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Guidelines for integrating transparency for sustainability into the design evaluation of digital services that enable a circular economy

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ABSTRACT

Transparency is one of the key concepts to enable sustainable development, implying a more ethical communication in relation to the social, environmental, and economic dimensions at all levels of organizations. Communication is a fundamental part of digital services, where transparency can enable value creation for sustainability through digital interactions. Particularly in the emergent context of digital services for a circular economy, transparency can help to stand for its strategies and to expose the flows of resources to be seen and interacted with. The authors explored how to support the integration of transparency for sustainability on Service Design evaluation activities, in the context of digital services as enablers of a circular economy. With such intent, the study was conducted based on the Design Science Research method, organized in three phases. The first phase helped to understand the research problem from a broader perspective through a literature review, an assessment of transparency on existing digital solutions, and workshops with the potential users of the intended Guidelines. The second phase was characterized by fieldwork activities with three progressive cycles of Workshops based on Action Design Research for proposing, developing, and evaluating the intended Guidelines in a collaborative and critical way with digital services from different sectors in the context of a circular economy. The third phase addressed the cross-analysis and learnings. This paper provides a set of Guidelines to support a design evaluation of transparency for sustainability at the early stages of the Service Design process, including Guidelines for the systematization of activities, scope, and key elements of analysis. Transparency for sustainability can be approached as a quality criterion when articulating service offerings. A structured design approach can encourage service organizations to have a more active attitude towards transparency and sustainability.

KEYWORDS

Transparency for Sustainability; Digital Service; Circular Economy; Design Evaluation; Guidelines

Diretrizes para integrar transparência para sustentabilidade na avaliação de design em serviços digitais que habilitam uma economia circular

RESUMO

Transparência é um dos conceitos-chave para permitir o desenvolvimento sustentável, implicando uma comunicação mais ética em relação às dimensões social, ambiental e econômica em todos os níveis das organizações. A comunicação é uma parte fundamental dos serviços digitais, onde a transparência pode permitir a criação de valor para a sustentabilidade por meio de interações digitais. Particularmente no contexto emergente de serviços digitais para economia circular, a transparência pode ajudar a posicionar suas estratégias e expor os fluxos de recursos a serem vistos e com os quais interagir. Os autores exploraram como apoiar a integração da transparência para a sustentabilidade nas atividades de avaliação do Design de Serviço, no contexto de serviços digitais como facilitadores da economia circular. Para isso, o estudo foi conduzido sob o método Design Science Research, organizado em três fases. A primeira fase ajudou a entender o problema de pesquisa de uma perspectiva mais ampla por meio de uma revisão de literatura, uma avaliação da transparência em soluções digitais existentes e workshops com os usuários potenciais das Diretrizes pretendidas. A segunda fase foi caracterizada por atividades de trabalho de campo com três ciclos progressivos de Workshops baseados na Action Design Research para propor, desenvolver e avaliar as Diretrizes pretendidas de forma colaborativa e crítica com serviços digitais de diferentes setores que permitem a economia circular. A terceira fase abordou a análise cruzada e os aprendizados. Este artigo fornece um conjunto de Diretrizes para dar suporte a uma avaliação de design da transparência para sustentabilidade nos estágios iniciais do processo de Design de Serviço, incluindo Diretrizes para a sistematização das atividades, escopo e elementos chave de análise. A transparência para sustentabilidade pode ser abordada como um critério de qualidade ao articular ofertas de serviço. Uma abordagem de design estruturada pode encorajar organizações de serviço a terem uma atitude mais ativa em relação à transparência e sustentabilidade.

PALAVRAS-CHAVE

Transparência para Sustentabilidade; Serviço Digital; Economia Circular; Avaliação de Design; Diretrizes

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1. INTRODUCTION

Historically, the understanding of transparency evolved from a visibility attribute (GRIMMELIKHUIJSEN, 2012; ALLOA and THOMÄ, 2018) to a moral ideal and political instrument (BALL, 2009; KOSACK and FUNG, 2014; MEIJER, 2015), and more recently, to a form of interaction between organizations and individuals for reshaping relationships and the balance of power in society (FUNG et al., 2007; GRIMMELIKHUIJSEN, 2012; CHRISTENSEN and CHENEY, 2015; ALBU and FLYVERBOM, 2019). This research acknowledges the historical evolution of transparency and focus on a more recent perspective, approaching transparency as an enabling concept to promote sustainability goals and strategies (EGGERT and HELM, 2003; MOL, 2010; GRIMMELIKHUIJSEN and WELCH, 2012; KOSACK and FUNG, 2014; FLUCK, 2016; MCCARTHY and FLUCK, 2017; ALLOA and THOMÄ, 2018; ALBU and FLYVERBOM, 2019).

Transparency is one of the key concepts to enable sustainable development, implying a more ethical communication in relation to the social, environmental, and economic dimensions at all levels of organizations (HOFSTEDE et al., 2004; HOSSEINI et al., 2018; ALLOA and THOMÄ, 2018; ALBU and FLYVERBOM, 2019).

Communication is a fundamental part of conceiving, implementing, and maintaining sustainability strategies. It helps in establishing common visions about a more sustainable society, enables building up social cohesion, and can contribute to valuing diversity, raising awareness, and making informed decisions towards more sustainable standards (HOFSTEDE et al., 2004; GRIMMELIKHUIJSEN and WELCH, 2012; PARRIS et al., 2016; GENÇ, 2017; UN, 2021).

Specifically in the context of services enabling a more Circular Economy (CE) as a strategy for sustainability, transparency implies in new ways of communicating with product-service end-users along all life cycle stages (e.g. design, production, commercialization, usage, disposal), enabling new forms of value-creation (HEYES et al., 2018). The awareness and knowledge of the end-users about the social, environmental, and economic impacts of adequate ways of obtaining, using, and disposing the products is one of the most important aspects for achieving a successful CE implementation (SKOUBY et al., 2014; MA and HIPEL, 2016; SANTOS et al., 2022; WBCSD, 2023). However, according to Schöggl et al. (2020), CE studies lack consideration of the end-user perspective and their role in promoting circular transitions and sustainability outcomes.

The revised literature showed that organizations face many barriers to transition their business models and service offerings to CE, especially small and medium-sized enterprises (SME) (HEYES et al., 2018; TAKACS et al., 2022). Among the barriers, the most critical for transparency efforts are: the lack of data, knowledge, technologies, and technical skills to increase information sharing through digital platforms; cultural issues related to open collaboration and communication practices; conflict of interest, values, and modes of operation between different stakeholders regarding transparency (HEYES et al., 2018; TURA et al., 2019; WBCSD, 2023).

Thus, the mere introduction of digital technologies will not automatically lead to higher transparency. However, it will leverage new sources of data, from which information can be transformed into new forms to communicate and interact through product-services for sustainability (BUMBLAUSKAS et al., 2017; BRESSANELLI et al., 2022).

In Service Design field, ethical and sustainability issues are gaining relevance, concerning what to stand for, how to identify the critical dilemmas or issues, how to critically identify the potential impacts and unintended consequences, and how to incorporate ethical criteria into design decisions (VERMAAS, 2019; MAGER et al., 2020; BOEHNERT et al., 2022).

According to Ceschin and Gaziulusoy (2020), in the Design field, sustainability focus has broadened from material, component and product levels, with an environmental emphasis, towards other levels that encompass a range of socio, economic, political, and ethical aspects. Such expansion demands a corresponding increase in interdisciplinary collaboration to achieve changes at socio-technical-ecological system level, especially for organizations facing business transformations to address sustainability in a more effective way. Despite its relevance, Design for Sustainability (DfS) approaches for dealing especially with transparency are limited or nonexistent.

In this context, this study explored the integration of transparency for sustainability on digital service design in the context of circular economy, introducing a set of Design Guidelines intended to support evaluation activities at the early stages of the Service Design process.

2. THEORETICAL FOUNDATIONS

2.1. Framing transparency for sustainability and circularity

Transparency for sustainability can be understood as a resulting state or condition formed by ethical, communication, and value characteristics. In digital services, it is built by different mediations of a service's social, environmental, and economic reality, resulting in a situated state of that mediation that can enable value creation for sustainability or inhibit the parts (LOMBA and SANTOS, 2023).

For both transparency and sustainability concepts being considered a “moving target” (OLIVER, 2004; BAGHERI and HJORTH, 2007), it implies approaching them in a more continuous, iterative, and systemic way. Using a direct corollary, transparency for sustainability is not a problem to be solved, but it is more the status of a system that can be continuously changed and improved overtime.

Hence, transparency for sustainability challenges can be difficult to formulate and understand, involving conflicting interests and points of view from a diversity of stakeholders. There is no immediate solution due to the variety of ethical, social, environmental, and economic complexities (RITTEL and WEBBER, 1973).

Services are typically part of a production and consumption system and influence the sustainability of that system. The service can have a dominant role in how it operates and processes inputs and outputs in a given system. Thus, service transparency should refer to the sustainability of that service-system, considering the service inputs, processes e outputs regarding environmental, social, and economic aspects (Figure 1).

Circular economy is usually described as an alternative system model to the predominant linear production and consumption model (with flows from raw materials, manufacturing, distribution, consumption and disposal of products at the end of their life cycle) (PAES et al., 2019). The CE model considers waste as a resource and keeps in sight the regenerative role of the systems (GEISSDOERFER et al., 2017; EMF, 2023).

The application of circular strategies implies considering the regenerative aspect of a system in which the inflows and outflows of resources are prevented, minimized, and optimized (GEISSDOERFER et al., 2017; PAES et al., 2019). As one of the many approaches to implement sustainability, the CE model aims to: a) prevent and reduce waste based on consumption

prevention and minimization; b) extend the lifespan of products and parts in the system at the usage stage through processes like reuse, repair and remanufacture; c) transform waste as a resource with processes like recycling.

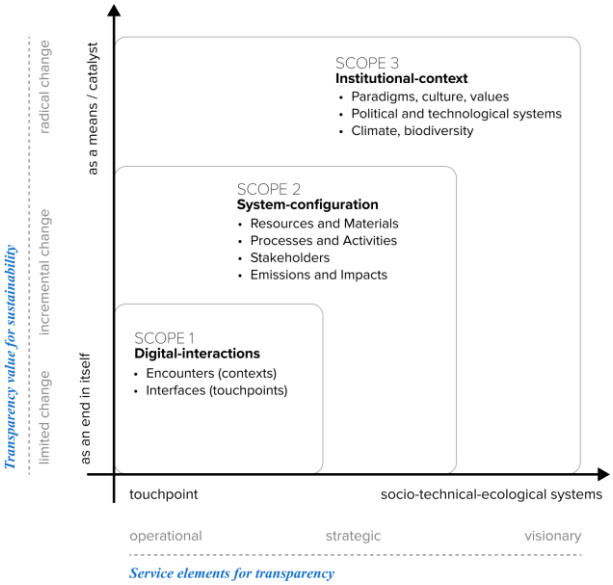


Figure 1 Scopes of digital service design for transparency on sustainability (Source: LOMBA and SANTOS (2023)).

The service systems for circularity are complex, involving different sectors and actors, with different needs and interests in transparency for sustainability. However, transparency strategies must be careful not to accentuate the asymmetry already in place. This implies that transparency strategies need to ensure that plural narratives are included in communication flows about sustainability (LOMBA and SANTOS, 2023).

Framing transparency for sustainability on services enabling a circular economy means standing for broader goals and principles of sustainability, creating and presenting touchpoints to be seen and interacted with. By bringing light to invisible flows of information and resources through the promotion of interactions among the various stakeholders of the service-system, it intends to contribute to value creation, social relationships, and, at the same time, better care of the environment.

2.2. Transparency as a trigger for changes towards sustainability

Rather than communication, transparency can have an active role as a means for sustainability from developing awareness to promoting behavioral changes, while supporting informed decision-making and value creation.

Transparency can enable organizations to enhance stakeholder participation and the continuous learning process through higher governance, rapid identification of problems and opportunities stimulating continuous improvement towards sustainability, improving value perception by the consumer regarding sustainability, increasing profits and risk reduction for investments (FLUCK, 2016; PARRIS et al., 2016; MABILLARD and ZUMOFEN, 2017; ALBU and FLYVERBOM, 2019).

From a behavior perspective, transparency strategies could be approached as a facilitator or a trigger for influencing the environment (context) and social behavior of the service's end-user towards more sustainable and circular behaviors, for example, Niedderer et al. (2016) argues that context-oriented design approaches typically use prescription or prevention strategies by redesigning the environment (interaction context) or the artifact (touchpoint) to enable or decrease a desirable or undesirable behavior respectively.

This situational logic aligns with Morelli et al. (2021) perspective of *service as an infrastructure*, where the design activity is in creating the conditions for end-users to create value. In this case, triggering and supporting sustainable and circular situations through transparency strategies could contribute to behavior changing processes and value creation.

Transparency for sustainability on services can also be framed from a social practice perspective. For Spurling et al. (2013), behaviors are just the tip of the iceberg, as expressions of more general social phenomena or practices.

Shove et al. (2012) proposes a scheme to support a general abstraction and interpretation of social practices formed by: a) Materials include the things, technologies, tangible physical entities, and the stuff of which objects are made; b) Competences include skill, know-how and technique; c) Meanings include the symbolic meanings, ideas, and aspirations (Figure 2).

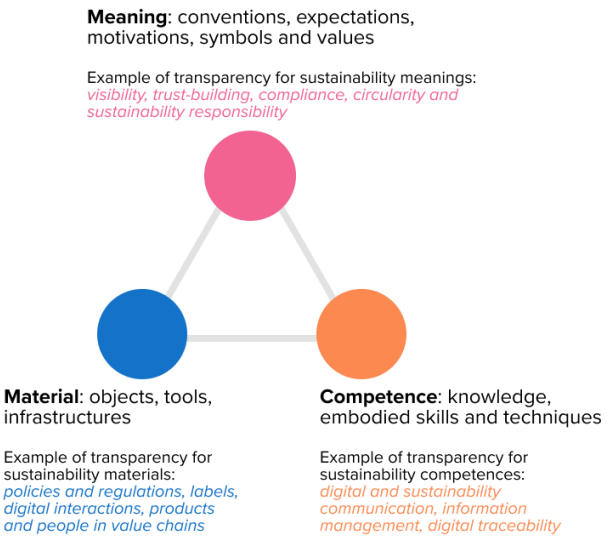


Figure 2 Transparency for sustainability as a social practice (Source: the author, adapted from Shove et al. (2012)).

A resulting state of transparency from the practices of a service is constantly changing and shaping relations between the service provider and end users (SPURLING et al., 2013; ALBU and FLYVERBOM, 2019).

A design approach for transparency based on practices would consider the arrangement of interconnected elements (formed by materials, competences, and meanings) in a given situation to address a circular goal, such as reducing product dependency or promoting knowledge-building on forms of reuse.

2.3.Key factors influencing transparency on digital services enabling a circular economy

The term "digital service" or "digitally enabled services" has been used to refer to services based on Information and Communication Technologies (ICT), where the degree of digital dependence can vary according to the type of technology and adoption by the customers and organizations (PENIN, 2017; HARTWIG and BILLERT, 2018). Digital services are characterized by direct customer interaction with the service through digital touchpoints, such as a website or mobile app with internet access, serving as a mediator for the service provision (digital and non-digital).

Digital services are among the main types of business models addressing circular strategies (e.g., sharing platforms, product-as-a-service, product life-extension, etc.). They usually focus on one of the circular stages and strategies, but it is possible that the same service supports more than one circular strategy, depending on the business model. This presents different transparency challenges for the service in supporting communication and interactions with different flows of resources.

Digital services enabling a circular economy can be typically associated with new business models, but it can also refer to those conventional services in existing operations (e.g. municipal urban collection, technical assistance), which digitized part of the processes and customer interfaces (RHA and LEE, 2022).

Digital services adopting a more transparent communication to promote circularity should consider the level of digitalization of the information flows throughout the products life-cycle; the privacy protection regulations; the level of openness of the systems; the inclusion of users with different levels of sustainability knowledge and needs; the education for sustainability (especially children and young people), influencing behavior change (ISLAM et al., 2021; LIU et al., 2022).

Regardless of the circular context, digital services have a potential strategic role since they can be positioned as a "connector" between users, manufacturers, retailers and public services. Such a position can be used as an enabler to promote changes in a system, including how users could have a role in achieving a more sustainable circular system by changing the ways they obtain, use, reuse, and discard products (HEYES et al., 2018; KAZA et al., 2018).

2.4.Integrating transparency for sustainability on service design evaluation

In terms of scope, design projects can be oriented to design a new service (also known as new service development) — which includes the introduction of a new service concept, offering, and delivery system; or — the redesign of existing services (the locus of this research) — implying incremental changes to a current offering and system (FOGLIENI et al., 2018).

A service design evaluation can be considered a more analytical approach to understand how well an existing service is achieving its intended aims, providing insights to optimize service outcomes and impacts (MAFFEI et al., 2013). This approach is an opportunity to make transparency improvements a common cause for the stakeholders, and benefit the people using the service by systematically reviewing the existing offers and fostering a service evaluation culture for a continuous learning and innovation process (POLAINE et al., 2013; FOGLIENI and HOLMLID, 2015; MOULE et al. 2016).

Transparency for sustainability can be approached as a specific design goal, or it can be embedded into other design goals — as service quality criteria when articulating the offerings, improving the service, and fostering organizational change.

From a methodological perspective, integrating a service evaluation at the early stages of the Service Design process would be fundamental for it to be part of the initial design strategy and to be able to facilitate other stages of development. It is at the early stages of the Service Design process where insights and requirements are gathered, problematized, and decisions are made, informing a new design or the improvement of an existing service. The focus is not on the solution itself, but on the identification of a set of opportunities and gaps that the design should address (MORITZ, 2005; PENIN, 2017).

In order to design a service evaluation process, Foglieni et al. (2018) proposed six guidelines (Figure 3) that could be clustered into three main phases: a) framing the context, goals, and available resources; b) defining the strategy including the evaluation objects and perspectives, and also the selection of data collection and analysis tools; c) operationalizing the data collection and analysis, while building insights to propose recommendations.

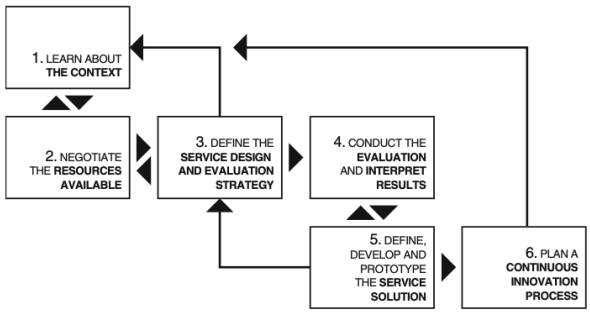


Figure 3 Guidelines for service evaluation and design (Source: Foglieni et al. (2018)).

The strategic delimitation of the service objects for a transparency evaluation is fundamental, influencing the types of data and information under study, as well as the key transparency stakeholders which will be included, influencing the organizational and end-user's perspectives.

3. METHOD

The research was conducted based on the Design Science Research (DSR) method, considering the exploratory characteristics of the research problem and the objective of combining theory with practice to build knowledge that supports problem solving. It predominantly employs abductive logic. Theory building focuses on the discovery of how a design proposition (named artifact) works in a certain problem situation. DSR allows the collaboration between researchers and organizations, for testing new ideas in a real context, enabling the development of scientific knowledge, and helping organizations to solve real problems (DRESCH et al., 2015).

The research adopted predominantly a phenomenological qualitative approach. The researchers' positioning was oriented to the meanings and relevance of the content raised on the field research (PRODANOV e FREITAS, 2013). The researchers maintained direct contact with the environment and the object of study in question, requiring more intensive field work, and the data collected are descriptive, portraying the greatest possible number and variety of elements to obtain a deep understanding about reality.

The research strategy was organized into three main phases (Figure 4): Phase 1 - Problem Understanding and Solution Awareness; Phase 2 - Artifact Development and Evaluation; Phase 3 - Reflections and Learnings.

Phase 1 focused on understanding the research problem from a broader perspective. A Non-Systematic and a Systematic Literature Review was conducted based on the protocol described by Conforto et al. (2011), to understand the historical evolution, key conceptualizations, and existing solutions.

To verify the adherence of the theoretical findings with real-world phenomena, an assessment of the transparency practices on digital solutions was conducted, based on an Exploratory Multiple Case Study (*ex-post-facto*)(YIN, 2010). Nine cases were selected representing innovative companies that were approaching transparency for sustainability (at the

time of the research). The data collected was predominantly qualitative, organized, and tabulated as an inventory of the "state of the art" of transparency for sustainability practices. Data analysis consisted of examining, categorizing, and classifying the evidence, in view of the study's propositions (YIN, 2010). The cross-analysis of the cases was carried out in a comparative and qualitative manner, to examine the common aspects and divergences between the theory and the evidence gathered (YIN, 2010). The results contributed to refine the theoretical framework and the requirements for the intended artifact.

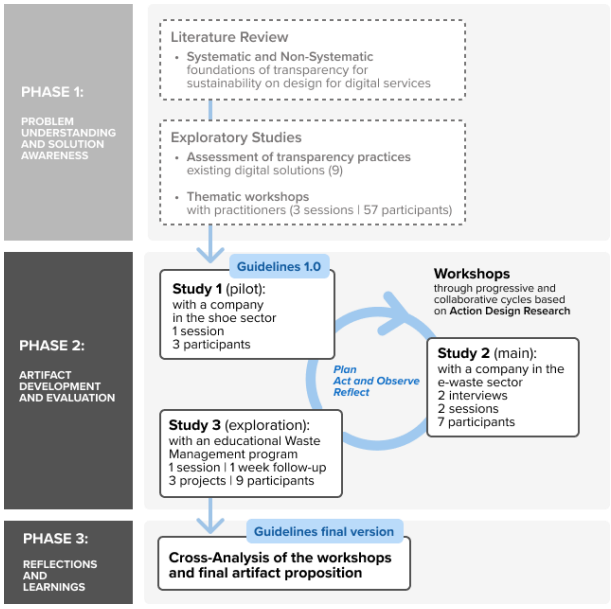


Figure 4 Research strategy (Source: the authors).

Phase 1 also included short remote thematic-workshop sessions with a broad audience of participants representing the potential users of the intended Guidelines. These thematic-workshops included people interested in knowing and exploring transparency in a strategic way through Design. The selection of participants included: design students (undergraduate and postgraduate), design professors, entrepreneurs, innovation managers, product managers and design practitioners (UX Designer, Graphic designer, Digital Designer, Strategic Designer) in consulting and private companies from different sectors (total of 57 participants). The first part of the workshop consisted of an introduction to the main concepts and examples. A practical exercise was applied for critical discussion in the second part of the workshop. The analysis of these workshops has adopted a thematic approach, with a triangulation of data strategy to obtain internal validation. The analysis consisted of a qualitative technique for identifying and analyzing patterns (themes) in the data by means of thematic codes (ABDULKAREEM, 2018).

One of the results derived from the studies from Phase 1 has already been published and deals with the elements of the service-configuration and the Design Principles for characterization and analysis of transparency for sustainability practices (LOMBA and SANTOS, 2023). The studies conducted during Phase 1 of the research were not the scope of this paper, which deals with the scope of Phase 2 and 3 of the research, built upon the results from Phase 1.

Phase 2 was characterized by field work with progressive cycles of workshops based on Action Design Research for proposing, developing, and evaluating the Guidelines (as the prescribed artifact) in a collaborative way (LEWIN, 1946; DRESCH et al., 2015).

Integrating Action Research within Design Science Research ("Action Design Research") can be a strategy when the cycles of artifact development and evaluation depend not only on the researcher's perspectives, but also on the critical collaboration of participants (which can directly influence the direction of the research). At the same time, the direction of the research is affected by this collaborative learning journey, which is, in turn, supported by the artifact. According to Ørngreen and Levinsen (2017, p.73), Workshop as a research method is an approach in studies that are emerging and unpredictable, "*… the participants, along with their expected and performed agency, become part of the research design and the data-producing apparatus*".

The workshop cycles started with the application of the Guidelines' first version, and the results were used to refine the Guidelines for the next cycle in a progressive way, until the last cycle. The results and reflections from the last cycle were incorporated into the final version.

To explore real world situations when integrating transparency for sustainability on service design evaluation activities, the workshop cycles were held with multiple participants from digital services on different circular economy sectors. For that, the workshops were organized into three stages: a) Plan; b) Act and Observe; c) Reflect.

The workshop Plan stage deals with the Guidelines proposition, described and represented with graphical abstractions for clarification. The inputs for this stage came from Phase 1 and the outputs from each of the cycles in Phase 2. During the field research, the most promising insights were regularly (re)combined and integrated into the artifact proposition (DRESCH et al., 2015).

The Plan stage also resulted in a workshop protocol describing the sampling and activities planned for each cycle/iteration of the study. The sample for the workshop cycles considered: digital services for end-users or citizens (B2C) with offerings addressing circular economy strategies; companies of small size; companies with core business offerings addressing sustainability and circular economy.

Table 1 shows the 3 studies conducted during the research for the application and evaluation of the Guidelines, and the respective sector and profile of the participants.

Table 1 Profile of the participants of the fieldwork studies

Study	Participant / Expertise
Study 1 (Pilot) shoe sector	3 Participants - Business and Design professionals
Study 2 (main) e-waste sector	7 Participants - Business, Sustainability, Marketing, Logistics, Commercial, Technology and Design professionals
Study 3 (exploration) waste management sector	9 Participants - undergraduate students in regular Production Engineering and Computer Engineering courses.

(Source: the authors)

The first application of the artifact was characterized by the researchers having greater control and usage of the Guidelines, while in the last one, the participants of the workshop were able to have greater control and usage of the Guidelines.

The Act and Observe stage deal with the practical application of the Guidelines with the intended public and

context. The primary source of data included workshop direct observation, tools / image registering, while semi-structured interviews, document gathering, and questionnaire were used as secondary sources of data.

After each application through the workshop sessions, in the Reflect stage, the lessons learned and identified improvements were then analyzed by the researchers. Such reflections resulted in further improvements to the artifact itself, based on the criteria of relevance (importance), effectiveness (usage) and completeness (components).

The data analysis at this stage adopted a similar logic to the one employed on Grounded Theory (LEHMANN, 2001; ABDULKAREEM, 2018), with a cumulative inductive reasoning approach, through a process of coding and categorization. Each new finding was confronted with the existing ones, analyzing their convergence or, alternatively, included as new proposition. The new findings were reviewed and integrated into the following version of the artifact.

Phase 3 was built upon the results from Phase 1 and Phase 2 and characterized by discussing and explaining the results according to the research questions and goals.

Reflection was initially conducted through a cross-analysis of lessons learnt through the cycles of artifact development in Phase 2, based on the logic of Thematic and Grounded Theory analysis (LEHMANN, 2001; ABDULKAREEM, 2018). The reflection involved discussing the artifact of relevance (importance), effectiveness (usage) and completeness (components).

The observation of the field research focused on the elements of service-system such as processes, stakeholders, and resources, rather than the actual user experience and behavior, as both were not addressed in this research. In other words, it deals with the general principles that govern the operation of the service rather than specific user requirements. The observation of the field also considers improvements in services ranging from digital touchpoints, user journeys, and service system-configuration. Structural or cultural changes at organizational level were not addressed in this research.

4. RESULTS

The theoretical and empirical findings were the main outcomes from the research Phase 1, serving as a basis for the general characterization of the intended artifact.

The literature review on existing artifacts showed that most of them were intended to support data-driven applications of transparency having openness as the end-goal (JANSSEN et al., 2017), rather than transparency as a means to sustainability, as the focus of this research. From a Design perspective, knowledge building in transparency is characterized by research in Information Design, and Human Computer Interaction fields addressing informational issues such as accessibility, explainability, and understandability. Artifacts for approaching transparency for sustainability as part of a service design process and service evaluation activities were limited to corporate contexts with sustainability reporting standards (GRI, 2020). Also, they do not focus on the design of digital services or even the context of a circular economy.

The findings from the research Phase 1 reinforced the need for a simple and easy format to learn and use, organizing the key transparency-oriented activities while providing guidance for application and reducing complexity in use by favoring already existing service design methods and tools.

Phase 2 of the research addressed the development and evaluation of the intended artifact to support the integration of transparency for sustainability on digital service design evaluation. This section describes the results from field work studies, through cycles of Workshops based on Action Design Research.

4.1.Proposition of the Guidelines (version 1.0)

Based on the findings from Phase 1 of the research, the artifact was conceived and proposed as Guidelines to support a continuous form of practice at the early stages of the Service Design process. It aims to organize and provide indications to articulate key elements and activities when understanding the current situation of transparency for sustainability and, at the same time, identify opportunities for improvement.

With a diagnostic function, the Guidelines focused on service redesign for improvement and optimization of transparency on digital services. The Guidelines were not intended to support the evaluation of the use and effective performance of transparency during service delivery (*in-itinere*) (as SERVQUAL from Parasuraman et al., 1985), or its adoption or impact (*ex-post*). It is intended for an exploratory evaluation of the configuration of the transparency practices on a service, informing intervention opportunities for design, during service development and optimization activities (*ex-ante*) (FOGLIENI et al., 2018).

The proposition of the first version of the Guidelines was informed by the service evaluation guidelines proposed by Foglieni et al. (2018) to consider the key aspects of a service evaluation, combined with the early stages (Discover and Define) of the general design process model from Design Council (2019), to be more easily adaptable to different application contexts. The approach adopted to integrate transparency for sustainability on service design was based on social practice theory (SHOVE et al., 2012) to characterize and analyze the communication practices with the service end-users to enable value creation for sustainability and circularity. Also, the Guidelines were based on the theoretical review as the core knowledge foundation to support the integration of transparency for sustainability on digital service design evaluation (LOMBA, 2024).

First, an organization considers evaluating how an existing service satisfies transparency for sustainability criteria and based on this, identify opportunities for improvement. Figure 5 shows the initial proposition for the Guidelines, organized in three main phases: Planning, Evaluation and Communication.

At the Planning Phase, guideline “G.1 Prepare the preliminary settings” aims to support the initial setup for the service evaluation by gathering information about its context, and to define the goals, scope, and available data resources and tools. At the end of this first activity, the team is expected to be aligned with the service and transparency challenge to be addressed.

The Evaluation Phase refers to specific data collection and analysis about the different service elements to first enable the understanding of the current conditions and practices of transparency, and then to reflect on its implications for the service.

Guideline “G.2 Characterize the service configuration for transparency” was derived into two others, each one addressing a different scope of the service “G2.1 Describe the service-system for transparency” and “G.2.2 Describe the service digital-interactions for transparency”. To achieve this, an initial interview with stakeholders can be conducted, a service walkthrough and other specific data collection according to the available sources (the System Map and Service Blueprint were the Service Design tools selected for visual representation). Once sufficient information has been collected, it is recommended to “G.2.3 Describe the key factors influencing the service transparency” concerning both digital

and systemic service scope. There are different types of factors influencing transparency on literature that can be used as a reference for this reflection, based on the literature review from the Phase of the research, depending on the application context.

Then to "G.3 Diagnose the service transparency" it was recommenced to first "G.3.1 Analyze the practices of transparency for sustainability" to unveil the key practices, emphasis, gaps, tensions, and conflicts (an auxiliary tool can be used to support analytical activities).

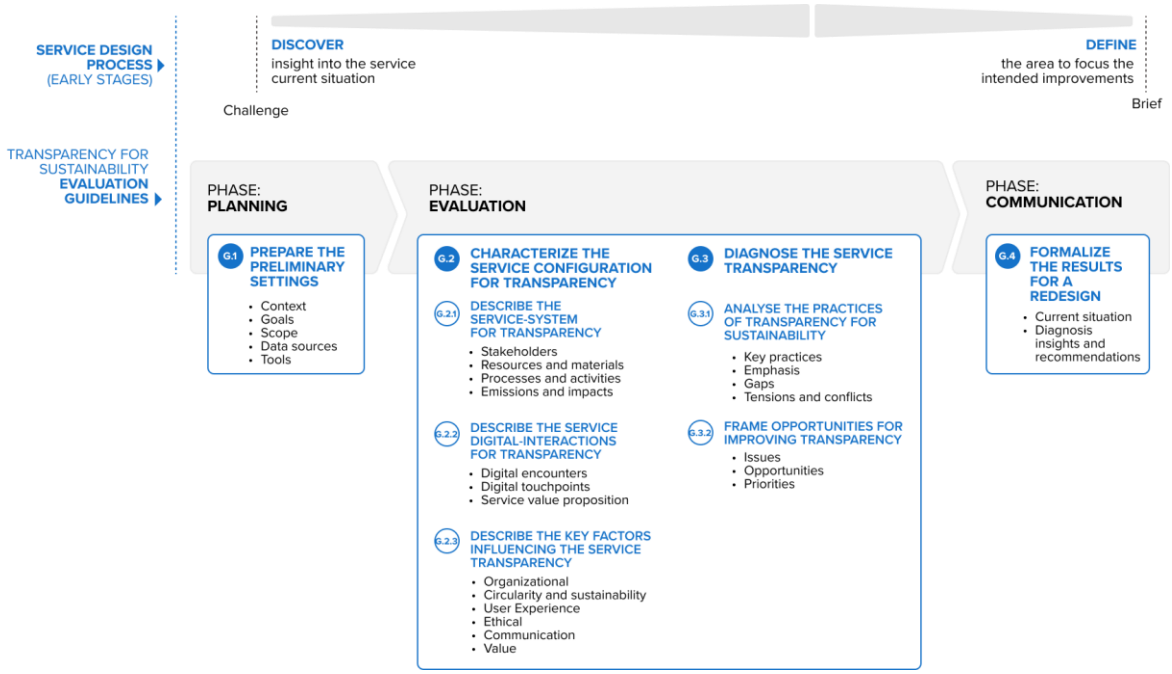


Figure 5 Guidelines for the integration of transparency for sustainability on digital service design evaluation (version 1.0). (Source: the authors).

Then, with the findings from the current situation it is possible to explore and "G.3.2 Frame opportunities for improving transparency" to identify the key issues, opportunities, and priorities, which combined with the other findings can support the diagnosis output.

The Communication Phase aims to "G.4 Formalize the results for a redesign" with the service stakeholders since they can learn from the outcomes and to devise further explorations or treat it as briefing for future actions. The output is formed by a description of the current situation of transparency for sustainability, and the insights and recommendations to improve transparency.

The Guidelines were prescribed to be conducted by a design research team in collaboration with the stakeholders from the fieldwork studies.

4.2. Study 1 (Pilot) - in the shoe sector

This pilot study aimed to better explore the design, development, and evaluation of the Guidelines, with a local and small company selected to join this study, from February to June of 2022.

4.2.1.The application of the Guidelines

The company, situated in Curitiba (Brazil), with 8 years of experience in designing and manufacturing of original and genderless shoes. Its products employed materials extracted from other industries' waste, combining traditional handcraft techniques with design for handmade products. The company prioritizes the use of natural and recovered materials whenever possible, having recovered more than 3 tons of materials (at the time of the research) that were originally destined to be discarded. The services offered by the company could be classified as product-oriented, including services for selling, repair/maintenance, and customization of the shoes.

The application of the Guidelines began with the preliminary settings (*Pilot study, Guideline G.1*). Desktop research was conducted to gather public information on the official digital channels of the company. In a kick-off meeting, the company co-founders provided an overview of the business, and the "Care, maintenance and repair service" was selected for the study. This service was considered by the company directors as its most important service, besides the services associated with selling. The goal was aligned with the company as an exploratory evaluation of the service transparency for sustainability to identify opportunities for improvement. The final customer of the company would not be directly involved in the process. The available digital data and interactions with the customer would be provided by the company and public secondary sources.

In a service discovery workshop session, the company co-founders provided an overview of the business and the "Care, maintenance and repair" service (*Pilot study, Guideline G.2*). In the same session, it was provided with the customers' profile, the service offering, and market information, among others (*Pilot study, Guidelines G.2.1; G.2.2*). For data collection, the Miro platform was used for a more participatory session with the company using the service design tools System Map and User Journey. The customer profile information was collected based on internal data the company already had.

After the session, the inventory of collected data was transferred to a Service Blueprint, helping to identify any missing data and highlight the key factors influencing transparency as informational layers of the diagram (*Pilot study, Guideline G.2.3*). In the second workshop, a summary of the discovered information representing the current situation was validated with the company.

The service's user journey was organized in five stages: 1 - Shoes usage; 2 - Search for repair; 3 - Repair estimate; 4 - Repair execution; 5 - Delivery of repaired shoes.

The main type of customer of the repair service was represented by brand-loyal and recurring customers (due to

the close relationship, they already know the brand and product). The current value proposition of the repair service focuses on convenience and the technical quality of the repair, since such customers already know the brand and product.

A critical point in the user journey was the repair estimate stage, where the service provider assesses the technical feasibility of the repair and the type of maintenance interventions that would be required. In some extreme cases, the repair could be assessed as unfeasible, and the company would then offer the possibility to collect it and adequately manage its disposal destination. Thus, at this stage, there was a need to explain to the customer the technical assessment and budget regarding the feasibility and level of repair required, supporting the customer's decision-making regarding repair services (*Pilot study, Guideline G.3.1*).

During the time of this study, the company mentioned the interest in developing a new page for their website, dedicated to better communicate to the customers the importance of taking care of their shoes (most of this communication was either non-digital or through social media) (*Pilot study, Guideline G.3.2*). This would provide maintenance tips and instructions to get access to a repair service. During the service mapping, it was discovered that most of the digital interactions with the customers were through messaging apps (Instagram inbox, mail and WhatsApp), due to the relational characteristics of the brand (*Pilot study, Guideline G.3.1*). The collected data was used to reflect upon the service governance and practices of transparency for sustainability (*Pilot study, Guideline G.3.1*).

The analysis revealed that transparency in this company was partially characterized by an active attitude on awareness-raising and clarification regarding the shoes production processes, and the origin of the materials (Figure 6).

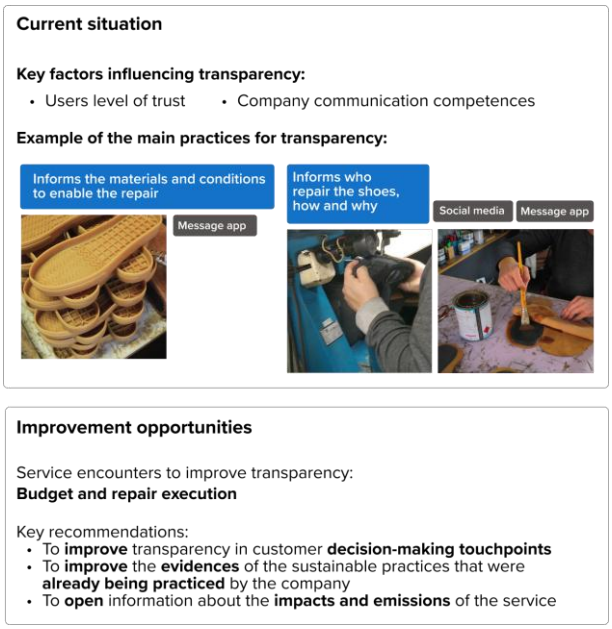


Figure 6 Pilot Study: Example of the transparency diagnosis. (Source: Nascimento (2022) and the authors).

The company argued that sometimes they keep updated indicators on waste management at the product stage, based on their internal processes, and flows of resources and materials. However, at the repair stage, they still did not have established indicators yet (*Pilot study, Guideline G.3.1*). Digital communication regarding care, maintenance and repair of the shoes was mostly dependent on individual direct messages with the customers, based on a simple protocol for reinforcing the service differential on the level of intervention on the shoes and the material choices in terms of cost and environmental impact (*Pilot study, Guideline G.3.1*).

According to the company director's perception, transparency for sustainability at the repair/reuse stage was not a priority for their loyal customers. The loyal customer expects to continue using the loved and repaired product, having absolute trust in the manufacturer's adequate ethics when taking care of their shoes (*Pilot study, Guideline G.3.1*).

Due to the circular characteristics of the business, the main opportunity aligned with the company was to improve transparency in customer decision-making touchpoints (*Pilot study, Guideline G.3.2*). It was recommended to open information on the sustainable practices that were already being practiced behind the scenes by the company and could add value for end-users, such as information for helping them to self-evaluate the shoes conditions and discover care, maintenance, and repair alternatives. It was also identified the need to provide fact-based evidence on the known and unknown environmental/social/economic impacts of the repair service and products. One of the founders presented some key questions that should be provided to the customer: *"What is this supplier providing to the brand? What is the origin of the materials? What is the process for treating raw materials? Is this certificate real?"* (*Pilot study, Guideline G.3.2*).

The results were presented to the company directors, including the service maps, to better illustrate the transparency findings and respective improvement opportunities (*Pilot study, Guideline G.4*).

4.2.2.Reflections

Participants of the pilot study considered the activities totally relevant and effective for the evaluation goal. The pilot study showed that the participants from the company were interested in having a more active role in the process.

The pilot study showed that the first version of the Guidelines has a viable potential to achieve its goal in supporting the company's understanding of the current sustainability transparency situation and opportunities for improvement.

The analysis was based on the qualitative data from the workshop evaluation and the aspects which worked were: a) it has stimulated the participants to critically think about the service conditions and offerings through the evaluation activities; b) it has introduced a new format to frame and discuss transparency for sustainability; c) it has enabled practical insights and opportunities to the company to further explore and implement them.

The key improvements to the artifact identified during the pilot study concerned how to better address completeness and effectiveness. The activities related to the "Evaluation phase" could be grouped into categories related to the analysis of the current situation and the analysis of opportunities for improvement. Also, the activities could address the different levels of components of the service more specifically to better support the practical application.

4.3.Study 2 - in the e-waste sector

This study aimed to test the propositions of the Guidelines with a company effectively working with digital services in the context of circular economy, and a small company was selected to join this study, from February to April of 2023, with a follow-up in July of 2023.

4.3.1.The e-waste digital service

The study was carried out in partnership with a reverse logistic startup from the city of Rio de Janeiro in Brazil, incubated by a

national technology and innovation consultancy. Since most companies focus on the B2B market, this one was chosen as its offerings were aimed at the B2C market, with a digital service for the citizens as end-users, enabling a circular economy in the context of electronic waste management. Also, the company was selected because of its active role in promoting sustainability.

Since 2017, the selected company collects and correctly disposes of e-waste (electronic waste). In 2022, with the digitalization of the operation, a digital platform was launched to enable the customer to directly schedule/request a collection service. The company operates with the domestic segment, managing electronics from city households.

The company is not a recycler itself, but acts as an intermediary that facilitates the implementation of the Law 12.305/2010 (National Solid Waste Policy) in the electronics sector for reverse logistics, by the collection, processing and selling the sorted parts and materials to companies specialized in recycling, and to electronic manufactures.

In addition to their corresponding accessories like wires and cables, the company works with any electronic equipment that requires or has utilized electrical energy or batteries to function. Computers, televisions, chargers, remote controllers, and other devices are included. Lamps, cartridges, printer toner, VHS tapes, cassettes, and floppy disks are among the items that the company does not deal with.

Therefore, the company relies primarily on the recycling process, which consists of dismantling electronic equipment and separating materials that can be recycled (plates, copper, aluminum, plastic, iron). Each piece goes to its specific recycling processes, returning to the production chain as raw material. The collected items are processed according to the most prevalent material and sold to interested or specialized companies. Organizations, whether private or cooperative, are the main buyers of these materials.

In Brazil, the focus of services enabling circularity has been at the end of the lifecycle of products, with private and public offerings for reverse logistics and recycling. This is one of the consequences of the National Solid Waste Policy (Law 12.305/2010) that sets targets for companies based on the weight of waste from the products they have placed on the market.

Reverse logistics is one of the strategies to implement a circular economy and a central theme of the Brazilian National Solid Waste Policy. It can be defined as an "instrument of economic and social development characterized by a set of actions, procedures and means designed to enable the collection and return of solid waste to the business sector, for reuse in its cycle or in other production cycles, or other environmentally appropriate final destination" (Law 12.305/2010). Electronic waste depends on a specific reverse logistics system that needs to be managed in a collaborative effort between consumers and companies to be effective.

4.3.2.The application of the Guidelines

The workshop was planned to be conducted in online/remote mode. Since it was planned to mix participants from different departments of the company, the exercises were individual and shared with the group, relying on the participants contextual professional experiences, knowledge and provided information.

To optimize the time of the participants, a data collection procedure was conducted before the workshop sessions. This way, the participants could move directly to reviews during the workshop, editions and discussions regarding the current situation and improvement opportunities for transparency. The researcher conducted desktop research to gather secondary and auxiliary information about the company, the digital channels, and waste management in the city. Then, a semi-structured interview was conducted with the founder of the company, to gather primary data, clarify questions, and align the goals, scope, and stakeholders for the study (*Study 2, Guideline G.1*).

The purpose of the workshop was set as both an educational and an exploratory evaluation to inform improvement opportunities for design, with a focus on household waste management through the digital service (*Study 2, Guideline G.1*).

The selected audience for the workshops were the professionals from the company effectively working with the digital service. The workshop was planned to be conducted in two online sessions in two days to enable greater participation of people (*Study 2, Guideline G.1*).

The researcher also conducted desktop research on digital services that were similar to the service under study with the partner company, to help the participants of the workshop with examples from the e-waste sector and also to support the activities related to idea generation (*Study 2, Guideline G.3.2*).

Since the data sources for the study were limited to existing secondary data and primary data provided by the company, the study did not include user research activity. The information about the service customers and types of electronic equipment was represented as extreme profiles, during the initial settings with secondary data provided by the company (*Study 2, Guideline G.1*).

The selected types of users fall into one of two categories: engaged household owners who already have attitudes toward sustainable management of electronic waste, or conventional household owners who do not. It included the profile of the property manager of a residential condominium and the profile of the target electronic equipment processed by the service (*Study 2, Guideline G.1*).

At the beginning of the workshop, the researcher conducted learning activities on the essentials for the day, as part of the educational setup for setting up a common foundation and vocabulary (*Study 2, Guideline G.1*). According to the participants, the content resonated with their work context and needs, with a focus on the customer in a more active way.

The researcher as the facilitator explained the activity and the participants started to review and make changes to the initial version of the Stakeholders Map (*Study 2, Guideline G.2.1*). Most of the changes were related to the secondary and tertiary layer of actors, and the activity fostered collaboration among the participants from different departments to refine the map (Figure 7).

The Stakeholders activity helped to evidence the key service actors from the e-waste service-system; their areas/contexts; the type of relation between/connecting then; the transparency factors influencing them (*Study 2, Guideline G.2.1; Study 2, Guideline G.2.3*).

According with the participants, for both the end-user (as the household owner that uses the waste management services) and the representative on behalf of the user (e.g.: property manager of a condominium) the demands for transparency were mainly driven by notions of mistrust, uncertainty, or insecurity on companies in which the offerings deal with environmental concerns, in that case, the proper handling of e-waste. It was also perceived as related to external contextual changes such as in legislation (*Study 2, Guideline G.2.3*).

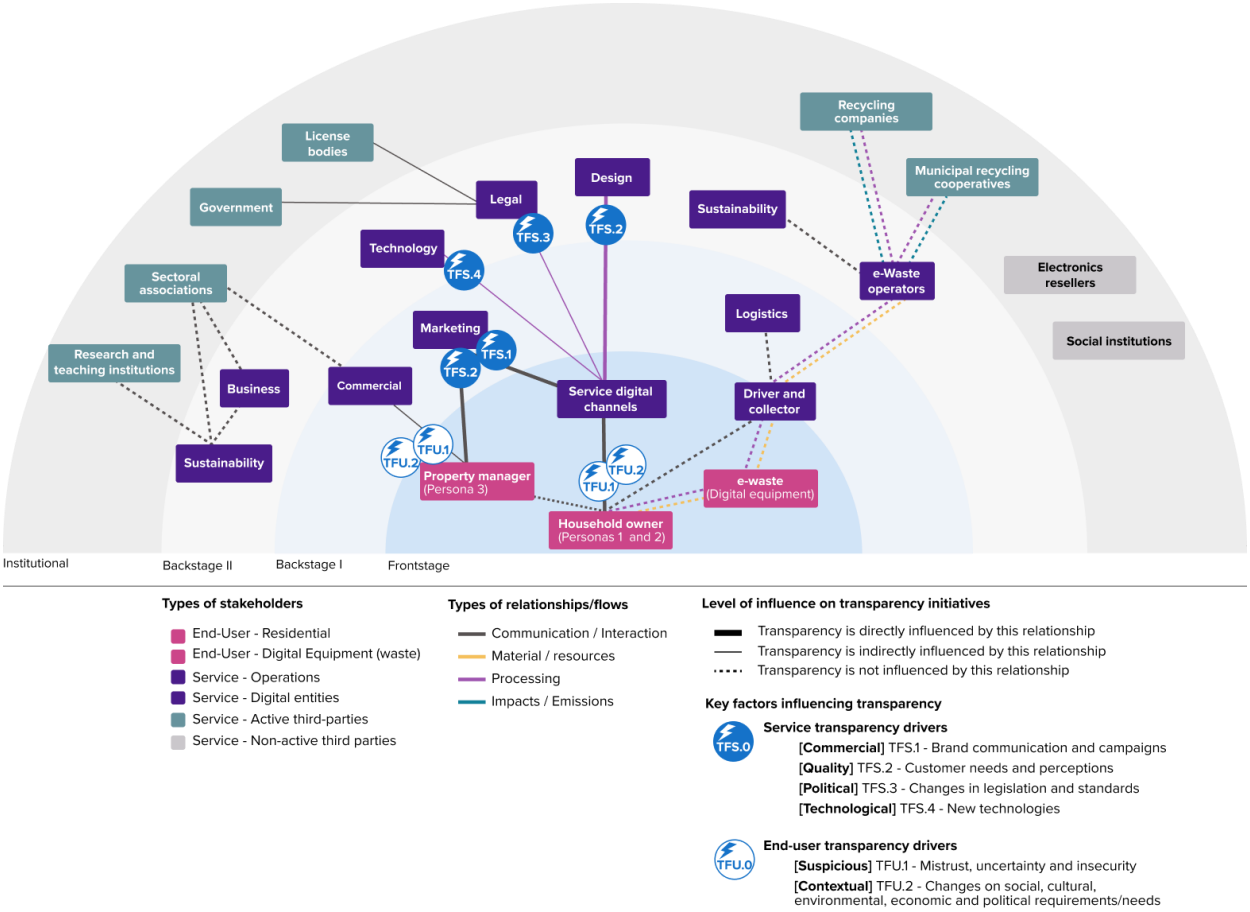


Figure 7 Study 2 - Service Stakeholders Map with data from the workshop. (Source: the authors).

From the organizational perspective, according to the participants, the transparency offerings of the research partner company were driven mainly by the user needs and perceptions, with the support of design and marketing departments (the ones closer to the users and who carry out research), followed by changes in legislation and standards affecting the organization (*Study 2, Guideline G.2.3*).

Although the activity was planned to dive first into the current situation, most of the changes and discussions among the participants were related to transparency projects under development and to be implemented in the near future (*Study 2, Guideline G.3.2*). These "future actions" included: partnerships with local recycling cooperatives (especially for other fractions such as paper, plastic, and glass); electronics resale and donation for social organizations (e.g.: reconditioned electronic equipment). The participants also mentioned that they hope digital technology will contribute more to transparency in the future. The intended stage—more automated communication to increase scale, without requiring human interaction to process the data—has not yet been attained (*Study 2, Guideline G.2.3*).

According to the participants, there was no legislation in place requiring full digital traceability at the time of this research (from the customer's house to the processing system), although it was a topic under discussion among the sectoral organizations. The research partner company acts between the end-users and the entire ecosystem that can process e-waste. Traceability, in their perspective, could be a determinant for residents and property managers to choose their service and be able to know that the parts and materials were properly allocated (*Study 2, Guideline G.2.3*).

Participants were invited to expand their analysis to a systemic perspective in which the service was inserted. To begin, the facilitator presented the activity and the preliminary data mapped, provoking the participants to first review the current system configuration and then, characterize the transparency according to the dimensions of sustainability versus each element of the system (*Study 2, Guideline G.2.1*) (Figure 8).

Based in the data from the workshop, the Service System activity helped to evidence the key elements, characterize the transparency points and respective sustainability dimensions. This representation allows the visualization of the service-system elements that were not being communicated (opaque state), the elements that were communicated, and the ones that the company wanted to communicate (*Study 2, Guideline G.3.1*).

The Service System complements the Stakeholders activity, and according to the information reviewed by the participants, despite the actors and flows influencing transparency demands and offerings in the current situation, the actual transparency provided by the service was limited to a small part of the service-system, with focus on marketing processes of campaigns and events to promote the service and recycling education (*Study 2, Guideline G.3.1*). Strategic operational processes, actors, and resources were not included in transparency communication with the end-user (*Study 2, Guideline G.3.1*).

Participants mentioned improvements on (*Study 2, Guideline G.3.2*): individually weighing the collections and being able to give this feedback to the customer per collection; performance report from a collection point in collaboration with a local partner (weight, CO2eq saved); a calculator on the website with some key indicators such the total weight collected, number of collections, how much CO2 was already avoided in the atmosphere, among others.

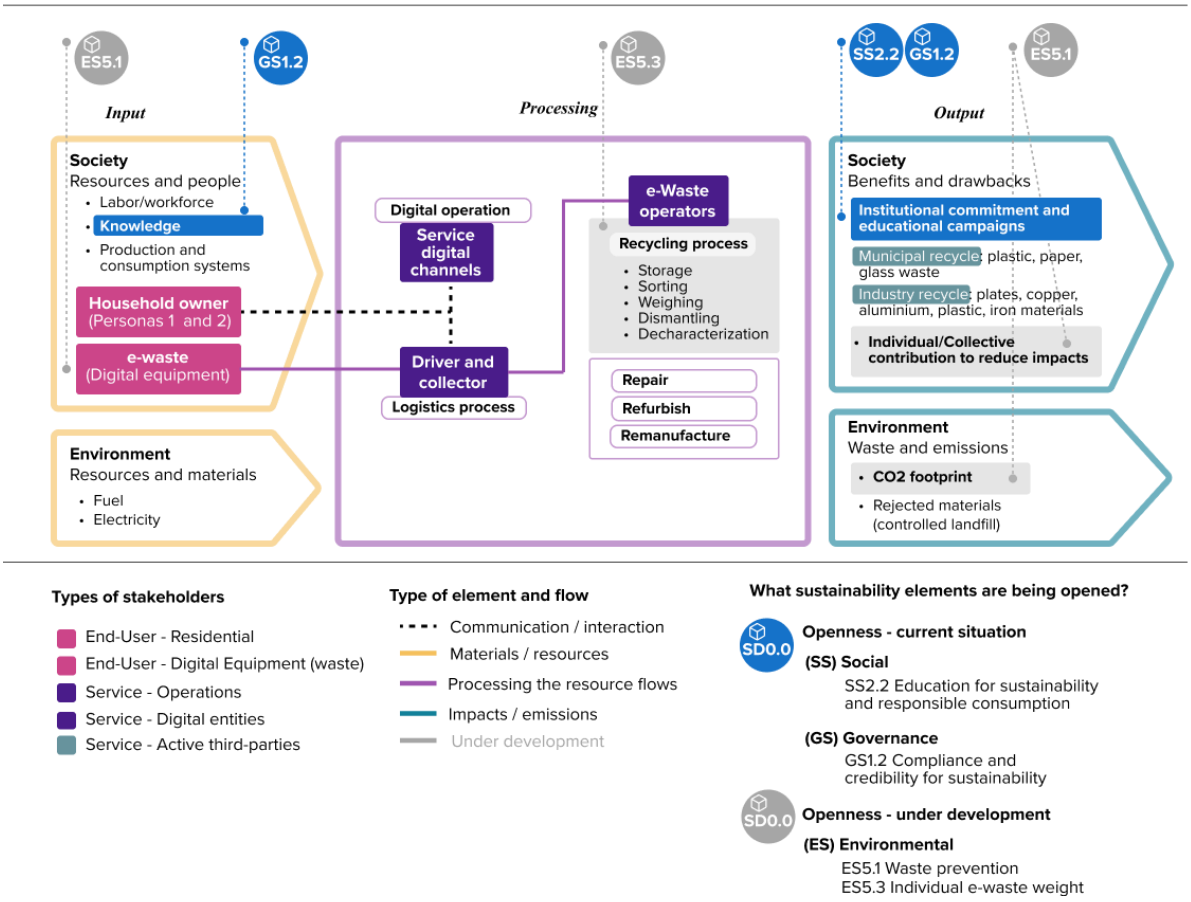


Figure 8 Study 2 - adapted service system-map with data from the workshop. (Source: the authors).

In addition to the points raised by the participants, other areas of the service-system were candidates for improvement on transparency, such as the implementation of collaboration with the local recycling cooperatives (rather than only the municipal, for recycling other fractions of waste resulted from the service operation). According to the workshop participants, this could cause a greater social and environmental impact (*Study 2, Guideline G.3.2*).

Next, participants were invited to reflect on the digital interaction scope of the service, exploring a closer focus on the user's digital journey. The facilitator presented the activity and read together the preliminary user's digital journey. The participants were called to first review the current user journey and identify current transparency practices at each service encounter (*Study 2, Guideline G.2.2*). The Service Blueprint Map was used, adapted to include a transparency line situated between the service actions at the service frontstage, and the visibility line of the service actions in the backstage. Characterization of the transparency practices was based on the Design Principles of Transparency for Sustainability (LOMBA and SANTOS, 2023) and the user personas.

The Service Blueprint helped evidence the transparency practices for the analysis, and the transparency pain points for the users. This representation also allows the visualization of the service stages (as the encounters) which were not communicating (opaque state) with the user (*Study 2, Guideline G.2.2*).

The Service Blueprint activity reinforced the notion that the service efforts in communication were concentrated at the service discovery stage, while the core service journey was lacking in communication to better assist the user throughout the service (*Study 2, Guideline G.3.1*). Also, it was highlighted for the participants the lack of attention to the pos-usage of the service, to retain customers and stimulate recycling and other circular flows for electronic equipment stored at home (*Study 2, Guideline G.3.1*).

According to the information about the users, a key concern for them to join this type of service was associated with the company's compliance with environmental standards (*Study 2, Guideline G.2.3*). However, the communication on this issue was limited, lacking in the provision of evidence and verified facts for the users (*Study 2, Guideline G.3.1*). Discussing with the participants, this pain point was also related to the service usage and retention stages.

The transparency of the service process itself was the primary topic of discussion among participants (*Study 2, Guideline G.3.1*). As a general strategy, improving that might also contribute to the sustainability of the service.

Since the current service journey didn't provide alternate pathways for the users to continue using the service, the main use case was characterized by a first-time and single use case (*Study 2, Guideline G.3.2*). Through the activity, it was also highlighted by the participants the role of transparency also in improving the service interactions with the customer, by making the digital touchpoints at least open for the user (*Study 2, Guideline G.3.2*). Unlike domestic waste such as organic and those originating from packaging such as plastic and paper, electronic waste has a smaller periodicity in user daily lives, implying in the need for strategies to continue the relationship with the end-users and, at the same time, emphasizing lasting interactions with private/public organizations that have a more continue relationship with e-waste (*Study 2, Guideline G.3.2*).

Once the participants reflected the current situation of transparency for sustainability, they were invited to identify the improvement opportunities (*Study 2, Guideline G.3.3*).

As previously identified, most of the current transparency practices were located at the pre-service encounter intended to educate the end-users regarding their e-waste (*Study 2, Guideline G.3.1*). To provide more value to the end-user and to promote circularity, the participants determined that, in

addition to improving transparency at pre-service encounters, they also needed to expand it. This included addressing a more formative and participative transparency to improve service usage and retention (Figure 9).

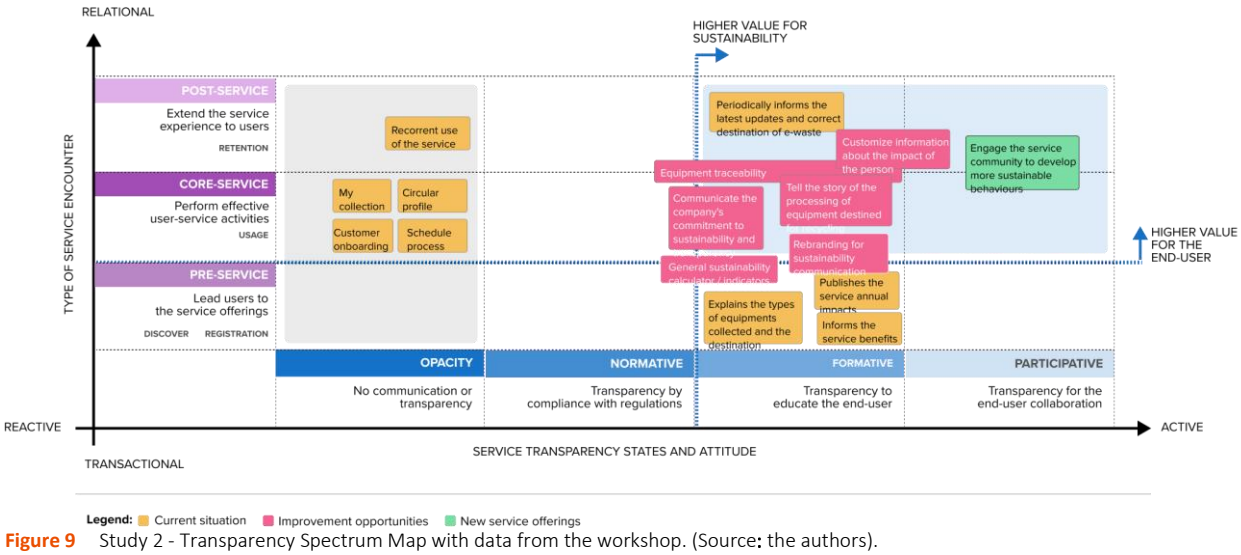


Figure 9 Study 2 - Transparency Spectrum Map with data from the workshop. (Source: the authors).

Among the main themes of opportunities discussed it included (*Study 2, Guideline G.3.2*): the rebranding of the service to better guide the sustainability communication as internal initiative; the individual feedback and storytelling of the waste collection and it respective impacts, to a more personalized communication during the core service usage and the post-service stage; the engagement with the service community to promote more sustainable behaviors for circularity, initially without personalization.

The prioritization considered the factors that inhibits the service in providing transparency for sustainability (*Study 2, Guideline G.3.2*): the level of competence of the company in digitalization of the service; the level of usability of the digital service; the level of quality of the available digital data.

According to the participants, besides the visual aspects of the rebranding idea, this could help them to clarify the service positioning and value proposition. Specially for property manager end-users and in B2B contexts, the participants highlighted from the activity that the main value from transparency could be in the service being a partner that helps the property managers to prove that they are managing their waste in a sustainable way. While in the current situation, the value proposition was characterized by a convenient and utilitarian way for end-users to dispose of electronics (pick-up at home) (*Study 2, Guideline G.3.1*).

In this sense, the ethical dimension of transparency would play an important role in communicating the service's competence in an "expert/consultant" role (*Study 2, Guideline G.3.2*).

Personalization of some types of information was the topic perceived as having the one with greatest value for the end-user, but also the one with greatest operational limitations for implementation (*Study 2, Guideline G.3.2*). Taking this information in consideration, although some ideas were raised to approach a more participative transparency, prioritization concerned enabling the end-users to customize the information needs, based on the normative and formative states (*Study 2, Guideline G.3.2*).

Regarding the promotion of engagement for more sustainable behaviors, the participants argued that ideally the purpose of the service was to enable other circular strategies, especially life extension and responsible consumption. In that sense, the participants wanted to explore how transparency could have a role in that challenge (*Study 2, Guideline G.3.2*).

Once the workshop participants framed the key issues and opportunities of improving transparency for sustainability, they were invited to creatively explore prioritized themes as future scenarios, to help formalize the design brief (*Study 2, Guideline G.4*).

This activity was based on the scenario-based design approach (ROSSON and CARROLL, 2012). A scenario is a description of an envisioned hypothetical use, event, or situation. For example, describing how people would use a digital service to accomplish recycling tasks. Scenarios can help designers to make sense of different problem spaces and reflect on what the possible implications might be for a service under study.

In the previous activity, the participants framed the key themes of future opportunities to address the findings from the diagnosis of the current situation (*Study 2, Guideline G.3.2*). Then, the participants were asked to explore insights for each theme, aimed at characterizing the envisioned future scenarios.

To inspire the quick ideation session, the facilitator presented examples of transparency for sustainability practices in digital solutions from different sectors (*Study 2, Guideline G.1*). The participants were invited to quickly generate ideas for each theme. A total of 15 ideas were generated and then classified according to the potential value for the end-user versus the feasibility for the company. The participants selected the ideas classified with "high value and high viability" and with "high value and medium feasibility".

The participants used the ideas to refine and described the scenarios, which described each concept with the following fields: a) overall description; b) how it works; c) the differential from current situation and competitors; d) transparency characterization in terms of ethical responsibility, communication format, and value proposition (*Study 2, Guideline G.4*).

By the end of the workshop, the facilitator reflected on the outcomes and learnings from the workshop with the participants, including the service maturity in terms of transparency for sustainability. The company was identified with developing maturity on the theme, because the team already had knowledge and active initiatives directly aimed at improving transparency for sustainability. The main barrier for the company was the technological capability and resources to implement the projects (*Study 2, Guideline G.4*).

4.3.3.Reflections

The participants of Study 2 perceived the Guidelines as totally relevant, effective, and complete, (*Study 2, Participant from Design sector*) "*…it helped me to have a basis for future studies*".

The Guidelines' application in the "current situation" and "improvement opportunities" stages were beneficial; however, because the current situation was primarily defined by projects that were being developed for the future, the facilitator had to make sure that the participants were reflecting on the initiatives that were actually implemented at that point in the workshop. If they weren't, they would be more focused on the future than the current situation.

Study 2 showed that Guidelines helped the participants in understanding transparency for sustainability, and evaluating their current situation, while exploring opportunities for improvement.

Analysis was based on the qualitative data from the workshop evaluation and the aspects which worked were: the setup was fundamental to plan the study, immersion of the researcher in the context of the service and optimize time with participants; the modular approach have guided the participants to approach transparency for sustainability systematically, rather than in isolated views; the diagnosis of the transparency for sustainability enabled the participants to understand, elicit and classify their practices according to its function in the service and strategy.

Spreading the workshop over two days allowed the participants to digest the information and reflect on the implications for their department and work on progress. In this sense, the researcher observed that the multidisciplinary application of the Guidelines can also be used to align a team's vision of transparency for sustainability, structuring future actions in a more integrated way.

The end-user faces gaps in communication and service offerings along the cycle of electronics. For instance, at the purchase stage, shopping digital services usually focus on the product's technical characteristics and less on the sustainability and circularity aspects, such as the type of assistance for extending product life in the future. The subsequent usage and discard stages require a great deal of effort from the end-users to figure out how to be adequately informed and find suitable alternatives (GREENELETRON, 2021). The researchers observed that despite the organization's intent, attitudes and strategies, the effective implementation of transparency for sustainability through digital touchpoints was the key challenge for the company, due to operational, economic, and technological factors.

4.4. Study 3 - in the waste management sector

The purpose of this study was to investigate the Guidelines with a student-centered initiative for developing and implementing digital services with companies in the waste management sector.

4.4.1.The application of the Guidelines

This study was conducted as part of an international research project name "Zero Waste Co-lab" between Federal University of Paraná (Curitiba/Brazil), Paulista University (São Paulo/Brazil), Aalborg University (Copenhagen/Denmark) and BOFA - Waste Management Company (Bornholm/Denmark).

It was selected a student-centred initiative named SDG Challenge in partnership with University of Brasilia (UnB) Brazil, for developing projects that could be strategic to the achievement of the 2030 Agenda's goals.

The study was carried out in person during 1 week of August/2023. A total of 15 students as participants attended the workshop distributed in 5 groups. However, only 3 groups (9 participants) were interested in approaching transparency in their projects. The selected audience were undergraduate students in regular Production and Computer Engineering courses. Both engineering courses adopt "design thinking" at the early stages of project development.

The researcher conducted a semi-structured interview with the program coordinators to align the requirements and conditions for the study (*Study 3, G.1*). The workshop aimed to guide the transparency evaluation of the project briefings that would be further used as the scope of the semester courses.

The waste management program addresses waste prevention, reduction, reuse, and recycling in the city of Brasilia, Brazil. The program has led to the development of various projects, particularly focused on solid waste management issues, including solutions such as apps for waste pickers, self-piloting waste collection machines for bodies of water, IoT sensors for waste containers, and other technology-based initiatives addressing the identified problems.

In this edition, the primary theme was "Waste Management for the Circular Economy" and the students were briefed on the key issues. They were asked in groups to select one challenge to work with during the workshop. Throughout one week, the students engaged in intense learning and design-thinking sessions to assist them in developing the projects as part of the program. The researcher conducted a class focused on transparency for sustainability with the students to teach the theoretical foundations and practical examples (*Study 3, G.1*).

Once the researcher made the Guidelines available to the students in advance, most of the students had already seen the material previously. In the second part of the workshop, the researcher presented and explained the Guidelines, and the students were invited to use them to approach transparency for sustainability as one of the analytical and creative lenses in their projects (*Study 3, G.1*).

Although the workshop was planned to be conducted in person, the Guidelines was built in the Miro platform to facilitate the access and use by the students. Also, the researcher provided printed versions of the Guidelines to all students to use the material more freely in the classroom (*Study 3, G.1*).

The students used the material provided as reference to conduct the activities and partial deliverables. Also, each group of students met with the researcher for direct supervision, sharing their progress and obtaining clarifications.

To describe the current situation of the services, the students first performed desktop research (*Study 3, G.2*), and then they were asked to identify a major sustainability transparency issue that the project would address to share with the class (*Study 3, G.3; G.4*).

Part of the groups engaged with transparency during the understanding of the problem stage, but only 1 group effectively integrated more clearly transparency in the project during the elaboration of the propositions. Mainly because of the time limitation of the official program, the other 2 projects had a different scope, being already at the under-implementation stage, rather than the discovery and definition stages.

The "Sustainable Hub" group addressed the problem related to the lack of alternatives for the population to build awareness and engage in sustainable actions, with a focus on recycling and reuse. According to the group analysis, in the city of Brasilia, waste and sustainability information was decentralized in different digital platforms and was not sufficiently supporting the promotion of more sustainable and circular consumption patterns (*Study 3, Guideline G.2.2*). The

group used the provided Guidelines to discover the current informational situation (*Study 3, Guideline G.2.2*), and to frame the design opportunities (*Study 3, Guideline G.3.2*) (Figure 10).

Based on the findings, the group discovered that the city of Brasilia already had social and environmental initiatives (NGOs, projects, and events) that could benefit from greater participation of the population, but digital findability and visibility was a barrier (*Study 3, Guideline G.2.3*). The group understood that transparency could play a role to: open information and interaction alternatives between the citizens, local initiatives and commerce enabling circular strategies such as reuse, repair, recycling; a funding and activism to enable people's awareness and action (donation, volunteer, etc.); circularity education contents and triggers for actions (e.g.: correct disposal, options for resume and recycling, near collection points, etc.)(*Study 3, Guideline G.3.2*).

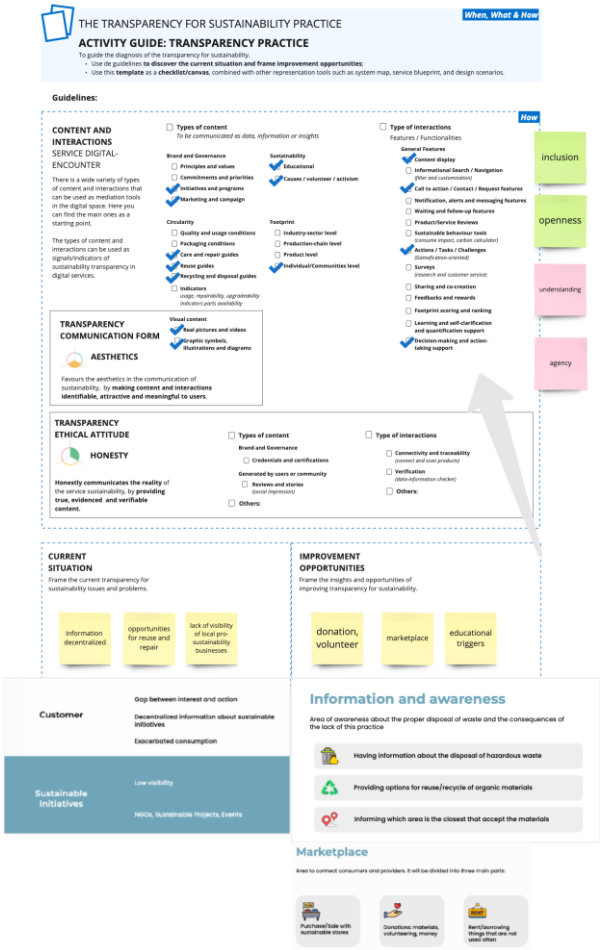


Figure 10 Study 3 - example of the Guidelines in use by the students. (Source: the authors).

The participants of the "Sustainable Hub" group mentioned that it was easier for them to use the Guidelines starting at the digital scope (*Study 3, Guideline G.2.2*), with the types of information and interactions, and then linking with the transparency design principles they want to activate. The students suggested the continued use of the provided Guidelines to support the implementation of transparency practices on their proposal for the phase of their project (concept and development).

4.4.2. Reflections

The participants of Study 3 perceived the Guidelines as relevant, effective, and complete, (Study 3, Participant "Student B", Production Engineering course) "The material is easy to understand and very complete, but I missed having a version of the checklist that I could apply later in the development of the project, to know if it is meeting what was proposed and how it is meeting".

The researcher observed that the Guidelines helped participants visualize the possibilities in a more tangible way to articulate transparency in their projects. The most attractive aspect for the students was having access to a complete and structured guide, including educational and practical support. The format helped to simplify the complexity of the theme from the class and to identify the transparency elements of candidates for the projects.

Based on the experience of the groups that effectively used the Guidelines, the researcher observed that the guidelines for the service system (*G.2.1*) and digital scope (*G.2.2*) of the service were the most used. The fact that the groups didn't have time to carry out primary data collection with stakeholders and potential users was a possible reason for that, focusing on the elements that were closer to their knowledge areas.

The guidelines were also used by the participants as criteria to know whether transparency was relevant to specific problems of their design projects. However, the groups didn't fully utilize the possibilities offered by the material, again, possibly due to limited time and being more oriented towards proposing a solution than exploring the problem.

The study showed the importance of taking a more proactive approach to sustainability in projects by incorporating transparency early on the design process. Inciting changes instead of waiting for the requirements for transparency to be identified.

Additionally, the researcher observed that study fostered key transparency competence among the students regarding: observation and interpretation of current situations; critical thinking for sustainability through transparency; anticipatory attitude for circularity considering transparency of multiple scenarios of use; interpersonal attitude for design.

4.5. Reflection and learnings

4.5.1.Discussion

Regarding relevance, the results of the studies showed that the process for integrating transparency for sustainability on digital service evaluation was valued by the participants as a new approach from a design perspective, rather than usual technological, legal, or corporate perspective. The Guideline's adaptable structure (which included phases, stages, and different analysis scope) offered a logical model on how to organize data collection and analysis activities.

Throughout the fieldwork cycles, the understanding of the artifact requirements and research problem evolved, from an artifact as an operational solution for running an evaluation (a more positivist perspective), to a more strategic artifact aimed to unveiling blind spots and provoking critical reflection. This way, the researchers understood the relevance of providing structured Guidelines to the participants of the workshops, for them to be able to self-articulate the key elements of transparency and digital service enabling circular economy, considering the implications in their own context. Most of the feedback for improvement concerned the artifact completeness in terms of having more recommendations and practical examples, to help with the effectiveness of usage.

Regarding effectiveness, the Guidelines provided guidance on how to evaluate a service current situation and identify opportunities for improvement of transparency for sustainability on digital services.

The studies reinforced the importance of developing an anticipatory attitude to enhance the effectiveness of the

impact of transparency on circularity goals. This implies adopting a more active attitude (MABILLARD and ZUMOFEN, 2017) to address ethical and behavioral issues towards sustainability, rather than focusing on meeting functional needs (such as convenience and compliance). The end-user journey for circular economy involved gaps in communication and service offerings, meaning that transparency strategies need to foresee the multiple communication needs of the end-users, but also the principles and goals of circularity and sustainability which the service organization stands for. However, it was not usual for the workshop participants to consider this level of detail and communication fragmentation.

Regarding completeness, the approach revealed barriers in the service provision of organizational infrastructure to include the service end-user on the strategies and actual implementation of transparency for sustainability. Services from different sectors will have different stakeholders influencing transparency, even varying from company to company due to organizational culture and contextual aspects. It was not under the scope of this research collecting data from end-users of the services or analyzing the service organizational culture. However, to alert these issues, it was included in the Guidelines to consider the end-user and the organizational perspective on transparency studies. Despite the potential of the Guidelines to create awareness to transparency and sustainability, in the case of malicious organizations (such as supporters of practices of green washing, not interested in real sustainability), this problem goes beyond the scope of the proposed artifact.

In terms of applicability, the Guidelines to integrate transparency for sustainability on digital service diagnosis are presented in a structured way to provide flexibility in its use. For example, in low maturity contexts it was easier for the participants of the workshops to start thinking about transparency at service-digital level (the touchpoints, types of digital interactions and information) and then move on to a more systemic level including sustainability and circularity issues. The researchers also observed that the workshops revealed different usage intensities and possibilities by the participants along the fieldwork studies. Some of them used Guidelines for consultation as references, for taking notes and as a checklist.

It is recommended that people with previous knowledge of the related themes act as mediators and facilitators during the application of the process to evaluate transparency for sustainability in the design of digital services for the circular economy. The fieldwork studies showed that having an external mediator was important to ensure that the team discussed in a collaborative way the conflicting situations, relationships, and practices influencing transparency efforts in the organization.

Based on the outcomes from the fieldwork applications within real situations, the Guidelines can be used:

- As an educational function to support the development of competences to integrate transparency for sustainability on design projects, particularly in the context of digital services enabling circular economy. It promotes the critical reflection on the ethical and communicational aspects of the service, and the value-propositions enabled by transparency practices to the service end-users;
- As a diagnostic function to characterize and evaluate the level of maturity of a service organization and the current state of the practices on transparency for sustainability. It can also be used to identify requirements on transparency for sustainability to inform action plans and design activities;
- As a creative function to inform the key elements to consider when exploring insights and design scenarios to improve transparency for sustainability in the context of digital services enabling a circular economy;
- To analyze sustainability dimensions and circularity elements of the service system that are critical for transparency;
- To analyze the digital touchpoints enabling transparency along the critical service encounters for the end-users.

The studies showed that a service organization or educational service design project can apply the Guidelines to analyze an existing digital service, implementing any of the circular economy strategies in the core business. The analysis can be: a) exploratory - running most of the activities to have a full picture of the transparency, typically for a long-term action plan; b) issue-oriented - addressing a specific goal and scope of analysis, typically for a short-term action plan.

The Guidelines can also be applied to build awareness, identify possibilities, and begin to prioritize transparency as part of the service strategy when there is insufficient or basic maturity. Within developing and consolidated maturity, the artifacts can be applied to expand the value propositions and continuously manage transparency strategies.

The application of the Guidelines was limited to educational contexts and small to medium-sized companies, with restrictions on the level of implementation of digital technologies and the scope of circular strategies. For this reason, the Guidelines may not be suitable for application in large companies and value chains due to the particularities of its systemic complexity. Although technological infrastructure capability of organizations can affect the implementation of transparency, the adoption of the Guidelines by circular services in different sectors are mainly affected by the lack of knowledge and resistance to the theme, the lack of organizational support or difficulties in engaging the service-system stakeholders. The Guidelines were intended to be used as an analytical lens for value-creation, and its adoption may face barriers within inactive or reactive organizations. In the case of organizations with active intent to improve transparency, the challenge is mapping the great variety of elements and information objects of service-system.

4.5.2. The final version of the Guidelines

Improvements from the studies were incorporated into the final version of the Guidelines, which were meant to give service designers at different sectors, an indication of a course of action on how to integrate transparency for sustainability in digital service design evaluation process (Figure 11).

The literature unveiled that transparency can be addressed more as a spectrum, implying that different strategies contribute to overall types of transparency and outcomes (MOL 2010; SCHNACKENBERG and TOMLINSON, 2016; MABILLARD and ZUMOFEN, 2017). The theoretical and empirical results of this research helped to evolve the understanding of transparency as a resulting enabling state of a set of strategies articulated at different “layers” of a service. The researchers understand that a service organization intending to integrate transparency for sustainability on digital service design should consider approaching the concept at three layers (Figure 12):

1. **Governance**: deals with the competence of a service organization to actively and systematically approach transparency for sustainability and circularity practices;

2. **Practice**: deals with the sustainability and circularity value propositions for the end-user through transparency digital interactions. Transparency practices can be focused on:
   2.1. **Institutional communication**: concerning the service management of sustainability and circularity;
   2.2. **Product-service communication**: concerning the resource flows, impacts and emissions handled by the service through the product value-chain;
   2.3. **Individual communication**: concerning the behavior of end-users and collaborators of the service.
3. **Relational** - deals with the relationships among the service stakeholders that influence transparency for sustainability practices.

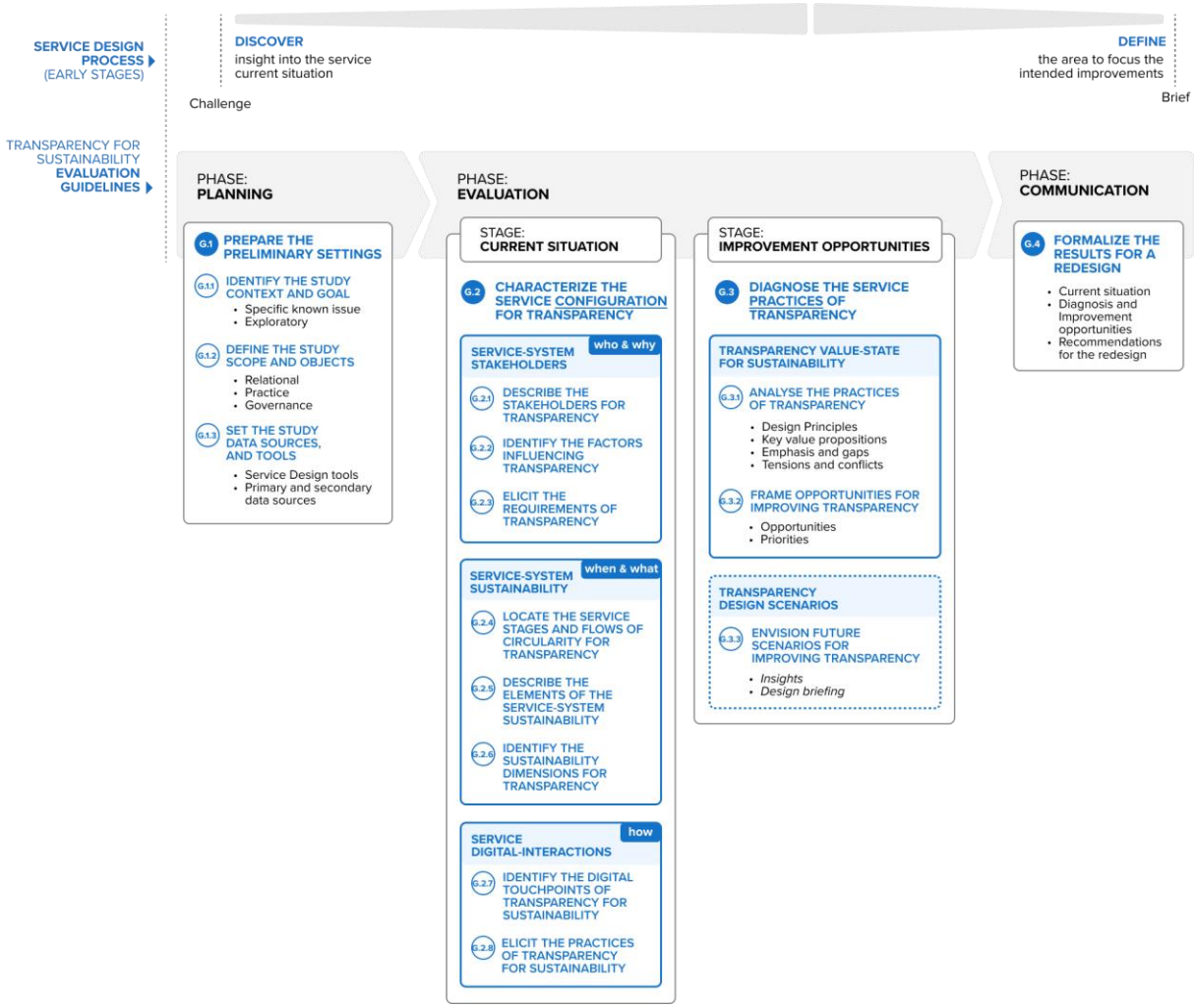


Figure 11 Process-oriented guidelines for integrating transparency for sustainability on digital service design. (Source: the authors)

Governance and Relational scope were secondary on this research but recommended to enrich the analysis and impact of the Practices of transparency for sustainability, since both scopes are interconnected. At Practice Scope, transparency strategies could focus on the elements of the service-system to be communicated (WHAT) along the service encounters for circularity (WHEN), through the digital touchpoints (HOW). While the Relational and Governance scope could influence the priorities (WHO, WHY) and competences (WHERE) for transparency practices.

Thus, at the **"Planning"** phase of the process, it is recommended to define the transparency scope and elements of the evaluation, according to the intended goals. Also, the respective tools and available data sources to conduct the study. Conventional Service Design tools can be used and adapted to highlight transparency, sustainability, and circularity aspects to support the analysis.

The **"Evaluation"** phase was organized into two stages to more clearly state data collection and data analysis activities. The **"Current Situation"** stage deals with the characterization of the current service configuration for transparency. The guidelines were organized into three modules that combine service and transparency scope. According to Shove et al. (2012), approaching the different elements that form a practice helps to identify emergent patterns and connections.

At the **"Service-System Stakeholders"** module, it is recommended to characterize both, service end-users and service organizational actors.

Different groups of service end-users could have different transparency perceptions, informational and interaction needs, as well as sustainability attitudes. The research showed that there are a range of factors that drive or motivate end-users to demand transparency for sustainability (e.g.: mistrust and uncertainty, changes in lifestyle, social influences, etc.). There are a range of factors that facilitate or prevent service end-users in benefiting from sustainability transparency (e.g.: type of technology and digital functions, understandings and beliefs, educational and behavioral background, etc.) (MCCARTHY and FLUCK, 2017; MATHEUS and JANSSEN, 2020). Understanding the end-user's requirements which the service should satisfy or solve regarding transparency will further support the evaluation of the enabling value of the actual transparency practices, as well as the end-users included.

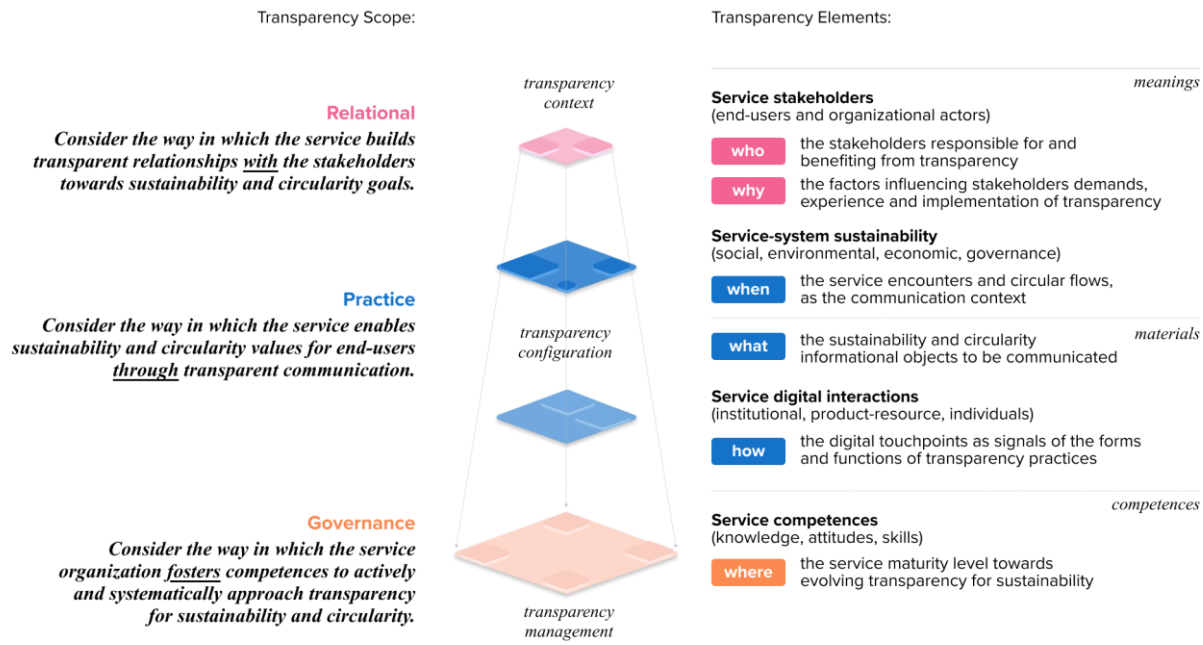


Figura 12 Scope-oriented guidelines for the integration of transparency for sustainability on digital service design evaluation (final version). (Source: the authors).

Table 2 Circularity-oriented guidelines to characterize the service transparency.

Circular context	Transparency guidelines
Purchase	Consider transparency on promoting consumption prevention and minimization.
Prevent and reduce	- transparency on consumption efficiency, sufficiency, and impacts. e.g.: What is the manufacturer and retail responsibility? What are the alternatives to buy a new item?
Usage	Consider transparency on optimizing the use and extending the lifespan of products and parts.
Reuse	- transparency on the use of a product that is still in good condition and fulfils its original function. e.g: What are the conditions and defects, the repairs made, etc.
Repair	- transparency on the maintenance and/or fix of defective products so it can be used for its original function. e.g.: How to maintain this item? What is the repair viability and cost, durability after repair, etc.
Remanufacture	- transparency on the alternative use of parts of a discarded product in a new product with the same function. e.g.: What are the options to extend the life of the parts of this item? What is the remanufacture viability? etc.
Post-usage	Consider transparency on the valorization and treatment of waste as a resource.
Recycle	- transparency on the responsibility and processing of waste to transform back into raw materials. e.g.: What and how to recycle? What does reverse logistic mean?

(Source: the authors, adapted from Islam et al. (2021) and Liu et al. (2022))

Regarding the service organizational actors, it is recommended to characterize the core internal and external actors in a service-system that might have a role in transparency for sustainability and circularity. The research showed the need to consider human and non-human actors from the service-system, such as digital platforms or entities. During the research, the activities for mapping the stakeholders helped the participants to more clearly visualize how much the service organizational actors were influencing transparency current offerings: direct, indirect, no influence.

The research showed that there are a range of internal and external factors that drive or motivate organizational actors to address transparency for sustainability on services (e.g.: technological, commercial, quality, political, etc.) (MCCARTHY and FLUCK, 2017; MATHEUS and JANSSEN, 2020). There are a range of factors that facilitate or prevent service organizational actors in implementing transparency practices (e.g.: technological, operational, ethical, legal, etc.). Understanding the organizational requirements which the service should satisfy or solve regarding transparency will further support the evaluation of the actual transparency practices, as well as the service maturity.

At the **"Service-System Sustainability"** module, it was evidenced the key guidelines to support the characterization of circularity flows that gives the context and the sustainability elements that comprises the informational objects communicated through transparency practices.

In the context of services in different sectors enabling circular economy, the research showed the need to locate the circular stages and strategies in which the service(s) offerings are situated (Table 2). A service under evaluation could support more than one circular strategy and vice-versa, depending on the business model and sector. Each circular stage presents different transparency challenges for the service.

Besides the circular context, it's important to locate the service digital encounters under the transparency evaluation, as the moments or situations in which the end-users go through when interacting with transparency practices. The research adopted the following key types of encounters from Woorhees et al. (2017):

- PRE-SERVICE: when communication leads end-users to service offerings. Consider transparency on awareness building, willingness to join the service, and decision-making for sustainability (e.g.: information search, initial contact with the service, transactions, service onboarding).

- CORE-SERVICE: when end-users perform main service activities. Consider transparency on effective interactions with core service processes to fulfil end-users needs and to promote attitudes towards sustainability and circularity (e.g.: scheduling, delivery, follow up, notifications, instructions, profile update).

- POST-SERVICE: when communication extends the service experience to end-users. Consider transparency on service review and to help retain end-users by sustainability and circularity reasons (e.g.: service recovery efforts, feedback, reviews, recommendations).

The last activity recommended at the **"Service-System Sustainability"** module is based on the understanding that the service is part of a system and influences the sustainability of that system. The service can have a dominant role in how it operates and processes inputs and outputs in a given system. Thus, transparency should refer to the sustainability of that service-system, considering the openness of the service resources, stakeholders, processes, impacts and emissions, regarding environmental, social, economic, and governance aspects (GIANNETTI et al., 2019).

At the **"Service Digital-Interactions"** module, the focus is to identify the digital touchpoints of transparency with the end-users and elicit transparency practices.

Touchpoints are interaction instances, that can be used as signals/indicators of the forms of transparency practices in a service (e.g.: discover repair alternatives for my phone on the service webpage; detect the recyclability of unused electronics on QR code scan). The research showed that transparency touchpoints could be mapped from the type of digital interface/medium (e.g.: call to action, menu, message, QR code, etc.), type of informational content (facts, indicators, concepts, insights based on the service-system elements), or the type of task/function (e.g.: exploring, transactional, conversational, fact checking, prescription, etc.).

The transparency practices can be expressed by the elements mapped along with the characterization of the current situation. The **practices can be formulated as statements**:

- how (digital touchpoints) + what (informational objects) + when (service encounter and circular stage) + who and why (stakeholder requirement and desired benefits or outcomes);

- example: Sends a didactic message on the types of electronic waste collected when onboarding the recycling process to help with the awareness of people with non-technical knowledge and unused electronics stored at home.

Once the key building blocks that configure the service transparency have been identified at the **"Current Situation"** stage, data collected can be analyzed at the **"Improvement Opportunities"** stage with a diagnostic function.

The guidelines from the **"Transparency Value-State for Sustainability"** module deals with the effective evaluation of the current transparency practices of a digital service, to identify potential gaps and issues on the service communication that might hinder end-users on new forms to build awareness on sustainability, to promote behavioral changes and informed decision-making to address sustainability and circular goals.

The analysis strategy adopted in this research consisted of a qualitative analysis to support critical reflection by verifying the adherence of the elicited practices to the Design Principles of Transparency for Sustainability (LOMBA and SANTOS, 2023) as the selected evaluation criteria.

For the practical application it is recommended to create a checklist of the transparency practices (organized by service encounter) versus the dimensions of the Design Principles (similar to Study 1 and 3) or to adopt a more visual way (similar to Study 2) with narrative or map-oriented tools (e.g.: Service Blueprint, Transparency Spectrum Map) to locate emphasis and gaps, and also to frame areas for improvement and priorities.

The **"Transparency Design Scenario"** module was included in the final version as an auxiliary guideline to locate the moment along the evaluation process to explore insights and requirements to help with a design briefing to address the priorities for the intended improvements from the analysis.

At the **"Communication"** phase, the results from the study are formalized to be able to integrate a continuous process for evolving transparency for sustainability.

5. CONCLUSIONS

This research explored the adaptation of the concept of transparency for sustainability at the early stages of the Service Design process through the development of Guidelines to support such integration. Particularly, this integration addressed service design evaluation activities on digital services enabling the circular economy.

The research revealed that addressing transparency for sustainability on digital services is complex, and there are several aspects and elements that need to be considered by Design.

Approaching transparency for sustainability on digital services requires a multidimensional perspective to expand the space for intervention. The existing literature wasn't sufficient to answer the research questions, either because it had an exclusive focus on the topic of transparency in Information Systems contexts (HOSSEINI et al., 2008; GRIMMELIKHUIJSEN and WELCH, 2012; CAPPELI et al., 2013), or because they had an emphasis on the classification of types or strategies of transparency (HOFSTEDE et al., 2004; SCHNACKENBERG and TOMLINSON, 2016; MABILLARD, and ZUMOFEN, 2017).

The cross-analysis from the studies enabled the researchers to propose Guidelines intended for the design evaluation process, considering the systematization of key activities, scope and elements of analysis; and the goal of transparency in a given context of circularity.

It was understood that transparency for sustainability can be approached at the early stages of Service Design, as a research and analytical practice among the procedures adopted in the configuration of service projects.

The Guidelines were conceptualized, developed, and tested through progressive cycles of Workshops based on the Action Design Research strategy. The cycles of fieldwork study allowed the researchers to get closer to different real-world contexts for the application and evaluation of the Guidelines under development. The cycles of fieldwork study were fundamental to supporting researchers in understanding the problem and evolving the propositions.

In keeping with the more recent generation of research that views transparency as an enabling concept for value-creation, the Guidelines can be used to direct the strategic pathways to be taken into consideration in order to improve the impact for sustainability (EGGERT and HELM, 2003; MOL, 2010; GRIMMELIKHUIJSEN and WELCH, 2012; KOSACK and FUNG, 2014; FLUCK, 2016; MCCARTHY and FLUCK, 2017; ALLOA and THOMÄ, 2018; ALBU and FLYVERBOM, 2019).

Based on the learnings from this research, there are some opportunities for future studies:

- To expand the studies to include structural or cultural changes at the organizational level;
- To include the activities from the solution space of the design process ("the second diamond" with stages of develop and deliver) such as ideation and concept development with a focus on transparency for sustainability;
- To expand the focus of the evaluation to after the service delivery, concerning the use and effective performance of transparency for sustainability. It could explore the synergies with the SERVQUAL model (PARASURAMAN et al., 1985), which focuses on service performance and perceived quality, as well as user studies through usability and ethnographic methods;
- To expand to new service development, support the analysis of the service and business model offerings driven by transparency for sustainability;
- To explore other application contexts and possible uses, to extend the contributions and provide greater generalization and configuration of parameters.

From these recommendations, it is expected to expand transparency research on the Design Sustainability field, broadening the scope of the design intervention, from insular digital interactions to socio-technical-ethical-ecological systems.

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