Understanding the Customer Experience with Smart Services

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Purpose – This article provides an in-depth understanding of customer experience with smart services, examines customer perceptual responses to smart and connected service environments, and enriches this understanding by outlining how contextual factors (in terms of goals, activities, actors, and artifacts) influence the customer experience.

Design/methodology/approach – This study adopts a qualitative approach in order to understand customer experience in the smart energy service setting. Semi-structured interviews and focus groups were conducted with 31 participants forming three groups of energy service customers: advanced smart energy (ASE) customers, electric mobility (EM) customers, and high-consumption (HC) customers.

Findings – The findings show that customer experience with smart services involves a multidimensional set of perceptual responses, comprising specific smart service dimensions (e.g., controllability, visibility, autonomy); relationship dimensions (relationships with the service provider and with the community); and traditional technology-enabled service dimensions (e.g., ease of use, accessibility). The analysis of contextual factors such as goals, activities, actors, and artifacts shows that smart services enable a more autonomous experience, wherein customers can integrate a myriad of actors and artifacts and expect the main service provider to support them in taking the lead.

Originality/value – Smart technologies have profoundly changed the service environment, but research on customer experience with smart services is scarce. This study characterizes smart services, provides an in-depth understanding of customer experience in this new context, and discusses relevant implications for management and service research.

Keywords: Smart Service, Customer Experience, Smart Energy Services, Technology-enabled services.

Paper type – Research paper

Introduction

Technology has been considered a game changer in the service context (Ostrom et al. 2015). Smart devices can sense their own condition and surroundings, facilitating real-time data collection, continuous communication, and interactive feedback (Allmendinger and Lombreglia, 2005). They provide connectivity for customers anywhere and offer unprecedented opportunities for companies to provide services, such as pre-emptive monitoring or diagnostics, which enable customers to control objects like their home appliances (Georgakopoulos and Jayaraman, 2016). A service delivered to or via such a smart device is commonly referred to as a smart service (Wünderlich *et al.*, 2015). Although smart services offer multiple benefits for service providers and customers alike (Wünderlich *et al.*, 2015), many customers still struggle to adopt complex smart service systems like smart homes (Ahuja and Patel, 2018). To understand the barriers that arise in smart service adoption and to design smart service systems that appeal to customers, managers need to gain insight into how customers experience smart and connected service environments.

This study explores customer experience in smart service contexts. The study contributes to the literature by identifying how smart technology impacts customer experience, which is becoming increasingly relevant with the emergence of smart devices and services (Foroudi *et al.*, 2018). Smart services typically involve a vast array of interactions between multiple actors, such as customers, providers, and technology artifacts, which, in turn, enable different kinds of activities and interactions, from transactions to social information sharing (Verhoef *et al.*, 2017).

This paper offers an in-depth understanding of customer experience with smart services through a qualitative study with smart energy service customers. The energy sector offers a rich empirical setting, as it is going through a large transformation toward the digitization of energy services (IEA, 2019). New smart home technologies enable home owners to experience home energy consumption in novel ways (Raimi and Carrico, 2016). Operators and utility providers expect that the implementation of smart services will result in cost reductions for customers, as well as reductions in environmental impacts through the decrease of carbon emissions (Dincer and Acar, 2017). However, how the smart service context impacts customer experience has remained largely unexplored.

This article advances the understanding of customer experience with smart services by shedding new light on customer perceptual responses to smart services, revealing a) smart service-specific dimensions such as information visibility, controllability, or autonomy; b) different relationship dimensions with both service providers and communities; and c) traditional technology-enabled service dimensions such as ease of use and accessibility. Building on Activity Theory (Kaptelinin and Nardi, 2006) and Customer Experience Modeling (Teixeira *et al.*, 2012), this study further enriches this understanding by outlining how contextual factors (De Keyser *et al.* 2020; Becker and Jaakkola, 2020), such as customer goals, activities, actors, and artifacts, influence the customer experience in the smart service environment.

The paper is structured as follows: The conceptual background section covers extant literature related to customer experience with smart services. The methodology section describes the qualitative approach based on 31 interviews with energy customers. The study findings provide an in-depth characterization of customer experience with smart services, examining its perceptual dimensions and contextual factors. Finally, the discussion section examines the contributions of the study's findings to service research as well as implications for managing customer experience in the smart service context.

Conceptual Background

Smart Service

The ongoing trend of virtualization and digitization is accelerating the shift from a product-oriented business paradigm to a service-dominant logic (Vargo and Lusch, 2016). This trend, which profoundly transforms businesses and societies around the globe, is fueled by synergies between new technological developments, the widespread adoption of mobile devices, data science, and the Internet of Things (IoT). Smart solutions comprise both the core parts, which enable their basic function, and smart components, such as sensors, microprocessors, data storage, and connecting technology, which enable remote communication and establish the link between devices, users, manufacturers, and service providers (Porter and Heppelmann, 2014). Smart objects considerably alter the design and delivery of services, as they can gather and analyze data, make decisions and act accordingly, enabling the development of an ecosystem of interconnected smart services (Allmendinger and Lombreglia, 2005). The spectrum of smart services ranges from monitoring, optimization, control, and autonomous pre-emptive services, (e.g. smart metering), to interactive remote repair services of complex industrial machines (Wünderlich *et al.*, 2015; Vargo and Lusch, 2016).

Smart services extend to many service settings across industries such as energy, health care, transportation, and information and communication technology (ICT). The implementation of smart services is expected to result in substantial efficiency gains due to cost reductions, more flexibility, and time saving, while at the same time providing increased value to their customers (Porter and Heppelmann, 2014). Moreover, the "always on" connection and maintenance of smart products allows service providers to establish and cultivate close ties with their customers (Beverungen *et al.*, 2017), enabling the use of customer behavior data that will translate to better information about customer needs and business models (Wangenheim *et al.*, 2017). However, the analysis of customer behavior data is interwoven with questions regarding the protection of data and data privacy, (Ukil *et al.*, 2014). To address the data protection and privacy challenge, different smart solutions have been deployed using policies, rules, and profiles to provide security and privacy for customers (Ukil , A. 2010)

Research on smart services has greatly increased in recent years, due to new developments that embed intelligence into objects, immerse customers in complex networks of people, organizations, and objects (Verhoef *et al.*, 2017), and enable new ways of using and interacting with smart services.

Research in the areas of service marketing, management, information systems, and engineering has explored the phenomenon of smart services mostly from two perspectives. One area of research has focused on the identification of technology resources (e.g., devices, infrastructure, communication protocols, platforms); the various stakeholders and people involved; and organizations that operate together for mutual benefit (Maglio *et al.*, 2009). For example, technology for smart homes or smart cities not only needs a common infrastructure but must also satisfy multiple stakeholders (Beverungen *et al.*, 2017; Perera *et al.*, 2014). Against this backdrop Breidbach *et al*. (2013, p. 428) emphasize that “successful technology-enabled value co-creation is contingent upon the quantity and quality of interpersonal relationships, or social connectivity, between humans that interact and exchange resources by means of ICT (Information and Communication Technology).”

Particular attention has been given to user adoption of smart services, which has been predominantly explored in business contexts so far. Studies have identified substantial adoption barriers, such as concerns regarding self-efficacy, control, privacy, and data security (Keh and Pang, 2010; Wünderlich *et al.*, 2013). Customers, for example, tend to reject service innovations that are highly invisible and enable the service provider to access sensitive information (Wünderlich *et al.*, 2015). Studies in the context of mechanical engineering show that both employees directly affected by smart services (machine users) as well as administrative personnel express anxiety regarding loss of control and fear of reduced self-efficacy (Wünderlich *et al.*, 2013; Paluch and Blut, 2013). This underlines the need to design smart services with a high level of transparency and visibility, as well as to implement overriding controls that increase the actual and perceived control of adopters (Wünderlich *et al.*, 2015). Previous research has already explored some barriers to user adoption, but a deeper understanding of customer experience with smart services is needed.

Customer Experience with Smart Services

The concept of customer experience was introduced by Holbrook and Hirschman (1982) and gained increased attention with Pine and Gilmore’s (1998) seminal article. Since then, customer experience has become a central concept in both marketing and service research (Kranzbühler et al., 2018), as well as a top business priority (De Keyser *et al.* 2020). Customer experience can be broadly defined as “non-deliberate, spontaneous responses and reactions to offering-related stimuli along the customer journey" (Becker and Jaakkola, 2020). However, this definition has been considered too broad and all-encompassing, and a set of customer experience components was proposed to make this definition more actionable (De Keyser *et al.* 2020). These components include customer responses to interactions with a service and their surrounding context.

Customer responses are the building block of several definitions of customer experience (Meyer and Schwager, 2007; Verhoef *et al*. 2009; Verhoef and Lemon, 2016; Becker and Jaakkola, 2020). Customer responses can be characterized through several dimensions such as cognitive, affective, emotional, sensorial, social, physical and behavioral ones (Verhoef et al. 2009; Becker and Jaakkola 2020; De Kayser *et al.* 2020). Customer experience has also been viewed as a holistic and context-specific construct influenced by a rich set of contextual elements that include customer, situational and sociocultural contingencies (Becker and Jaakkola, 2020), or individual, social, market and environmental aspects (De Kayser *et al.* 2020). However, although smart technologies are predicted to lead to profound changes in service (Ostrom *et al.*, 2015), there is little research on customer experience in this new environment, namely regarding customer responses and the context of interaction with smart services.

Early research on customer experience in technology contexts identified specific customer response dimensions such as efficiency, fulfillment, system availability, and privacy (Parasuraman *et al.*, 2005). Related research on technology-based services has focused on factors such as control and convenience, exploring how they influence different customer experience responses (Collier and Sherrell, 2010). Recent literature has also started to identify customer perceptual responses that are specific to the smart service context, like invisibility, autonomous decision-making, and risk (Wünderlich *et al.*, 2015), or the main barriers for adopting smart home services, namely perceived risk, privacy, and safety concerns (Yang *et* *al.*, 2017; Chou *et al.*, 2014). Research on technology dimensions has identified characteristics such as pervasiveness, information intensity, autonomy, and interactivity, which are enabled by the implicit characteristics of smart technology that are grounded on intense data flow, interactions in a network of actors, and visibility of data (Carsten *et al.*, 2018). While some literature has already examined customer perceptual responses in technology-enabled contexts, customer perceptions of smart services still require further research (Wünderlich *et al.*, 2015).

The importance of contextual factors in technology-related settings has also been studied, namely the pivotal role of human goals and actions for the success of the interactions with technology-enabled systems (Breidbach *et al.*, 2013), and the different roles (facilitator, enabler, performer, task allocator, quality controller, governor, conductor and expert) that actors can take when co-creating value with technology (Breidbach and Maglio, 2016). Building on Activity Theory (Kaptelinin and Nardi, 2006), Customer Experience Modeling (Teixeira *et al.*, 2012) advocates that the customer context can be captured by focusing on the goals, activities, people, devices, and organizations that shape the service environment. However, research on contextual factors related to smart services is still lacking.

Overall, given the profound impact of smart technologies on the service environment, further understanding is needed on customer experience with smart services, particularly in terms of what customer perceptual responses and contextual factors are relevant, and how they impact the customer experience. Namely, it is important to understand what are the customer perceptual responses to smart services, what goals customers want to achieve with these services, what activities they perform to achieve these goals, and what is the context (actors, systems, and physical artifacts) that shapes these responses.

Methodology

To gain an in-depth understanding of customer experience with smart services, a qualitative study was undertaken in the energy sector, involving in-depth interviews and focus groups. The energy sector was selected because it has been going through major transformations due to the emergence of new smart technologies (Raimi and Carrico, 2016), which are profoundly changing the customer experience. This study considered that a smart energy system consists of management systems that enable customers to control and visualize home energy consumption, among other functionalities and devices (i.e., electric vehicles, home appliances, etc.), and has sensors embedded that allow the connection with management systems through Wi-Fi and autonomous operation.

The study followed theoretical sampling procedures (Charmaz, 2006), starting with an initial sample that tried to cover different kinds of usage and different ways of experiencing smart services. An initial set of 10 interviews with energy customers was conducted and analyzed, from which three groups emerged. Additional interviews and focus groups were then undertaken to further densify the emerging categories of data analysis in terms of customer perceptual responses and contextual factors, until no new categories emerged. Moreover, the additional interviews explored the different groups and enabled a richer understanding of customer experience perceptual responses and contextual factors. Based on this process, three final customer groups were defined: Advanced Smart Energy (ASE) service customers; Electric Mobility (EM) customers; and High-Consumption (HC) residential customers

Advanced smart energy service (ASE) customers (n = 11) actively used a set of smart energy services to manage and control their home energy consumption. This group used some kind of smart home energy management system, which consists of a centralized system that provides information about home consumption and energy production in real time, allowing to remotely monitor, control, and manage home appliances so that they work according to schedules defined by the customer (Liu *et al.*, 2016). Customers in this group also used at least one energy production tool at home, such as photovoltaic panels.

The second group consisted of electric mobility (EM) customers (*n* = 10) who owned a car that required electricity instead of gas. EM customers adopted smart energy services to use the car more efficiently, namely, to remotely control the electric vehicle's functionalities (e.g., automatic charging or automatic adjustments of temperature).

Finally, the third group consisted of high-consumption (HC) residential customers (*n* = 10) characterized by a high consumption level of electricity and no utilization of smart energy services. Since the Portuguese energy regulator considers a 100 EUR average monthly bill as a higher level of consumption (www.erse.pt/atividade/regulacao/tarifas-e-precos-eletricidade/), this was the criterion used. These HC customers had not yet adopted smart energy services and used traditional energy services to perform regular daily activities like cooking and washing.

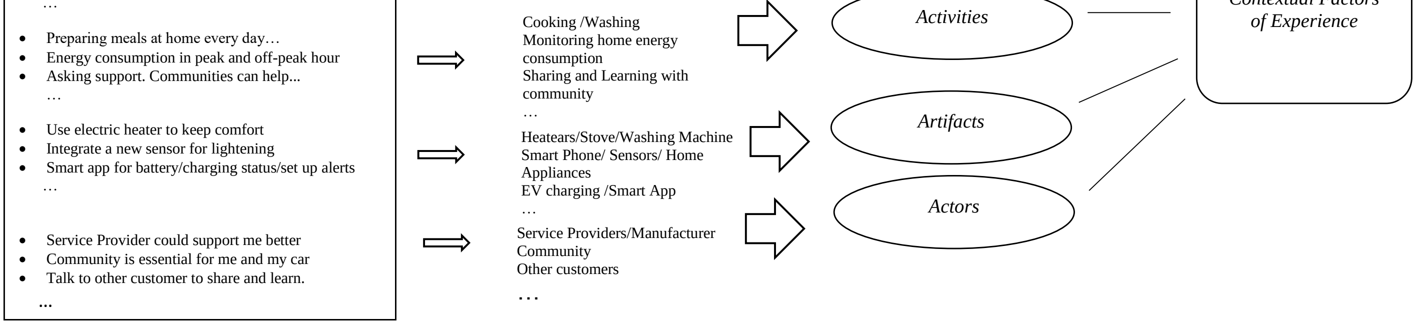
The overall sample had a total of 31 interviewees, comprised of 26 males and five females. This uneven gender distribution can be considered a limitation, but may also reflect the population of smart service users, as reports have shown that males tend to be more technology-oriented (Standal *et al.*, 2020). A semi-structured approach to the interviews provided a broader scope and consistency for the data collection (Corley *et al.*, 2004), while encouraging a broad discussion of customer experience (Ng *et al.*, 2016).

Building upon Customer Experience Modeling (Teixeira *et al.*, 2012), the interview protocol covered customer experience contextual factors and customer responses to the multiple interactions with their smart energy service solution. As such, interviews covered the smart energy services customers used, how and why they started using the smart services to identify their goals and activities, as well as the actors and artifacts with whom customers interacted. The interview then covered customer perceptions that emerged from the service use.

The study involved a combination of 17 in-depth individual interviews lasting 40-60 minutes. In addition, two focus groups were undertaken, one with nine ASE customers and another with five EM customers, lasting approximately two hours each. The themes that emerged from the initial interviews and focus groups were examined in the subsequent interviews to facilitate closure (Lincoln *et al.*, 1985). The individual interviews were voice recorded, the focus groups were video recorded, and all were literally transcribed for descriptive validity (Maxwell, 2012).

To develop a comprehensive understanding of customer experience with smart energy services, the data analysis involved an iterative process of joint data collection and analysis (Shah and Corley, 2006). The software NVivo supported the data analysis process, from the first-order concepts to the aggregation of dimensions and additional revision of authors. Data was processed using open coding to identify first-order concepts (Corley *et al.*, 2004; Gioia *et al.*, 2013) that captured the customer experience along the overall journey of energy consumption, leading to the emergence of a considerable number of categories. The analysis was performed by one main coder, complemented with regular sessions to analyze the coding with two additional researchers, wherein the categories and the raw data were analyzed. This analysis considered the terms customers used and the themes that were raised (e.g., daily consumption, self-sufficiency, mobility, sustainability, energy costs, regulation issues, support services, and community, among others).

In the second-order analysis, the emergent themes were analyzed in relation to, and were substantiated by the literature (Corbin and Strauss, 2008). The next step consisted of identifying similarities and differences among the many categories and reducing them to a manageable number (Corbin and Strauss, 2008; Gioia *et al.*, 2010). Building upon literature on customer experience, as well as Activity Theory and Customer Experience Modeling (Teixeira *et al.*, 2012), these categories were refined and consensus was reached in five categories where dimensions could be aggregated (Gioia *et al*., 2013). A summary of these levels of categorization can be seen in Figure 1.


…
Preparing meals at home every day…
Energy consumption in peak and off-peak hour
Asking support. Communities can help...
…
Use electric heater to keep comfort
Integrate a new sensor for lightening
Smart app for battery/charging status/set up alerts
…
Service Provider could support me better
Community is essential for me and my car
Talk to other customer to share and learn.
...
Cooking /Washing
Monitoring home energy consumption
Sharing and Learning with community
…
Heatears/Stove/Washing Machine
Smart Phone/ Sensors/ Home Appliances
EV charging /Smart App
…
Service Providers/Manufacturer
Community
Other customers
…
Activities
Artifacts
Actors
Contextual Factors of Experience

Findings: Understanding the Customer Experience with Smart Services

To achieve a rich understanding of customer experience with smart services, this qualitative study focused on two elements: First, it examined a multidimensional set of customer experience perceptual responses to smart services, considering the multiple interactions with a myriad actors and artifacts that comprise the smart energy service context. Second, it enabled the understanding of the contextual factors that influence customer experience with smart services in terms customer goals and activities, as well as the actors and artifacts with which the customer interacts.

Customer Experience Perceptual Responses to Smart Services

The findings show that the customer experience with smart services involves a multidimensional set of perceptual responses, as shown in Table 1. These dimensions correspond to customer perceptual responses to stimuli and interactions with multiple actors and artifacts along the customer journey (Becker and Jaakkola, 2020), which in this case is the home energy management journey with smart services. These dimensions were structured in three groups: smart service specific dimensions, relationship dimensions, and technology-enabled service dimensions.

	Sustainability	*16*	*terms of noise (electric vehicles) and air pollution (CO_2 emissions).*	*"My energy consumption is more efficient through the smart energy management. It means that I emit less carbon into the atmosphere. I feel more responsible (ASE_10)."*	
	Autonomy	*14*	*The ability of the smart service to offer useful suggestions or taking adequate actions without customer intervention, such as turning on and off home appliances according to photovoltaic energy production or suggesting the best routes for EVs according to available charging stations*	*"I appreciate how automatized the home appliances operations and lightening can be with the smart service. I do not even need to be close to them all the time."(ASE_10)."* *"My charging system at home start automatically whenever I plug the car to the charger. The smart service alerts me about failures and the current charging status…(EM_2)."*	(Sifakis, 2019)

Enabled Dimensions				*control my home energy consumption from everywhere. In this case, only a WI FI connection is required... (ASE_5).”*	
	Ease of Use	*10*	*The degree of easiness to which customers use the smart service to accomplish a specific task.*	*“I only plug and play the smart service. It is very easy (ASE_6).”* *“Currently, the smart service is easy to assemble (components and sensors) and integrate to other devices” (ASE_3).*	(Parasuraman *et al.*, 2005) (Wolfinbarger & Gilly, 2003)
	Ease of Learning	*9*	*The degree to which customers learn about the smart service basis and capabilities before and during the use.*	*“I have learned with my community how to use the smart service to manage my electric car…It is easy (EM_3).”* *“I could learn how to use the smart service to improve my overall energy consumption very quickly… (ASE_11).”*	

Smart service specific dimensions

Data analysis identified five perceptual dimensions that are specific to the smart service context (see Table 1): controllability, visibility, self-configuration, sustainability and, autonomy. These perceptions are associated with smart service-specific characteristics, namely the ability to sense and collect data on their own condition and surroundings (Allmendinger and Lombreglia, 2005), and to enable customers to monitor and control artifacts like their home appliances (Georgakopoulos and Jayaraman, 2016).

Controllability was mentioned by most interviewees as the extent to which the smart service enables them to change the system's status and behavior, as well as to define the way the service should behave according to a set of rules. For example, interviewees valued the possibility to change the smart service status (e.g., turn home appliances and heaters on and off) according to their own needs. As mentioned by an ASE user, *"I program the washing machines to work from 10:30 am until 3:30 pm to reap the benefits of the energy produced by the photovoltaic panels"* (ASE_11). While controllability has been shown to be a relevant factor in the B2B smart service context (Wünderlich *et al*., 2013), this study extends current knowledge by showing its importance in the end consumer context as well: *"I use the smart service to control my home consumption and my electric vehicle… I feel safer if I can control everything"* (EM_4).

Related to controllability, visibility was often mentioned by the interviewees, as customers perceived that they can control the smart service by visualizing relevant information on system status and behavior. The majority of the interviewees positively remarked on how the smart service interfaces enabled them to visualize their personal energy consumption as well as the different smart service behaviors, such as the energy consumed, home appliance status or energy production. As stated by one EM customer: *"...My management system allows me to view the total consumption of the house, the energy, the EV charging status, among* *other things. I have a detailed view"* (EM_10). In addition, interviewees valued the support that visibility gave them in making decisions regarding energy consumption. As mentioned by one customer *"I look at my energy consumption daily. Based on this information, I program the home appliance operations and the heating system to work in specific periods" (ASE_9).*

Self-configuration was also identified as the extent to which customers can assemble and configure the entirety, or part of, the smart service overall solution to fit customer specific needs. As mentioned by an ASE customer: *"I choose, buy, assemble and configure the sensors and other smart artifacts needed to manage the system solution"* (ASE_3). The multiple artifacts, information systems, and interfaces that comprise the smart service environment enable customers to personalize the combination of devices they use, the home appliances they sense and control, the information they visualize, and the automatic instructions the smart service follows. For example, if customers decide to manage a non-smart appliance, they can add a sensor to it in order to have remote control and visualize the appliance status*: "I have added smart plugs to the home appliances and developed an app to analyze the grid quality before charging my car in my house"* (EM_9). While previous studies have addressed personalization as undertaken by the service provider (Montgomery and Smith, 2009), study results show that smart energy customers configure and personalize the solutions by themselves to support their specific goals and daily activities, while considering the costs of implementation and the devices available in the market.

Another perceptual dimension that emerged from the data is the smart service autonomy, viewed as the ability of the smart service to offer useful suggestions or take adequate actions without customer intervention. For example, turning home appliances on and off according to photovoltaic energy production or suggesting the best routes for electric vehicles depending on available charging stations. Interviewees highlighted that after they assembled and configured the smart service solution, it could operate autonomously: *"I* *configure my home management to operate autonomously. It usually alerts me if a programmed operation goes wrong"* (ASE_1). Autonomy has been previously analyzed from a technical perspective as the capacity of a system to achieve a set of coordinated actions on its own (Sifakis, 2019). This study shows that, in a smart service context, these autonomous actions should also be adequate for the customer as they bring automation for daily activities that would otherwise require customer intervention. As mentioned by an EM customer, *"My electric vehicle system calculated where and when to stop to charge the car when I traveled to France before I requested [it]"* (EM_9).

In addition to the previous dimensions, which are more related to the technological characteristics of the smart service, sustainability also emerged as a relevant perceptual dimension specifically associated with smart services. The results showed that sustainability is related to smart service ability to decrease energy consumption-related environmental impacts, namely in terms of noise (electric vehicles) and air pollution (CO_2 emissions). Customers highlighted that sustainability is something they consider in the early stages when deciding which smart solutions to implement: *"When I bought my electric vehicle, I installed an application to visualize the noise pollution impacts"* (EM_4). Interviewees also mentioned that sustainability may become more appreciated as they use the service and realize how it positively impacts the environment, as highlighted in the following comment: *"Through my electric car, I decreased my carbon footprint significantly… 300 kg in one year. It is amazing!" (EM_1).*

Relationship dimensions

The results reveal the importance of relationship perceptual dimensions with the service provider and the community of other smart service customers. The relationship with the service provider was viewed by interviewees as the degree to which there is an adequate level of interactions and the service provider is knowledgeable and provides adequate support for customer needs. This relationship dimension is also related to the extent to which the provider is transparent in terms of procedures and rules, including support and maintenance procedures, data protection, and compliance with regulations However, the majority of interviewees, particularly ASE and EM customers, evaluated their relationship with the main energy service provider in a negative way, voicing a lack of interactivity and support, and criticizing the complexity of integrating multiple service providers and offerings*: "The service provider installed my home management system in my house and never contacted me again… providers should better support their customers"* (ASE_2).The relationship with the service provider has been shown to be a key perceptual dimension in traditional services (Parasuraman *et al*., 1988). However, study results reveal that, in the smart service context, customers are not dependent on one main service provider. Instead, they combine multiple offerings and are more prone to taking the lead, expecting the service providers to support them in this role. As one customer noted: *"…I usually solve the problems of the smart service by myself, but I think the service provider should support me more with the maintenance"* (ASE_4).

The results also show that the relationship with online communities is an important dimension in the smart service context. Interviewees expressed the value of interacting, learning, and sharing experiences in online communities, social networks, and forums, mainly to get advice regarding alternative solutions, to learn about the usage of smart services, or to share best practices*: "An electric vehicle customer from the online community recommended the best solution for an issue with the battery health information on my the smart app… the solution was crucial to saving time and money"* (EM_4). Company social networks can be used by customers as a supplementary information source offered by the service provider (Martins and Patrício, 2018), but study results show that smart service customers view social networks and consumption communities as primary information sources. One customer highlighted the importance of the relationship with a community as follows: *"A customer learns more from the community than from the information made available by (electric vehicle) manufacturers…"* (EM_7).

Technology-enabled service dimensions

Some perceptual dimensions that have been found in other technology-enabled contexts (Parasuraman *et al.*, 2005) also emerged in the smart service context. Study results highlight the importance of cost-benefit perceptions. As shown in Table 1, a large majority of interviewees often compared the benefits gained through the smart services with the cost and effort of using them. The interviews highlighted that this trade-off emerges more intensively in the early stages, as customers analyze the costs and benefits of a smart service before choosing and implementing the service, which is related to the goal of value for money: *"I implemented the smart energy service to save money… it is an investment that will return in the long term"* (ASE_11). Customer cost-benefit considerations have been discussed in previous literature predominantly in a financial context, e.g., building a balance between savings and the use of devices (e.g., thermostats) (Ellabban and Abu-Rub, 2016).

Ease of use, ease of learning, and accessibility were identified as relevant perceptual dimensions of customer experience with smart services. Interviewees remarked that smart energy services do not require too much effort to use and learn. As some customers stated, *"It is very easy to use the smart service"* (ASE_5) and *"It is simple and quick to learn"* (ASE_8). Accessibility was also mentioned as the opportunity to access and act upon the smart service from any location at any time, enabling customers to act in real time to change anything they need: *"I like to see my home energy consumption even when I am on vacation…"* (ASE_5). Such responses have also been identified in previous studies of technology-enabled services (Wolfinbarger and Gilly, 2003).

Overall, the results reveal a multidimensional set of customer experience responses to smart services. These responses comprise smart service-specific perceptual dimensions that emerge from the technological characteristics of smart services (controllability, visibility, self-configuration, and autonomy), as well as sustainability that is indirectly associated with smart technology positive environmental impacts through efficient use of home energy. Relationship dimensions were also deemed important in the smart service context, as results highlighted the growing role of consumption communities and the secondary role of traditional utility service providers. Finally, a set of perceptual dimensions that relate to previously identified technology-enabled literature (cost-benefit, ease of use, ease of learning, and accessibility) were found to be relevant in the smart service context as well.

Contextual Factors of Customer Experience with Smart Services

To further enrich the understanding of customer experience, this study also identified a set of contextual factors associated with the smart service environment in terms of customer goals and activities, as well as the actors and artifacts the customer interacts with.

Customer goals and activities in the smart service context

Using the lens of Activity Theory, the data analysis enabled the identification of a set of interdependent customer goals and activities. Goals are conscious, reflecting what customers intend to achieve (e.g., thermal comfort, value for effort), and activities are defined as a set of actions undertaken to achieve customer goals (Kaptelinin and Nardi, 2012). For example, a customer with solar panels who wants to be energy self-sufficient (goal) monitors daily solar energy production and programs home appliances to function on peak periods of production (activities). As shown in Table 2, the different goals and activities offer a rich illustration of how customers shape their daily routines of energy consumption in the context of smart services.

Table 2: Customer goals and activities in the smart service environment

Categories	**Sub-Categories**	**Frequency (N=31)**
Goals	*Value for Money (Save Money, return on Investment, keeping energy costs under control).*	*28*
	Comfort	*9*
	Sustainability	*9*
	Value for Effort (Hassle-free energy consumption and management)	*8*
	Mobility Performance	*7*
	Energy Self-Sufficiency	*7*
Activities	*Managing Energy Consumption*	*21*
	Researching and Planning the implementation	*10*
	Sharing and Learning with Community	*10*
	Charging EV	*10*
	Cooking and Washing	*10*
	Planning daily routines and longer trips.	*8*
	Managing Home Energy Production	*8*
	Install efficient appliances.	*8*
	Heating the house	*6*

The large majority of interviewees mentioned value for money as one of the goals they want to achieve with smart services, as shown in Table 1. Value for money may range from the goal of keeping energy costs under control, to saving money, or to having a positive return on investment. For example, HC customers were more focused on keeping costs under control: *"I check the electricity bill monthly… don't want to pay more for electricity"* (HC_3). On the other hand, ASE customers highlighted the need for return on investment, as they made significant investments in renewable energy production and new energy management systems*:* *"My analysis indicates that return on investment will occur in five years…"* (ASE_10). Additionally, although EM customers assume that an electric car is expensive, they mentioned that they can save money with fuel as the overall cost with electricity is lower than gas: *"…300 km of autonomy costs 3 EUR… now compare it with the gas costs for the same 300 km…"* (EM_9). Study results therefore indicate that, as using smart service solutions requires a significant initial investment in terms of money and effort, the goal of value for money, and the related perceptual dimension of positive cost-benefit, are crucial for adoption decisions and significantly affect the customer experience.

Customers also vary in terms of other goals, according to their different profiles. Whereas comfort and hassle-free consumption is key for HC customers —"*My daily life is busy… I do not have time to manage my energy consumption"* (HC_3) —ASE customers value energy self-sufficiency. EM customers, meanwhile, value mobility performance and the sustainability of electric mobility and smart service solutions. As mentioned by two EM customers: *"I want to increase the autonomy of my car as much as possible"* (EM_3)*;* or "*I chose an electric vehicle as I aim to be cleaner and greener…"* (EM_2);

Data analysis also shows that goals are achieved through a sequence of activities that range from activities related to daily energy consumption (e.g., heating the house, cooking and washing, planning daily routes for the electric vehicle), to activities related to controlling and monitoring of energy consumption. ASE and EM customers make a significant effort in activities related to rethinking and improving the existing smart service, such as researching and planning the implementation of the smart service based on information gathered through social networks and communities. For example, one customer stated: "*…I started to research on the Internet to learn more about the smart service…"* (ASE_11). Sharing and learning activities involve knowledge acquisition based, not only on the technical content published, but also on the experiences of other customers who are members of online communities dedicated to sharing. These recommendations help customers use energy efficiently and develop their plans for daily activities (e.g., charge the car based on car autonomy, locate charging stations, or configure sensors). The customers value community-based information because it relates to their own problems and experiences: *"In the community we all share the same difficulties and different experiences"* (EM_4).

Actors and Artifacts in the Customer Experience

Building upon Customer Experience Modeling (Teixeira *et al.*, 2012), the understanding of the customer experience was enriched by other contextual elements, e.g., artifacts and actors. Artifacts can be physical or digital devices with which the customer interacts to perform energy management activities, such as smartphone applications to visualize energy consumption and production levels. Actors are participants with whom the customer interacts (Teixeira *et al.*, 2012). As shown in Table 3, the data analysis identified a myriad of actors and artifacts that support the customer experience with smart services. Actors and artifacts facilitate the performance of the daily activities, enabling customers to visualize system status and behavior, control the inputs and outputs, and manage consumption according to their needs.

Table 3: Customer actors and artifacts in the smart service environment.

Categories	Sub-Categories	Frequency (N=31)
Actors	*Family, Friends and Neighbors*	*24*
	Energy Service Provider	*23*
	Community (online forums, associations, online community)	*11*
Artifacts	*Smart Applications*	*18*
	Heating systems	*15*
	Home Appliances (smart and traditional)	*12*
	HEMS	*11*
	EV	*11*
	Photovoltaic Panel	*10*
	Smartphone/tablet/PC	*10*
	Charging Stations	*7*
	Sensors (temperature, lights and motion)	*3*

The findings show that the main energy service provider is only one actor in the customer constellation—and one with whom customers have few interactions. The results also reveal that the customer experience with smart services is social (Lemon and Verhoef, 2016), as it involves a network of actors interacting with each other during the performance of activities (Mickelsson, 2013). Families, friends, and neighbors play a key role, and online communities are especially important for ASE and EM customers. Interactions with online communities are intense and customers consider them as essential for the learning process and for improving the smart service, as mentioned by an EM customer: *"I ask the electric vehicle community for recommendations when I have to charge my car in a public charging station…"* (EM_1). On the other hand, interactions with the traditional utility service provider are few, as customers revealed that service providers and manufacturers do not actively develop relationships with them. As an EM customer highlighted: "*When I have a problem or a question, I usually ask [for] help [in] my community… I rarely contact the provider"* (EM_7).

The results also show that customers use a large variety of smart artifacts that support their daily activities by enabling the visualization of energy consumption status or the control over home appliances or energy production. Artifacts like smart applications, smartphones, and home energy management systems and sensors enable overall management of energy consumption by acting upon photovoltaic panels, heating systems, home appliances, electric vehicles, and charging stations, among others. This use of a wide set of smart artifacts is beyond the control of the main service provider, as customers select and configure them by themselves to satisfy their needs.

Overall, the results indicate that in a smart service environment, both customer goals and activities go well beyond the typical effort tied to the use of traditional energy services. Customer goals range from getting the best value for money and value for effort to goals that are more related to the smart service, like energy self-sufficiency, mobility performance, and sustainability. While HC customers aimed for a hassle-free consumption, the activities of ASE and EM customers seemed to require significant effort to manage the smart service in a more independent way, supported by the online communities that enable customers to learn and share experiences.

Results also indicate that goals and activities are supported by the use of smart artifacts and the interaction with different actors goes well beyond the main traditional service provider. In this smart service context, a broader network of actors, including other customers and communities, actively influences the customer experience, which is also supported by the smart artifacts that are selected, installed, and used by the customer.

Discussion

This study offers an in-depth understanding of customer experience with smart services, including the exploration of customer perceptual responses and contextual factors. This study therefore makes four major contributions to both theory and practice on customer experience with smart services.

First, the study contributes to smart service literature by providing insights into the customer experience with smart services. While some of the perceptual dimensions found in the study have already been identified in smart technology literature from a technical perspective on a specific system (Beverungen *et al.*, 2017), this study empirically examines these perceptual responses from a customer and service perspective. For example, although visibility and autonomy have already been associated with smart technologies (Carsten *et al*., 2018), study results show that in the smart service context, visibility focuses on customer ability to visualize the system and consumption status and behavior, especially as it supports them in making energy consumption decisions. Moreover, by identifying and analyzing these perceptual dimensions and contextual factors since the early stages of the experience, this study also contributes to the literature on smart service adoption (Wünderlich *et al.*, 2013). Although the study focuses on the energy sector, this understanding of the customer experience may also be applicable to other domains like smart home services, which involve smart energy management as well as the management of water consumption, security systems, heating systems, that also require a smart system composed of sensors and smart applications.

Second, the study contributes to deepening the understanding of customer experience with smart services by capturing the perceptual responses that emerge in this new setting. Going beyond traditional dimensions associated with technology-enabled services (Wolfinbarger and Gilly, 2003), this study expands this understanding by analyzing the perceptual responses that are specifically associated with smart service technology, such as controllability, visibility, autonomy, and self-configuration. These specific dimensions highlight how the experience with smart services changes when compared with traditional services, showing what customers value and how they now take more control over their experience in a more autonomous way. While some of these dimensions have been conceptually discussed in previous literature (Wünderlich et al. 2015), this study empirically examines them in a rich smart service context.

Third, the study shows that relationship dimensions, which are key in traditional dyadic services such as retail banking (Parasuraman *et al*., 1988), are also relevant in the smart service context. However, this study shows how this relationship goes beyond one main service provider and how the relationship established with a community of customers that support each other in their daily routines of energy consumption becomes crucial. At the same time, the relationship with the main service provider may become infrequent and weak. While previous research has shown that company social networks can enhance service provision (Martins and Patrício, 2018), this study indicates that in the smart service environment customers develop and contribute to their own online communities, where they share experiences and support each other. These results therefore contribute to a more in-depth understanding of how smart services to lead to more autonomous, networked customer experiences (Ostrom *et al.*, 2015). At the same time, in the smart service context, customers may not see the service provider as the focal actor, highlighting the need for service providers to move from a reactive performer role, to a proactive facilitator role in the customer experience (Grönroos and Voima, 2013; Breidbach and Maglio, 2016).

Fourth, this study offers a rich understanding of the contextual factors that enable the customer experience with smart services (Becker and Jakkola, 2020; De Keyser *et al.* 2020), showing that it involves a myriad of actors and artifacts. Smart service customers interact with a complex set of devices such as smart apps, home appliances and home energy management systems, and interact with multiple providers, family, friends and communities that go well beyond a unique service provider. These results therefore extend knowledge on service orchestration in complex human-centered service systems (Breidbach *et al*. 2016), by illustrating the interdependencies between actors and resources in smart energy contexts. Moreover, by examining customer goals and activities associated with smart service usage, the study enables better understanding the context within which the experience unfolds and exploring the interrelationship with perceptual dimensions. For example, as value for money is a key goal for customers, cost-benefit is a highly mentioned perceptual dimension of customer experience with smart services. By acknowledging that customers expect smart services to support their activities of managing energy consumption and planning daily routines, it also becomes clearer why control and visibility are important dimensions of customer experience. This study therefore reveals that customer experience with smart services is embedded in the daily routine and is interpreted by the customer, furthering the understanding the interdependencies and the impact of contextual factors (Becker and Jaakkola 2020; De Keyser *et al.* 2020).

Study results also offer relevant managerial implications, as they show which perceptual responses dominate customer experience with smart services. As smart services involve novel technologies and require a significant initial investment in terms of money and effort, cost-benefit is an important factor in the customer experience. Managers should therefore carefully support customers in evaluating alternatives and configuring a good value for money solution, especially in the initial stages of the customer journey.

Results indicate that managers should also cater to customer needs for information visibility and sustainability of smart services. Customers are highly interested in the sustainable outcomes of the smart services and value the display of information regarding their usage patterns (visibility). Some also value the controllability and self-configuration of smart services, so managers are advised to provide the appropriate means and processes to customers to enable visibility, personalization and control. This effort may require the analysis of customer data between partners in the service network, focusing on touchpoints that are most relevant for the customer experience along the journey. On the other hand, as customers can autonomously integrate different solutions from different providers, each service provider needs to be aware that a negative experience in one touchpoint in the network can cascade and damage the overall experience. As such, managers need to balance how much control and personalization they allow their customers to have to enhance the customer experience with their smart service.

The findings further indicate that, in the smart service environment, there are multiple activities and interactions that go well beyond one provider's control. For example, customers use a multitude of smart technologies and interact with many providers and other customers to configure their own smart energy solutions. For smart service providers, it is therefore crucial to look beyond their offerings and to understand the constellation of actors and artifacts that facilitate the customer experience (De Keyser *et al*. 2020), so they can better position and design their offering within the customer value constellation (Patrício *et al.*, 2011).

Moreover, smart service providers need to understand how customers are re-defining their role within the smart service context and the implications of the increasing customer autonomy (Ostrom *et al.*, 2015). Study results show that customers value the ability to configure their own solutions and expect a supportive relationship from the service provider. In this context, service providers should understand how they can become partners and support customers in creating their own experience, instead of being lead orchestrators. Also, service providers should offer customers access to other fellow customers, for example by integrating them in the smart service network and communities. This may represent a substantial change in the role traditional service providers such as utility companies have played, as well as a significant power shift from providers to customers.

Conclusion and Future Research

Technology advances enable the emergence of a new, always on, and always connected smart service environment, where customers are taking the lead in their experiences in a more personalized and autonomous way (Ostrom *et al.*, 2015). This study offers an in-depth understanding of the customer experience with smart services, examining customer experience perceptual responses and characterizing smart service contextual factors in terms of customer goals, activities, actors, and artifacts. The study highlights how these customers are empowered and are taking the lead, valuing the controllability, visibility, self-configuration, autonomy, and sustainability offered by smart services. Customers are also seeking the support of fellow customers in online communities, replacing service providers as the main go-to actor in their networks. These findings advance our understanding of customer experience in the smart service environment and offer important implications for smart service managers. However, future research could expand the understanding of how the contextual factors and perceptual dimensions of smart services are interlinked, and how these responses are interconnected.

This study also has some limitations, as it focuses on smart services related to energy. While rich and timely, the energy-related smart service setting is only one possible context for smart services. Future research can study other smart service contexts and draw comparisons between them. It would be particularly relevant to study how the relative importance of customer experience perceptual dimensions changes in other contexts and how this depends on the prevalent smart artifacts, goals, and activities in each context. Continuing smart service research in different settings, such as health care, characterized by different customer goals, activities, actors, and artifacts, can expand the current study's findings. Future research can also explore customer experience in more open contexts of interactions, such as smart cities, which represent a more complex setting, or to understand how customer experience changes with smart services supported by open access technologies. Additionally, as smart service solutions expand, become more integrated and customers gain experience and become more knowledgeable, future research could focus on how customer perceptions evolve. Namely, it would be interesting to explore how customer perceptions related to the relationship with the service provider and autonomy, and how other perceptions, e.g. related to data privacy and security, might evolve and emerge, respectively, as smart service solutions and customers become more mature.

A more in-depth comparative analysis of different groups of customers can bring relevant contributions for managers. For example, comparing the relevant perceptual experience dimensions and contextual factors between advanced smart energy customers and traditional high-consumption customers can help managers design their service offerings to influence customers that have not yet started using smart services, turning them into active and advanced customers in the smart service network. This transformative vision of smart services can also enable managers to understand how to engage actors, including service providers, in different roles and with different levels of control.

With the rapid evolution of smart technologies, customers are taking the lead in their experiences. As the smart service context evolves, it will offer new and interesting challenges for both service providers and researchers as customer wishes for a connected and sustainable lifestyle already spill over to their expectations regarding service offerings. This study advances the understanding of the customer experience in this fast-changing smart service context and paves the way for future research on how the use of smart offerings actually enables customers to "become smarter" and fulfill their goals.

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