Take-it-back Service: meta-scenario for white-good appliances

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Abstract

The need to change the consumer behavior in relation to the disposal of home appliances promotes a discussion to create a meta-scenario for a take it back service that can create value in the relationship between Waste Electrical and Electronic Equipment (WEEE) consumers and manufactures. This paper presents a study on home appliances' take-it-back service using Internet of Things (IoT) sensors integrated into a collaborative digital platform, focusing on promoting transparency for consumers. The research method was a systematic literature review combined with a range of Service Design Tools. The study first introduces an explanation of reverse logistics and its relationship with the IoT. Service Design tools such as Focus Group, Card Sorting, Tomorrow's Headlines, and Storyboard, were used for a better understanding of the problem and to support the generation of alternatives process. The insertion of emerging technologies as a key factor to the meta-scenario proposed corroborates with the change in the consumer behavior for sustainability, and it helps the user for better decision-making.

Keywords: service design, take-it-back, Internet of Things, transparency.

Introduction

In 2015, the United Nations (UN) agenda 2030 with the sustainable development goals (SDGs) was promulgated 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 (UN, 2015). This joint movement, of which Brazil is also part, brings reflection to organizations, public, private, and social, in the context of thinking about solutions for people that are more inclusive, accessible, and sustainable.

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, where the prevention of waste generation is the action with greater environmental impact, as shown in Figure 1, having sufficient consumption, that is, “the one strictly necessary to live in a healthy way” (Alcott, 2010 apud CGEE, p.21 2022) transforming role in sustainable consumption habits.

Figure 1. Hierarchy of priorities in waste management. Source: Center of Management and Strategic Studies - CGEE, 2022.

In the case of solid waste, in Brazil, the correct destination is provided for in the National Solid Waste Policy (PNRS - Law 12.305/2010) and regulated by the Federal decree on mandatory reverse logistics (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 through the performance monitoring group need to present and maintain information on waste generation which in many cases generates difficulties in the management of this entire process.

From this context, this paper was developed through the discipline of Sustainable Services Design of the Postgraduate Program in Design at UFPR, in partnership with the company Electrolux Brazil. The challenge of designing a solution for the take-it-

back service of cooking appliances, from a meta-scenario, 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 high influence on innovation perspectives, as shown in Figure 2, together with creative techniques for the design of services.

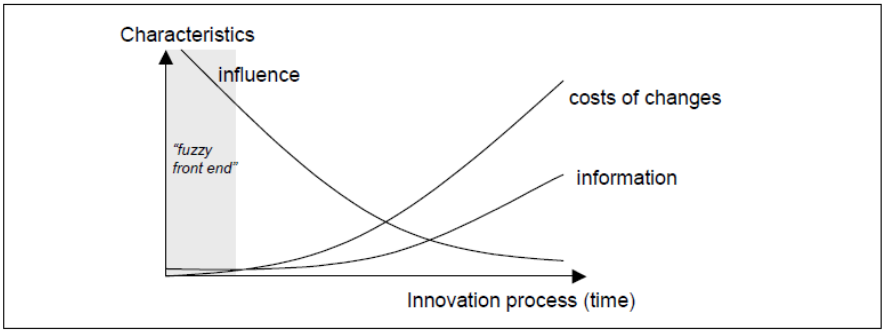

Figure 2. Influence, cost of changes, and information during the innovation process. Source: According to von Hippel (1993), modified by Herstatt & Verworn (2004).

Being aware of the interaction between all actors within the design of a sustainable service involves a more judicious look at the transparency of information regarding the current situation in which the system is located. In the case of the investigation of this article, the perception of the credibility in the information regarding the take-it-back service for cooking appliances proved to be a key point in driving 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 apud Rodrigues et al. 2021).

In the end, the prototype of the alternative, identified as the best suited to the reality of a win-win between users and the multinational within the target scenario for take-it-back services, was generated. A primary emphasis on knowledge generated for the change to sustainable behavior within a PSS (Product-service System) 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 lacks actions today.

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 divided into 5 principal phases: 1) Strategic Analysis; 2) Informational Project; 3) Conceptual Design; 4) Detailing and Implementation, and 5) Continuous improvement.

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 created by him according to the context where the project is inserted.

For each phase of this study, a range of Service Design Tools was 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 the understanding of the context where the project is inserted.
		Benchmarking	To measure similar products, services and systems and understand how they are performing.
		System Map	Introduce 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	Map 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 emotions.
3) Conceptual	This phase is responsible for all	Focus Group	A guided discussion

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Design	the creation process, representation of ideas and selection of solutions.		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 the visualization of the interactions between the user and the service.
		Bodystorming	A technique that uses the body to express, create or represent ideas.

Table 1. Source: The authors (2022) 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.

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.

The Focus Group was selected as a tool for the start of the creative workshop. Conducted through three predefined questions based on the theme of reverse logistics of home appliances, it enabled the first dialogue, contextualizing the authors regarding the repertoire of knowledge and experiences of the participants. The established 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 in research carried out in the problem identification phase of the project.

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

> "A using 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, n.p).

The cards were designed considering four main moments in a microwave oven disposal journey, highlighted in the upper portion of the cards: what decision will you make? How will you execute your decision? Which communication platform will you use? And what do you expect to obtain as an advantage for your decision?

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

Figure 3. Cards designed for Card Sorting application. Source: The authors, 2022.

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 inserted icons and subtitles to support the proposal comprehension.

Before beginning 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 facing a situation of being unable to use their microwave oven and/or an action they would be interested in realizing, in case it was possible, as presented in Figure 4.

Figure 4. Participants contact with Card Sorting. Source: The authors, 2022.

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, leaving 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.

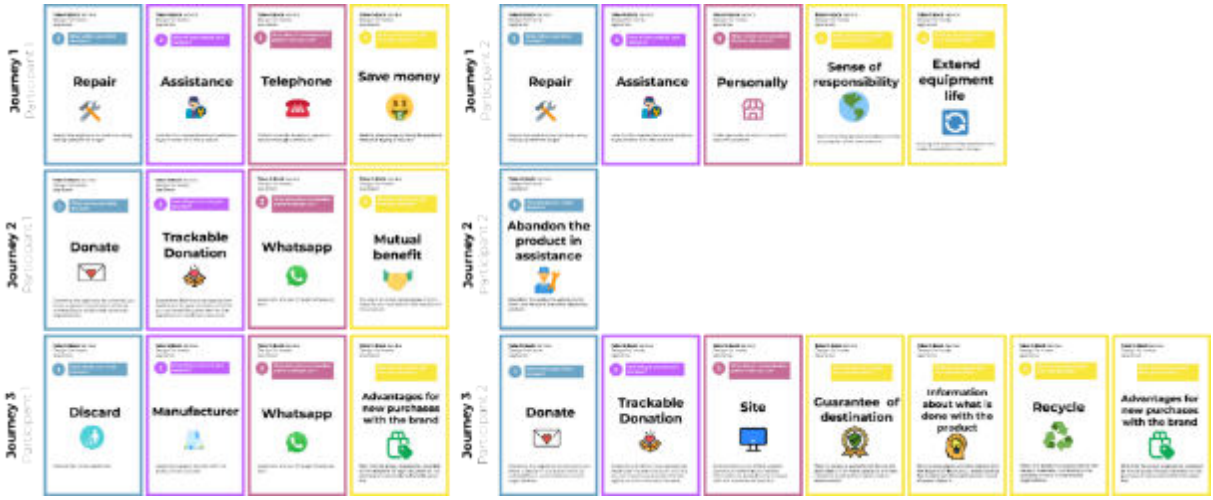

Figure 5. Journey created by the participants. Source: The authors, 2022.

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.

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 have a positive impact on whoever receives it. On the other hand, in the impossibility of repair, the action indicated by participant 2 would be to abandon technical assistance, with no continuity in taking actions.

For journey number three, the participants were asked to indicate a sequence of actions that they consider ideal to solve 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.

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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 with 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 the Electrolux.

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 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 participant 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 possible that 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 and 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 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 NGO's, could register and make direct contact with the user, schedule the service and/or donation. For this stage, the possibility of tracking the disposal and/or donation of the product was also considered, since it was an interest registered by the participants in the Card Sorting.

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 conversion of 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 the 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 a 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.

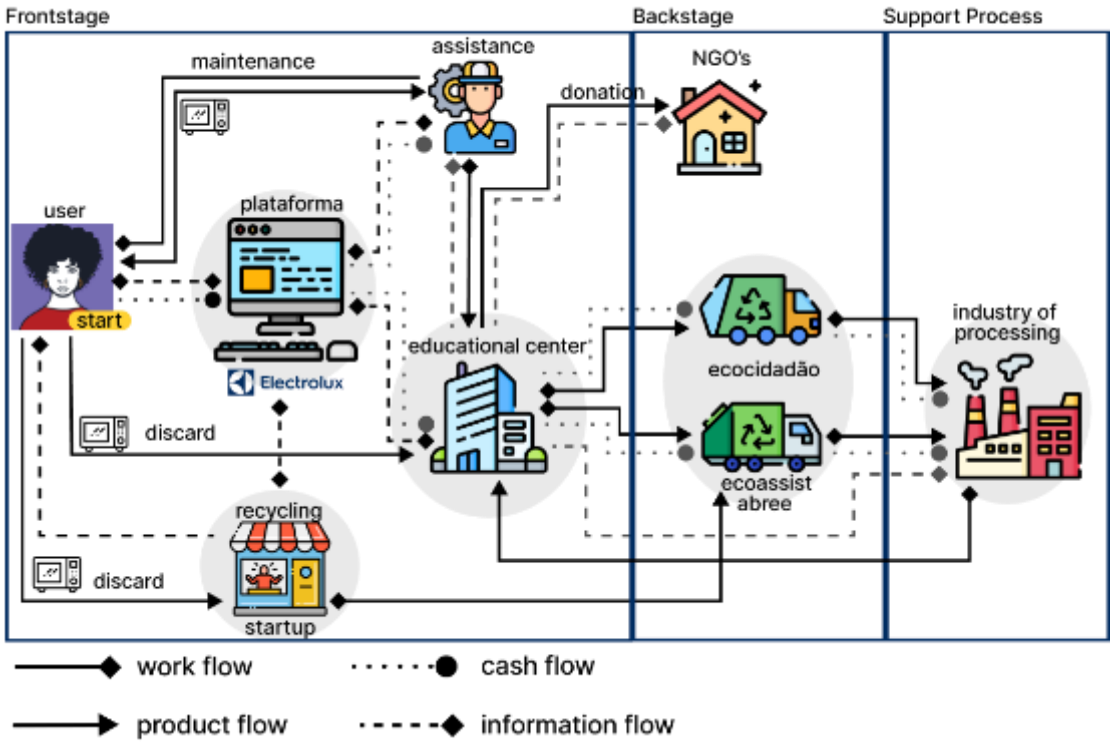

Figure 6. System map of the take-it-back service proposal for Electrolux. Source: The authors (2022), inspired by Morelli (2006) and Van Halen (2005).

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, with a focus on promoting transparency for Electrolux consumers. The service contemplates the three dimensions of sustainability: environmental, economic 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 home appliances take-it-back service meta-scenario consists in 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. Source: The authors (2022)

With the Card Sorting tool, it was possible to validate the skills of the users of service with digital technologies, therefore, the take-it-back service starts with the registration of the microwave serial number in the application via cell phone or platform, via the website. The microwave, 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 will 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 in the user's region certified by the Electrolux Center, 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 NGO's or institutions registered on the Electrolux platform. The platform will guide the user to choose 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.

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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, as well as Electrolux's partner collectors, giving the user the power of decision. In case of 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, being able to check if the device was correctly sent for recycling in the processing industries through geolocation. 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.

Conclusions

Service design tools such as those presented in the methods session and results, contributed to the evaluation and reformulation of the service in a meta-scenario, it brings results in benefit to the consumer-product-company relationship.

In this case, the quality of a take-it-back service, focused on the user to dispose of it correctly and progressively acquire a sustainable awareness, is interconnected through IoT that connects the product and the platform on which the person has access to carry out the process. From the decision-making process, the proposal works on the concept of having partnerships with existing recycling bins and startups and that make them integrated through an Electrolux Educational Center, a proposal that is part of the design details of this article, whose theme is central to the approach of a meta-scenario for the take it back service for white goods, more specifically as cooking appliances.

The proposed take-it-back service contemplates the three dimensions of sustainability as it involves income generation for local service providers, through the training and certification offered by the Electrolux Educational Center (economic

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dimension), inserts the donation option of products with the possibility of use for NGO's (social dimension) and directed the user to adequate disposal options through the platform, facilitating contact with service providers, proposing partnerships that expand the network of receiving materials for recycling and proposing a return of components from the processing industry to Electrolux, so that they can be inserted into the production of new products (environmental dimension).

The combination of emerging technology (IoT) with transparency in the service proposition, aligned with the interests of the users mapped by Card Sorting, brings greater user involvement in the disposal stage, promoting through the service a greater environmental awareness and directing the user to a more sustainable behavior.

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 on how the product can be transformed within the process. The platform promotes sustainable behavior and the user understands the entire life cycle of the product, thus narrowing awareness with decision-making in favor of the take it back service with a 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 centralized space for this information can reduce the points of contact and facilitate the entire process, optimizing 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, it brings an intersection between the actors and artifacts that integrates the product life-cycle involving the solution to the disposal problem, that involves the public and private sectors through practical applications of emerging technologies.

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