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Tackling the Design of Platform-Based Service Systems, Integrating Data and Cultures: The Case of Urban Markets

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Abstract: Different design traditions address the design of services. When adopted alone, they can limit design, especially if services systems are complex. Some combinations among service design traditions are theorized in the literature and a cultural synthesis is considered a priority. This paper discusses a practical application of that synthesis: systematic/data-driven methods from engineering and service innovation are applied within a participatory and transformative environment. Intangible versus material and functional versus experience service elements are considered. The case study on urban markets shows that economics and the transactional/functional mechanics of a service system must be understood for proper design actions, and that overcoming separations between strands of literature is necessary to achieve this aim. Moreover, since urban markets are two-sided platforms in a physical setting, the study allows easier investigation than in modern digital platforms regarding how platform economics affect the design of a service system, providing insights for digital services as well. Originality is due to generally scant contributions on urban market design, since markets are often regulated, rather than designed, beyond the rare practical attempts of cultural synthesis.

Keywords: service system platforms; data-enabled design; urban markets

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1. Introduction

Today, service systems are mainly enabled by ICT platforms, whether physical or internet-based. These ICT platforms, on the one hand, activate peculiar transactional and functional mechanisms, the awareness of which is relevant in the design of service systems; on the other hand, they embody a way to collect data that is useful in designing the service system as well. The matter of discussion regards the integration of those elements of knowledge from the different disciplines of designing a service, so that service systems (even more regarding platforms) can be properly designed.

The design of service systems has usually been approached from disjointed cultural schools of thought that have created quite separate strands in the literature [1]. Such distinction among disciplines ensures methodological coherence, since it refers to homogeneous cultural domains [1,2], but may somewhat limit the comprehension of the service system itself (especially when complex) and the design action.

Integration between the different cultural traditions in any of its forms (namely, 'Multi'-'Inter'-'Trans'-disciplinary research) has long been considered a research priority [3]. Nevertheless, even attempts to find whether a conceptual synthesis among cultural traditions exists (e.g., [4,5]), applications in practice are scant [6].

This paper addresses this challenge: the described case study proves that formal, systematic, data-driven methods with their roots in Engineering and Service Innovation culture can be practically adopted in constructivist and participatory Service Design settings. In this sense, this paper also proposes a model for the design of service systems that

merges different cultural domains (e.g., Urban Planning, Economics, Service Design), oriented towards multi-stakeholder contexts, adopting both systematic and process/experience-oriented tools within each phase. In particular, data-driven and systematic tools become means by which communication and participation in design becomes immediate.

What is proposed here is aligned with the approaches by [7,8], from Service Design, and by [9], that used, from a Service Innovation perspective, empirical data to aid the design of service systems. The generated evidence is coherent with the antecedents of experience, as in [10], and is consistent with [11] in considering public service peculiarities to which to adapt the Service Dominant logic.

The proposed matching of different design traditions and cultural domains instead is original in view of the scant other attempts in the literature (as stated in [6]), both methodologically [12] and because of the peculiarity of the case study (see Section 2). This paper shows that, without merging perspectives, some design requirements would not be equally determined.

What is proposed here is also aligned to the systematic processes of concept generation of Product Services System design, especially in view of solving interferences among tangible and intangible components (e.g., [13]), even if the case described in the paper does not strictly belong to the typical classification of PSS. In fact, following traditional classifications [13–17], the retail case described here involves material products, even if these are not to support delivery, are not followed by additional services, are fully transferred to customers (both in their ownership and functions), and their physical component cannot be replaced by intangible one. Instead, the case study can be classified as a *complex service system* for the nature and the architecture of the system, according to the classification proposed by [18].

Incidentally, therefore, an urban open-air market (or "markets" hereafter) system in a citywide setting embodies a rather unique design case with respect to other services studied in the literature, for various reasons.

First, markets are a widespread retailing channel that fulfill multiple functions in a city; they have a significant economic value and a strong socio-cultural role. From the last report in Europe, markets employ approximately 1.5 million people. Italy has an especially high number of open-air markets, which involve approximately 160,000 firms, with an employment of 350,000 people and a total turnover of 26 billion Euros [19]. In view of that, a European plan on urban food systems is scheduled for completion in 2030 [20].
Although not being a product service system, urban market design includes the four elements cited by [21] because of its nature as a complex service system [17]. At the local level, an urban market embodies a multi-agent service system that behaves as a (physical) platform. This two-sided nature in a physical setting allows for easier investigation (without the elements of complexity of internet-based platforms) of how platform economics, such as agglomeration phenomena or externalities, affect design. Additionally, such a two-sided nature implies that these design issues are driven by the needs and the experiences of both sides of the service system. At the city level, instead, the urban market network represents an intriguing case of a multi-interface service system in which specific issues (e.g., service coverage, overlaps in offering, competition, etc.) make the study of interaction between the interfaces particularly interesting. Finally, contributions to urban market design are scant in the literature [22], and markets have often been thought of as something to be regulated [23], instead of being designed as a 'service system'.

The objective of this study is determined through the specific objectives described in Figure 1.

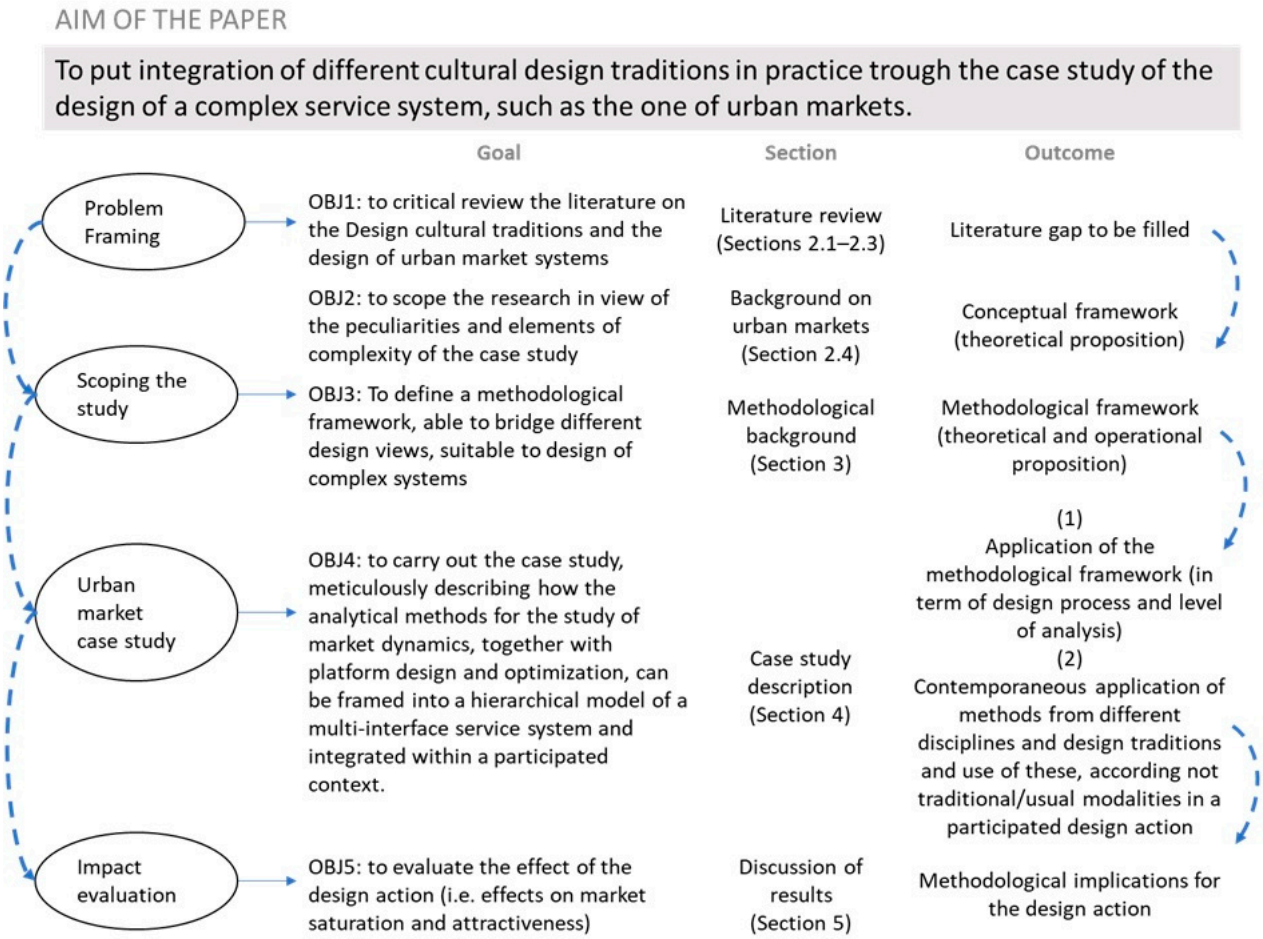


Figure 1. How the research aim is pursued through the paper.

The following investigates the relevant literature, guides the reader through the methodological description of the overall approach, and then proceeds with the case study description. Finally, implications for designers are drawn and further research directions are discussed.

2. Literature Review and Background

2.1. The Different Cultural Traditions That Approach the Design of Services

The design of services can be approached from four different perspectives that vary because of their different notions of 'service', and because they are rooted in different schools of design [1,2]. Two traditions characterize the design of services. One, which arises from Engineering, mainly considers 'design' as *problem solving*; the other, from Architecture and the Arts, tends to conceive 'design' as an *exploratory investigation* process. Moreover, and independent of those cultural traditions, the two possible perspectives are traditionally adopted when looking at a service as the 'object of the design activity'. The former tackles the design activity, considering the service as a *category of artifact*; it therefore looks at the service components and the service architecture. The latter instead focuses on the *activities* and *processes* involved, sometimes also tackling the *temporal nature* of them.

Drawing from the demarcations stated in [1], these cultural differences can be framed, as shown in Figure 2.

		Service as a category of artefact	**Service as a locus of exchange**
Engineering	**Design as problem solving** (often system perspective is adopted)	(1) Service Development (NSD) and Service Innovation	(2) Service Dominant Logic (SDL)
Arts and Architecture	**Design as enquiry** (often the temporal nature of design activities is considered)	(3) Design Thinking and Co-Design	(4) Design for Service Trasformative Design

Figure 2. A possible framework, inspired by [1].

Therefore, in Engineering, design is specified in advanced problem-solving processes, which use systematic procedures and rigorous methods. This view branches into two. If the service system is considered a category of an artifact–being similar to a product, albeit an intangible one–one can refer to *New Service Development* (NSD) and *Service Innovation* (e.g., [23,24]). Conversely, if the service system is thought of not only as an intangible output, but as a process in which resources, experience, and knowledge are exchanged (e.g., [25,26]), the *Service Dominant Logic* (SDL, [27–31]) prevails. In these two streams of research, while some contributions have addressed the design of customer-oriented design processes from a methodological point of view (e.g., [4,32–36]), others have covered specific features, such as operational and administrative [35–37], technological (e.g., [35,38]), architectural [39], and social issues (i.e., regarding the human interactions inside the service, [40–44]). Again, although focused on experience (e.g., [45–49]), design choices were aided by systematic methods (e.g., [50,51]).

Instead, according to the traditional interpretation as outlined in Architecture and the Arts, design must be conceived as an exploratory investigation process. This tradition maintains the dualism in considering service systems either as an outcome or as a process. In the case of the former, *Design Thinking* and *Co-Design* are well-known methodological references and both can be indifferently applied to products or services (e.g., [52]). In the latter case, *Service Design* is seen as a "platform for action" by which a variety of actors are continuously engaged over time. A specific 'temporal' meaning is attributed to services, which are viewed as continuously evolving contexts. This choice characterizes the '*Design for Service*' literature [53–55] and, in public services, the *Transformative Design* approaches [56,57].

Recently, some contributions attempted to blend both the two engineering and architecture/arts traditions [4,5]. This paper aligns with these contributions, being persuaded that the typical methodological rigor of engineering does not hinder the freedom of designers to explore the complexity that is inherent to a service 'as a process', and to attain intensive involvement by the actors. The core of this synthesis lies in a human-centered focus, which is generally common to all of the above approaches, and in considering the integration of methods/tools from different domains possible [3].

2.2. Service Design and Platform Design Applied to Services

Among the systematic methods used to design service systems, *Modularity and Design Platforms* are an option. Their use has attracted increasing interest over the last 10 years (e.g., [58,59]), and from the fields of Service Operation, Marketing, and Management. These are usually adopted for managing the conception of more variants from the same system architecture, and for managing the trade-off between flexibility and differentiation costs (e.g., [60]).

Platform design has been applied to a variety of service sectors, such as healthcare (e.g., [61]), logistics (e.g., [62]), finance (e.g., [63]), and IT (e.g., [64]); while it has rarely been applied to public services, though excluding healthcare.

The limited application to the public sector likely depends on the fact that public services have traditionally been studied either without considering the design viewpoint (for instance, markets have just been studied considering urban planning criteria) or because they are designed through approaches that naturally do not consider platform methods as suitable, since they are usually adopted for non-participatory design decisions.

However, when modularization influences customer evaluations and service complexity is significant, modularization and platform design methods from Engineering Design have been suggested as the most appropriate (e.g., [65,66]). Today, digital service systems have made them a key design pilot [67], and they are usually adopted to provide personalization/customization.

Moreover, the specific goal of this paper distinguishes the use of platform design from other contributions in the literature. Platform methods and modularization are usually applied to services, but with the aim of operational optimization (e.g., [68–70]), or for designing service extensions and changes over time (e.g., [66,71]). In these cases, design implies the inclusion/exclusion of service modules to improve performance, or to reduce costs with respect to previous versions. Instead, in this study, design entails understanding which parts represent the essence of the service being offered and its value constellation, which instead can be devoted to generating differentiated experiences. Moreover, the aim of this paper is to use these methods to primarily maximize customer utility, and not to maximize the market share or profit of a specific economic player, as in other contributions (e.g., [72–74]).

2.3. Urban Markets and Their Design

Urban markets represent a worldwide, widespread retail service system. Sometimes they, although maintaining in a minimal part their commercial connotation, take also a touristic meaning (Boqueria at Barcelona, Portobello Road or Govent Garden at London). This embodies the cultural and social role that always has been recognized to markets [36]. The analysis of this role is beyond the objectives of this study; markets maintaining the original retail purpose are here considered.

Urban markets differ worldwide: in the USA, they are mainly 'farmer markets', while in Europe and Asia, markets take place in closed settings and/or with fixed stalls. In Italy, they are always located in an urban context and in the open air with movable stalls. They provide different categories of goods; most operators are pure retailers that source from general distribution hubs, while a minority are farmers.

Despite these differences, worldwide urban markets that open every day or on a given weekday have been traditionally considered trade areas, where customers find basic, cheaper goods and often excellent foodstuffs, and with careful assistance in purchasing. Therefore, people are able to find everything they need within walking distance from their home, to meet neighbors, and to establish trusting relationships with the retailers that regularly operate there.

Urban market economic and social relevance is evident [75], but nothing is available in the literature regarding their design as a 'service system'. Both the nature of urban markets (e.g., [76]) and the methodologies for their design and planning [22] are understudied. When investigated, markets have been studied in sociological or economic terms [23], considered as part of the urban commercial system [77], or as objects of regulation (e.g., [78]), and spatio-temporal planning is the most investigated issue (e.g., [79]) even if they are considered as an opportunity for social innovation (e.g., [80]) or economic development (e.g., [81]).

Retail Management has neglected this commercial channel [82]. Intra-channel or inter-channel competition issues have been mainly studied in regard to large trade formats

(e.g., [83]), and marketing strategies specific to this channel are seldom explored ([84]). Service Design has mostly neglected markets as well, although they embody a public service and the literature on public services is fairly rich [53].

The application of design approaches (and, specifically, an integration of these) instead would provide value to the urban market system. Markets, in fact, have particular elements of complexity (discussed hereafter in Section 2.4) that call for formal, systematic, data-driven methods, even if they are practically adoptable in constructivist and highly participatory settings.

2.4. Complexity of Urban Market Services and (Two-Sided) Platform Dynamics

Designing an urban market network means facing specific elements of complexity:

1. Urban markets are distributed over an urban area. This requires a study of the service system at two levels: the single market itself as a retail platform and the entire network of markets in the city, where each market embodies one interface within a multi-interface service system. Consequently, hierarchical modeling of the service and the study of the system architecture are critical. For the former issue, even in retail contexts where interaction and organizational issues still remain central, SDL can be helpful [50]; for the latter, System Engineering can provide a valuable aid. These approaches clearly belong to cells 1–2 in Figure 2.
2. Urban markets embody a two-sided platform, for which two distinct groups (i.e., retailers and consumers) provide each other with utility and externalities as a result of participating in the platform. There is ample literature on two-sided platforms (e.g., [85,86]), which however are mainly concerned with ICT services (e.g., Uber, Airbnb, or Amazon). Platforms nowadays have become extremely relevant because of their economic value and since their tendency to follow a winner-take-all strategy, which ultimately leads to monopoly. This usually occurs when network externalities are strong, the costs of participating to multiple platforms are high and differentiation between platforms is low [86].

   Urban markets are iconic, since they are a physical platform with strong network externalities, low costs of participating to multiple platforms and specific differentiation mechanisms). This nature of this economic platform requires studying those variables that govern the system dynamics and which affect the service value, as SDL suggests ([27–30], located in cell 1 in Figure 2). A single focus by designers on experiential and intangible service dimensions, neglecting the economics of the system, would lead to misleading design actions.

Particularly, designers must consider that two-sided platforms are driven by agglomeration phenomena; same- and cross-side externalities [85]. A larger market (a higher number of stalls) will attract a larger number of consumers and this will attract, in turn, more retailers. Conversely, if supply is poor, consumer traffic will be low and this will turn retailers away. Therefore, each market (i.e., a single service interface) is only definitively effective if it attracts not only customers (as usual), but also retailers.

Therefore, designers have to investigate the needs and motivations of both sides of the service system, since both must be considered as users. They both (not only customers) are independent economic actors, not passive agents of the service system, leading to particularly relevant consequences:

- Urban markets, different from other ICT-platforms for retail, propose a purchasing experience in which consumers physically visit the retail outlet, without a multichannel configuration. In this sense, they differ from other cases in the literature (e.g., [87]) and instead face different issues: a sufficiently large city, in fact, will host a network of markets; this distribution of markets in the urban territory ensures service coverage to customers, but provokes intra-channel competition within the single market and among markets in the city, as well as inter-channel competition with shops and supermarkets.

- In some countries, such as Italy, the choice of where to operate in a market is left free on a daily basis to retailers, who may consider it more or less convenient to sell in a specific area. This autonomous choice determines the daily market assortment, and presents a different chance for each market to face competition.

If the choice of retailers is autonomous, designers can only make a proposal of market design. This proposal must consider competition and differentiation, looking at the urban territory, but must also be explained to retailers engaged in each single platform, in order to make it a shared project and guide behaviors towards a common benefit. Service innovation and Platform methods (Figure 2, cell 1), which are demonstrated valuables in several contexts [88], can be adopted to manage differentiation requirements, while participatory approaches (Figure 2, cells 3) can be adopted to capture motivational aspects.

3. Market areas are public, and municipalities aim to ensure service coverage in the urban territory, avoiding underserved districts or boroughs, both in terms of the presence of markets and for assortment completeness. Municipalities exert their administrative power to provide the physical platform within which markets operate (i.e., the market area) and commercial licenses, which grant market retailers with the right to sell a given commodity in a public market area (depending on the local regulations, the right to occupy a specific stall place in a given market and on a given day). However, retailers can give up their rights on the basis of personal considerations (e.g., in some cases depending on the day, and due to weather). Therefore, the license mechanism often results in being unable to plan and confirm regular service coverage in each market area within a city.

Optimization methods could be used for planning optimized coverage (Figure 2, cell 1), but an urban market service system is a multi-stakeholder negotiation environment. Therefore, participatory approaches are mandatory for capturing those aspects of a service configuration that evolve in engaging a variety of actors over time, whose interests are sometimes conflicting. In this case, designers cannot neglect the use of transformative approaches (e.g., [57]; Figure 2, cell 4).

4. Finally, the attractiveness of a market depends on its value proposition that attracts consumer traffic inside the market. This depends on assortments (which, as previously mentioned, is definitively defined by the number of stalls selling each commodity), on its quality, on expectations, and emotional aspects, or on the social relations that each market fosters among its participants. These elements are again dependent on the behavior of individual retailers that decide what they will offer, and are also influenced by the same-side effects typical of economic platforms. Each retailer in a market, for instance, also has to cope with the opportunistic behaviors of unpleasant colleagues (e.g., not complying with opening hours, neglecting stall appearance of the goods on display, etc.), which damage the attractiveness of the market.

Designers must consider such side effects as an urban market, in a similar way to other market-based platforms, is perceived by customers as a whole [89]. Again, the only possibility designers have is to engage retailers in the project and guide their behaviors toward a common goal and mutual benefits.

Figure 3 depicts how all of these complex elements make the adoption of a single design perspective insufficient, while only the integration of design tradition can be really valuable.

	Market as a system	Market as a locus of social exchange
Design as problem solving	(1) All the stakeholders (customers, retailers, municipality, etc.) are analysed in their interaction within the two-sided market. Service processes are considered according to their transactional and functional nature and with respect to management issues (e.g. differentiation, competition, operations, etc.).	(2) All the stakeholders (customers, retailers, municipality, etc.) are analysed in their multiple interactions. Service processes are considered by looking at social and organizational issues, focusing on the exchange of experience and knowledge.
Design as enquiry	(3) All the stakeholders (customers, retailers, municipality, etc.) are involved in a partecipated design action Service processes are investigated to identify stakeholders' needs, emotional and motivational aspects in negotiated contexts.	(4) All the stakeholders (customers, retailers, municipality, etc.) are involved in a participated process of transformation, which progressively evolves according to shared political actions and decisions. The design process never ends.

Figure 3. The balkanization of approaches in the case of markets.

3. Aiming at an Integrated View of the Design of Service Systems

3.1. Emergent Issues

The previous section outlines the risks and limitations of 'reducing' design to consider different conceptions of service and to one singular cultural tradition. Complex cases, such as urban markets, show it is necessary to bridge different design views and to blend systematic methods with participatory approaches.

Single-design cultural traditions might be limiting when a service contemporaneously calls for:

- An analytical study of the variables that govern service economics (Figure 3, cell 1);
- A rigorous study of the system architecture and processes, especially in view of interactions and experiences (Figure 3, cell 2);
- A participatory approach to cope with the multi-stakeholder/public nature (Figure 3, cells 3–4).

The next sections describe how the analytical methods for the study of market dynamics, together with platform design and optimization (Figure 2, cell 1), can be framed into a hierarchical model of a multi-interface service system (Figure 2, cell 2), integrated within a participated context (Figure 2, cell 3)[Error! Reference source not found.]. While types of integration (2 + 3, or 2 + 4) are already present in the literature of the design of services (e.g., [5]), such a typology (1 + 2 + 3, 1 + 2 + 4) has not yet been attempted in the literature.

Conversely, without mixing these perspectives, the service design problem would not equally consider the requirements in Table 1. In Section 4, the results clearly show how all of the requirements that further emerge can be merged to complement the service system.

Table 1. Requirements derived from the economics of the service system.

Requirements from the System's Economics	**Requirements from Stakeholders**		
	Municipality	**Retailers**	**Customers**
(to investigate): service system from a hierarchical perspective	(constraint): multi-stakeholder, negotiating environment, subject to political tensions		
(to investigate): agglomeration phenomena, same-side and cross-side externalities, typical of two-sided platforms (constraint): attractiveness of each market depends on assortment decided by independent economic actors, but it had an impact on the customers' interest	(to ensure): service coverage and assortment completeness (constraint): the adopted license mechanism	(constraint): retailers are independent economic actors and not passive agents of the public service	(constraint): customer experience, in a similar way to shopping malls, is affected by agglomeration (poorer vs. richer configurations)

(to ensure): service coverage in an intra-channel and extra-channel competition environment	
(to ensure): physical purchasing experience, without a multi-channel configuration	

3.2. The Methodological Proposal and Its Founding Roots

In terms of the systematicity and methodological rigor of the study, a service design problem of such complexity can be approached using two well-known perspectives: the SDL [50] and the Engineering Design traditions [90].

The SDL can be used for the definition of design tasks, focusing on the hierarchical modeling of the service system from the overall service concept and its entire value constellation up to the design of the service encounter. These three levels of design, as shown in Figure 4, are conceptually connected with the hierarchical levels of the service system itself. In the case study, the value constellation embraces the entire urban service offering provided through the multiple interfaces (i.e., the markets). The service architecture represents the entire set of service components of the value constellation, and, if one adopts the platform design methods, it implies designing both the platform and the single modules. Finally, each of the multiple interfaces is implemented through a specific service encounter.

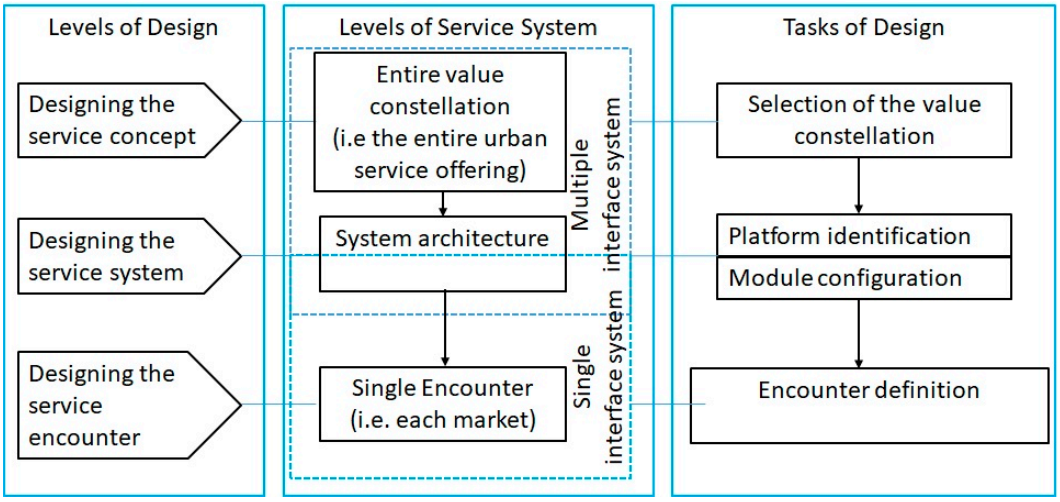


Figure 4. Levels of designed vs. levels of service system.

SDL focuses on the value generated for/by the actors engaged in the service through an interdependent and reciprocally beneficial exchange [28,30]; therefore, SDL has always conceptualized co-creation [30,91], even if only recently, and it has also focused on the role of institutions [92]. However, an appropriate integration with participative approaches finds scarce practical applications, especially for public services [12]. In this paper, the authors cope with this challenge through the followed design process and the adopted methods, making the adoption of a participatory perspective even more explicitly evident. The combination of participatory approaches occurs at all of the following three levels:

1. At the *encounter level*: here, economic, transactional, and functional aspects are not only studied to perform an effective design action, but also to activate the participatory process. User needs and encounter processes in the service system can be investigated through more traditional (focus groups and questionnaires, customer journeys, etc.) or novel (field data analysis, if using digital platforms) methods; however, the functioning mechanisms and underlying economics must be thoroughly

analyzed through systematic and empirical approaches, to then be shared to stakeholders, to increase awareness, and to build a common vision regarding the design problem.

2. At the *system architecture level*: a platform-based approach is suggested for the design of the architecture to find a balance between flexibility and differentiation. This might be even more useful for designing digital services, where personalization/customization are key drivers. However, these methods are not in contrast to the aim of adopting participatory approaches. Given the simplicity of the concept of modularity, they can be used to structure the enquired data and to discuss the alternatives with stakeholders [93], formulating a "platform for action" by which to enact the co-design processes [94].
3. At the *value constellation level*: the different value constellation alternatives can be generated from the combination of modules, to be put either inside or outside of the previously defined platform. Generally, the main design issue for multi-interface systems is caused by the coherence and coordination among the service interfaces [48]. In this case, the coordination of the service alternatives is particularly relevant to address differentiation, and the platform-based design ensures coherence. At the level of the service system, again, the use of platform methods helps in the formulation of design choices and the negotiation/sharing processes with stakeholders.

The second reference [90] instead structures the entire design process according to a usual Engineering Design approach. Despite the marked consistency from a problem-solving perspective [1], this model has not been found to be in contrast to Service Design perspectives. In fact, this model does not limit the possibility of considering a process as the subject of a design activity, nor does it neglect the experience associated with the service. Finally, it does not imply any detachment between the designer and the design object; hence, it can easily be applied in participatory co-design or multi-stakeholder contexts.

The overall process results are depicted in Figure 5, and they are divided into four phases (i.e., Problem Setting, Need Identification and Requirement analysis, Concept Design, and Detailed Design). They are articulated as per the three abovementioned levels of the service system.

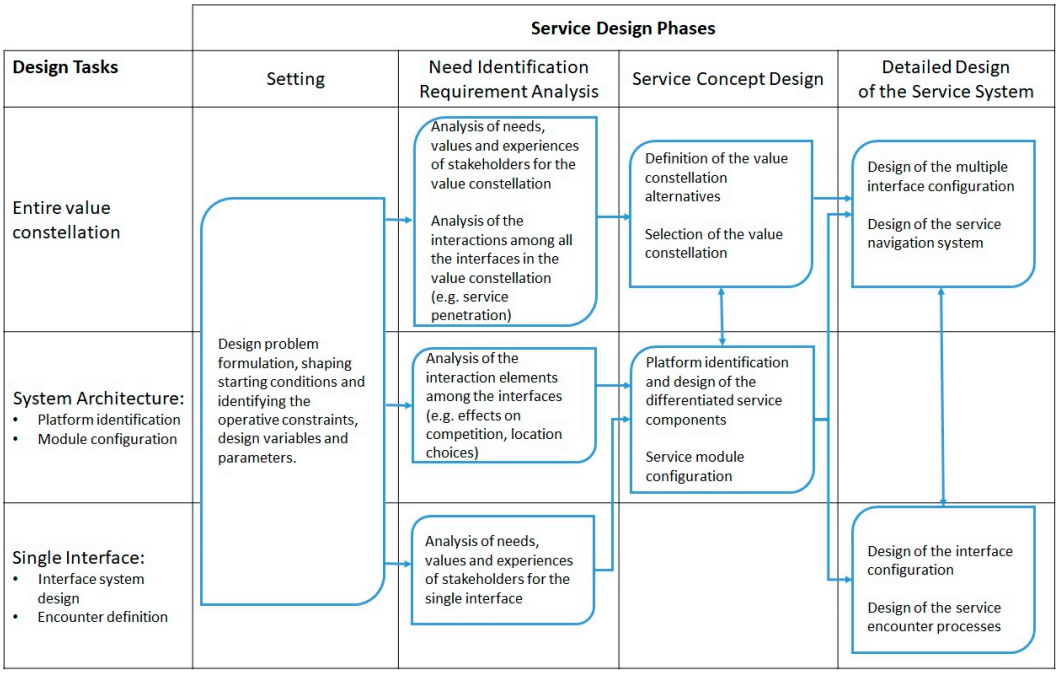


Figure 5. The integrated design process for a multi-level service system.

The merging of the different approaches to design occurs again in this setting: the design phases, which are usually conceived for a traditional problem-solving approach, become a guideline by which to move between the different levels of the service system. Within each phase, single and multiple interfaces are designed, considering the service process, the experience gained during the process, and the multi-actor and participatory environments.

The proposed matching of different design traditions and cultural domains has not yet been attempted in the literature, and, as will be illustrated, it enables a comprehensive identification of the service requirements that would not be equally determined. The next section describes the methodological approach adopted through the illustration of a case study. As previously illustrated, the reasons as to why the design of the market service system embodies a unique design make them appropriate for the illustration of such an approach. The issues of validation and generality for the application and the shift from the specific case in hand to other service cases will be illustrated in the results section.

For reasons of brevity and for clarity of presentation, the collected data, analyses, and further methodological insights are provided in the Annexes.

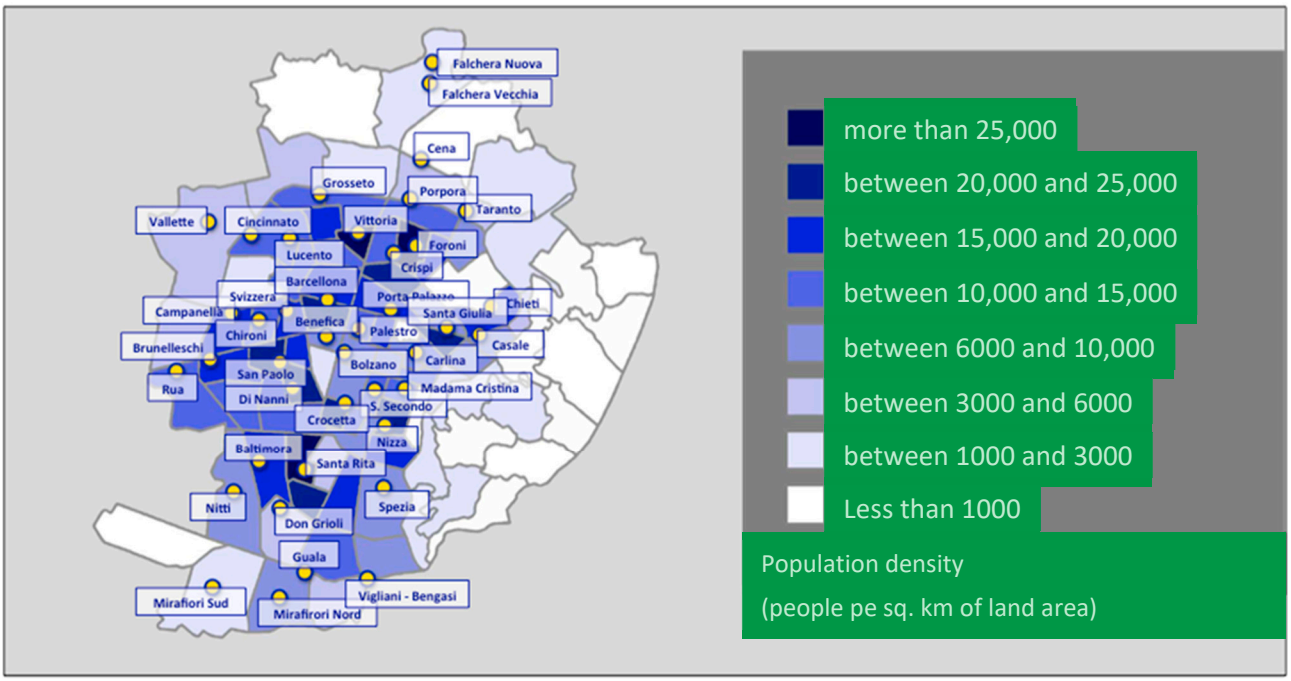
4. The Case Study

4.1. The Market Service System in Turin

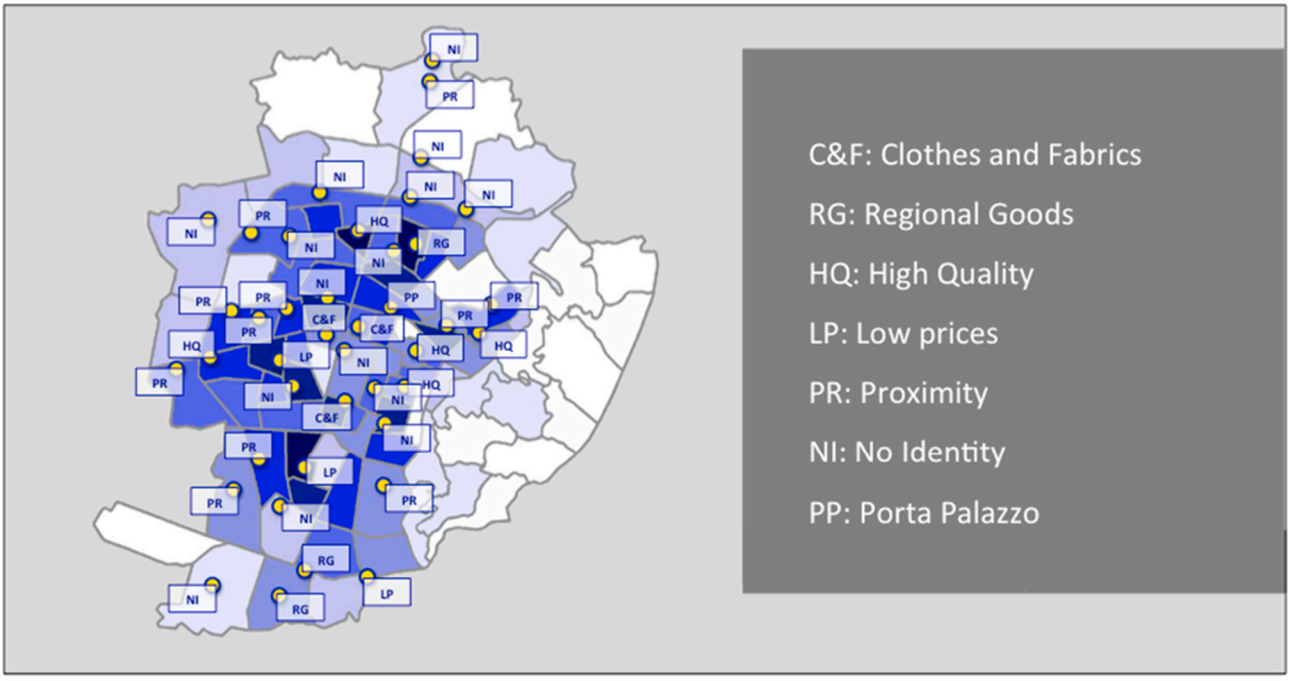
Turin is an important business and cultural center in northern Italy.; the metropolitan area has a population of approximately 2.2 million. Today, it is a lively commercial city with 28,000 stores, 203 supermarkets, and 7 shopping malls and 42 open-air markets spread throughout its districts. It is an interesting case study since, together with Barcelona and Warsaw, it is one of the European cities with the highest number of urban markets. Porta Palazzo, which is close to the city center, is also the largest urban open-air market in Europe [95].

In Turin, markets mainly offer four product categories: fruit and vegetables, other groceries, clothing and fabrics, and a minimal variety of other goods (e.g., detergents, etc.). These categories are not equally relevant for the general assortment of a given market, as some of them decide the market's commercial value proposition. In most cases, fruit and vegetables are the main 'anchor category', even if some markets attract traffic through an attractive assortment of other products (e.g., clothing and fabrics).

Figure 6 shows the configuration of the 42 open-air markets within the city. Figure 6a shows their distribution with respect to population density, while Figure 6b describes the 'de facto' offering at the time of the project, according to three marketing variables: assortment (generalist vs. specialized on specific commodities), price/quality (high price and quality vs. low price and quality), and geographic location (proximity vs. long range). For instance, "proximity markets" provide a generalist offering for closer customers, while "clothes and fabrics markets" provide a specialist offering able to attract customers from the entire urban area. "No vocation (no specific value proposition)" markets do not have a specific characterization able to attract customer traffic inside, thus causing the Municipality to doubt their necessity.



(**a**)



(**b**)

Figure 6. (**a**) The territorial distribution and (**b**) the competitive view of urban markets within Turin.

In Turin, the licensing procedure is one of the most complex. Retailers have the freedom to choose between two administrative procedures: a license specifying a regular schedule of attendances in predefined markets, or a license with the freedom to make decisions on a daily basis according to personal preferences. In this latter case, license holders can go to any area they prefer, but their admission depends on the precedence they have achieved through historical rankings. Highly ranked retailers are more likely to be admitted to any market, but they obviously tend to go to the most visited markets. The coverage depicted in Figure 6b is the outcome of such a policy, emerging from spontaneous location decisions of each retailer and not as an outcome of planning actions. The

municipality is far from being able to plan/ensure regular service coverage in the city and in each market area.

Competition among stores, markets, and supermarkets is embittered by a ring of shopping malls in the surrounding area and by new formats of food retail that have originated in Turin (e.g., the high-end food store, Eataly). Finally, political tensions between the municipality and incumbent retailers are also fueled by progressive (still not completed) applications of EU regulations (e.g., the Bolkenstein's 2006/123/CE directive). Between 2012 and 2013, these tensions even erupted in a few rallies and riots.

In view of such a complex situation, the municipality over time became aware of the necessity for a structured design approach, beyond the traditional urban planning criteria, to rethink the entire market service system and to redefine the role of markets for the city. A similar choice was made in other European cities (e.g., London, [96]).

4.2. The Design Process to Reach the Design of the Entire Value Constellation

In the case study, the setting phase of the design process in Figure 5 consisted of the study of the current situation (S1, in Figure 11 at the end), and in identifying the economic and structural variables that were shaping the markets' functioning and attractiveness (S2).

An empirical analysis of the daily market saturation and the commodity percentages from the local police authorities was conducted. At the level of the single market system, data were used to investigate saturation, but to also check whether urban markets were truly size-sensitive as other two-sided platforms. Then, at the level of the urban service system, these data were used to understand how commodities were distributed. The results showed that:

- A total of 26 markets out of 42 had significant problems in service delivery (16 markets had a saturation <50% of the total allocated space, and 10 markets achieved less than 30%);
- The market size effectively represented a structural variable dominating attractiveness: the larger markets attracted more customers than the smaller ones, and vice versa, confirming their two-sided nature (Figures A1 and A2 in Appendix A);
- The markets' offerings were quite haphazardly distributed throughout the city, often with adjacent markets sharing the same offering (e.g., markets with "clothes and fabric" were concentrated in the city center, see Figure 6b).

This empirical evidence was quite valuable to both the municipality and the retailers. In particular, the municipality became aware that:

- Market size was due to the allocation mechanism that influenced the retailers' location choices. The principle of giving retailers freedom to choose where to locate themselves led them to move to where they perceived they would gain more. As an outcome, the municipality's service coverage goal was not being achieved;
- Customer experience was affected by poorer vs. richer configurations. Again, the Municipality's objective of ensuring a good service experience in each of the city's markets was not met;
- More interventionistic approaches to allocate retailers to markets with the aim of improving market coverage would have implied a complex effect on market size and, as a consequence, on attractiveness.

This awareness led to the municipality to give up on the idea of forcing retailers to locate in pre-defined places and to take a more participated approach; i.e., involving the retailers in the design action and making them more aware of the consequences of their choices. Meetings to present and explain the empirical evidence to retailers and representatives of the Trade Unions (FIVA, ASCOM, Coldiretti, etc.; details in Appendix D) were arranged and retailers could realize the following:

- Despite the freedom they had to locate anywhere they wanted, the interdependence of their behaviors was affecting the dynamics of the system. The allocative

mechanism that seemed to give them freedom was actually generating distorted dynamics that damaged the entire market service;

- An unevenly distributed service in the urban territory was generating both an inadequate service coverage for customers (thus weakening markets with respect to interchannel competition from supermarkets and shopping centers) and distorted intrachannel competition on the supply side.

The empirically marked evidence of the two-sided market mechanism called for need identification and requirement analysis for both sides of the platform: customers and retailers. Focus was first trained on the purchasing behaviors, needs, and retail experiences of the customers (R1 in Figure 11), and then on the location choices, positive/negative externalities, and competition effects for the retailers (R2). Successively, the analysis examined the overlaps in market offerings, service penetration (R3), and the economic fundamentals of the retailers' operations, including the incentives and costs associated with being located in different areas at different times (R4). R3 and R4 are not discussed here for brevity.

From the perspective of customers (R1), the design team organized 15 focus groups and administered a questionnaire. A total of 151 people attended the brainstorming sessions; while questionnaire data were collected from a sample of 1315 customers. Appendix B describes the selection criteria for participants, the post-processing actions for the focus groups, the questionnaire structure, and the sampling procedure.

From focus groups, mental maps (see Figure A3 in Appendix B) showed the main positive elements associated with customers' 'conception of market': they were Safety, Trust, Encounter, Amusement, Tradition, and Convenience. These elements were confirmed to be associated with expectations and emotional aspects, such as cheerfulness (due to colors and the atmosphere) and familiarity with the setting typology. The main negative perceptions instead were: Accessibility, Safety (again), Chaos, and Dirt; these were due to feelings experienced (e.g., noise, odor, cold/hot weather, exposure to the elements, etc.), impressions (e.g., chaotic environment), or actual facts (e.g., pickpocketing).

In addition, customer journey maps and swim lane diagrams were adopted to study the purchasing processes (see Figure A4 in Appendix B). They exhibited different levels of interactions between retailers and customers in the two main product categories, i.e., food vs. clothes and fabrics, encouraging a different view of ancillary services.

Correspondently, a tri-section quantitative survey, shown in Appendix C, was built from previous evidences and specifically focused on: (1) demographic variables to profile the respondents; (2) the role of a market with respect to the other retail channels, consumers' general habits, and their purchasing behavior; (3) the relationship between the respondents and their most frequently visited markets and exploring their typical 'purchasing journey'. Factor analysis elicited (with an explained variance of 51.5% and a KMO sampling adequacy = 0.797) four factors as the main determinants of the experience (in Table 2): "usability", "product range", "safety", and "convenience". Usability encapsulated elements such as accessibility and the opportunity to take advantage of extra services. The term "safety" encompassed both personal security and the quality of products. The product range included the scope and the extent of the offer. Finally, convenience was confirmed for both monetary and nonmonetary accessibility (e.g., opening hours).

Table 2. The relevant factors in customer experience.

	Factor			
	Usability	**Safety**	**Product Range**	**Convenience**
Product Quality	−0.008	0.693	0.195	−0.067
Assortment Width	0.160	−0.142	0.649	0.055
Assortment Depth	0.073	0.167	0.666	0.191
Service Efficiency	0.530	0.139	−0.195	0.280
Safety	0.302	0.643	−0.062	0.074
Hygiene	0.130	0.766	0.077	0.137
Easy to Reach	0.296	0.307	0.134	0.358
Opening Times	−0.054	0.110	0.175	0.830
Complementary Services	0.375	−0.092	0.078	0.577
Pleasant Area	0.677	0.167	−0.036	0.169
All Weather Conditions	0.656	0.018	0.346	−0.030
Accessibility	0.682	0.176	0.319	−0.020
Cost-Convenience	−0.008	0.246	0.598	0.052

Note: All are Rotated Factor Matrix values.

Mental maps and questionnaire evidence represented at the successive stages a key point in the design process and for module characterization.

From the perspective of retailers (R2), focus groups were also conducted with retailer trade unions; 50 randomly chosen interviews were carried out in 20 markets, while 500 questionnaires were collected by FIVA at all the markets in the city (see Appendix D). From this data collection and analysis, two main themes emerged.

The first was the perception of a significant difference between the service provided by the markets and the one offered by supermarkets/shopping centers. Markets were open every day, but only during working hours, which was unsuitable/inaccessible for most consumers. Moreover, opening times were neither communicated to customers nor faithfully observed by retailers, thus generating uncertainty regarding service availability. Service components, such as pre-arranged orders, home deliveries, e-commerce services, communication, promotions, and advertising, were all left to the initiative of the individual retailers and were not provided by the market as a whole.

This latter evidence highlighted the difficulty of managing negative externalities due to the opportunistic behaviors of unpleasant colleagues. Different from malls, where strong coordination mechanisms are present, such harmful behaviors are more difficult to manage and affected customers' perceptions (in Figure A7 in Appendix D, one could appreciate, for instance, the effect of opening hours on visits). Therefore, a key challenge for retailers was to design and implement mechanisms of coordination/control to supply service modules, not only as individual retailers, but by the market as a whole.

Table 3 summarizes the requirements elicited. In particular, it complements the requirements of Table 1, demonstrating that the previously identified variables were generally valid and that the economics of the system had to be studied (bold characters), as well as the requirements derived from the different stakeholders (in italics).

Table 3. The full list of derived requirements.

Requirements from the System's Economics	**Requirements from Stakeholders**		
	Municipality	**Retailers**	**Customers**
(to adopt): a hierarchical perspective to the study	(constraint): multi-stakeholder, negotiating environment, subject to political tensions		
(to investigate): agglomeration phenomena, same-side	(to ensure): service coverage and assortment completeness		(constraint): customer experience, as in

and cross-side effects of two-sided platforms (constraint): Attractiveness of each market depends on the assortment decided by independent retailers **Markets attract consumers on the one side as well as retailers on the other, market size matters**	(constraint): the adopted license mechanism **16 markets had a saturation < 50, 10 markets achieved less than 30%.** **Retailers move where they achieve higher gains, consequent inability of the Municipality to reach a regular service coverage.**	(constraint): retailers are independent economic actors, not passive agents **Despite the location freedom, the interdependence of retailers' behaviors and utilities affects entire market attractiveness.** *Opportunistic behaviors of unpleasant colleagues without a central coordination and too high difference with the services of supermarkets or shopping centers.* (to ensure): *mechanisms of coordination/control to supply service modules, not only as individual retailers, but by the market as a whole*	shopping malls, is affected by poorer vs. richer configurations *(from focus groups) Customer experience is affected by Safety, Trust, Encounter, Amusement, Tradition, and Convenience* *(from survey) the main determinants of experience are "usability", "product range", "safety" and "convenience"* *(from focus groups) Customer feelings of: scarce Accessibility, Safety, Chaos and Dirt*
(to ensure): service coverage in an intra-channel and extra-channel competition environment **Unevenly distributed service on the urban territory, inadequate service coverage, high inter-channel and distorted intra-channel competition, cannibalization**			
(to ensure): physical purchasing experience, without a multi-channel configuration			*(from customer journey maps)* *Different purchasing processes by products*

Once the requirements were identified, the concept design phase of Figure 5 started. Despite the retailers' cultural distance from the design methods, they appeared quite trusting when communication was technical and 'crisp', while they often appeared to feel deceived by 'softer' communication approaches. In view of that, platform methods were chosen not only to aid the generation of the differentiated market alternatives, but also to communicate the transparency of the design actions and to share the analysis of trade-offs.

The discussion at the single-market level focused on the service modules and their combination to characterize each market as a 'designed service component' within the entire urban service system (CD1). Adjacency matrices [97] were used to study the inter-component relationships of the system, and the Lanner and Malmqvist optimization procedure [98] was adopted to define the market configuration. Adjacency matrices were an easy-to-read representation of services through which the two-fold configuration of the traditional offerings in Turin's markets was highlighted.

As shown in the Figure 7, the two main modules, including some sub-modules, resulted in:

- Food: Fruits and vegetables, Grocery, Preparation and packing, Support to the final purchasing decision, Home delivery;
- Non-Food: Clothes and fabrics, Other categories, Assistance during purchasing, Single pre-arranged orders.

	Fruit and vegetables stalls	Grocery (fish, bread, etc.) stalls	Purchasing decision support	Preparation and packing service	Single systems for home delivery	Assistance during purchasing	Single systems for prearranging orders	Clothes and fabrics stalls	Other category stalls
Fruit and vegetables stalls		2	2	2	2	1	1	1	1
Grocery (fish, bread, etc.) stalls	2		2	2	2	1			1
Purchasing decision support	2	2		2	1	2	1		
Preparation and packing service	2	2	2			1			
Single systems for home delivery	2	2	1						
Assistance during purchasing	1	1	2	1				2	2
Single systems for prearranging orders	1		1					2	
Clothes and fabrics stalls	1					2	2		1
Other category stalls	1	1				2		1	

Figure 7. The original module configuration.

This two-fold configuration represented the starting point for triggering a one-year long design process, participated in by the municipality and trade unions, to rethink the market service. In the end, four additional components of the service system were designed starting from the established limitations of the previous configuration:

- An 'accessibility' module, including home delivery, e-commerce, and free parking areas;
- A 'usability' module, including services for collecting, carrying, and storing goods;
- A 'promotion' module designed to improve the basic pleasantness of the setting, communication, and the trusting relationship between the retailers and the customers;
- A 'specific services' module designed to improve the emotions/atmosphere within the market. This same module also dealt with security, entertainment (e.g., laboratories and courses), and leisure activities (e.g., places for eating).

The former two modules were more 'functional-oriented'; the latter two were more 'experience-oriented'. However, decisions regarding which modules to make common to all markets and which to take 'out of platform' to design differentiating elements for specific experiences (CD2) were the step forward.

Once again, a technical yet simple representation, such as the two-dimensional map (Figure 8), provided an intuitive representation of the possibilities. The figure maps each service module according to the value of standardizing and keeping it in platform ('similarity') and the value of differentiating it and placing it 'off platform' ('specificity'). On the basis of this analysis, a combination of modules was progressively developed through strenuous discussions with retailers, and five possible market configurations were eventually conceived (CD3, in Figure 9) as differentiated alternatives to the common designed platform.

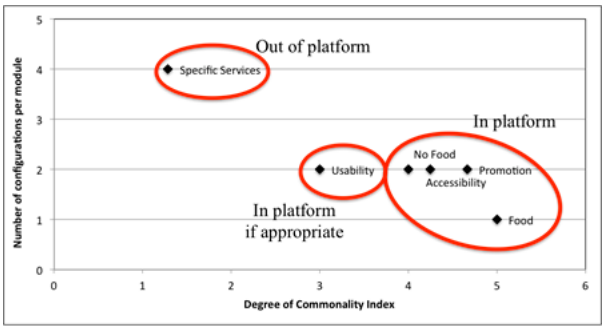


Figure 8. Mapping modules for platform composition.

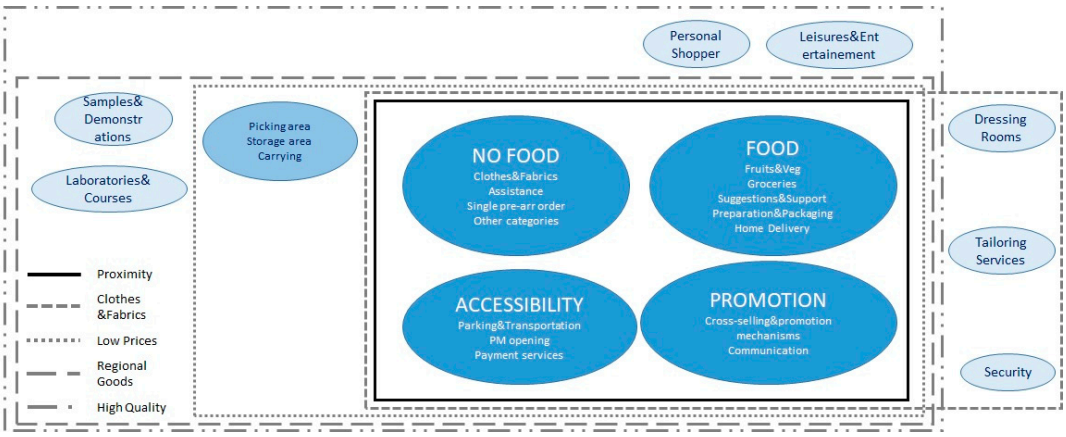


Figure 9. The platform and the derived market alternatives.

It is apparent that these alternatives are not far from the original ones; this approach allowed (providentially) existing value propositions to be developed and improved without introducing excessive perturbations from the precedents, but instead to design new propositions for those markets that were missing one, or, in a few cases, to decide to suspend the service.

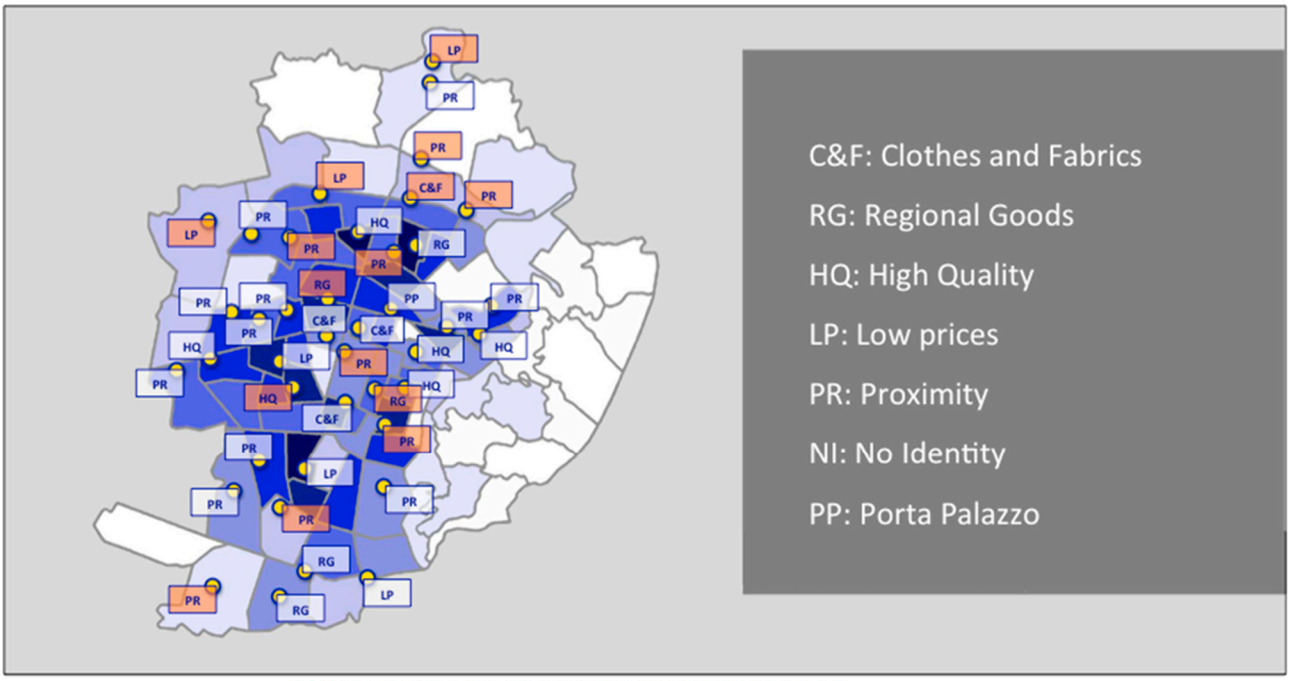
The entire value constellation eventually resulted from the distribution of these conceived alternatives in urban territory (CD4). Distribution was defined considering further following constraints (derived from R3 and R4, not discussed here), such as:

- The risk of cannibalization by adjacent markets providing similar customer experience;
- The structural and environmental conditions;
- The capacity constraints, efficiency issues, and retailers' availability to relocate.

Optimization methods were then used to address such constraints and aid the design. Two models (in Appendix E) were adopted to suggest the alternative assignment of retailers to markets in the urban area. The former considered the historical rankings retailers were subjected to; the latter considered the actual willingness of retailers to attend the markets. The rationale behind and the benefits obtained from these two alternatives were again explained to the retailers to solve the evident trade-offs in the designed solutions (CD5-CD6). The idea was to avoid a situation where assigning retailers to markets in which their license created a better fit with the market proposition could have clashed with their habitual attendance at another market and harmed their relationships with their habitual customer base.

Further meetings with trade unions and the entire constituency of retailers were finally planned: the municipality organized a broader action, with press conferences, open events, and training courses addressing retailers who had not previously participated. Technical and political outcomes of the design process, differences from the past setting,

and benefits were illustrated to gain acceptance. Figure 10 shows the differences in the final distribution of markets over the territory; it emerged as a compromise between the solutions generated by optimization and further negotiations.



The process ended with the detailed design that dealt with each single-service interface, considering its architectural elements (DD1) and its navigation system, the operational and administrative procedures for the daily assignment of the stalls to retailers (DD2), and the coordination mechanisms and common marketing initiatives (DD3). The methods adopted in this phase were–once again–a mixture of those usually used in Operations Management and Service Design.

The overall design process, along with the specific activities performed during each phase, as described above, is presented in Figure 11; it re-proposes Figure 4, while explaining the sequential progress of the design activities.

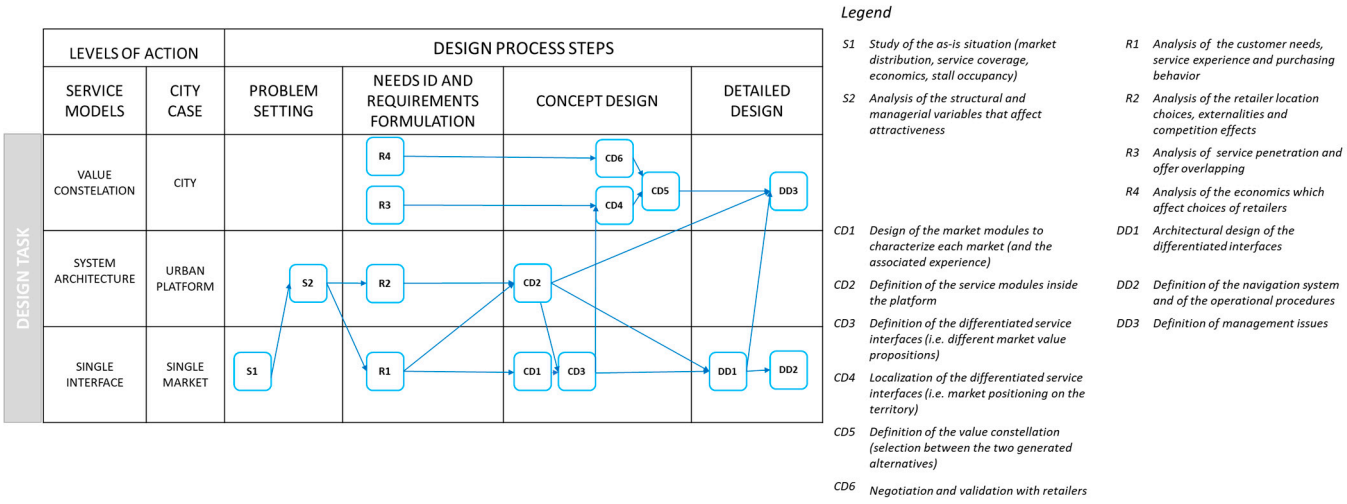


Figure 11. The design process for an urban market service system.

5. Discussion of the Results and Practical Implications

The results can be discussed in view of the specific design problem and at a more general level.

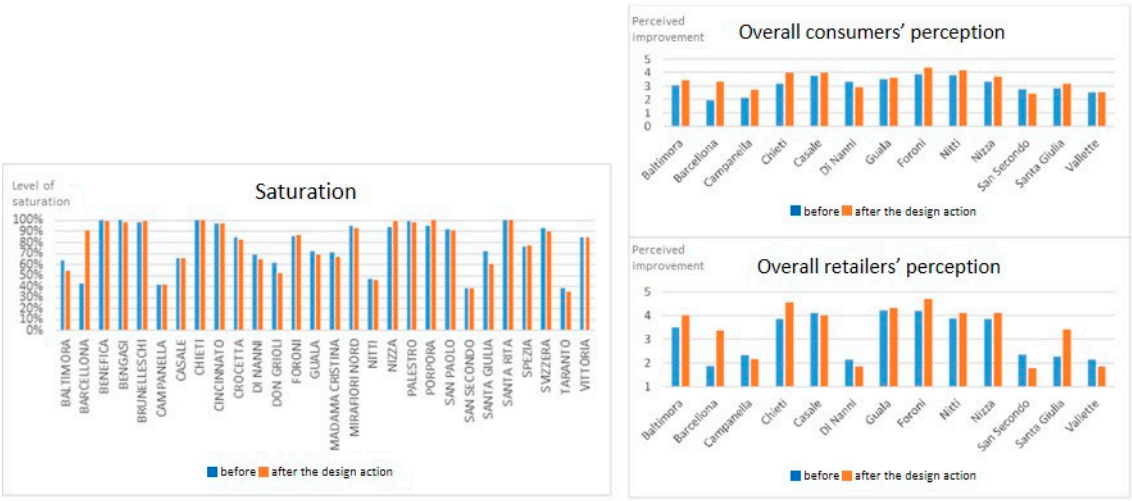
Regarding the case study, the results obtained are compliant to design policies for 2030 [15]. Markets that previously had no clear value proposition were given one (Table 4), and the municipality was able to ensure better coverage of the territory by providing 'proximity' markets that catered to the local neighborhoods and ensure that more markets than before were given a distinct commercial identity. All markets began developing service offerings more coherent with the differentiated value propositions.

Table 4. The final balancing of the differentiated components in the value constellation.

Identity	Label	Original Configuration	%	Designed Configuration	Delta Due to Differentiation	%
Clothes and Fabrics	C&F	3	7%	4	1	10%
Regional Goods	RG	3	7%	5	2	12%
High Quality	HQ	5	12%	6	1	15%
Low Prices	LP	3	7%	6	2	15%
Proximity	PR	12	29%	20	8	49%
No Identity	NI	15	37%	-	−15	-

Note: Absolute and percentage delta in saturation values.

A first outcome consisted of the saturation of markets that remained broadly stable after having exhibited a marked decline over previous years (Figure 12a). According to the evidence collected, this was because retailers were persuaded to locate in a more rational way, thus leading to a positive spiral of attracting customers and additional retailers.



(**a**) (**b**)

Figure 12. Effects on saturation (**a**) customer and retailer perceptions (**b**).

Moreover, after 6 months, a new survey was given at 13 markets to investigate the perceived quality of both sides of the market (Figure 12b). The evidence was comforting. The few cases that confirmed stubbornly low saturation levels and low attractiveness were the ones previously in decline (also because of the nearby presence of hypermarkets, demographic/economic decline of the neighborhood, or low accessibility).

The municipality appreciated the participatory design approach; although this did not disguise the complexity of the problem, it was able to promote the active involvement of a constituency that, in the past, had been somewhat disorderly and highly resistant to any change. The designed configuration was not considered to be permanent; the adopted

approach, at this point assimilated by the municipality and retailers, would have allowed the continuation of designing and implementing improvements.

This collaborative design action was made possible by the combined use of methods. Table 5, derived from the proposed four-phase framework, shows the design tasks in the process in rows, and summarizes the suite of methods that have been used in the case in columns. They are described according to their background, the modality of use in the process, the role of each participant, and the benefit gained from their integration.

Table 5. The coordinated use of the methods in the participated process.

Design Tasks	Method	Cultural Domains/Approaches	Object (to Study/to Design)	Role in the Process			Benefits (Participants have been Made Aware of/have Learnt)
				Customers	Retailers and Trade Unions	Municipality/Other Stakeholders	
S1	Descriptive statistical analyses	(Figure 3, cell 1)	The current situation		As an audience, to be aware of current situation	As an audience, to be aware of current situation	Current situation
S2	Gravity models	(Figure 3, cell 1)	The structural and managerial variables affecting market functioning		As an audience, to be aware of the effects of their location choices	As an audience, to be aware of the licensing mechanism effects	The effects of their choices
R1	Focus groups, Cognitive maps, Customer Journey Survey	(Figure 3, cells 2, 3)	Needs, purchasing behaviors, and the retail experience	Active participation to express opinions and improvement suggestions	As an audience, to be aware of customer preferences	As an audience, to be aware of customer preferences	The customer service requirements
R2	Focus groups Survey	(Figure 3, cells 2, 3)	Individual motivations, positive and negative externalities		Actively involved to express opinions and to contribute to improvement	As an audience, to be aware of service requirements	The consequences of design choices
R3	Descriptive statistical analyses	(Figure 3, cell 1)	Overlaps in the offerings, service penetration, and the economics of retailers' choices		As an audience, to be aware of requirements led by their location choices	As an audience, to be aware about a rationalized service coverage	The consequences of design choices
CD1	Adjacency matrices Multi-level service system	(Figure 3, cells 1–4)	The service modules at the single interface	Co-design with consumer organizations	Co-design with retailer associations	Co-design with officials from Municipality	How to operate in the future
CD2	Platform-based design Multi-level service system	(Figure 3, cells 1–4)	The service platform and the modules in common to all markets	Co-design with consumer organizations	Co-design with retailer associations	Co-design with officials from municipality	How to operate in the future
CD3	Platform-based design Multi-level service system	(Figure 3, cells 1–4)	The market alternatives at architectural level	Co-design with consumer organizations	Co-design with retailer associations	Co-design with officials from municipality	How to operate in the future
CD4	Optimization Multi-level service system	(Figure 3, cells 1–4)	The value constellation at urban level	Co-design with consumer organizations	Co-design with retailer associations	Co-design with officials from municipality	How to operate in the future

CD5	Focus groups Training courses	(Figure 3, cells 3, 4)	Active participation (entire constituency of retailers)	Active participation and facilitator	How to operate in the future

At a more general level, Table 5 shows how the proposed framework allows a synergistic integration between methods spanning widely different traditions and schools of thought. The proposed matching of different design traditions and cultural domains has not yet been attempted in the literature, as it allows for a comprehensive identification of service requirements that would not be equally determined.

By translating the framework to the specific case in hand (from Figures 5–11), the approach can be adopted for the design of any service system, even if it might not be suitable for small and well-structured service design problems. In such cases, one could retain the principle of understanding the economic functioning of a service. Conversely, the approach fits well in the case of unstructured problems to be tackled in organizational contexts, with significant political and negotiation issues among multiple stakeholders. In the context of services that are increasingly based on (ICT) platforms, knowledge of the economies that govern them could be essential in order not to have the design activity fail.

Table 5 shows the tools that have been used in this case; they may obviously be enriched with what emerges from the specific design problems. In principle, it is up to academics and practitioners to rely on their knowledge and experience to develop the most appropriate methods for each design problem. However, an interesting direction for further research could involve developing a survey of methods and tools used in the design of services and classifying them according to their applicability within the four phases of the methodology.

The proposal set forth in this paper grants designers significant latitude in framing the design problem and in choosing the most appropriate tools to be used within the framework. This is not to be viewed as a limitation of the approach, but as a way to ensure generality. Concerning generality, the paper follows numerous other papers that have proposed design approaches and validated them thanks to their application in a single case study. Of course, this is not enough to demonstrate the universal applicability of the approach, which is something that can only emerge through repeated experiences. However, the case study demonstrates the benefit of such an approach in identifying a larger set of requirements, as well as it one application case in a real setting within a domain where the major authors state these attempts of integration as scant [6,12].

6. Conclusions

Although conceptual barriers between traditions of the design of service systems ensure methodological coherence within each, these same barriers can also lead to partial views of the complex service system and/or of the environment in which the design occurs.

Recently, few contributions have attempted to blend these diverse cultural traditions and constitute an attractive direction for research. Within this stream of the literature, this paper provides the description of a case study that allowed for the synergistic use of structured methods from the Engineering and Service Innovation literature, and applied them in constructivist and highly participatory settings. The proposal of the consequent validated framework not only provided originality, but also a methodological insight for practitioners and a theoretical contribution to the literature.

Regarding methodology, this paper shows that the transactional and functional mechanics of the service system must always be known for correct design actions, to avoid misunderstandings and mistakes, and to allow participants to share in the same knowledge of the system. In many instances, this level of understanding of the service system requires rigorous and quantitative methods. Approaches from Engineering (and Economics) are often set aside in Service Design. This is probably due to a fear of hindering the designers' freedom in exploring the complexity that is inherent to service "as a

process" and in securing the intensive involvement of the actors. However, Engineering methods allow for rigor in the analysis of service complexity, avoiding unstructured outcomes from the exploration, and even enabling crisp and convincing communication with non-technical stakeholders.

The theoretical outcome instead proves that a unifying framework is possible; unusual and even unexpected modalities of use of design methods can be explored thanks to the adaptability and flexibility of the methods themselves. Methods from different traditions can, hence, not only be applied together, but also integrated within participatory environments. Platform design methods, for instance, have lent themselves to aid participation, allowing stakeholders to easily attain a shared awareness of the solutions and to explore new ideas.

Problems characterized by public relevance are defined by a degree of complexity that requires this type of participatory and comprehensive approach, as well as digital platforms that embody two-sided markets with a further level of complexity. In this sense, the case of a citywide network of urban markets represented a formidable design exemplificative case.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

The empirical analyses were conducted by collecting data on daily market saturation and commodity percentages from the local police authorities over a period of 8 weeks. The data were used to investigate market saturation and to check whether the markets truly worked as two-sided platforms.

In general, if retailers wanted to avoid or reduce competition, they would locate themselves far away from each other and would not be concentrated. Moreover, since retailers in urban markets are free each day to decide whether or not to operate in a specific market area, a market can be occupied to various degrees each day. The saturation level of a single urban market, therefore, mirrors the market's attractiveness, and the location decision of retailers results in the more or less complete saturation of the area available for each market.

If the universal rule of competition were true for urban markets, assuming market areas and population as equally distributed, retailer stalls would more or less occupy the same number of slots in all the markets, and the large markets would be more unsaturated and the smaller ones would be more saturated. On the contrary, if economies of agglomeration prevailed in open-air markets, the larger markets would have the higher occupancy rates.

A simple correlation analysis between the potential market capacity (i.e., Market size) and the saturation level (i.e., Saturation index) can check the hypothesis and show whether larger markets attract more retailers.

Figure A1 shows a positive correlation between size and saturation level, proving the presence of agglomeration phenomena and refuting any possibility of the competitive mechanism being predominant.

		Market size	Saturation Index
Market Size	Pearson Correlation	1	0.488 **
	Sig, (2-tailed)		0.01
	N	42	42
Saturation Index	Pearson Correlation	0.488 **	1
	Sig, (2–tailed)	0.01	
	N	42	42

Figure A1. Correlation analysis between the potential Market size and Saturation. ** Correlation is significant at 0.01 level (2-tailed).

Moreover, data on the potential number of customers for each market (x-axis in Figure A2) were placed in relation to the number of slots actually occupied (y-axis): the former represents the attractiveness of the market platform on the customer side, the latter represents the attractiveness on the retailer side. In principle, these two variables should not have been correlated, as they were separately calculated (the former was derived by applying the consolidated Huff's model to the actual counts of customer visits per each market area; the latter was derived by data on slot occupation). They instead showed a weighty relationship (Figure A2).

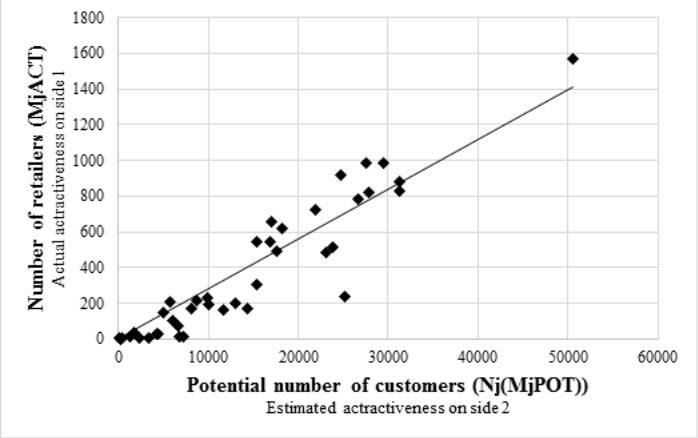


Figure A2. Performance points of Turin's open-air markets on the two sides of the platform.

This correspondence proved that open-air markets are two-sided markets, where the attractiveness of one side of the platform corresponds to the attractiveness of the other side. The values estimated by means of Huff's model validated this measure.

Appendix B

A total of 15 focus groups were organized, each composed of 8 to 12 people embodying the four main customer segments: elderly people, people in their forties and fifties living in a family, singles in their forties to fifties, and millennials. A total of 151 people were involved in the brainstorming sessions. Table A1 describes the sample, organized in terms of age and gender, of people interviewed through focus groups.

Table A1. The sample of people interviewed through focus groups.

Age	Males	Females	Total
15–24	15	20	35
25–44	22	26	48
44–64	18	27	45
65+	4	19	23
Total	59	92	151

The brainstorming sessions were audio recorded on a digital device, then transcribed and the text was analyzed. The content was coded into one linguistic register, identifying 115 recurrent statements (i.e., expectations, motivations, and attitudes) or first order categories. Then, the patterns across these statements were studied, allowing grouping into 20 s order themes, which in turn were associated with aspects of the market experience (i.e., the Macro Categories in Table A2), namely: Products, Service, and Market Area.

Table A2. First order attributes.

Macro Categories	Second Order Themes
Product	product quality (1), food products (2), apparel (3), household products (4), assortment width (5) and length (6), product warranty and authenticity
Service	price advantage (8), loyalty and trust with the merchant (9), usability (10), opening time flexibility (11), speed of purchases (12), Tradition (15)
Market Setting	Amusement and leisure (13), accessibility (14), parking (16), safety (17), cleanliness (18), protection from the elements (19), Familiarity and social place (20)

The mental maps in Figure A3 regarding positive and negative aspects of customer concepts of markets were depicted as a further outcome of the discussion.

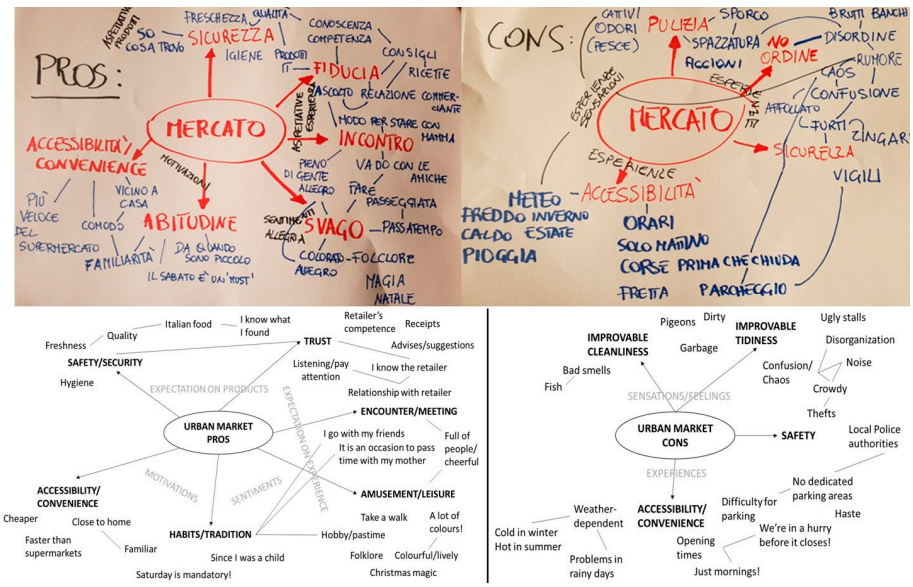


Figure A3. The mental maps from focus groups.

The customer journeys in Figure A4 were instead used to detail the purchasing process of the two main product categories; i.e., food vs. clothes and fabrics. In the former, the purchasing experience requires a "full service" system: customers cannot even touch

the goods before making his/her choice; the shop assistant can help them by giving suggestions, and can even provide preservation or recipe recommendations. At times, vendors offer home delivery, especially for elderly customers. In the case of apparel, the retailer tends to only help the customer if he/she is not able to find the sought product or the correct size. As an additional service, these vendors can offer the possibility of prearranging orders (e.g., "I'll check with my supplier to see if I can find this item for you"). Therefore, the two purchasing processes exhibited different levels of interactions between retailers and customers.

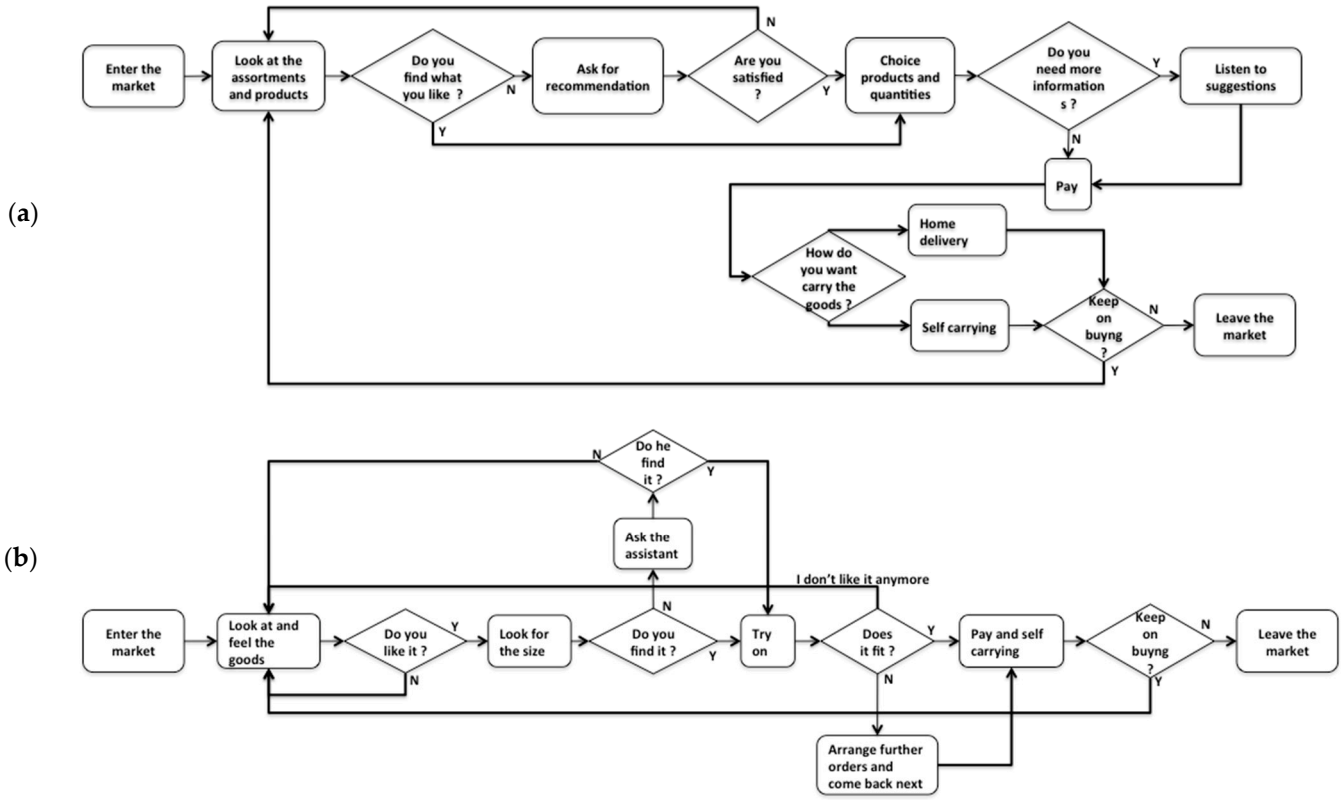


Figure A4. The purchasing processes for consumable (**a**) and durable (**b**) goods.

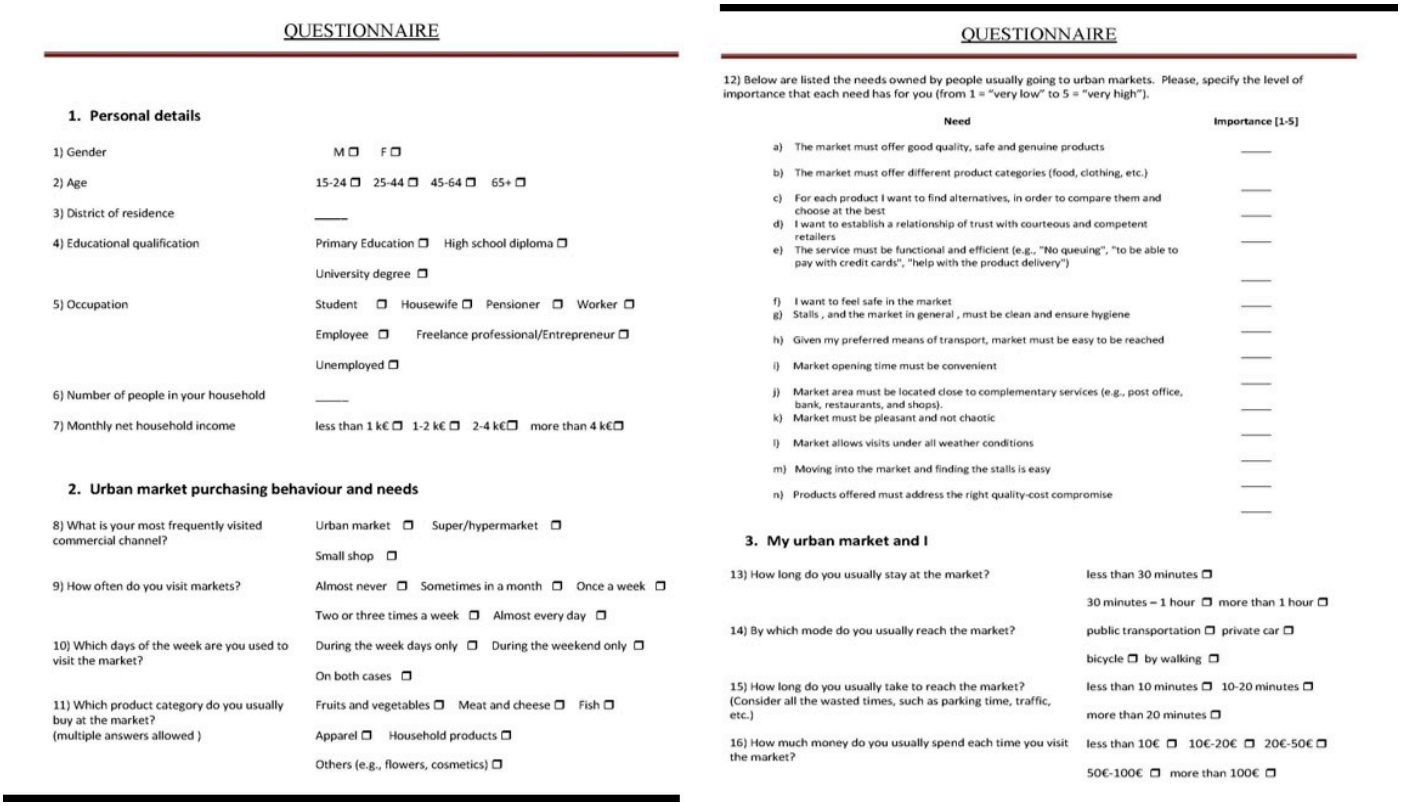
Appendix C

The questionnaire data were collected from a sample of 1315 customers based on stratified sampling, which was proportional to the population's distribution, with respect to age, gender, and district of residence. The respondents were interviewed on the streets, but not in proximity of the markets, to avoid any bias with respect to purchasing preferences. The stratified sampling method is presented in Table A3; the submitted questionnaire is presented in Figure A5.

Table A3. The questionnaire administration strategy.

Age		**15–24**		**25–44**		**45–64**		**65+**		
Gender		**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**Total**
District of residence	1	6	8	22	24	16	17	20	7	120
	2	10	10	21	24	39	20	16	18	158
	3	14	15	54	39	45	27	28	18	240
	4	6	10	24	18	17	15	13	9	112

5	14	11	17	24	30	22	20	16	154
6	12	14	21	23	33	17	16	15	151
7	8	11	21	21	15	10	15	8	109
8	3	7	5	4	16	6	17	6	64
9	5	5	19	20	24	23	21	16	133
10	4	4	12	10	11	10	13	10	74
Total	82	95	216	207	246	167	179	123	1315



QUESTIONNAIRE

1. Personal details

1) Gender M ☐ F ☐

2) Age 15-24 ☐ 25-44 ☐ 45-64 ☐ 65+ ☐

3) District of residence _____

4) Educational qualification Primary Education ☐ High school diploma ☐ University degree ☐

5) Occupation Student ☐ Housewife ☐ Pensioner ☐ Worker ☐ Employee ☐ Freelance professional/Entrepreneur ☐ Unemployed ☐

6) Number of people in your household _____

7) Monthly net household income less than 1 k€ ☐ 1-2 k€ ☐ 2-4 k€☐ more than 4 k€☐

2. Urban market purchasing behaviour and needs

8) What is your most frequently visited commercial channel? Urban market ☐ Super/hypermarket ☐ Small shop ☐

9) How often do you visit markets? Almost never ☐ Sometimes in a month ☐ Once a week ☐ Two or three times a week ☐ Almost every day ☐

10) Which days of the week are you used to visit the market? During the week days only ☐ During the weekend only ☐ On both cases ☐

11) Which product category do you usually buy at the market? (multiple answers allowed) Fruits and vegetables ☐ Meat and cheese ☐ Fish ☐ Apparel ☐ Household products ☐ Others (e.g., flowers, cosmetics) ☐

QUESTIONNAIRE

12) Below are listed the needs owned by people usually going to urban markets. Please, specify the level of importance that each need has for you (from 1 = "very low" to 5 = "very high").

Need	Importance [1-5]
a) The market must offer good quality, safe and genuine products	_____
b) The market must offer different product categories (food, clothing, etc.)	_____
c) For each product I want to find alternatives, in order to compare them and choose at the best	_____
d) I want to establish a relationship of trust with courteous and competent retailers	_____
e) The service must be functional and efficient (e.g., "No queuing", "to be able to pay with credit cards", "help with the product delivery")	_____
f) I want to feel safe in the market	_____
g) Stalls , and the market in general , must be clean and ensure hygiene	_____
h) Given my preferred means of transport, market must be easy to be reached	_____
i) Market opening time must be convenient	_____
j) Market area must be located close to complementary services (e.g., post office, bank, restaurants, and shops).	_____
k) Market must be pleasant and not chaotic	_____
l) Market allows visits under all weather conditions	_____
m) Moving into the market and finding the stalls is easy	_____
n) Products offered must address the right quality-cost compromise	_____

3. My urban market and I

13) How long do you usually stay at the market? less than 30 minutes ☐ 30 minutes – 1 hour ☐ more than 1 hour ☐

14) By which mode do you usually reach the market? public transportation ☐ private car ☐ bicycle ☐ by walking ☐

15) How long do you usually take to reach the market? (Consider all the wasted times, such as parking time, traffic, etc.) less than 10 minutes ☐ 10-20 minutes ☐ more than 20 minutes ☐

16) How much money do you usually spend each time you visit the market? less than 10€ ☐ 10€-20€ ☐ 20€-50€ ☐ 50€-100€ ☐ more than 100€ ☐

Figure A5. The submitted questionnaire.

Appendix D

Data from retailers were collected by focus groups with the retailer trade unions, 50 randomly chosen interviews carried out in 20 markets, and 500 questionnaires collected by FIVA at all the markets in the city. Figure A6 shows the outcome of one of the focus group sessions.

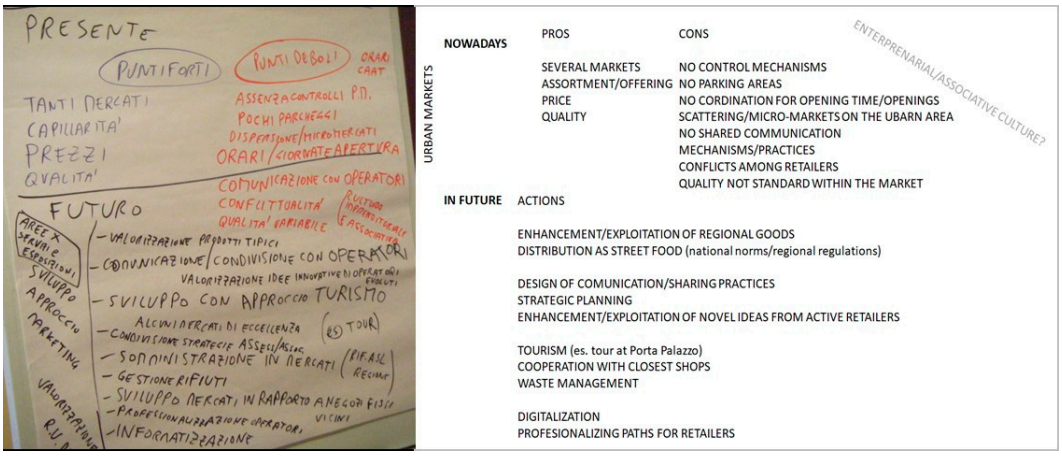


Figure A6. The mental map from focus groups with retailers.

Evidence from focus groups was confirmed by the other more generally collected data. Quantitative analysis of the available data on customer visits, for instance, showed that markets where opening hours were ignored had significantly less visits (up to 45%). Moreover, in those markets, visits suffered from a more significant 'border effect', as in Figure A7. Independent of absolute numbers, the peak of visits is recorded for a less prolonged period of time when openings times are not respected.

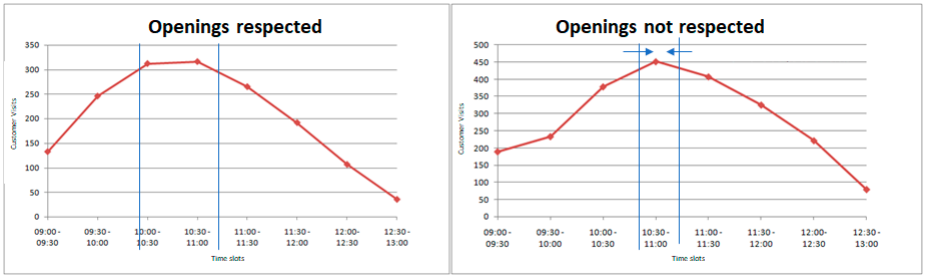


Figure A7. Comparison of customer visits between markets compliant vs. non-compliant to planned opening.

Appendix E

Parameters

Binary parameter to define the structure of the markets

$$a_{i,p,m,t} = \begin{cases} 1 \; if \; slot \; p, in \; market \; i, at \; time \; t, of \; commodity \; sector \; m \; exists \\ 0 \qquad\qquad otherwise \end{cases} \quad (A1)$$

Binary parameter to define the commodity sector of each retailer

$$b_{j,m} = \begin{cases} 1 \; if \; retailer \; j \; belongs \; to \; commodity \; sector \; m \\ 0 \qquad\qquad otherwise \end{cases} \quad (A2)$$

Parameter that expresses the historical rankings (lower values of r_(j,i) and p_(j,i) correspond to better rankings)

$$r_{j,i} = historical \; rank \; of \; retailer \; j \; in \; marekt \; i \quad (A3)$$

Parameter that expresses retailers' preferences

$$p_{j,i} = rank \; of \; market \; i \; in \; retailer \; j's \; preference \; list \quad (A4)$$

Variables

Decision variable to define slot-to-retailer matches

$$x_{i,p,j,t} = \begin{cases} 1 \; if \; retailer \; j \; belongs \; to \; commodity \; sector \; m \\ 0 \qquad\qquad otherwise \end{cases}$$

Model 1

$$\min\left[\sum_i\left(\sum_m\sum_p a_{i,p,m,t} - \sum_p\sum_j x_{i,p,j,t}\right)\right] * \sum_i\sum_p\sum_j\left(r_{j,i} * x_{i,p,j,t}\right)$$

s. t.

$$b_{j,m} * a_{i,p,m,t} \geq x_{i,p,j,t} \; \forall \; i,p,m,j,t \tag{A5}$$

$$\sum_i\sum_p x_{i,p,j,t} \leq 1 \; \forall \; j,t \tag{A6}$$

$$\sum_j x_{i,p,j,t} \leq 1 \; \forall \; i,p,t \tag{A7}$$

$$\sum_p\sum_j x_{i,p,j,t} * a_{i,p,m,t} \leq \sum_p a_{i,p,m,t} \; \forall \; i,m,t \tag{A8}$$

Model 2

$$\min\left[\sum_i\left(\sum_m\sum_p a_{i,p,m,t} - \sum_p\sum_j x_{i,p,j,t}\right)\right] * \sum_i\sum_p\sum_j\left(r_{j,i} * x_{i,p,j,t}\right)$$

s. t.

$$b_{j,m} * a_{i,p,m,t} \geq x_{i,p,j,t} \; \forall \; i,p,m,j,t \tag{A9}$$

$$\sum_i\sum_p x_{i,p,j,t} \leq 1 \; \forall \; j,t \tag{A10}$$

$$\sum_j x_{i,p,j,t} \leq 1 \; \forall \; i,p,t \tag{A11}$$

$$\sum_p\sum_j x_{i,p,j,t} * a_{i,p,m,t} \leq \sum_p a_{i,p,m,t} \; \forall \; i,m,t \tag{A12}$$

Note

[1] For reasons of focus and length, the paper does not discuss the transformative aspects of the design process (cell 4).

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