there were those things we kept putting off. There are always other things to do, so we keep putting them off."
		No longer having a garden	0	1	"Yes, but then I had to give up the (urban) garden, so when I gave up the garden, I stopped composting."
	Artifacts	Composting Bin Garden	1 0	0 1	"And then that (compost bin) ended up breaking, and I wasn't really in the habit of using it." "Yes, but then I had to give up the (urban) garden, so when I gave up the garden, I stopped composting."
Desired	Composts Over Collection	—	3	0	"So, if there were that much, well, yes, but I don't think there would be that much waste, even though we do use quite a lot of vegetables and such here at home. Still, I don't think there would be that much excess waste to put in the organic bin, so I'd probably just compost it and leave the organic waste as is."
	Wants to Compost Again	—	1	0	"I sometimes see compost bins for sale and think, 'One of these days I'll start again, I'll look into it again,' because maybe, in the meantime, there's a lot more information out there—and up-to-date information, I don't know, right? Things change, knowledge changes, and seeing that makes me think, 'One of these days I'll buy one again and give it another try.'"

Current Journey

From the interviews conducted, it was found that two of the citizens used to compost but no longer do. One of the residents explained that the reason behind no longer composting was that they were no longer a part of the urban gardens project, where they used to compost.

“Yes, but I then had to give up the urban garden, so when I gave it up, I stopped composting.”

The other citizen explained that, once their composting bin broke, combined with the lack of time and interest of the family, they ended up not continuing the composting process. However, once more, this citizen also displayed an interest in going back to composting, should they have the resources and time.

“But then there were those things we keep putting off. There are always other things to do, so we keep putting them off.”

Desired Journey

As mentioned, one citizen claimed they would like to compost again, provided they informed themselves once more on the composting process and collected the necessary artifacts, such as the composting bin.

“I sometimes see compost bins for sale and think, one of these days I’ll start again, I’ll get back into reading, because perhaps, in the meantime, there’s a lot more information out there – and up-to-date information, I don’t know, isn’t there?”

Finally, three citizens affirmed that, once they started composting, they would prefer it over the selective collection initiative. This information is especially relevant considering the cannibalization issues confirmed by the experts. This goes to show that, even with more convenient options available, some citizens still prefer composting over other organic waste management methods. This finding goes against the current literature and what the expert claimed, that with an easier alternative, citizens would prefer it over composting HC (Rahman et al., 2025). This proves that there should be further study into this to see if these findings are the exception or if there is a significant portion of the population that prefers composting above all else, and the motivation behind this.

6 Recommendations

This chapter is focused on explaining the service design based on the data gathered from the interviews. The design of the service includes three main schemes: a Storyboard, which explains the idea behind the service and how citizens might interact with it; a Service System, which is an example of a service interaction from the citizen; and a Blueprint, which provides a deeper look into one of the interactions within the service system.

Furthermore, this chapter also aims to provide some recommendations that can improve the current service design or be used to design other services. Compiling the answers into recommendations also helps future service designers understand what citizens find valuable and motivating.

6.1 Service Design

The service designed for this project is a smartphone application, with features that directly reflect the needs and preferences expressed in the citizen interviews. As gamification was one of the most mentioned initiatives, this will be a core aspect of the service design.

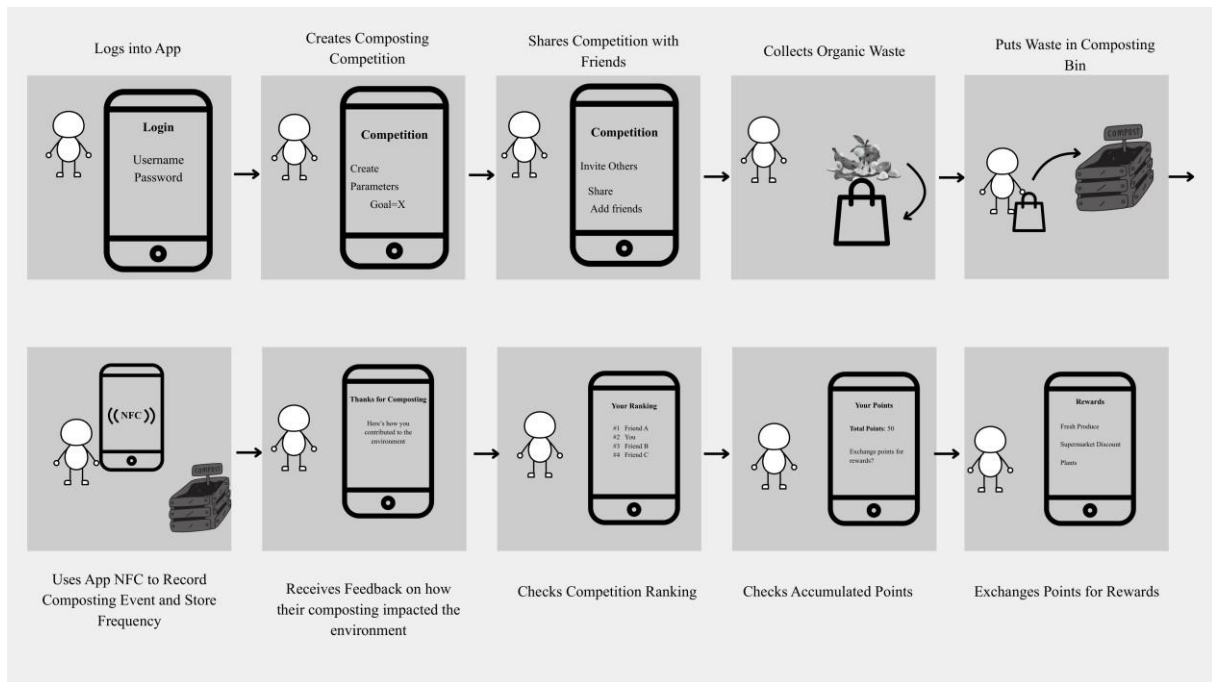
The provider of this service should be the main organization responsible for organic waste management of the place where the service is implemented, in Porto it would be LIPOR. Such organizations are well-positioned for this role due to their established community presence, strong ties to local municipalities, and deep expertise in composting requirements. Additionally, they are likely to be the least biased service providers, as their primary mandate is waste management rather than promoting private sector interests.

The existence of a point system that could be exchanged for rewards was also highly requested. This would be one of several gamification features, alongside competitions and social challenges, that citizens expressed interest in. Together, these gamification elements provide a holistic solution that appeals to the majority of citizens. A smartphone application would be a practical way to implement these features, as most citizens already own a smartphone.

However, the mobile application may pose as a barrier to those who are not as digitally literate. This, just as was found through the mixed perceptions discussed by the interviewees, goes to show that no one solution can be appropriate for the whole population. Just as initiatives should be adapted to different geographical locations, as seen in the experts' interviews, services need to be compiled of various options to serve a wider population.

Storyboard

Figure 2- Storyboard



The creation of a storyboard is an example of experience prototyping (Fisk et al., 2013), which is a way of testing the service experience through a visual manner. This tool is a low-fidelity way of how the citizen might interact with the service designed; in this case, the service is connected to a mobile application.

In the storyboard presented, there are five main interactions presented: Logging into the app, creating a competition, composting waste and recording the process, visual representation and reminder of environmental impact, and verifying the points accumulated and rewards.

The login activity is a standard practice in any phone application, where users need to verify their identity to access their account. These personal accounts are a way to ensure the points are strictly contained to a singular user and are not transmissible.

The competition activity is based on two main concepts: the community-creation aspect that citizens requested, and a loyalty ensuring perspective. The creation of a competition with others (such as friends or family) can allow citizens to feel connected when composting and part of a community. Additionally, participants in the competition can hold each other accountable for composting, ensuring a more consistent participation. This aspect of the service is a way to keep motivation to compost, even after the initial adoption process.

The visual representation of the impact of the composting action is also a way to motivate citizens to be consistent in their composting. From the analysis of the interviews, it was discovered that citizens would be motivated to keep composting if they were reminded of their positive impact on the environment.

Complementarily, although not depicted in this storyboard, citizens who expressed interest in community composting also wished to know the final destination of the compost produced. A possible solution for this desire would be the tracking of compost bags collected from the community composting bin and the subsequent representation of this on the mobile app.

The more technical aspect of this application is the recording of the composting frequency. Citizens can use their mobile phone, combined with the composting bin, to record each time they place waste in the composting bin.

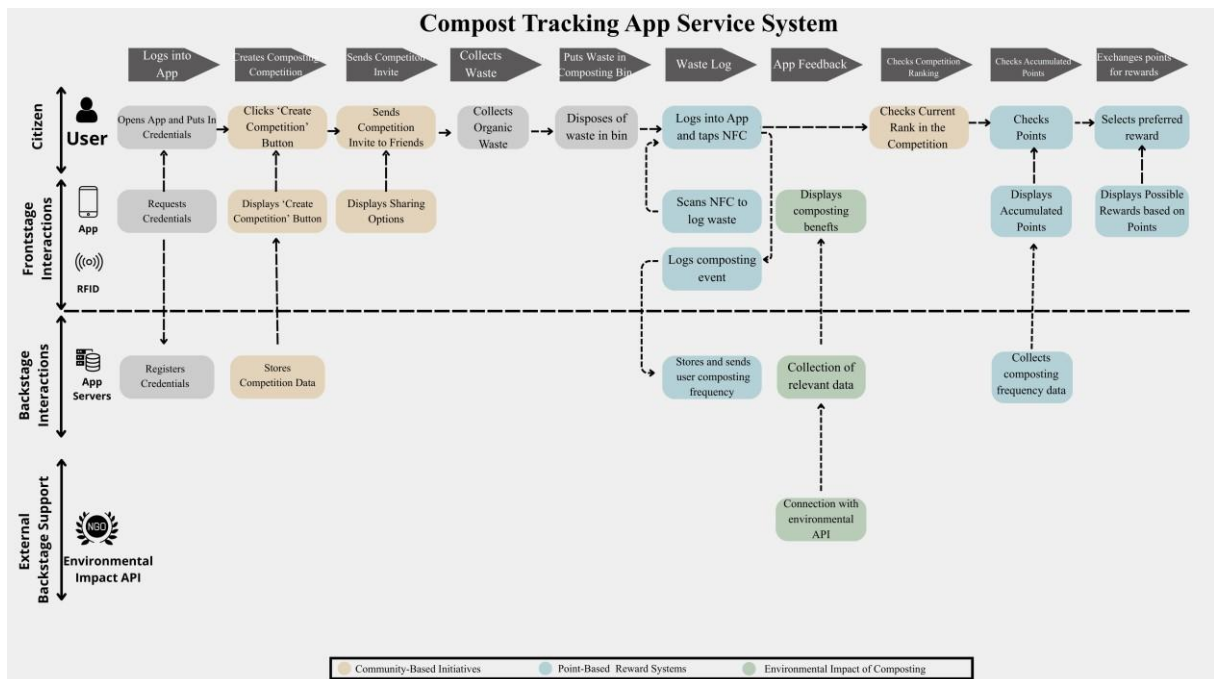
The composting frequency is what allows citizens to accumulate points that can be later translated into rewards. For this design, frequency was considered the best method of point accumulation; however, weight was also considered as a measuring factor. Because the focus of this project was simply the design of a theoretical service as a possible solution to the qualitative study conducted, these measuring options were not properly tested.

If alternative measurement methods prove to be more effective, the point system can be adapted accordingly. The study and testing of more practical aspects of this service should fall to those who wish to implement it, as this is merely a theoretical suggestion based on the data gathered and analysed.

Finally, the last activity depicted in this storyboard is the point system and associated rewards. The rewards and points needed to achieve them should be defined by the service provider in accordance with the reality of where the service might be implemented (e.g., economic reality). From the analysis of the interviews, the rewards most requested by citizens were discounts in businesses and events in the area, or gardening materials (e.g., seeds and plants) and produce.

Service System

Figure 3- Service System



The design of a service system implies a holistic design that combines a mix of the service offering and interfaces that support the service (Fisk et al., 2013). The service system created is based on the storyboards designed. In this service system, the different citizen requirements mentioned in the interviews were color-coded to help with visualization.

This service system is separated into frontstage and backstage. In the front stage, there is the citizen section, where the citizen is referred to as “user” and where their actions are represented.

Moreover, in the frontstage section of the service system, there are frontstage systems such as the mobile application and the RFID of the composting bin.

The backstage is also divided into two sections: backstage interactions and external backstage support. In the backstage interactions, the system represented is the mobile application services, which store all the data from the app. In the external backstage support, it is represented with an environmental impact API. The connection with this API is so that there is a way to provide users with the information regarding their impact on the environment from their composting actions.

Through the design of the service system, the interactions between actors and systems become clearer. It also allows for a better understanding of where citizen participation is required and where it is not.

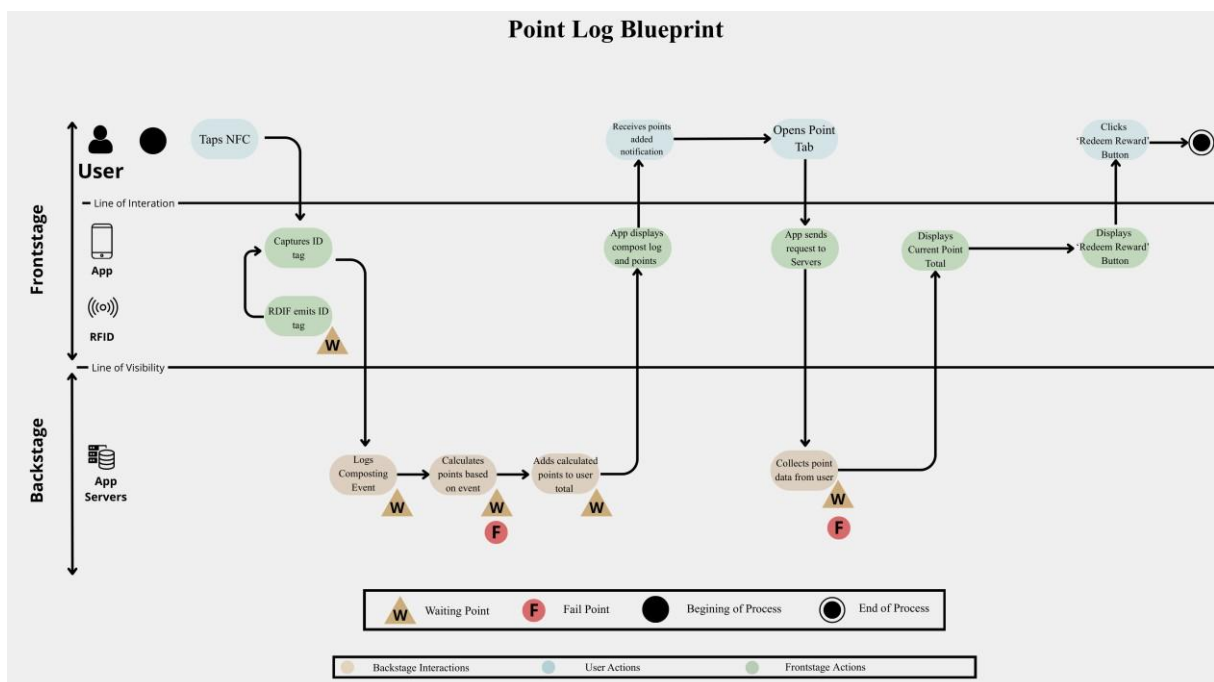
For the login in and the actual act of composting, the citizens are required to provide a higher degree of participation. Without citizen participation, these actions would not occur, explaining once more how citizens are the central aspect of service design.

For the community initiative and the point system, while citizen participation is essential, there is also a high density of backstage interactions. This illustrates how, for these actions, the service is not fully dependent on the citizen but on factors that are more easily controlled, such as hardware and software.

Finally, the environmental impact notification is automatic once the composting action has been logged onto the application server. Here, the citizen is not required to directly interact with the service of the interface. However, if the notification is not interesting to the citizen, they might not read it and simply dismiss it. This might mean that the service failed in providing this experience that was seen as motivational through the interview analysis.

Blueprint

Figure 4- Blueprint



The action selected to map out through a blueprint was the logging of points through the mobile app. The point system was one of the most referenced initiatives analysed in the citizens' interviews, making it valuable to understand and map out.

Service Blueprinting is a visual representation, in the form of a diagram, that maps the key activities within a service delivery while distinguishing between frontstage and backstage components (Patrício et al., 2011).

For the design of this blueprint, the interaction was divided only between frontstage and backstage, as there was no need for external backstage interactions. The frontstage is once more represented by the citizen, or user, as well as the mobile application and RFID within the composting bin. The backstage is composed solely of the mobile application's servers.

Within this blueprint, there have been identified failure and waiting points. Only one waiting point was identified in the frontstage, which happens while the NFC scanner reads the RFID tag in the composting bin. This was identified as a waiting point, as it might take a while for the smartphone to properly read the RFID. In this scenario, it is important to display messages assuring the citizen that the reading is in process to keep them engaged and knowledgeable of the ongoing process.

The four remaining waiting points and two fail points identified were all identified as being part of the backstage. The waiting points are associated with the logging, collection, and calculation of points that the citizens acquired from a composting activity. This process might take some time due to the need to process the data collected and translate it into points for the user. Once more, the need to assure citizens that the action is in process is essential for their satisfaction and engagement with the activity.

The two fail points identified are once more associated with the amount of points the citizen has accumulated. The first possible fail point is that the calculation of the points obtained might be incorrect. This reveals that there needs to be a deeper study into these technologies and important alternatives should they fail. This fail point is essential to customer satisfaction, as the accumulation of points might be the main motivation behind composting. Moreover, the collection of the accumulated points from the citizens is also a possible fail point. Should there be any issue with this step in the process, the citizen might believe they have more or fewer points than the reality. This type of uncertainty also negatively affects the citizen experience within the service, highlighting once more the need for alternatives in case of failure.

Through the analysis of this blueprint, fail and waiting points were identified. This identification and subsequent prevention are essential for citizen satisfaction, which is the key factor for loyalty to participating in composting.

6.2 Recommendations

In this section, a list of recommendations will be provided so that future organizations that might want to develop or use the service designed may do so in the most appropriate manner.

It is important to preface these recommendations with a reminder that each situation is unique and must be studied beforehand. The implementation of a service anywhere needs to be prefaced with the study of the environment and the stakeholders involved. Moreover, various solutions need to complement each other to reach a holistic solution that can appease and motivate the citizens who compost.

While Porto is an example of an urban city and has similar characteristics to others around the world, it is still important to study the stakeholders involved. Moreover, citizens of Porto, thanks to LIPOR's efforts, are able to easily gain access to composting bins, surpassing one of the barriers identified in the literature.

The interviews conducted provided different ways of motivating citizens to take up composting. One of the findings believed to be the most relevant is the convenience of the practice. The experts explained how, from their point of view, citizens are not willing to put a lot of work into composting. Complementarily, citizens' interviews displayed how convenience in forms of accessing the composting bin is essential for motivation. By facilitating access to composting bins and normalising the act of composting, this might become a more widely adopted solution.

As was explained in the description of the service designed, this solution might not be the most adequate for those who are not technologically literate. A solution recommended by citizens in the interviews was the addition of a composting bin in nursing homes. This is a way of turning nursing homes into a more sustainable place and engaging the occupants in outdoor activities.

Complementarily to this solution, citizens emphasised the importance of disseminating information regarding the practice and benefits of composting in schools. This can be done through school trips to the main waste management organization and, for those schools that have the space, the placement of a composting bin on the premises. The promotion of composting in schools is a long-term plan that generates future citizens who are more environmentally conscious and who see composting as a routine and normal practice. Moreover, students might convince their families to take up composting, thus raising the adoption rate.

In Porto, school trips to LIPOR already happen, something that was mentioned by some citizens who do not compost but are aware of the practice. The existence of these school trips can explain why environmental concerns are such a prevalent motivation for citizens, as they have been educated on environmental issues from a young age. However, as composting adoption is still not generalised, this education must be more thorough and insistent.

Concerning the community composting initiative, citizens also expressed the desire to know the destination of the compost produced. This transparency regarding the compost usage makes citizens feel more involved in the process and thus more motivated to continue.

The transparency of compost usage could either be associated with the smartphone application designed in this project or a plaque displayed near the community composting bins. A visual reminder of the environmental impact of composting, combined with information about where the compost is used, can strengthen citizens' connection to the action and sustain their motivation. The most efficient solution would be a plaque next to the community composting bin, as citizens would see this information each time they deposit their organic waste.

As one of the rewards mentioned by the citizens is receiving produce in exchange for composting, a possible solution is establishing a connection between community composting and local farmers. This was suggested by one of the experts during the interview, who believes this might be a solution that benefits both farmers and citizens. Additionally, one of the citizens interviewed was knowledgeable about the reality of farmers in the area, and also agreed that this might be a profitable solution, as farmers spend high amounts of money on fertilizers. By providing farmers with this compost, they can save on fertilizers, benefit from organic farming solutions, and, with what they save, they can then provide produce or discounts on produce to those who compost.

7 Conclusion and Limitations

This project aimed to design a service capable of increasing composting adoption rates. The motivations behind this goal stem from environmental and public health concerns surrounding municipal solid waste, of which organic waste is the largest fraction. Although composting is a sustainable way of managing organic waste, its adoption remains low, highlighting the need to identify factors that can promote its adoption.

To achieve this goal, a qualitative methodology was employed, grounded in the service design framework. The analysis centred on semi-structured interviews with two stakeholder groups: experts (from LIPOR and Maiambiente) and citizens residing in the Porto area (those who compost and those who do not). The interviews sought to identify the barriers and motivations influencing composting adoption, to map the citizen journey, and to gather perspectives on potential service innovations capable of enhancing adoption rates.

The collected data were analysed using the NVivo software and yielded several key contributions: a comprehensive understanding of barriers and motivations behind composting adoption; a set of Customer Experience Requirements (CERs); and a citizen journey mapping current and desired experiences of citizens. These insights were then used to design the service proposed in this project, which centres on gamification.

The proposed service, a smartphone application, encompasses features that address both citizen needs and identified barriers, such as a visual representation of composting's environmental impact. Additional functionalities include a points-based reward system and competition-based events aimed at cultivating a sense of community.

The project concludes with a set of theoretical implications and recommendations for future researchers and service providers. This is consistent with the iterative aspect of the service design framework.

THEORETICAL IMPLICATIONS

This project set out to design a service that aims to raise the adoption rate of composting. This design was based on interviews conducted with two main stakeholder groups: experts and citizens. The interviews resulted in a deep understanding of the barriers and motivations behind the adoption of composting. Complementary, the results allowed for a compilation of the journey citizens experienced or wished to experience during the composting process.

The barriers and motivations found aligned closely with those found in the literature. One of the most relevant barriers found was the lack of awareness of the existence of composting as an organic waste management practice. Just as awareness is a strong barrier, the lack of knowledge regarding the composting process is also an obstacle to adoption.

Education regarding the process and benefits of composting is essential to raising the adoption rate. The education of citizens can help dispel some perceived barriers, such as the existence of smells or the amount of effort it takes to compost.

The Customer Experience Requirements found through the analysis of the citizen interviews were not documented in the literature. The most frequently cited one being the need for transparency regarding the destination of compost. This suggests that citizens find themselves more willing to participate if they feel included in the process and informed of the outcome of their efforts.

The presence of training prior to composting is also something citizens found invaluable. While the literature acknowledges knowledge gaps as a barrier, it does not describe how free, accessible training, such as that offered by LIPOR, can effectively overcome this barrier. Meaning, this initiative is essential for composting adoption and should be more widely implemented.

The willingness and request for composting in a community were also not expected from the analysis of the literature. Given the highly urbanised context of the studied area, the expectation was that the majority of citizens would rather compost alone at home rather than in a community bin. However, because of said urbanization, most citizens live in apartments and do not have the proper space to hold a composting bin. This shows that by making composting accessible to citizens, most of them would manage their organic waste that way, highlighting the need for the expansion of the community composting initiative.

RECOMMENDATIONS

The analysis of the citizen journey also allowed for an understanding of what could lead a citizen to stop composting and what motivates them to keep doing so. Trying to resolve some of the issues disclosed by the citizens, while not something that directly raises adoption, is something that ensures citizen loyalty.

The service proposed as a solution to the barriers found was based on a mobile app. This application allowed citizens to create a community through competitions, register the frequency of the composting, and exchange it for points, and receive visual feedback on their positive impact on the environment.

The design of the service focused on what was learned from the interviews; however, it is not possible to ensure on single solution can satisfy all citizens. Additionally, as was mentioned by both experts and citizens alike, there will always be individuals who will never wish to compost.

The citizen interviews highlighted the need for composting education to address the awareness and knowledge barriers. Citizens often mentioned schools as the primary channel for this education. However, some citizens also placed this responsibility on the municipalities. Community events organised by local authorities could help disseminate this education to a wider demographic, extending beyond school-age children and their immediate families.

The citizens' perspective is essential not only for the implementation of initiatives but also for the maintenance of said initiatives. As found in the interviews, some citizens displayed dissatisfaction with the current service offering. A solution to this would be to frequently inquire citizens on their contentment and accept suggestions they might have to better their experience.

The literature analysis revealed that citizens might choose easier alternatives to composting, such as door-to-door collection. The expert interviews also revealed this, claiming that some citizens stopped composting once door-to-door collection became available. However, from the citizen interviews, a few claimed they would choose composting over all other options. While this finding is not generalised to the wider population, it stands relevant to conduct further research on this and understand the factors behind this preference.

The solution proposed in this project was a smartphone application that incorporated a point system. Should an organization use these suggestions or something similar, it would be imperative to set up a monitoring service. While economic incentives were considered the most likely to raise adoption by the citizens interviewed, fraudulent behaviour might occur. In-person

verification visits to confirm ongoing bin usage. would constitute one possible monitoring strategy, though the associated human resource implications should also be considered.

LIMITATIONS

The service design suggested a point system based on frequency of composting; however, this might not be the most appropriate solution. Further studies should be conducted on the technologies best suited for establishing a point system, as that was not the goal of this project. The rewards that citizens can obtain from this system must also be adapted to the reality of the citizens who will be the beneficiaries of this system. While in Porto, the most suggested ideas were discounts in businesses and events, and the receipt of produce and plants, which might not be the same everywhere.

One of the limitations of this project was the interview sample; although the interviewees were distinct, there was no citizen who composted in the community bins without being part of the urban gardens project. This is considered a limitation because their experience would be essential for the design of the service, as the majority of those who do not currently compost claim they would do so in the community composting bins.

The biggest limitation of this project was the lack of testing of the service design, which is an essential step of the service design framework. Should any organization decide to use the results obtained in this project, it is recommended that they test it with the population first to ensure citizen satisfaction.

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9 Sustainable Development Goals

Table 7- Sustainable Development Goals

SDG	Goal	Contribution	Performance indicators and metrics
12	12.5	Help raise the adoption rate of composting, which allows for a sustainable disposal of organic waste	Amount of waste composted

The Sustainable Development Goals are targets set by the United Nations as part of the 2030 Agenda. This Agenda was defined as an action plan for sustainability in all areas around the globe.

This study is a contribution to Sustainable Goal 12- Responsible Consumption and Production (Goal 12 | Department of Economic and Social Affairs, n.d.). With Goal 12, target 12.5 focuses on the reduction of waste generation. Composting is the biodegradation of organic waste, posing as a way of achieving full circularity in the waste production process.

This study aimed to design a service that could raise the adoption rate of composting, while maintaining citizen loyalty to the practice. Through the service design framework, this study managed to develop a service that can achieve this alongside a list of recommendations that can be used by future service providers.

The quality and impact of this study can be analysed through the examination of the amount of waste composted before and after the implementation of the results. ~

10 Appendix A- Expert Interview Script

Section A- Current Offering

1. From your experience, how do you think people perceive home composting? What do you believe stops someone from composting at home?
1. How about those who do compost more consistently? What are normally the motivations behind that?
2. What is your current service offer aimed at home composting? Can you describe them?
1. How successful are these initiatives? Why? What challenges have you faced?
2. Was there any project that you tried to implement that never happened?
3. What key performance indicators do you use to assess the success of these home composting services? What other KPIs would you like to use?

Section B- Resident Motivations and Engagement

1. How do you engage citizens and promote home composting and your services?
1. How do you keep citizens engaged?
2. How do you monitor usage?
3. What makes them quit?

Section C- Innovation and Closing

1. Imagining there were no constraints (money, resources, etc), what would be the ideal service to address the low adoption of home composting?
2. To wrap up, is there anything we haven't covered that you believe is critical to implementing a home composting service in Porto? Is there anything else you would like to add?

11 Appendix B- Citizen Interview Script

Home Composting is the act of biodegradation of municipal organic waste and is a way of sustainably recycling from home. In simpler terms, it's a way of recycling by putting food waste or other organic waste into a composting bin.

General Data

- Age
- Occupation
- Number of Household members
- Type of home (house with garden, apartment with balcony, apartment without balcony, etc.)

Interview Questions

1. To begin, could you indicate whether you practice home composting?

Section A- Already composts at home

1. How long have you been practicing home composting? What made you start?
2. Where did you first hear about this practice? Did you have any help when you started?
 1. Policymakers; Other home composters; social media; Sustainability groups; other?
What?
3. What type of composting do you practice (composting bin at home, worm farm, Bokashi, other)? Why that particular choice?
4. Could you describe your composting process (how you do it, duration, what you use it for, etc.)?
5. What has motivated you to keep composting to this day?
 1. What do you consider to have been the highlights of your composting journey?
 2. And the low points?
6. When you first started, what were the biggest challenges or surprises?
 1. How did you overcome those issues?

2. Are there any barriers you have not yet managed to overcome? How have you adapted?
7. Have you come across any initiatives to support the composting process?
1. Have you used any of them? What do you think worked best, and what could be improved?
8. In your opinion, what kind of initiatives could further encourage home composting in the community? Is there any type of initiative that would particularly motivate you to maintain or deepen your practice?
9. Considering your current experience, what would the ideal way for you to practice home composting look like? How would that fit into your daily routine?

Section B- Doesn't compost

1. How do you usually manage your organic waste?
2. Before today, had you heard about home composting?
1. If so, where did you first hear about this topic? Did it generate any interest?
3. Have you ever considered practicing home composting?
1. If so, what led you to decide against it or prevented you from going ahead?
2. If not, would you consider doing it now? Why or why not?
4. What would encourage you to start participating in home composting?
5. In your opinion, what kind of initiatives or incentives would be most effective in encouraging people to adopt home composting? Is there any action that would personally motivate you to participate?
6. If you were to adopt home composting, how would you imagine it fitting into your daily routine? What format or conditions would you consider ideal for doing so?

Section C - Closing

1. To conclude, do you think there is any relevant aspect that has not been addressed, and that could help us create a support service for composting adoption? Would you like to add any additional information?

12 Appendix C- Informed Consent Experts

CONSENTIMENTO INFORMADO PARA PARTICIPAÇÃO EM PROJETO DE INVESTIGAÇÃO E PROCESSAMENTO DE INFORMAÇÃO PESSOAL
Por favor, leia a seguinte informação cuidadosamente, caso ache que algo não está correto ou pouco claro, pode pedir mais informações por email: up202402836@up.pt Caso concorde em participar no estudo, pedimos que forneça o seu consentimento ao assinar no fim do documento. Participação é voluntária. Pode parar de participar a qualquer momento, sem qualquer consequência, contactando o investigador pelo endereço de email fornecido.
1. INFORMAÇÃO DO PROJETO
Título: Compreensão das motivações e barreiras à compostagem caseira no âmbito de desenho de serviços Instituição Responsável: Faculdade de Engenharia da Universidade do Porto (FEUP) Investigador Principal (Diretamente Responsável): Carolina Trindade Salgueiro Pereira de Almeida Descrição Geral do Projeto: O estudo tem como objetivo identificar as motivações e obstáculos associados à compostagem caseira e desenhar um serviço facilitador para a adoção desta prática. O estudo está agendado para decorrer por um período de um semestre e é financiado pelo projeto 'FEUP-Circulartech'. Será pedido aos participantes que respondam a uma entrevista semiestruturada, em pessoa ou online, dependendo da sua preferência. Durante a entrevista, participantes serão questionados sobre a atual oferta de serviço da empresa relacionada com a compostagem caseira. O estudo pretende ainda obter as perspetivas dos participantes em relação às motivações e barreiras que os residentes da área do Porto demonstram em relação à compostagem caseira. Participação neste estudo é voluntária e os participantes podem desistir a qualquer momento. Caso um participante decida desistir, informação recolhida será totalmente descartada. Contudo, caso a desistência apenas aconteça depois da informação ter sido tornada anónima, pode não ser possível descartar a informação por completo, independentemente desta situação, os dados brutos serão eliminados.
2. PROCESSAMENTO DE INFORMAÇÃO PESSOAL

Objetivos do Projeto:

Informação será utilizada para perceber as motivações e barreiras à compostagem caseira e, posteriormente, utilizada para desenhar um serviço que aumente a adoção desta prática.

Dados pessoais serão recolhidos de modo a contactar o participante.

Dados Pessoais:

Para este estudo, os seguintes dados serão recolhidos, dependendo da informação que o participante escolhe partilhar:

- Detalhes de contacto: nome e forma de contacto (email ou número de telemóvel)
- Gravações de áudio e notas de investigador (apenas com o consentimento do participante)

A informação será recolhida através de entrevistas gravadas. Caso um participante deseje não responder a uma pergunta, encontra-se no seu direito de o fazer e não será forçado a responder.

Propósito do Processamento:

Os dados recolhidos serão processados de acordo com a legislação nacional e da UE aplicável e apenas serão utilizados pelos investigadores com o objetivo de pesquisa académica e no âmbito de uma tese de mestrado.

Controle de Dados:

Faculdade de Engenharia da Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto.

Armazenamento e retenção de dados pessoais:

Os dados serão armazenados num computador protegido por palavra-passe, acessível apenas pela equipa de investigação (investigador principal e supervisores). As entrevistas serão transcritas. Contudo, qualquer fator identificador será excluído, com os nomes dos participantes sendo tornados em pseudónimos.

Dados identificadores serão apenas guardados pela duração do processo de pesquisa e serão eliminados posteriormente. Informação não identificadora (pseudónimos) será guardada por um período de até quatro anos para validação académica e, posteriormente, eliminada.

No caso de uma desistência de um participante antes dos dados terem sido tornados anónimos, a gravação e as transcrições com a sua participação serão eliminadas. Caso isto apenas ocorra após os dados terem sido tornados anónimos, já não será viável eliminar toda a informação. Contudo, mais nenhuma informação identificadora será retida ou utilizada.

Medidas de Segurança:

A informação será guardada num computador pessoal e protegida por aplicativo de palavra-passe, cujo acesso está limitado à equipa de pesquisa. Os dados coletados não serão suficientes para identificar os participantes, com os nomes não sendo registados e os participantes sendo referidos através de pseudónimos (Participante A/B/C, etc.).

Partilha de Dados:

Os dados brutos serão apenas acessíveis à equipa de pesquisa. Qualquer resultado obtido será apenas partilhado com a LIPOR. Caso os dados necessitem de serem partilhados por motivos académicos, será apenas feito através de pseudónimos.

Direitos do sujeito de dados:

Como sujeito de dados, a lei garante-lhe os seguintes direitos: Informação, Acesso, Retificação, Apagamento, Portabilidade de dados e Restrição de processamento. Para exercer qualquer dos seus direitos, por favor, utilize o seguinte endereço de email: up202402836@up.pt

Encarregado de Proteção de Dados (EPD):

Para exercer os seus direitos em relação a este projeto, participantes podem contactar o investigador através do email up202402836@up.pt.

Participantes podem ainda contactar o Encarregado de Proteção de Dados da Universidade do Porto através do email dpo@reit.up.pt. Caso o participante considere que os seus direitos foram infringidos, pode registar uma queixa com a Autoridade Portuguesa Supervisora, a CNPD (Comissão Nacional de Proteção de Dados).

3. Declaração de Consentimento Informado

- | | |
|---|--------------------------|
| 1. Eu li e compreendi a informação sobre o projeto, incluindo a identidade do responsável, o tipo de dados a serem recolhidos e o objetivo da recolha e do processamento. | ☐ |
| 2. Eu li e compreendi como os meus dados pessoais serão guardados e por quanto tempo, incluindo dados em caso de desistência. | ☐ |
| 3. Eu tive a oportunidade de colocar perguntas e esclarecer qualquer dúvida sobre este projeto. | ☐ |
| 4. Eu compreendo que posso decidir desistir de participar a qualquer momento, sem necessitar de justificar a minha decisão e sem qualquer penalização ou consequência negativa. | ☐ |
| 5. Eu compreendo como comunicar a minha desistência e como exercer os meus direitos como sujeito de dados. | ☐ |

O Participante:

Eu declaro que li e compreendi este documento, tal como qualquer informação verbal fornecida previamente.

Eu concordo em participar neste estudo e autorizo a utilização dos dados que forneço voluntariamente.

Nome:

Assinatura:

Data: /.....

/.....

13 Appendix D- Informed Consent Citizens

CONSENTIMENTO INFORMADO PARA PARTICIPAÇÃO EM PROJETO DE INVESTIGAÇÃO E PROCESSAMENTO DE INFORMAÇÃO PESSOAL
Por favor, leia a seguinte informação cuidadosamente, caso ache que algo não está correto ou pouco claro, pode pedir mais informações por email: up202402836@up.pt Caso concorde em participar no estudo, pedimos que forneça o seu consentimento ao assinar no fim do documento. Participação é voluntária. Pode parar de participar a qualquer momento, sem qualquer consequência, contactando o investigador pelo endereço de email fornecido.
1. INFORMAÇÃO DO PROJETO
<u>Título:</u> Compreensão das motivações e barreiras à compostagem doméstica no âmbito de desenho de serviços <u>Instituição Responsável:</u> Faculdade de Engenharia da Universidade do Porto (FEUP) <u>Investigador Principal (Diretamente Responsável):</u> Carolina Trindade Salgueiro Pereira de Almeida <u>Descrição Geral do Projeto:</u> O estudo tem como objetivo identificar as motivações e obstáculos associados à compostagem doméstica e desenhar um serviço facilitador para a adoção desta prática. O estudo está agendado para decorrer por um período de um semestre e é financiado pelo projeto 'FEUP-Circularartech'. Será pedido aos participantes que respondam a uma entrevista semiestruturada, em pessoa ou online, dependendo da sua preferência. Durante a entrevista, participantes serão questionados sobre as suas atuais práticas de gestão de resíduos orgânicos. O estudo pretende ainda obter as perspetivas dos participantes em relação às motivações e barreiras em relação à adoção da prática da compostagem doméstica e a sua perspetiva em possíveis serviços para aumentar a adesão. Participação neste estudo é voluntária e os participantes podem desistir a qualquer momento. Caso um participante decida desistir, informação recolhida será totalmente descartada. Contudo, caso a desistência apenas aconteça depois da informação ter sido tornada anónima, pode não ser possível descartar a informação por completo, independentemente desta situação, os dados brutos serão eliminados.
2. PROCESSAMENTO DE INFORMAÇÃO PESSOAL

Objetivos do Projeto:

Informação será utilizada para perceber as motivações e barreiras à compostagem doméstica e, posteriormente, utilizada para desenhar um serviço que aumente a adoção desta prática.

Dados pessoais serão recolhidos de modo a contactar o participante.

Dados Pessoais:

Para este estudo, os seguintes dados serão recolhidos, dependendo da informação que o participante escolhe partilhar:

- Detalhes de contacto: nome e forma de contacto (email ou número de telemóvel)
- Informação sociodemográfica (idade; ocupação; número de residentes na habitação; tipo de habitação)
- Gravações de áudio e notas de investigador (apenas com o consentimento do participante)

A informação será recolhida através de entrevistas gravadas. Caso um participante deseje não responder a uma pergunta, encontra-se no seu direito de o fazer e não será forçado a responder.

Propósito do Processamento:

Os dados recolhidos serão processados de acordo com a legislação nacional e da UE aplicável e apenas serão utilizados pelos investigadores com o objetivo de pesquisa académica e no âmbito de uma tese de mestrado.

Controle de Dados:

Faculdade de Engenharia da Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto.

Armazenamento e retenção de dados pessoais:

Os dados serão armazenados num computador protegido por palavra-passe, acessível apenas pela equipa de investigação (investigador principal e supervisores). As entrevistas serão transcritas. Contudo, qualquer fator identificador será excluído, com os nomes dos participantes sendo tornados em pseudónimos.

14 Appendix E- Declaration of Generative AI Usage

In accordance with the University of Porto and the Faculty of Engineering of the University of Porto (FEUP) guidelines regarding the usage of Generative AI, this section serves as a declaration of the usage of this tool.

Generative AI was used in the transcription process of the interviews conducted to help make the process more efficient. These transcriptions were then reviewed by the researcher to ensure they stayed as true to the original audio as possible.

Generative AI was also used for language checking throughout the writing process of this project. This tool was also used when translating excerpts of the interviews for data analysis from European Portuguese into English.

However, this tool was not used to generate research findings, data analysis, or conclusions, and all intellectual work remains the original work of the research team. Generative AI was merely used to verify the relevance and coherence of the solutions proposed and their alignment with the findings from the data collected. All final decisions regarding the project were made by the research team.