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RESEARCH PAPER

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Unleashing the digital building bricks

A smart service taxonomy for retail

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Abstract
The increasing online competition, associated changes in customer behaviors, and effects of the pandemic in recent years have led to increasing retail store closures. This development has given rise to a downward spiral in terms of a decreasing attractiveness of local shopping places and a further reduction of stores. Research has recognized that smart services can unleash the potential to compensate for the competitive disadvantages of physical retailers by combining tailored physical and digital offerings to enhance customer-oriented value creation. However, most approaches are limited to in-store services without addressing the wider shopping experience in retail surroundings. Therefore, this paper provides a classification framework for smart services in retail evaluated against 163 use cases, as well as six service archetypes. This work contributes to understanding relevant service design elements and proposes applying the idea of a holistic customer experience to service design in physical retail environments.

Keywords Smart service · Service design · Customer experience · Retail · Taxonomy

JEL Classification L81 · M31 · O18 · R11

Introduction

For years, stationary retail has been experiencing a decline in market shares and a decreasing number of retailers around the globe (Bartelheimer et al., 2018; Källström et al., 2021). To describe the devastating consequences for the competitive situation of physical retailers, this development has been described in the literature with the term "retail apocalypse" (Helm et al., 2020). In particular, physical retail is suffering from offerings of additional online competitors addressing customers' convenience with spatial and temporal independence, decreased transaction costs (e.g., for search), and lower prices (Grewal & Levy, 2007; Hauser et al., 2019; Yang & Kim, 2012). The impact of the COVID-19 pandemic exacerbated local retailers' situation, causing them to take social distancing measures and close stores, and thus inhibiting in-store experiences (Baersch et al., 2021). Notably, customers are expected to retain some of the new behaviors they adopted before and during the crisis over the long term, which increasingly leads to a growing decoupling of shopping from physical locations (Roggeveen & Sethuraman, 2020a, b; Zwermann, 2021).

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Giving rise to the reduction of existing stores, this development negatively impacts the attractiveness of local shopping areas, such as those often found in city centers (Baersch et al., 2021; Källström et al., 2021). Thus, to strengthen stationary retail, it is necessary to fetch back customers by creating an attractive shopping environment and designing consumer-oriented services (Rosemann et al., 2021). In this context, smart services have been recognized in research to play a key role by providing consumer-centric value as a digital extension of physical retail offerings (Alexander & Kent, 2020; Riegger et al., 2021; Wolpert & Roth, 2020). However, these studies rarely consider retail beyond the boundaries of in-store services, which are considered as only a part of the customer journey in retail (Grewal et al., 2020; Lemon & Verhoef, 2016). More specifically, there is a dearth of research considering the physical environment of single stores, where the shopping process is influenced by further activities of customers, such as leisure activities (e.g., attending events or going to restaurants) or accessing a city center (e.g., using mobility services) (Betzing et al., 2018; Källström et al., 2021; Kranzbühler et al., 2018). As a first step towards mitigating this gap, the concept of "smart retailing" was introduced as a component of the broader smart city, which can be attributed to retail's essential role in shaping a city's character and attractiveness and making it a viable place of social, cultural, and economic interactions (Betzing et al., 2018; Källström et al., 2021; Pantano & Timmermans, 2014). Smart retailing underlines the importance of smart services that can unleash value creation potentials as a digital bridge to physical retail environments (Schütte et al., 2022; Pantano & Timmermans, 2014; Polese et al., 2019).

Although there are already several publications on smart retailing, these studies are mainly concerned with the associated technologies and less with a conceptual link to the underlying concept of smart services (e.g., Quinones et al., 2023; Torrens, 2022). Moreover, there is also a lack of research analyzing how smart services are designed in physical retail environments. Existing publications in the field of smart services provide general overviews of service characteristics from a technical perspective (e.g., Fischer et al., 2020; Paukstadt et al., 2019), but do not focus on the central components in the context of retail, such as the customer experience (CX) and the servicescape in which it is created (Riegger et al., 2021, p. 141). Against this backdrop, a classification of smart services allows for a deeper understanding of the smart retailing concept and provides guidance toward the building blocks to be considered in the development of consumer-facing services in physical retailing. Therefore, we adopt an integrative perspective on smart retail services and pose the following research questions (RQs):

RQ 1: *What are the key characteristics of smart services in physical retail?*

RQ 2: *What are the archetypes of smart services in physical retail?*

To answer these questions, we followed a five-stage, mixed-method approach consisting of the following process steps: (1) based on a systematic literature review (Webster & Watson, 2002), we (2) developed a taxonomy following Nickerson et al.'s (2013) approach for smart services in the physical retail environment. Subsequently, (3) we evaluated our taxonomy based on semi-structured interviews with seven domain experts (Szopinski et al., 2019). In the next step, (4) the taxonomy was assessed against 163 globally distributed retail-oriented smart services (Nickerson et al., 2013) and (5) identified six major smart service archetypes (Ward, 1963). The taxonomy and service archetypes enable exploration of how smart services are currently designed, leading to a better understanding of the concept of smart retailing in terms of its physical deployment area and technological scope. In addition, service design researchers and practitioners can use the taxonomy's characteristics to explore and design smart retail services.

The remainder of this research paper is structured as follows. First, the concept of smart retail is explained and a link to the concept of smart services is established. In the process, existing taxonomies are also delineated, highlighting the research gap addressed in this paper. Second, we describe our mixed-method research design. Third, we present our taxonomy for describing smart services, their evaluation, and the six smart service archetypes derived. Fourth, we discuss our results from the perspective of a holistic CX in physical retail environments. Finally, we summarize our results and present avenues for future research to further theorize on how smart services can be designed and integrated.

Theoretical background

Smart retailing

Due to the proliferation of new technologies, such as augmented reality (AR) and the Internet of Things (IoT), smart services in retail gained increasing attention in research in recent years, as they provide several benefits to customers, e.g., making the shopping process more convenient and efficient (Grewal et al., 2020; Lin, 2022). Similarly, retailers (e.g., Walmart, Burberry, Ralph Lauren, and Tesco) have introduced a multitude of smart technologies in their physical stores to create valuable services for their customers (Roy et al., 2020). For example, customers can get more information about products and save time by ordering products via self-order kiosks (Lin, 2022). Furthermore, retailers increasingly enable customers to try on clothes with a 360° view and to compare outfits using smart mirrors (Roy et al., 2020). The meaning of "smart" in research has evolved over time and was introduced in relation to objects or systems with the ability of sensing and controlling (Baz, 1996). In addition to these capabilities, today the term is often associated with interconnected and intelligent objects (Gretzel et al., 2015a, 2015b; Gretzel et al., 2015a, 2015b; Harrison et al., 2010). In this context, the concept of smart products emerged which consist of embedded sensors, controls, microprocessors, software, data storage, and connectivity components used to communicate with other objects over the Internet, with the ability to collect data and sometimes even interact with their environment (Paukstadt et al., 2019; Porter & Heppelmann, 2014). For the purpose of this paper, we refer to smart services as services based on such smart products that serve as boundary objects enabling the co-creation of value for customers through digital interactions with a service provider (Allmendinger & Lombreglia, 2005; Beverungen et al., 2019).

Based on this understanding, retailers are increasingly extending their services to create value for customers and to remain economically successful in an increasingly competitive environment, leading to the concept of "smart retailing" (Adapa et al., 2020; Roy et al., 2017). Smart retailing emerged as part of the broader concept of smart cities, where "smartness," based on the view described above, results from the usage of technologies to improve services for the purpose of improving the quality of life of citizens and supporting sustainable urban development (Pantano & Dennis, 2019). Starting from the same vision, smart retailing has been introduced as a new approach to retail management, adopting modern technologies to enhance retail services and thus create added value (Pantano & Dennis, 2019). Following this view, the concept of smart retailing emerges by adding smartness to the retail domain, augmenting the physical retail world with smart products and creating a value-creating connection to the digital world by means of smart service-based interactions with the customers (Roy et al., 2017).

Smart services can thus enhance value creation, and by connecting the physical retail environment with the digital world, unleash the potential for an improved CX (Riegger et al., 2021). Against the background of the CX concept, the customer attaches value not only to the rational evaluation of a transaction but also to the overall experience resulting from the set of interactions with organizations in a service context (Gentile et al., 2007; Holbrook & Hirschman, 1982). Therefore, we understand CX as a customer's internal and subjective (i.e., cognitive, affective, emotional, social, and physical) response to any direct or indirect contact with a company (Meyer & Schwager, 2007; Verhoef et al., 2009). Over the past decades, managers have increasingly placed CX strategies at the core of their offerings to remain competitive in the service landscape (Lipkin, 2016; Zomerdijk & Voss, 2010). CX is formed by the diversity of a customer's value-creating interactions with multiple actors (Kranzbühler et al., 2018). It appears as a unique phenomenon dependent on a multitude of determinants and social and cultural contexts (Akaka & Vargo, 2015; Verhoef et al., 2009). The creation of CX can be influenced by different determinants that are inside (e.g., product assortment, price, and service interface) or outside of the retailer's control (e.g., the influence of the customer's social environment) (Verhoef et al., 2009).

Following this understanding, CX in physical retail environments, often embedded within the space of cities, emerges from a variety of activities of the customer along the shopping process, e.g., including accessing a city center using mobility services, or going to a restaurant (Betzing et al., 2018; Källström et al., 2021; Kranzbühler et al., 2018). Hence, examining smart services in physical retail contexts requires an integrative view of retail consisting of a network of actors, such as customers, retailers, service providers, and other actors (e.g., from city domains related to retailing) (Chandler & Lusch, 2015; Maglio et al., 2009). Referring to the described special nature of the physical shopping process, we assume that existing in-store–oriented views or concepts such as high streets, described as an accumulation of stores in a city (Berendes et al., 2018), require an extension toward a more holistic view. Thus, our perspective of smart retailing integrates smart services at the intersection of the retail domain and its wider physical area of action within a city. Adapting this understanding of physical retail contexts, we apply the definition provided by Riegger et al., (2021, p. 141), who describe smart retailing as including "connected technologies in physical retail spaces to enhance the customer experience, by merging physical and digital dimensions and thereby creating an interactive, context-specific experience." Following this definition, we consider smart services as a value-creating "digital bridge" to the physical experience in retail spaces. Through the development of a taxonomy, this paper aims to identify relevant characteristics of smart services in physical retail environments, and thus contribute to understanding the scope of the term smart retailing according to its spatial application field, technological scope, and nature of CX.

Related work on smart service taxonomies

Existing literature on smart service taxonomies recognizes the changing nature of services toward more consumer-oriented offerings, enabled by the advancements in digital technologies (Gimpel et al., 2018). Therefore, information systems research has provided several taxonomies which can support researchers and practitioners in understanding the design elements of smart services from a technical perspective (Fischer et al., 2020; Paukstadt et al., 2019).

Some of the studies on smart service taxonomies present single consumer-related service elements. For example, Paukstadt et al. (2019) included smart service characteristics informed by service theories, such as the main outcome and value proposition of a service. Rau et al. (2020) derived service characteristics such as the customers' reliefs, benefits, and risks when consuming a service, and the external and internal stimuli that initiate service-related actions. The mentioned works can be considered a progress in research in integrating experiential service attributes that focus on customers' perceptions of a smart service (Rau et al., 2020). However, the mentioned taxonomies classify smart services from an overall perspective. Several taxonomies exist in the literature for individual application fields presenting specific smart service characteristics that are relevant in their respective contexts, such as Fischer et al.'s (2020) taxonomy for the smart living sector. Their work contains characteristics that are specifically relevant to the living sector, for example differentiating whether a service addresses a customer directly (e.g., smart mattresses) or their peripheral surrounding (e.g., home automation services). Furthermore, Lee and Lee (2014) proposed a typology for smart city services, including characteristics that are unique to urban contexts, such as differentiating between voluntary services (e.g., a citizen can decide to receive childcare support) and mandatory services (e.g., speed violation enforcement services that are provided to citizens regardless of their will). Cledou et al. (2018) presented a taxonomy for smart mobility services, containing domain-specific characteristics such as different types of services (e.g., traffic light optimization, driving guidance) and their benefits for different stakeholders (e.g., generating new sources of income, reducing commuting time).

However, as these studies are focused on smart services in other fields, they do not integrate smart retail's key components described in the previous section, namely the physical environment in which retail-related services can create added value. As our study aims to deepen understanding of the concept of smart retailing, the described smart service taxonomies are not sufficient to answer our research questions.

In the context of retail, smart service taxonomies are scarce. For instance, Wolpert and Roth (2020) presented a taxonomy for smart services in single stores. However, it provides rather high-level dimensions, such as the overall intended purpose of a service, from the retailer's perspective. Furthermore, it is limited to in-store services. Thus, it does not provide a comprehensive overview of the relevant consumer-oriented elements of smart services that can support managers to design value-creating services in physical retail contexts, as considered in our work. There are classifications in the literature that look at these aspects, but they tend to focus on classifications of the technologies that are the basis for smart services. As an example of a consumer-oriented focus, Grewal et al. (2020) introduced a typology of innovative technologies in brick-and-mortar stores focusing on their level of convenience and social presence for the customers. Pantano et al. (2017) classified innovations in the retail landscape into "shopping experience," "payment systems," "info/product display systems," "information search systems," and "others." Based on their work, Alexander and Kent (2020) sorted different types of in-store technologies into these categories and presented a framework that classifies the presented technologies according to their impact on CX. Riegger et al. (2021) illustrated potential personalization services and their expected consumer value based on a categorization of smart in-store technologies according to their technological characteristics, i.e., immersive/immobile systems, mobile systems, and hybrid systems. In contrast to these studies, which are focused on brick-and-mortar stores and deficient in broadening the view to the wider servicescape associated with the shopping process, Quinones et al. (2023) provided a categorization that includes both in-store and out-of-store technologies, into retailers' competitive strategies (e.g., enhanced CX, frictionless shopping). The authors describe exemplary service solutions based on technologies that can be used beyond single stores, such as location-based, personalized information/promotion, and Click & Collect services enabled by smart lockers (Quinones et al., 2023). However, the described studies are focused on retail technologies on a more abstract level, e.g., tablets, self-checkout systems, and in-store kiosks (Alexander & Kent, 2020; Grewal et al., 2020), and do not provide comprehensive insights about the services that can be offered through these technologies and their characteristics. Therefore, we developed a taxonomy that classifies relevant elements of smart services in physical retail environments, integrating characteristics from existing smart service taxonomies that are applicable to the given context. An overview of the analyzed set of smart service taxonomies and related classifications is presented in Appendix 1.

Research design

Taxonomies are used in information system research to provide a structure to the knowledge of a field (Glass & Vessey, 1995; Nickerson et al., 2013). They support researchers in systematically grouping objects of interest based on common characteristics (Nickerson et al., 2013; Rau et al., 2020). As taxonomies are helpful if little knowledge is available in a particular domain (Gregor, 2006) and research is lacking in terms of examining smart services in retail settings beyond single stores, we consider a taxonomy a suitable method for understanding the characteristics of smart services in physical retail. Examining the differences in services and classifying them support researchers in producing knowledge about the design of smart services in this context (Williams et al., 2010).

To answer our research questions, we followed a five-step, mixed-method research process. We combined taxonomy development with an interview-based evaluation, a qualitative use case observation, and a subsequent archetype development based on a systematic literature review (Table 1).

Stage 1: Systematic literature review for database creation

We conducted a systematic literature review (SLR) to create the literature base for our analysis (Webster & Watson, 2002). Our goal was to synthesize the literature on the evolving field of smart service for physical retail, following the perspective on smart services described above. We neutrally represented our findings and selectively cited papers from our sample without restricting the search basket to allow for exhaustive coverage. To identify relevant literature that covers both the unit of analysis of smart services and the specific domain of retail, we applied a search string that consists of keywords from the domains of retail (retail, shopping, etc.), a physical setting (local, city, etc.), and smart services (IoT, smart product, etc.). We queried four databases: Scopus (525), Web of Science (307), IEEE (284), and AISeL (2). For our literature screening process, we applied several general exclusion criteria (e.g., non-English, non-available, duplicates, and non-research publications) and quality criteria (i.e., relevance), which we drew from Vom Brocke et al. (2015). We included literature eliciting smart services either conceptually or describing concrete use cases in our literature base. We have identified publications as relevant if they follow our understanding of smart services, focus on smart service applications in physical retail environments, and contain customer-oriented service aspects. Although we did not apply a temporal restriction, the emerging topic of smart services led to research not being published before 2009 (Zhang et al., 2009). Applying these criteria to our initial set resulted in a final set of 79 papers.

Stage 2: Taxonomy development

The goal of our taxonomy was to propose an artifact for the classification of smart services in physical retail contexts from a consumer-oriented perspective. For the taxonomy development, we applied the methodology proposed by Nickerson et al. (2013) using a hybrid approach that includes both conceptually and empirically derived dimensions. Thus, we incorporated previously conceptualized dimensions from the literature while deriving dimensions from our literature-based sample of use cases reporting smart services. The taxonomy consisted of a series of dimensions that included mutually exclusive (ME) and non-exclusive (NE) characteristics. The characteristics within each dimension were complete and disjunct (Nickerson et al., 2013).

The development process of the taxonomy began with the definition of the meta-characteristic (Nickerson et al., 2013). Considering smart services as a digital bridge, adding value to customers in physical retail environments, we argue that the application of smart services in these settings leads to the concept of smart retailing. Thus, to define the

Table 1 Overview of the five consecutive research stages

Step	Input	Process	Output
1. Literature review (Webster & Watson, 2002)	((retail* OR shop* OR *commerce OR multichannel OR omnichannel OR multi-channel OR omni-channel) AND (local OR region* OR city OR cities OR urban OR "high street" OR mall) AND ("smart product" OR "smart service" OR "iot" OR "internet of things"))	1118 initial papers, 861 duplicate check, 79 title, keywords, abstract	Final literature sample with 79 papers
2. Taxonomy development (Nickerson et al., 2013)	Final literature sample	5 iterations, thereof 3 empirical, 2 conceptual	Taxonomy with 14 dimensions and 42 characteristics
3. Taxonomy evaluation with expert interviews (Szopinski et al., 2019)	Semi-structured interviews with 7 experts in the field of retail and smart services	Evaluation of the taxonomy's dimensions and characteristics based on quality criteria	Evaluated taxonomy with 14 dimensions and 42 characteristics
4. Taxonomy evaluation with real-world services (Nickerson et al., 2013)	International projects and mobile applications in the retail context, with a set of 163 relevant smart services	Case selection Evaluation of usefulness through service classification	163 taxonomy-based classified smart services
5. Archetype derivation (Ward, 1963)	163 taxonomy-classified smart services	Dendrogram- and elbow-based cluster determination, Hierarchical agglomerative clustering	6 archetypes of smart services in retail

meta-characteristic for our taxonomy, we applied the definition of smart retailing presented above as a lens to analyze smart services. Therefore, we structured the taxonomy into three subclasses, according to the service's (1) contribution to improving *customer experience*, (2) the *physical environment* in which it is applied, and (3) its underlying *smart product* as the central means to create and provide a service. To end the iterative development process, we applied the 10 objective and five subjective ending conditions (concise, robust, comprehensive, extendible, and explanatory) proposed by Nickerson et al. (2013). For the taxonomy development, we performed five development iterations with three using the empirical-to-conceptual approach and two involving the conceptual-to-empirical approach. An overview of the taxonomy development process for smart services in retail is provided in Fig. 1. In total, we derived 14 dimensions and 42 characteristics for describing smart services in retail. New dimensions resulting from the current iteration are depicted in gray shading. Our development process ended after the fifth iteration with no dimensions or characteristics added, every service from our sample classified, and all ending conditions fulfilled. We conducted three inductive empirical-to-conceptual (empirical) and two deductive conceptual-to-empirical (conceptual) development iterations. We provide more detail on the taxonomy development process and the fulfillment of the ending conditions in Appendix 3.

Stage 3: Taxonomy evaluation with expert interviews

To ensure that the classification of smart services meets the desired goals for researchers and practitioners, and is of the desired quality, we evaluated our taxonomy following the taxonomy evaluation framework presented by Szopinski et al. (2019). Therefore, we conducted semi-structured interviews with seven experts that have practical experience in the fields of physical retailing and smart services. Appendix 4 provides information about the participants and their backgrounds. The interviews, which we conducted online, lasted from 30 to 45 min. For the preparation of the interviews, we sent a short presentation about our research work and the preliminary version of our taxonomy with related descriptions of its characteristics to the participants via email two days before the interviews. We asked the participants to get a first overview of the taxonomy and think about potential improvements. We video-recorded and transcribed the interviews, paraphrased the participants' feedback, and checked our taxonomy against Nickerson et al.'s (2013) criteria: conciseness, robustness, comprehensibility, explanatory power, and perceived usefulness of the taxonomy (Szopinski et al., 2019). Furthermore, to get additional insights about relevant combinations of smart service characteristics from the practitioners' perspective, we asked the interviewees to describe service configurations that they would consider

	Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5
Approach	Empirical-to-Conceptual	Conceptual-to-Empirical	Empirical-to-Conceptual	Conceptual-to-Empirical	Empirical-to-Conceptual
Data Set	Random set of smart service objects	Conceptual papers from literature set	Random set of smart service objects	Related literature	Rest of smart service objects
Focus	Initial set of dimensions and characteristics	Adjusting taxonomy based on conceptually grounded prior classifications	Including classifications according to the urban environment	Improving and adding on dimensions related to customer experience and connected technologies	Revising and improving latest version of the taxonomy
Dimensions	Value Offering	Value Offering	Value Offering	Value Offering	Value Offering
				Value Perception	Value Perception
		Targeting	Targeting	Targeting	Targeting
	Service Realm	Service Realm	Service Realm	Service Realm	Service Realm
				Journey Phase	Journey Phase
	Behavioral Response	Behavioral Response	Behavioral Response	Behavioral Response	Behavioral Response
		Experience Determinant	Experience Determinant	Experience Determinant	Experience Determinant
			Spatial Level	Spatial Level	Spatial Level
	Actors	Actors	Actors	Actors	Actors
			Relationship	Relationship	Relationship
		Sustainability Contribution	Sustainability Contribution	Sustainability Contribution	Sustainability Contribution
	Main Interface	Main Interface	Main Interface	Main Interface	Main Interface
	System Topology	System Topology	System Topology	System Topology	System Topology
				Service Capability	Service Capability
Sum	6	9	11	14	14

New Dimension per Iteration | Existing Dimension per Iteration

Fig. 1 Taxonomy development process and iterations most valuable for customers. Based on the participants' feedback, we evaluated and revised the service classifications, leading to the final version of the taxonomy presented in the next section. Appendix 4 shows our interview guideline consisting of six open questions based on the described goals and quality criteria.

Stage 4: Taxonomy evaluation with real-world services

Beyond the application sample from our literature set and the interviews, we intended to further validate the taxonomy's practical applicability and usefulness in classifying smart services. Therefore, we used real-life smart services applied in physical retail settings (Nickerson et al., 2013). To build a comprehensive dataset, we systematically searched for smart services in the retail context. For this purpose, we conducted a search in mobile app stores (Google Play Store and Apple App Store) and international databases presenting projects in the physical retail context (Bable, 2021; Bee smart city, 2021; Cima.Digital, 2021) to identify an international set of relevant smart services. As a selection criterion, we considered apps or projects relevant, if they provide smart services in a physical retail setting, and thereby identified a set of 163 smart services.

According to the taxonomy evaluation framework provided by Szopinski et al. (2019), our approach can be characterized as an illustrative scenario evaluation based on a quantitative analysis of a representative set of real-world objects applied in the context of physical retail. Four researchers that were not involved in the development process iteratively classified each smart service using the taxonomy, by analyzing the services based on the descriptions provided in the mentioned sources and by downloading and exploring the related apps. The smart services were randomly distributed among the team of coders. We implemented measures for informing the coders, such as providing extended coding guidelines and ad hoc meetings in case of coding issues, to increase the reliability of the taxonomy application (Guba, 1981; Shenton, 2004).

Stage 5: Building archetypes of smart services in smart retail

In the last research stage, we performed a cluster analysis (Ketchen & Shook, 1996) based on the evaluation data of our derived taxonomy to gain further insights into commonalities of smart services in physical retail contexts (RQ 2). This form of analysis is particularly useful because it enables a group of objects to be differentiated from other groups based on the similarity of their characteristics to uncover underlying patterns (archetypes) (Bailey, 1994; Jain et al., 1999). Thus, building archetypes complements the developed taxonomy knowledge and allows us to group smart services in physical retail according to the taxonomy characteristics and similarities (Möller et al., 2019).

An essential prerequisite and a central challenge for the successful application of clustering algorithms is the determination of the optimal number of clusters (Anderberg, 1973). To cover that issue, we first applied a hierarchical method to obtain a first solution approximation as a starting point and derive a candidate number of clusters. Hence, we performed the agglomerative hierarchical clustering algorithm (HCA) with Ward's (1963) method and the Euclidean distance metric because both strategies have proven to be the most suitable and performant for clustering analyses (Punj & Stewart, 1983; Rencher, 2002; Tamasauskas et al., 2012). As our taxonomy data is described by binary values, we also applied hierarchical clustering with complete linkage and the Hamming distance metric but found no significant differences from the first approach (Nielsen, 2016). To qualitatively assess the clustering results, we visualized the clusters via a dendrogram (see Appendix 5). The results suggested an optimal number of clusters being 4 or 6. To support the process of choosing a robust clustering configuration, we further employed the elbow method to assist in determining the optimal number of clusters (Ana & Jain, 2003). We decided to triangulate our findings by employing the elbow method in combination with k-means clustering (see Appendix 5). Relying on the dendrogram and the elbow method in the context of the meaningfulness of the underlying database, we chose an $n = 6$ cluster solution. Consequently, we were able to form six relevant clusters in the second step by using HCA with Ward's method. Analyzing each cluster's similarities and focusing on shared characteristics as well as service offerings enabled us to derive six smart service archetypes for retail.

Taxonomy of smart services in retail

In this section, we present the final version of our taxonomy after the five iterative development steps and the revisions based on the feedback gained from our expert interviews. The developed taxonomy for smart services in physical retail consists of 14 dimensions, with a total of 42 characteristics (Fig. 2).

Customer experience

Value offering

Smart services can offer customers four different values. Smart devices (e.g., mobile phones, smart shopping trolleys) can show *information* on products, customer reviews, or the amount to be paid for the products in a cart (Algarni et al., 2020; Yogalakshmi & Maik, 2020). Other

	Dimensions	Characteristics					Mutual Exclusivity
Customer Experience	Value Offering	Information (67%)	Recommendation (10%)	Promotion (20%)	Convenience (57%)		No
	Value Perception	Utilitarian (98%)	Hedonic (8%)	Social (2%)			No
	Targeting	Individualized (15%)	Non-individualized (85%)				Yes
	Service Realm	Digital (36%)	Augmented (6%)	Physical (58%)			Yes
	Journey Stage	Pre-Purchase (78%)	Purchase (41%)	Post-Purchase (24%)			No
	Behavioral Response	Acquisition (50%)	Satisfaction (62%)	Loyalty (28%)			No
	Experience Determinant	Product Assortment (82%)	Accessibility (91%)	Social Environment (10%)	Atmosphere (5%)	Leisure (10%)	No
Physical Environment	Spatial Level	Store (51%)	Mall (5%)	District (5%)	City (39%)		Yes
	Actors	Retailers (95%)	Non-retailers (19%)				No
	Relationship	Bilateral (74%)	Multilateral (26%)				Yes
	Sustainability Contribution	Ecological (23%)	Social (2%)	Economic (96%)			No
Smart Product	Main Interface	Device (96%)	Smart Product (4%)				Yes
	System Topology	Service (43%)	System (40%)	System of Systems (17%)			Yes
	Service Capability	Monitoring (36%)	Controlling (52%)	Optimization (12%)			Yes

Fig. 2 Taxonomy of smart services in physical retail

information services that are beneficial in shopping-related activities include local news, events, opening hours, and the locations of stores or available parking places (Suciu, Balanean, et al., 2020; KC and Kang, 2019). Smart services can also provide *recommendations* that reduce available choices to a relevant set of options and give customers advice in the selection of different alternatives (e.g., stores, free parking spaces) (Dianawati & Harso Supangkat, 2020; Suciu, Balanean, et al., 2020). Customers can also receive *promotions* as part of loyalty programs or location-based advertising services that send customers promotions when they are close to a store using a beacon-based mobile application (Nukala et al., 2016; Spachos & Plataniotis, 2020). We also identified value offerings contributing to a customer's *convenience* in the shopping process. These services impact the design of the physical environment or value-adding services that make the customer's activities faster and more efficient (e.g., constant temperature in stores, self-checkout, and product delivery) (Sai baba et al., 2020; Yogalakshmi & Maik, 2020).

Value perception

Smart services in physical retail contexts can elicit three types of value perception. A *utilitarian* value contributes to CX by successfully accomplishing a customer's intended goal (Babin et al., 1994). Thus, a customer perceives utilitarian value if a shopping task is completed successfully and in an efficient, fast, and convenient way (Alexander & Kent, 2020; Babin et al., 1994). By contrast, *hedonic* value results from enjoyment, fun, and playfulness and reflects the potential entertainment and emotional worth of shopping-related activities (Babin et al., 1994; Paukstadt et al., 2019). *Social* value refers to the resulting value from interacting with the customer's social surroundings through community building and customer collaboration (Hoyer et al., 2020; Paukstadt et al., 2019).

Targeting

The targeting dimension classifies smart services according to how individually customers are addressed, that is, to what extent the content of a service is adapted to the customer's individual needs (Betzing, 2018). *Individualized* smart services provide relevant offerings by adjusting content or products of interest to customers based on their individual demands (Riegger et al., 2021). To deliver relevant personalized services "to the right person at the right time" (Tam & Ho, 2006, p. 867), services implicitly incorporate context specificity (e.g., location-based services) (Riegger et al., 2021). Smart mirrors provide personalized recommendations related to considered products based on the customer's preferences (Riegger et al., 2021). *Non-individualized* targeting refers to services that are not adapted to individual customers (e.g., interactive digital signs), offering the same content to different customers (Algarni et al., 2020).

Service realm

By connecting the physical retail environment with the digital world, smart services differ in terms of the service realm in which the service primarily influences the shopping experience. Smart services that focus on the *digital* realm foster interaction and information exchange between organizations and customers without being directly integrated into physical activities (e.g., information screens, virtual product catalogs) (Alexander & Kent, 2020; Algarni et al., 2020; Parise et al., 2016). By contrast, services from the *physical* realm directly influence how a customer acts or interacts within a physical service environment (Bolton et al., 2018). These services influence and make use of the physical environment through digital technologies to encourage a customer to engage in a service encounter (Bolton et al., 2018). For example, promotions are sent to a customer as he walks along the shopping street and enters the geofence of a beacon to draw his attention to a store in his physical surroundings (Betzing, 2018). Furthermore, we describe services as *augmented* if they digitally extend the physical environment based on AR solutions. AR can be defined as a real-time 3D visualization that unites physical environments with virtual elements (Azuma, 1997; Fegert et al., 2020), such services create a convergence between the physical and digital worlds of the customer. As an example, interactive AR apps can enable motor-impaired customers to digitally interact with physical items on shelves that are placed beyond their arm's length (Rashid et al., 2017).

Journey stage

In line with the conceptualization of CX in three overall stages of the shopping journey, smart services can be classified according to the pre-purchase, purchase, and post-purchase stages (Lemon & Verhoef, 2016). In the *pre-purchase* stage, the customer's interactions with the environment before a purchase transaction are addressed, including need recognition, product search, and consideration (Alexander & Kent, 2020; Lemon & Verhoef, 2016). Smart services can support these activities by providing product recommendations (Riegger et al., 2021) or by navigating customers to free parking places and store locations (Dianawati & Harso Supangkat, 2020; Golenbiewski & Tewolde, 2020). The *purchase stage* is characterized by the customer's interaction with a retailer and his environment during the purchase event and is addressed by smart services through checkout and payment services and product delivery (Lemon & Verhoef, 2016; Yogalakshmi & Maik, 2020). Services related to the *post-purchase* stage provide value according to activities after the actual purchase, including consumption and customer engagement, which can be incentivized through digital loyalty services (Alexander & Kent, 2020; Nukala et al., 2016).

Behavioral response

Smart services can be distinguished according to the consequences their consumption could have on a customer's attitude or behavior. Smart services can promote customer *acquisition*, which describes the process of a customer's first interaction with an organization until his/her first purchase. Location-based advertising services that try to catch the customer's attention by providing promotions to a nearby store can lead to customer's acquisition (Betzing, 2018). Perceived service quality contributes to customer *satisfaction* (Dreyer et al., 2019), which can be provided through personalized recommendation services that are adapted to satisfy the individual needs and contexts of customers (Dianawati & Harso Supangkat, 2020; Suciu, Balanean, et al., 2020). International currency translation services can enhance customer satisfaction by relieving the customer of the task of converting the purchase amount into his home currency (Sai baba et al., 2020). Services that promote customer *loyalty* provide special offerings and promotions as rewards to give the customer an incentive to visit a store or city center repeatedly (Betzing, 2018).

Experience determinant

CX in retail is shaped by various determinants (Verhoef et al., 2009). Smart services in physical retail contexts following our understanding, going beyond single-store encounters, appear to address and add to these dimensions. *Product assortment* refers to the range of available products in a shopping area and the attributes associated with these products (e.g., variety, uniqueness, quality, price) (Betzing et al., 2018; Verhoef et al., 2009). Smart services can also address *accessibility* by providing or supporting access to the shopping area and reducing customers' distance and travel costs (Hart et al., 2013). Smart services that address the *social environment* contribute to the customer's perceived relationship and interactions with the place and other people in her/his surroundings (Hart et al., 2013). Interactions of customers with other customers, service personnel, or friends and family members have been recognized to influence CX (Verhoef et al., 2009). Examples of smart services addressing this dimension include virtual assistants, such as robots or chatbots, providing personal conversations (Hoyer et al., 2020), but also solutions that enable social media connections in retail stores or support compliance with social distancing measures (Algarni et al., 2020; Elavarasan et al., 2021). *Atmosphere* describes the ambiance of the retail area, including the attractiveness and decor, safety, and cleanliness of stores and their surroundings (Howell & Rogers, 1981; Källström et al., 2021). Safety services (e.g., access control solutions) contribute to this experience dimension (Petrakis et al., 2020). Furthermore, smart services also support customers in activities that are not directly related to shopping but are part of the shopping experience as a *leisure* determinant (Källström et al., 2021). Such services address cultural and entertainment activities, visitors' attractions, restaurants, and cafés (Hart et al., 2013; Källström et al., 2021).

Physical environment

Spatial level

The spatial level describes the application area of a smart service that can be differentiated into four characteristics.

The smallest area of application for a smart service in our city-focused analysis is a single *store* (or a chain of stores). Services only available and accessible in a single store are described with this characteristic (e.g., smart dressing rooms store auditing) (Brooks & Brooks, 2014; Chaudhary & Murala, 2018). A shopping *mall* consists of several stores and is operated by a dedicated mall operator. This agglomerate of stores can provide additional services to customers (e.g., mall-specific payment services, and personalized in-mall advertising) (Sutagundar et al., 2018; A. Zhang et al., 2018). In contrast to a shopping mall, a *district* is a self-contained, mixed-used area with retail, office, and living spaces involving additional actors such as businesses, municipal representatives, and local marketing organizations (Neirotti et al., 2014). Hence, a district with its various actors can be conceptualized as a multi-sided market (Bartelheimer et al., 2018). An example of a district-specific service is beacon-based localization on a high street (Betzing, 2018). A *city* can consist of several districts with services that are available in a single city (e.g., parking services, access control services) or across multiple cities (Ádám et al., 2020; Cirillo et al., 2019; Petrakis et al., 2020). As this dimension is mutually exclusive, the larger-level characteristic subsumes possible applications in smaller scenarios. A service that is applicable both in a mall and across a city is classified as having the characteristic city.

Actors

We identified the *retailers* and additional *non-retailers* as involved actors in smart services in the context of city retail. As this taxonomy is developed from a customer's point of view, he/she is not included within the actor dimension. Within our sample of use cases, we identified a variety of external non-retail actors probably involved in service creation, provision, and delivery, such as city authority, technology service providers (Sutagundar et al., 2018), transport service providers (Wang et al., 2019), and mall operators (Algarni et al., 2020). While many of the smart services involve multiple actors from one class of actors (Shen et al., 2018), others only involve a single retailer providing the services (Brooks & Brooks, 2014).

Relationship

With a variety of actors involved in the use cases, smart services enable *bilateral* or *multilateral* relationships between customers and organizations involved in the service process. *Bilateral* services characterize the interactions between customers and a single retailer; thus, they do not go beyond a dyadic customer-retailer relationship in their immediate scope of action (Betzing et al., 2018). For example, location-based offerings provided by single stores based on beacon technology can be limited to a single retailer-customer interaction but provide a linkage to the customer's broader out-of-store experience in the retail area (Spachos & Plataniotis, 2020). *Multilateral* relationships are not limited to only one retailer but involve multiple actors that interact with a customer for the purpose of the service. For example, recommendations for the most suitable supermarket to visit, based on recent product availabilities as well as traffic and parking situations, integrate data from various retail and non-retail actors (Mohamad et al., 2017). Services that enable the direct transmission of information scanned from near-field communication NFC tags, such as those placed on products, to social networks enhance social interactions with other customers and actors (Je & Seo, 2019).

Sustainability contribution

In analogy to the smart city concept, which gave rise to the term smart retailing and which is increasingly focused on sustainable urban development (Bibri & Krogstie, 2017), smart services in retail also entail attributes that contribute to a sustainable environment. The three interconnected pillars of sustainability, which are reflected by the examined services, involve ecological, social, and economic factors and aggregate the goals of sustainable development (Purvis, 2019). *Ecological* smart services reduce the carbon footprint of a geographic area and positively influence customers' long-term health (Silva et al., 2018). These services reduce waste (Hadria et al., 2018) and energy consumption with smart lights (Y.-S. Yang et al., 2020), reduce emissions by optimizing the driving distance to find a suitable parking place (Chowdhury et al., 2019), or increase the utilization of smart products by sharing (Cirillo et al., 2019). *Social* services enhance the interaction among customers, address social differences, and encourage customer engagement (Giddings et al., 2002). Smart services enable and ease transactions and social shopping experiences (Suciu, Pasat, et al., 2020) or foster the distribution of information (Vakali et al., 2014). *Economic* smart services are concerned with the sustainable value proposition for the customer (Purvis, 2019). They involve reliable and shortened supply chains (Elavarasan et al., 2021) or goods and parcel delivery using ride-sharing (Wang et al., 2019).

Smart product

Main interface

The interface represents the central touchpoint through which users interact with the system, consume the service offerings, or create value in the context of value co-creation (Paukstadt et al., 2019). The interface can be divided into two categories: *device* and *smart product* (Paukstadt et al., 2019). The utilization of smartphones, tablets, smartwatches, or other mobile and browser-based applications for system interaction can be subsumed under the term device (Anke, 2019; Lim

& Maglio, 2018). However, many of the smart products also feature an analog or digital interface integrated into the product that allows direct access to the service (Rizk et al., 2018).

System topology

Smart services are based on smart products, which are autonomous system actors that share information using connectivity components, thus enabling the realization of innovative services (Mattern & Floerkemeier, 2010; Strobel, 2021). Smart services themselves can be aggregated in multi-level service networks and combined to form a service system or a system of systems (Brogt & Strobel, 2020). The starting point is a discrete *service*, in a smart shopping cart equipped with wireless modules, a display, and wheels for energy harvesting, which offers advertising as a basic service (Kim et al., 2017). A service *system* combines related smart products and services, optimizing overall service performance and satisfying broader needs by offering more comprehensive retail services (Porter & Heppelmann, 2014). For instance, RFID tags attached to merchandise can first be detected by a smart checkout system and then read by a smart billboard to analyze consumer behavior using data mining and display advertisements for complementary products in real-time (Nigam et al., 2016). Furthermore, multiple service systems can be combined into a *system of systems*, and thus enabling a more expansive service that delivers disproportionate value (Brogt & Strobel, 2020; Lukkien, 2016; Porter & Heppelmann, 2014). This integration enables, for example, a comprehensive parking management service that includes the billing of parking space usage, real-time display of the parking situation, and apps to find free parking spaces by combining several smart product systems (Sanchez, Muñoz, et al., 2014a, b).

Service capability

Smart products are boundary objects of smart services that enable the co-creation of value by integrating knowledge, resources, and activities, thereby transforming the CX (Beverungen et al., 2019). Identifiability, localization, and equipment with sensors and actuators all result in stacked capabilities of smart retail services (Porter & Heppelmann, 2014). *Monitoring* captures the status, operation, and environment of the devices and notifies changes in relevant parameters (e.g., location, customer movements) (Kim et al., 2017; Regalia et al., 2016). *Controlling* describes the control of smart products based on algorithms. It allows decisions to be made on the provider side using data aggregation and analysis, and thus enriching the service using personalization (Beverungen et al., 2019; Porter & Heppelmann, 2014). *Optimization* results from combining rich data and controlling devices by considering current or historical data to improve performance or take preventive action (Porter & Heppelmann, 2014). Hence, the shelf availability of fresh food can be optimized through real-time analysis of product availability and consumer interaction (Nukala et al., 2016).

Evaluation

To evaluate the usefulness and applicability of our taxonomy, we followed a two-step approach combining expert interviews with real-world applications. First, we evaluated our taxonomy against the five subjective ending conditions (see Appendix 3) in seven interviews with domain experts following Szopinski et al. (2019). This evaluation should ensure the applicability of the taxonomy in the retail domain. All participants confirmed the usefulness of the taxonomy for describing and developing smart services in physical retail environments. One expert noted that the taxonomy provides a means to design and assess services for a certain degree of maturity and to distinguish new services from existing offerings in the market:

> "For a company that wants to develop smart services, I would definitely consider the taxonomy to be very relevant. Because it is of course interesting to see how you classify your own services. Above all, it is interesting to test services with different characteristics and then compare them so that you can see differences between the services and conclude which characteristics work particularly well. I haven't seen the way retail works structured in this way before. For a deeper market understanding of services, I see the taxonomy as useful above all".

Furthermore, all interviewees agreed that the taxonomy can help practitioners and researchers to understand smart services. One participant highlighted the applicability and suitability for the context of physical retail:

> "The taxonomy fits the retail context. I've always had in mind that this is physical retail and I've never drifted into another area, so that's pretty clear".

Overall, the experts confirmed that the taxonomy includes all dimensions that are relevant to differentiate the object of interest, without containing too many dimensions. Thus, we also consider the criteria of conciseness and comprehensibility to be met. Assessing the taxonomy's robustness, one participant opened the discussion on whether services based on AR technologies are also covered. When going through all the dimensions of the taxonomy, he had problems classifying these services in the service realm dimension. Previously characterized by a duality of the *physical* and *digital* realm, we added the *augmented* characteristic based on his feedback:

> "Augmented reality plays a special role because it could give you a different shopping experience. There could be a separate characteristic, because the service is used in the store and the store is digitally extended".

This characteristic more clearly reflects the continuum of convergence between the physical and digital worlds and improves the taxonomy in terms of its robustness. Furthermore, the experts suggested to revise some terms in the taxonomy to make the characteristics more intuitively understandable, especially for practitioners. Therefore, we have changed the characteristics formerly mentioned as "dyadic" and "holistic" in the relationship dimension to *bilateral* and *multilateral.* To better distinguish the actors involved in smart services from each other, "external actors" were renamed *non-retailers.* Similarly, in the targeting dimension, we have renamed the characteristics "personalized" and "standardized" to *individualized* and *non-individualized*. In this way, we make it clear that there is a distinction between whether a service is customized for an individual person or not. After these revisions, and based on the feedback from all experts, we conclude that our taxonomy achieves the targeted goals and meets the quality criteria. In addition, since three participants noted that a textual description is helpful to understand all the dimensions and characteristics, we have created a corresponding document that can be used to support practitioners using our taxonomy.

Second, by applying our taxonomy to 163 real-world smart services, our objectives were (1) to further validate its practical applicability and usefulness in classifying smart services, and (2) to gain insights into how smart services are currently designed in physical retail environments. All examined smart services were successfully and completely classified based on the dimensions and characteristics of our developed taxonomy. The evaluation results are presented as hit ratios per dimension in Fig. 2.

According to the value offering, more than half of all objects (67%) provide information services and convenience (57%). These, as well as recommendations, have been identified to be almost exclusively of utilitarian value, which is provided by 98% of all smart services. Referring to the journey stage, we observed that the largest share of smart services relates to the pre-purchase stage (78%). Taking into consideration that customer acquisition (50%) is also represented by half of all services, we can conclude that many smart services are focused on providing potential customers with valuable information, recommendations, and promotions to support their decision to visit a shopping area or a specific store and fulfill their needs. Furthermore, a widespread service combination is the value offering of convenience (57%) associated with customer satisfaction (62%). Many of these services support customers in activities within the wider physical environment in a city (39%) and address the accessibility (91%) determinant. Typical examples are store finder applications and parking services, often combined with promotion services. In this context, it is worth mentioning that the CX determinant that is most frequently addressed is not part of typical CX models in retail (Verhoef et al., 2009). However, accessibility can be seen as an extension of more complex physical retail environments (e.g., district, city). One of our interviewees mentioned accessibility as particularly important for services in our context. He emphasized that due to the extended physical perspective on stationary retail, the CX must be viewed holistically and that in this context accessibility and also social stimuli are important determinants of this experience. However, we observed from our service set that only a share of 2% of the offerings provide social value offerings. Similarly, the individualized adaption of services to the customers' needs is only provided by 15% of the real-world offerings. This can be considered a relatively small share, referring to the notion given by literature that personalization is an important factor in enriching CX (Parise et al., 2016) and based on the feedback of our interviewees that individualization is an essential characterization for value-creating services.

Smart service archetypes for smart retailing

Based on the cluster analysis of our smart service evaluation, we were able to identify six different archetypes that represented the central characteristics of smart services for retail. To interpret the archetypes, we focused on primary and secondary distinct dimensions within the clusters, as well as their interplay. Within the dimensions, all characteristics and their interrelationships were considered. Tertiary and other dimensions were not considered because they are improbable to contain significant and prestigious knowledge for the archetype.

The first archetype—*Check & Go*—mainly contains services that provide location-sensitive information to satisfy customers' need for assurances and therefore lead to a sustainable reduction of resource usage. In this archetype, the value proposition is focused on information, while the service realm is digital, resulting in a focus on customer acquisition. When the customers' primary goal is to buy specific products, inventory checks to provide information on product availability either encourage them to visit the store or the customer is spared driving there for nothing, saving travel time, reducing CO_2 emissions, and preventing negative experiences. Additionally, store-finding services allow customers to find the nearest and open store available with location-specific information, supporting customers who want to make the trip to the store. Furthermore, this archetype comprises information on the customers' arrival, e.g., regarding the visitor numbers of a store or about real-time parking space availability. The latter service is displayed on digital street signs or smartphones to simplify the search for parking spaces. For example, Zara provides an availability check showing nearby stores with desired products, including additional store details like opening hours and directions (Zara, 2023). VivoCity, a Singaporean shopping center, offers an app service indicating available parking slots (VivoCity, 2023).

The second archetype—*Pay & Ride*—comprises retail services that combine payment processes with mobility services. These include Click & Collect services, where goods are purchased online and picked up from a reserved parking space at the retailer's location. The services also enable scanning and payment of the parking ticket directly via the smartphone app, in combination with reward programs. The main emphasis lies in increasing convenience, customer satisfaction, and the economic contribution to sustainability by complementing the shopping experience with location-independent payment services and benefits or rewards exclusively linked to the service. GameStop offers on-site product reservations for guaranteed availability, with email notifications when ready for pickup (GameStop, 2023). Another example is the Q-Park reward system, which offers a pre-booking service for parking lots including payment via Apple or Google Pay (Q-Park, 2023).

The third archetype—*Scan & Inform*—mainly encompasses services that make use of widespread smartphone use and, thus, the availability of a camera and a platform to place an application. The goal is to provide customers with a quick and independent option in-store to scan a product, either as an image or QR-code, barcode, or via NFC-tags, and display product-related information. The proposed value of these services comprises information and convenience and is perceived as utilitarian because customers do not need to interact with the retail staff that must be available in the first place. Nonetheless, the scanning of products requires physical access to the store and is therefore aimed toward the presence of customers in the retail store. Target, for instance, offers an app with a barcode scanner for accessing product information such as food ingredients or deals (Target, 2023). Sam's Club also offers a barcode scanner for product information and expands this feature with a "Scan & Go" checkout function that enables payment for scanned products in the supermarket, bypassing the checkout queue (Sam's Club, 2023).

The fourth archetype—*Locate & Navigate*—focuses almost solely on services whose value proposition strongly relates to the customer's location. The services aim to either provide customers with personalized location-based services, direct customers to products, or navigate customers to points of interest. Thus, the archetype subsumes intelligent parking guidance, vehicle location systems, and near-field, technology-based indoor navigation for location-based product placement. In addition to these purely retail-based services, the archetype also includes navigation concepts from the field of public transportation, which are related to retail activities but often provided by providers from other domains, such as urban mobility companies. For example, The Westfield shopping center app offers customers the fastest way to navigate to desired locations across multiple floors (Unibail-Rodamco Austria, 2023). The City Centres app provides a "Find My Car" service allowing users to locate their vehicle by entering the license plate number. Customers receive an image of their car via the parking garage's surveillance camera system, along with further information to help locate the parking lot (City Centre Deira, 2023).

The fifth archetype—*Plan & Prepare*—includes services that provide customers with shopping lists to prepare and organize their purchasing spree. Several retailers enrich their customer applications with shopping lists connected to an inventory of listed items. Hence, customers using this service know which items to expect in the retailer's store, and the service's value offering exceeds its informational characteristic by providing convenience. By implementing planning services such as shopping lists, customers are already accompanied during the pre-purchase stage up to when they visit the retail store. Integrations into mobile applications can benefit from the customer's use of the planning service by presenting further purchasing opportunities (e.g., up- and cross-selling), for instance, via advertisements, special promotions, or discounts. For instance, Decathlon provides an in-store availability indicator and a wishlist for desired products (Decathlon, 2023). Dollar General extends this service to include couponing and estimated total cost for added products (Dollar General, 2023).

The sixth archetype—*Save & Reward*—aims to increase customer satisfaction and associated loyalty by rewarding returning customers with benefits. Customer satisfaction will be increased primarily through promotional, and bonus offers, such as coupons, loyalty points, and collection campaigns. In addition to the value offering of promotions, the focus is primarily on customer convenience. For this purpose, typical customer actions along the shopping experience, such as the search for a parking spot, are linked to promotions. For instance, the Cities App with over 180 affiliated cities and communities in Austria offers a bonus world program including prize draws, collection passes, or vouchers (citiesapps, 2023). Another example is the City ilove app rewarding buyers with loyalty points by scanning receipts from stores in an associated shopping center (Baneasa Developments, 2023).

Discussion

The presented taxonomy fosters an understanding of how smart services are designed in physical retail. These insights enable us to better understand the term smart retailing, considering its connection to the underlying smart service concept. In particular, from the service characteristics presented in the taxonomy, we can discuss the scope of smart retailing and its application areas in physical shopping environments. From a technical view, it is striking that we could not find two characteristics previously suggested by the literature on smart services among the 163 objects examined. Literature has identified that smart services' main interface, besides the two characteristics that we propose, can also be characterized through human interfaces (Paukstadt et al., 2019). However, as we could not find proof for this characteristic from our service set, we assume that interactions with human interfaces are more relevant in domains in which personal contact with humans is of significant relevance, e.g., in healthcare settings. Furthermore, as an extension of the optimization capability, smart services can be classified as autonomous services (Porter & Heppelmann, 2014). Autonomy is finally achieved by adjusting service needs to user preferences automatically and requiring only the service provider to monitor performance and the overall system. This capability describes the self-coordination of a service with other systems, as well as self-diagnosis and self-service (Porter & Heppelmann, 2014), such as an autonomous vehicle parking system (Thomas & Kovoor, 2018). We conclude from this that the smart services currently implemented have not yet reached this level of maturity or are not relevant in practice because the service processes are not as complex as in other machine-based applications, such as energy systems. From a spatial perspective, we observed that retailers and related actors provide customers with smart services both not only within single stores, but also throughout their wider surroundings, such as shopping malls, and often throughout a city to address and combine different activities in the shopping process. During the research process, CX appears to be more complex than related CX concepts in literature and plays a central role in the design of smart services. For example, identified CX determinants add to the ones that form a single retail experience (Verhoef et al., 2009), including elements such as leisure and accessibility. Thus, smart services support retail-related activities throughout the whole customer journey, which extends across the scope of action of single retailers. Consequently, smart services are not limited to dyadic relationships in the context of value creation; rather, they enable the integration of multiple actors. Our observations reflect current theories in the service science field that consider CX as the result of a variety of interactions between customers and multiple actors in complex service systems (Becker & Jaakkola, 2020; Lipkin, 2016). Thus, based on the identified service characteristics, we propose the concept of a CX as an overarching meta-characteristic for the design of smart service. Such an experience can be shaped by the totality of all value-adding services related to a customer's retail activities. These services are realized through multiple touchpoints and stimuli that a retail customer comes into touch within a continuous process of value creation in physical retail environments (Becker & Jaakkola, 2020).

In addition, the archetypes show that many services in physical retail provide bundled offerings that support different customer activities, such as shopping and parking or buying online and picking products up at a store. Given that CX emerges from the sum of its determinants (Verhoef et al., 2009), we suggest that integrating services to link customer activities and address multiple determinants (e.g., product assortment and accessibility in the examples above) can enhance the holistic experience. In retail, this is already done to a large extent, as 86% of the analyzed services in our dataset address more than one CX determinant in combination. However, these are mostly distinct service bundles provided by single providers (such as the examples named above), rather than integrated services that cover the entire customer journey, e.g., combining shopping services with public transport or leisure offerings. Thus, we argue that the multitude of actors in physical retail environments should collaborate on integrating services to exploit the innovation potential and improve the CX.

This paper provides three central scientific contributions to expand the body of knowledge in the field of smart services in the retail context. First, in responding to RQ 1, we provide a conceptual model in the form of a taxonomy for smart services. We thereby deepen our understanding of which design elements are considered relevant in research on physical retail environments. Second, we consider smart retailing as a concept that results from the application of smart services in these contexts. Thus, through a comprehensive overview of smart service attributes, this paper contributes to the knowledge of the term smart retailing and its scope of action to create value for customers. Third, in response to RQ 2, the archetypes show that real-world smart services in city retail are characterized as bundled services that combine different topics, such as plan & prepare or pay & ride. As such, we identify service integration as a promising means to create and improve CX (e.g., by linking single experiences to each other and combining activities throughout the whole customer journey). In this context, we propose to apply the idea of a holistic CX to service design in smart retailing scenarios. This concept may serve as an orientation for researchers, for example, in supporting the development of suitable methods for smart service design. In this regard, we provide a basis for research to further theorize how services can be integrated for the purpose of such a holistic experience in retail.

Furthermore, the publication offers valuable insights for practice, especially for service design in smart retailing settings. The taxonomy and archetypes represent tools for describing and categorizing smart services and, thus, serve the description goal. They illustrate the modesty of current smart services and demonstrate important avenues for retailers and service providers to assess current and enhance future services. Practitioners can use our taxonomy and archetypes as an orientation on which service characteristics are relevant in physical retail and use these insights to analyze current and design new services. For example, the artifacts can be used to identify currently underrepresented service characteristics and develop competitive advantages, for instance, by enhancing CX through individualized offerings, social value, and technological autonomy. Moreover, the identified service characteristics and archetypes can serve as an inspiration for ideation processes to design services from a CX perspective. Furthermore, practitioners may take inspiration from our archetypes for how bundled services can be designed and used to create a holistic CX.

Aside from the scientific and practical implications of the results, the research is not free of limitations. It should be noted that the taxonomy was developed mainly from the literature and is, therefore, highly conceptual. To compensate for this limitation, the taxonomy was evaluated based on expert interviews and against 163 globally distributed smart services in physical retail contexts in a multi-stage research process. Furthermore, since conceptually grounded insights at the interface of smart services and retail are relatively scarce, the CX concept is taken from research on traditional retail and proposed to be transferred to our research on smart retailing. Furthermore, as the spatial scope of smart retailing has not yet been widely explored in research, we conclude from the application and evaluation of our taxonomy that the physical retail environment includes surroundings beyond single stores, or even malls or streets, and can diffuse into further areas of a city that are relevant for the shopping experience. Research is needed to find evidence to support the conceptualization of smart retailing from this perspective, as well as holistic CX and its creation in the physical retail context.

Conclusion and outlook

In this paper, we provided an integrative perspective on smart services and retail. Smart services represent a bridge between the physical and digital environments in retail and can enhance customer value, and thus stabilizing the competitive situation of stationary retailers. As extant literature in the field of smart services is mostly lacking to deepen understanding of relevant service design elements in the specific context of physical retail, we proposed a taxonomy that can support practitioners in the design of services to attract customers. In this context, we proposed service designers focus on service integration to create a holistic CX. Our taxonomy consists of three subclasses: CX, physical environment, and smart products. In total, the taxonomy includes 14 dimensions and 42 characteristics relevant to the description of smart services. With seven dimensions associated with the CX perspective, CX can be considered a major topic of interest when designing smart services. The application of the developed taxonomy to 163 smart services from the physical retail context revealed that most of the analyzed services were directly integrated into the customers' physical activities throughout the shopping journey, often addressing activities taking place in physical surroundings within a city beyond single stores. The application of services also resulted in six archetypes of smart services (i.e., check & go, pay & ride, plan & prepare, scan & inform, locate & navigate, and save & reward) that resemble typical smart service configurations.

Based on the presented classifications, we deepen understanding of the concept of smart retailing and suggest that smart services contribute to a holistic CX in physical retail. With this proposal, we provide a basis for further research to theorize how different design decisions of smart services impact such a holistic CX. Therefore, suitable conceptualizations of smart retailing and a holistic CX in retail should be developed. For this purpose, research needs to empirically examine which factors drive CX from the perspective of the consumers themselves in terms of their cognitive, emotional, and physical reactions and how these factors are interrelated. Thereupon, the research could provide approaches (e.g., service design methods) to support customer-oriented service design. From a technical perspective, researchers could present requirements and solutions for the integration of services (e.g., integrative smart service platforms) to support addressing customers' needs throughout the entire customer journey in physical retail environments. Addressing the proposed research avenues will support researchers and practitioners to enhance knowledge of smart services and improve their design toward creating a holistic CX in physical retail surroundings.

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