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Sustainable Service Design meta-scenario for take-it-back services on white-good appliances[1]

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ABSTRACT

Changing consumer behavior regarding the proper disposal of household appliances by designing a meta-scenario proposition for a take-it-back service, that generates value in the interaction between consumers, manufacturers and different stakeholders of electrical and electronic equipment companies, is the initial challenge of this article. It reveals an investigation into this current problem, and details the development process of the service by using Internet of Things (IoT) sensors integrated into a collaborative digital platform designed for Electrolux Brasil. The research and development of the proposal focused on promoting transparency for consumers throughout the service and seeks to meet the three sustainability dimensions. The methodology adopted for the research uses a systematic literature review combined with a range of service design tools. It begins with the comprehensive elucidation of reverse logistics and its combination with emerging technologies. Service Design tools such as Focus Group, Card Sorting, Tomorrow's Headlines, and Storyboard were carefully exploited, serving the dual purpose of deepening the dilemma and fostering the ideation process. The implications of emerging technologies as an axis of the proposed meta-scenario are consistent with the transformation of consumer behavior; it enhances consumer decision-making by emphasizing its role as a catalyst towards sustainability.

Keywords: Internet of Things, Service Design, Take-it-back, Transparency.

INTRODUCTION

In 2015, the United Nations (UN) 2030 Agenda was promulgated with the Sustainable Development Goals (SDGs) aiming for the countries to act collaboratively on issues such as eradicating poverty in all its forms and dimensions, protecting the planet through a more sustainable and resilient path and ensure that people can enjoy a future of peace and prosperity (United Nations, 2015). This joint movement, of which Brazil is also part, brings a reflection for public, private, and social organizations, on thinking about more inclusive, accessible, and sustainable solutions for people. To consider the environmental impact of inappropriate disposal of household appliances, as the Center for Management and Strategic Studies (CGEE, 2022) puts it, is to act in the stages of the product life cycle. Alcott (2008) said that:

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> Affluence is consumption (depletion) or emissions (pollution) per person; the sufficiency strategy attacks this affluence (A) factor, seeking to lower per capita resource consumption in hopes of thereby lowering total – or aggregate – consumption or impact (I). Of course, humanism demands restricting this strategy to those who are consuming at least enough for their health, reproduction, longevity and education. Lowering the affluence of the poor would after all mean more sickness, death, and armed conflict. The strategy thus envisions cuts in material and energy consumption within the 'affluent' target group that are large enough to reduce total impact even if (hopefully) the poor consume more (Alcott, 2008, pp. 770-786).

Waste prevention stands as a paramount environmental intervention, as illustrated in Figure 1. It hinges on the idea that adopting an essential lifestyle is fundamental to promote good health and plays a transformative role in promoting sustainable consumption behaviors. (CGEE, 2022, p. 21).

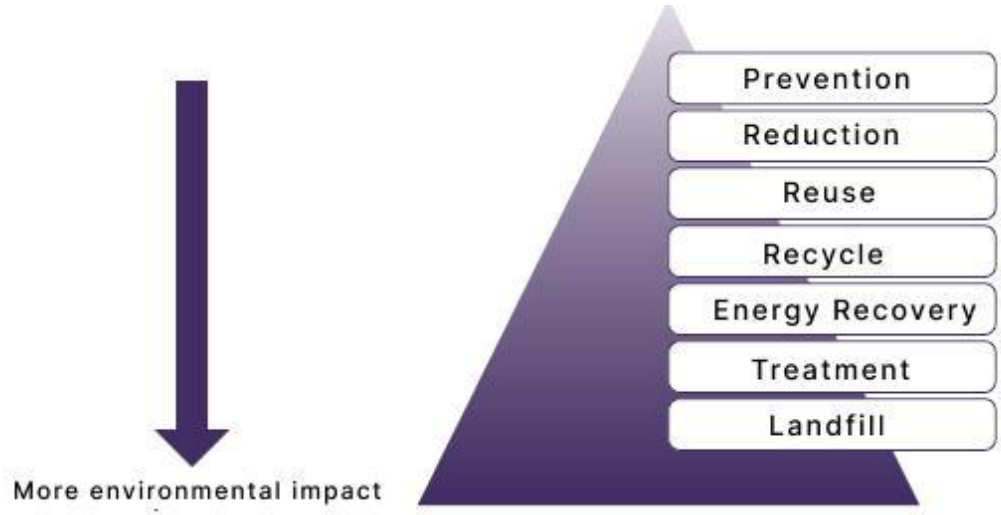

Figure 1. Hierarchy of priorities in waste management (CGEE, 2022, p. 21).

In Brazil, the correct destination of Waste from Electrical and Electronic Equipment (WEEE) is provided by the National Solid Waste Policy (PNRS - Law 12.305/2010) and regulated by the Federal decree on mandatory reverse logistics (Executive Order No 10.240, 2020), which provides responsibilities for generators of waste in the structuring and implementation of reverse logistics systems for electrical and electronic equipment and components for domestic use. Thus, manufacturers, importers, distributors, traders, and management entities need to present and maintain information on waste generation, which, in many cases, makes it difficult to manage the entire process.

1. SERVICES, TECHNOLOGIES, AND FUTURES

From this context, this paper was developed in the Sustainable Service Design discipline of the Postgraduate Program in Design at UFPR, in partnership with the company Electrolux Brazil. The challenge of designing a meta-scenario solution for the take-it-back service of cooking appliances can be understood as the projection of a situation within the 'fuzzy front-end' innovation strategy, which, according to Herstatt & Verworn (2004), encompasses in its first phase the generation of ideas and evaluation, according to attractiveness and risk metrics, and in the second phase, the conceptualization, development, and planning of a product. In the case of this paper, the focus is on the first phase, which presents a strong influence on innovation perspectives, as shown in Figure 2, along with creative techniques for service design.

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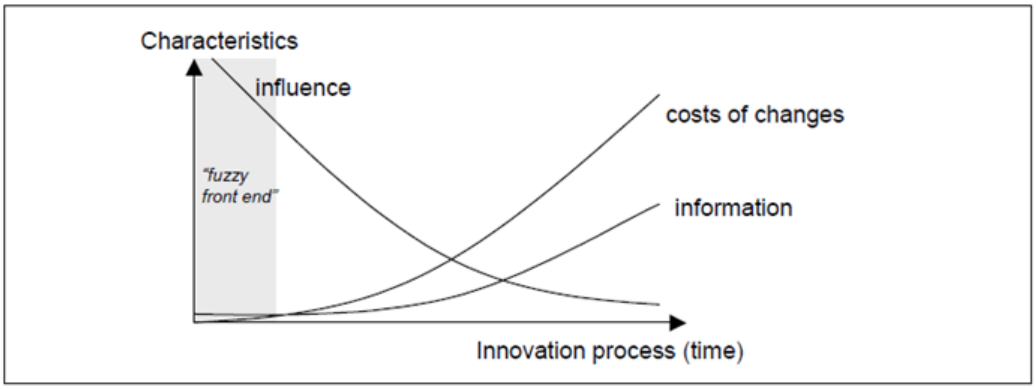

Figure 2. Influence, cost of changes, and information during the innovation process (Herstatt & Verworn, 2004, p.350).

As a way of translating these opportunities for innovation into the creation of products and services, the role of the designer emerges as a designer and researcher of trends and utilities. For Vezzoli, et al. (2018) the Designer role is to create opportunities based on the context. In this sense, the professional must aim to design products, services and systems (PSS) based on satisfaction, interaction, innovation and value creation dissociated from the consumption of resources. According to the authors, in the PSS projection, the value offer must integrate a mix of products and services, which together are capable of satisfying a particular consumer demand, enhancing the financial flow of suppliers and expanding the product life cycle.

The combination of the offer between products and services, according to Vezzoli et al. (2018): increased market flexibility, with the possibility of integrating new services into the portfolio; strengthening the relationship with the customer, who actively consumes the product and is an essential stakeholder for the service to function; and the improvement of the corporate image that is engaged with issues related to sustainability, positioning itself strategically by promoting transparency in its flow of activities and interactions between those involved.

Recognizing the interactions between all actors while designing a sustainable service requires an insightful view of the transparency and information flow about the current state of the system. In the case studied by this article, the perception of the reliability of information regarding the take-it-back service of cooking appliances has proven to be the key point towards a more sustainable behavior, especially when combined with emerging technologies such as the Internet of Things (IoT).

According to Hsu & Lin (2016), IoT uses the internet to create a large network of intelligent products connected through sensors that allow autonomous communication between machines and users. IoT offers new opportunities for expansion in product functions, with a high level of reliability and better use of products and their features (Porter & Heppelmann, 2014).

Given these facts, a primary emphasis on knowledge generated for the change to sustainable behavior within a Product-Service System (PSS) was given. As stated by Vezzoli, et al. (p. 106, 2018), it can be understood as "the one that deals with the production of sensations, emotions, memories, highly subjective reflections, and perceptions", and this construction in the proposed object, identified as the one that most lack actions today.

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1.1. Materials and Methods

The research method selected by the authors for this paper is a systematic literature review combined with a range of tools that enhance the Service Design process (Costa Júnior, 2012).

Service Design Tools can deliver an in-depth understanding of the user behavior and the service system itself. The results can also provide new solutions to be developed (Design Council and Technology Strategy Board, 2015).

The research on the literature already published regarding Sustainable Service Design, Take it back, Waste Electrical and Electronic Equipment (WEEE), White Goods, Internet of Things (IoT), Transparency, and the National Solid Waste Policy (PNRS – Brazilian Law 12.305/2010) were the focus on this phase of the study for a better understanding of the research problem.

In order to support and guide the Sustainable Service Design process for manufacturing companies that propose to integrate services into their portfolios, Costa Júnior (2012) developed a model that was adapted for this research.

According to the author, the model is divided into 3 main phases: Pre-development, Development, and Post-development. These phases are also divided into 5 principal phases: (i) Strategic Analysis; (ii) Informational Project; (iii) Conceptual Design; (iv) Detailing and Implementation; (v) Continuous improvement. The research explored up to the Conceptual Design Phase once it seeks a strong influence on innovation perspectives, according to the 'fuzzy front-end' innovation strategy, by designing a meta-scenario proposition.

The use of scenarios as a tool is common while planning the introduction of new visions, it can be made for consumption or production patterns. These types of proposals also allow actors to develop long or short-term strategies (Ceschin, 2012). According to Vergragt & Green (2001), scenarios are based on creativity workshops carried out with stakeholders and are intended to generate a vision for the future. The meta-scenario concept, developed on this research, adopted the same strategy as the study conducted by Scherer et al. (2021), where the meta-scenario proposal consists of understanding the current situation, identifying opportunities, and representing new macro interactions between stakeholders, by tackling a conceptual level of representation for a service design proposal.

1.2. Tools and application description

This research incorporates the phases of the model proposed by the author up to the Conceptual Design phase because it entangles the development of a meta-scenario for take-it-back services for white-good appliances for the partner Electrolux Brazil. The author also suggests the modification and flexibility of the model he created according to the context where the project is inserted.

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Table 1: Service Design Tools were selected and applied. The phases and tools are detailed below.

Phase	Description	Tool	Tool Description
1) Strategic Analysis	This phase incorporates the context of the project concerning the company strategies, products, and services provided and all the stakeholders involved.	Desktop Research	Provides an understanding of the context where the project is inserted.
		Benchmarking	To measure similar products, services, and systems and understand how they perform.
		System Map	Introduces all the stakeholders, their relationships, and the flow of the service.
2) Informational Project	Consists in collecting information about the user profile and all the legislative criteria, the data collected on this phase will provide the project requirements.	Persona definition (Navegg, a company that provides data, web analytics, and Data Management Platform (DMP), was used)	Describes the type of users for the service based on behaviors and needs.
		Service Safari	To experience the service in first-person to understand how it works.
		Blueprint	Maps out the entire processes of the service, the actors involved, and their actions.
		Touchpoint matrix	Provides a more understandable view of all the interactions of the user in a service.
		Customer Journey	Graphic representation of the path of all interactions of the user with the service system, connecting the touchpoints with the user's emotions.
3) Conceptual Design	This phase is responsible for all the creation process, representation of ideas and selection of solutions.	Focus Group	A guided discussion with a group of people about the product, service or concept.
		Card Sorting	Strategies and ideas organized in cards in a way that suits the users' mental models.
		Tomorrow Headlines	Project into the future by creating fictional articles to obtain a common vision.
		Storyboard	A set of sketches to assist in visualizing the interactions between the user, and the service.
		Bodystorming	A technique that uses the body to express, create, or represent ideas.

Note: Adapted from Costa Júnior (2012).

The assessment of a new proposition was carried out through a co-creation workshop with potential users of the service in phase 3 of this study. Combining the literature review and the empirical research findings with the Service Design Tools applied, the main result of this experience is a Meta-scenario for a take-it-back service for white-good appliances. The detailed use of the tools and results is shown in the next session.

2. RESULTS AND DISCUSSION

The selected service design tools met strategic functions in the respective moments of application, being responsible for conducting and recording the research steps. In order to create a script for the creative workshop, four tools were selected and presented to the participants in the following order: Focus Group, Card Sorting, Tomorrow's Headline, and finally Storyboard, proposing a generation of collaborative alternatives.

Focus Group was the first tool used at the creative workshop. Conducted through three predefined questions based on reverse logistics of home appliances, it enabled the first dialogue, contextualizing the authors regarding the repertoire, knowledge and experiences of the participants. The dialogue brought insights into how the current reverse logistics services provided for home appliances can be accessed and how they are seen by the participants. Through this tool, it was possible to confirm the gaps identified during the problem identification phase of the research.

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For the second section of the creative workshop, Card Sorting was applied, as defined by Sherwin (2018):

> Card sorting is an experience research method in which study participants group individual labels written on notecards according to criteria that make sense to them. This method uncovers how the target audience's domain knowledge is structured, and it serves to create an information architecture that matches users' expectations (Sherwin, 2018, p. 2).

The cards were designed considering four main steps and important decisions of a microwave oven disposal journey, highlighted in the upper portion of the cards: (i) What will be your initial decision? (ii) How will you execute your decision?; (iii) What kind of communication platform will you use? (v) What do you hope to gain from your decision?

To conduct an appropriate order for the card selection, the questions were numbered, and the categories were detailed by color, as shown in Figure 3.

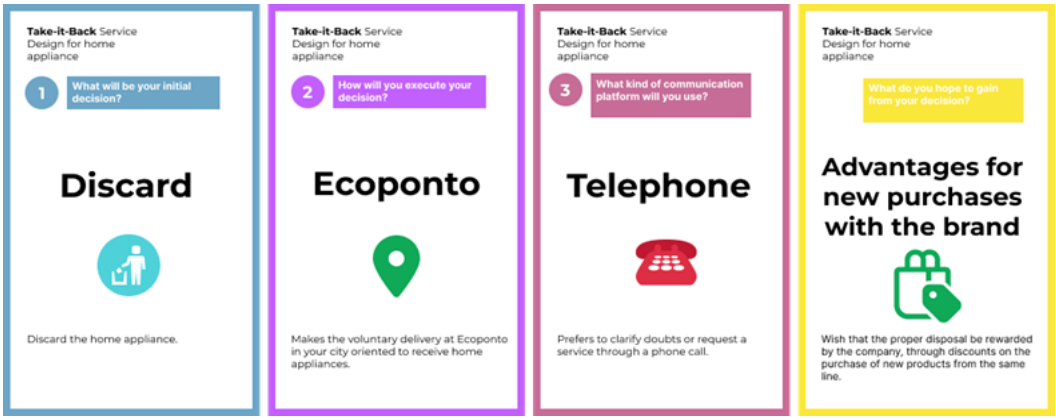

Figure 3. Cards designed for Card Sorting application.

As corresponding content for each category, the authors inserted alternatives, touchpoints, and identified advantages in pre-existing initiatives, as well as ideas generated throughout the process. For each card, there were icons inserted and subtitles to support the proposal comprehension.

Before starting with the application, the participants were informed about the tool usage, and subsequently, the cards were presented. The application was performed individually. Each participant organized three journeys to demonstrate their current action or decision when facing a situation where he was unable to use their microwave oven and/or an action they would be interested in realising, in case it was possible, an ideation, as presented in Figure 4.

Figure 4. Participants contact with Card Sorting.

The time estimated for the activity was fifteen minutes, with a maximum of five minutes being dedicated to each journey. A limit of cards that could be used was not informed, allowing the participant to insert more cards if they chose to use more than one contact platform and/or

wanted more than one advantage with the action performed. Blank cards were also made available for participants to suggest new alternatives if they identified other advantages.

The journeys created by each participant can be seen in Figure 5. The sequences were prepared with a greater or lesser level of environmental awareness, considering alternatives that can be accessed currently, but also hypothetical situations that the participants considered could have a positive impact on solving the problem.

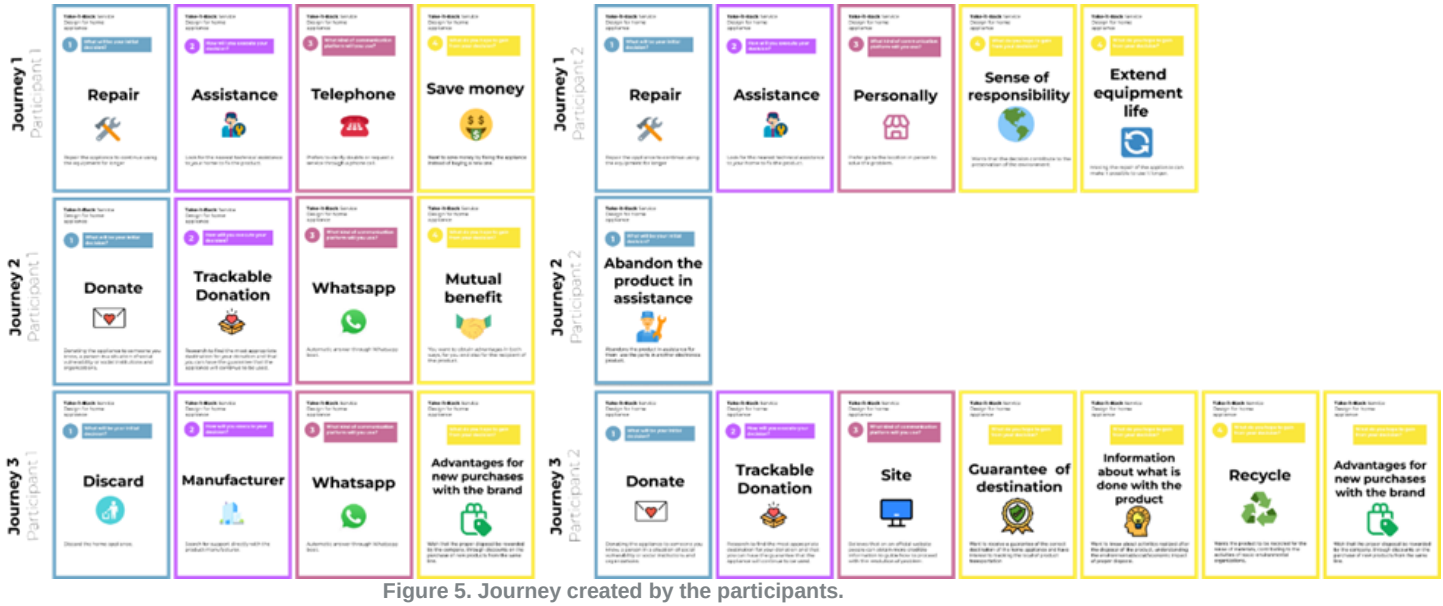

Figure 5. Journey created by the participants.

For journey number one, participants selected activities they would do as a first option in an attempt to solve the microwave problem. It was possible to observe that part of the decisions and actions were repeated, although the participants recorded different ways of making contact with assistance and different expected advantages with the action taken. In both cases, the first direction of the product would be for repair through assistance. From the selection of participants on the assistance contact card, it was possible to verify that the existence of different sources of contact with assistance can be a facilitator for the service to be contracted.

For journey number two, they were asked to rethink their actions if the product was too expensive to repair. Therefore, it became impracticable to do so. At this point, the journeys differed considerably. For participant 1, the donation would be a second option for solving the problem, indicating interest in the track of the donated product, as long as it is on WhatsApp, to make access to information easier and faster. The expected advantage at this point went from individual through savings, to mutual benefit, since the problem would be solved, and the product could positively impact whoever receives it. On the other hand, in the impossibility of repair, the action indicated by participant 2 would be to abandon the microwave at the technical assistance site, with no continuity in taking actions.

In both cases, it was possible to observe that the participants were interested in easier disposal. As the product is no longer considered by the consumer as something of value, the difficulty in finding a solution for disposal can encourage some abandonment attitudes, which ends up impacting service providers, who become the new responsible for managing the abandoned appliances.

For journey number three, the participants were asked to indicate a sequence of actions that they consider ideal for solving the problem of microwave disposal, even if the selected cards indicate alternatives that are not currently available. The journeys had different decision making. Participant 1 would opt for direct disposal with the manufacturer, while participant

2 would opt for donating the product to an institution responsible for ensuring a lower impact end-of-life cycle.

The channels that would be used to mediate the action taken were different, but both are associated with technological tools and no longer with face-to-face contact. As for the expected benefits of the actions taken, participant 2 showed greater environmental concern, indicating interest in ensuring proper disposal, concern with recycling, and interest in having access to data that show what was done with the donated product. The expected gain in common between the participants for this journey was obtaining advantages in the acquisition of new products with Electrolux.

Although the researchers believe that the correct disposal of appliances should not encourage the consumption of new products, it was interesting to observe that consumers appreciated and would be more motivated to participate in take-it-back services, as long as they obtain rewards with the brand. In addition, the visualization of the last consumer journey elaborated by the participants made it possible to observe that even though there are no projects implemented in Brazil, to trace donated or discarded appliances, the activity was considered relevant for one of the participants. This presents opportunities to be developed for the sector.

The Card Sorting tool proved to be efficient in presenting the differences between actions taken by participants currently, actions that they consider relevant that are available, and what would be, in their perspective, an ideal alternative for discarding the microwave. The tool brought significant contributions to the idea generation phase that occurred later, indicating which hypothetical actions that were inserted in the cards awakened interest in the participants.

Subsequently, in addition to Card Sorting, the Tomorrow's Headline tool was applied. Three fictional news were presented to the participants, and they were asked to organize them in order of content relevance. The news were preliminary ideas that were generated before the creative workshop stage, and the intention of applying the tool was to understand how the participants would evaluate the ideas generated as relevant.

The end of the creative workshop was conducted through the Storyboard tool, which enabled the generation of alternatives in a collaborative way. From the speeches identified in the Focus Group, journeys created with Card Sorting, and an indication of the order of relevance of the ideas already generated with Tomorrow's Headline, three Storyboards were produced with three frames, illustrated simultaneously with the debate of opportunities found with the application of the tools.

From the first journey generated by Card Sorting, it was possible to observe that it is the profile of the public for which the service is being designed, the search for assistance as the first action to be taken in an attempt to prolong the useful life of the product. Therefore, it is necessary that the service proposal contemplates and makes it possible a certified technical assistance is offered for the product that is out of warranty. Considering this insight, an alternative was generated with Storyboard from an Electrolux Educational Center, where local technical assistance service providers could be trained to receive a certificate of assistance indicated by Electrolux, promoting the economy, providing local services, and bringing benefits for users of Electrolux products.

The Card Sorting also made it possible to observe that the participants selected digital platforms among the options available to contact the manufacturer, assistance, and/or service

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providers. This confirms that the public is skilled with the use of technology, information that meets the profiles traced with the Persona tool.

Considering the participants' level of technological skills and with the objective of centralizing communication and connecting service stakeholders, an alternative of collaborative digital platform was created within the Electrolux website, so that home appliance collection service providers, technical assistance, and NGOs, could register and make direct contact with the user, schedule the service and/or donation. For this stage, the possibility of tracking the product's disposal and/or donation of the product was also considered, since it was an interest registered by the participants in the Card Sorting.

2.1. Electrolux 4.0

Finally, in addition to making repairs feasible and proposing centralization of communication, Card Sorting observed that the appropriate disposal of the product is also an option of public interest. Therefore, the third alternative generated via Storyboard was the proposition of a partnership with a recycling start-up responsible for receiving, making a correct destination, and converting adequate disposal into advantages for the user. At this point, it was thought to suggest specific advantages with Electrolux, such as the conversion of appropriate disposal of a microwave, into discounts on the purchase of new products with Electrolux.

At the end of generating alternatives using the Storyboard tool, it was observed that the three ideas generated could be combined into a single proposal, boosting the positive impacts of the take-it-back service and bringing benefits to the company, users, and the environment. Therefore, in the stage after the creative workshop, the idea was refined and presented in a System Map, where the information, financial, work, and product flows are presented in detail, as shown in Figure 6, inspired by Morelli & Tollestrup (2006) e Van Halen et al. (2005).

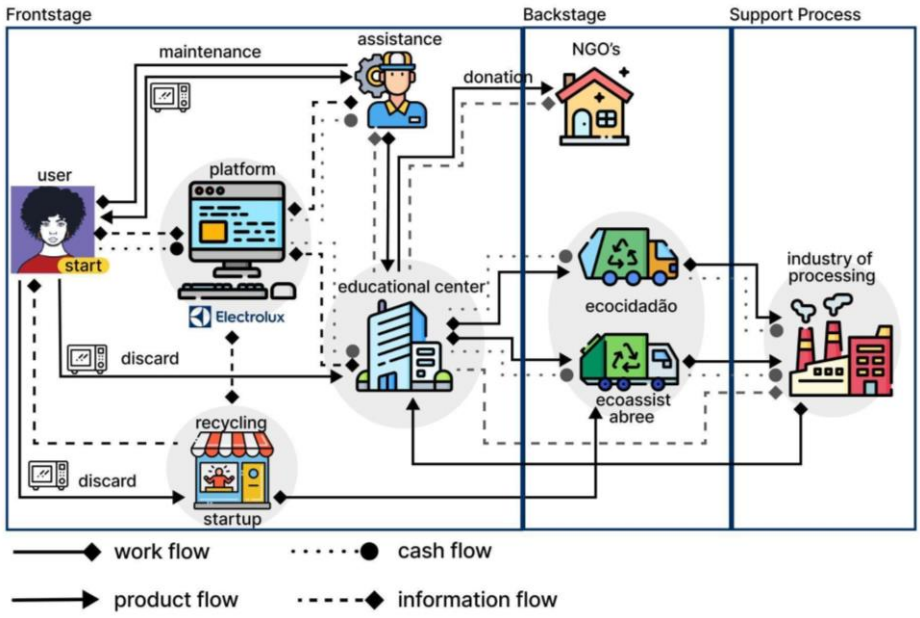

Figure 6. System map of the take-it-back service proposal for Electrolux.

The System Map made it possible to detail flows and connections between the proposals recorded by the Storyboard, based on the insights obtained with Card Sorting. The designed service was a take-it-back service for home appliances with IoT sensors integrated into a collaborative digital platform, focusing on promoting transparency for Electrolux consumers. The service contemplates the three dimensions of sustainability: environmental, economic,

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and social, and was initially designed with a focus on microwaves, but has the potential to unfold to other products.

Next, in order to represent the different stages, touchpoints, and functioning of the system proposed, a storyboard was illustrated. The proposal for the home appliances take-it-back service meta-scenario consists of connecting IoT sensors integrated into a collaborative digital platform, focusing on promoting transparency for Electrolux consumers, as shown in Figure 7.

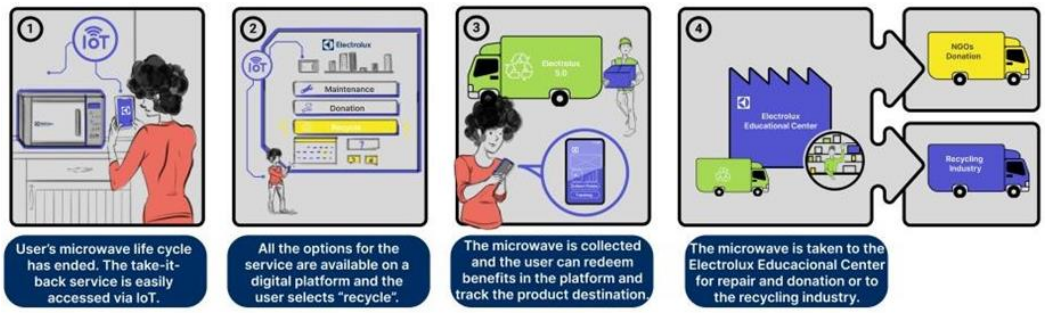

Figure 7. Storyboard of the take-it-back service meta-scenario proposal for Electrolux.

With the Card Sorting tool, it was possible to validate the skills of the users of the service with digital technologies. Therefore, the take-it-back service starts with registering the microwave serial number in the application via cell phone or platform via the website. The product, through the use of an IoT sensor, will send information regarding usage performance to a dashboard within the platform, where information on quality of use and product life cycle will be recorded.

In case of a technical problem or indication of the end of the product's useful life, the IoT sensor will send the information to the user's cell phone, which will be able to access the platform in an automated way through the notification received. On the platform, the user will be able to access the dashboard that will gather all the information about the product and suggest alternatives for repair, donation, or disposal of the product.

If the IoT identifies the possibility of fixing the technical problem, the platform will present the alternatives of service providers, listing the technical assistance certified by the Electrolux Center in the user's region, mapped from the geolocation of the microwave.

If the user chooses to donate the microwave that is still available for use, they may choose to donate to NGOs or institutions registered on the Electrolux platform. The platform will guide the user in choosing the institution and how to continue with the collection request (partner's responsibility) or delivery to the institution's address provided on the platform. Since it is mentioned as an interest of the participants during the detailing of the journey in Card Sorting, the donation of the products can be tracked, and the consumer can check the destination of the product by monitoring the location data offered by the device via the platform.

In the event of the product's end-of-life cycle, the IoT will indicate on the platform to the user the voluntary delivery points and Electrolux's partner collectors, giving the user the power of decision. In case of a request for home collection, the information will be sent immediately to the partner collector, and the user will schedule the collection through the platform.

Subsequently, after selecting if they want to make voluntary delivery or request home collection, the user will be able to track the transport steps through the platform and check if the device was correctly sent for recycling in the processing industries through geolocation.

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Subsequently, the user will be able to redeem points for the disposal carried out correctly. In this way, they will be directed within the platform to the SO+MA partner system, which will allow the exchange of these points for services or experiences in their city and/or advantages such as discounts on the purchase of new products with the Electrolux brand, this being an advantage mapped as positive through the journeys traced by the Card Sorting participants.

As a final proposition for the take-it-back service for an Electrolux meta-scenario, the processing industries would send the material processed from the recycling of the appliance back to Electrolux, which would be responsible for reusing the recycled materials in the manufacture of new products.

After structuring the take-it-back service, the researchers had the opportunity to present the project in person to the Designer Manager, Service Designer, and Sustainability Director of Electrolux Latin America. For Electrolux employees, the project proved to be innovative within the reverse logistics problem of appliances in order to conciliate the use of technology with consumer education. In addition, the Sustainability Director mentioned that the use of IoT is already being tested in the company and applied to some products in development, which demonstrates that despite the project having been developed for a meta-scenario, it is aligned with the themes of interest to the company.

In a second moment, Electrolux's Designer Manager was asked to contribute to the evaluation of the project, answering the question: What are the main barriers (environmental, social, economic, technological, and legislative) that large corporations face to implement Service Design projects, such as Electrolux 4.0? (Aimed at sustainability and relying on technology for the reverse logistics of their products).

According to Electrolux's Designer Manager, the main barrier is connecting the stakeholders to take-it-back services. For him, consumers need to be engaged and interested in returning the product to the manufacturer. The manufacturer and collection companies need to establish a partnership so that the products can be returned to the company for repairing, remanufacturing, and recycling processes. In addition, for reuse processes to happen, the manufacturer needs specialized labor.

On the other hand, the technology applied to the project was evaluated as a facilitator in the implementation of the service, since it helps monitor the product's life cycle, which allows the manufacturer to ensure that the product works longer and is reinserted in cycles of use. through parts and donations. In addition, to guide the user on the best practices for using the product, which extends its useful life and delays possible recycling.

Considering the feedback received on the Electrolux 4.0 project, it was possible to observe that to develop services for home appliance companies, it is necessary to design not only the dynamics for product collection, but also to compensate for the dynamics of development, production, and distribution. A service-product designed considering environmental, economic and social aspects will consequently have a production, consumption, and disposal stage with less impact. In this sense, designers are responsible for projecting new realities from their creations.

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3. CONCLUSION

Developing a take-it-back service and having the opportunity to discuss the project at a relevant international Service Design event, such as Service Design and Innovation Conference (ServDes), enabled the researchers to expand their understanding of the role of service in society. Designers attach their creations to specific publics and hope that they facilitate, in some aspect, the consumer's experience in a particular activity. However, serving requires an improved value offering, where the designer needs to be a facilitator, establishing a clear dynamic between touchpoints and ensuring that the service experience is rewarding for the customer, beyond the service as an end.

During the project's data collection phase, it was possible to observe that in all the journeys created by the participants, despite the decision-making starting from the individual context, the responsibility for the proper destination is always shared. Whether with the collection service provider, members of technical assistance, NGOs, or manufacturers. In this sense, it is possible to reflect on how services connect members of a particular community so that particular purposes become collective.

The discussion about the theme of technologies and the future, to which the research was linked in the Service Design and Innovation conference, is important to be carried out as the final consideration of the research because they were two points of attention during the investigation. For consumers, applying technologies in daily used products, such as microwaves, still seems far away. However, it can be observed that technology, despite having been presented in the project as an innovative resource, is not the issue pointed out by large companies such as Electrolux, as the most problematic in the face of implementing a take-it-back service. On the other hand, promoting connection between stakeholders is, for this institution, the most difficult barrier to overcome.

The products-services designed today by designers work within the experience of an individual context. However, shouldn't they serve as a foundation for new connections to be established and, consequently, new experiences to be created? Technological innovations do not fully demonstrate their potential if they do not promote community connection. In this sense, it is suggested that developments can be carried out from this initial investigation on ways to stimulate and facilitate the connection between stakeholders of the proposed take-it-back service so that, in the near future, the project can no longer be classified as a project for a meta-scenario.

The design tools selected for data collection proved to be efficient, enabled an assertive dialogue with the research participants, and helped in the process of recording the design development. The authors conclude that despite the fact that in the year of publication of the article, companies were still unable to implement a service such as the one proposed, the material serves for consultation and insights for future developments.

3.1. Implications of Internet of Things (IoT)

The implications of IoT are relevant for the service to be carried out in a transparent way, where the users are aware of what is happening with the product and through the platform, they can have direct access to what can be done later with the product. The flow of information and points of contact are also clearer when the Internet of Things (IoT) is used, as the contact can be done directly with the virtual assistant so that the disposal site is selected, such as the possible traceability of how the product can be transformed within the process. The platform

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promotes sustainable behavior, and the user understands the entire product life cycle, thus narrowing awareness with decision-making in favor of the take-it-back service with successful execution.

As discussed in the article, this technological insertion is currently used in several white goods. However, the improvement of the transparency that the company passes to its consumers, as well as having a centralised space for this information can reduce the points of contact and facilitate the entire process, optimising the communication flow. From the customer to the processing industry, the proposal for this meta-scenario makes the relationship and prospecting between the user act performed with what actually happens more effective.

Therefore, the take-it-back service for Electrolux, through collaborative digital interface and IoT, focused on the integration of actors and optimization of the flow of information, brings an intersection between the actors and artefacts that integrates the product life-cycle involving the solution to the disposal problem, which involves the public and private sectors through practical applications of emerging technologies.

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