Designing Product/Service Systems: A Methodological Exploration[1]

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1 Introduction

In this age of globalization and information technology, corporate strategies are more and more challenged to bring production in line with complex demands, which requires a substantial shift from the production of goods to the provision of knowledge-intensive systemic solutions.[2] Such solutions usually consist in a system of products and services.[3] Given their strategic business relevance, such solutions have rightly been widely discussed in the management and marketing disciplines.

In the design discipline, however, the methodological implications of product/service systems rarely have been discussed even though design components play a critical role in the development of PSS.

While it is true that designers' activities usually have focused on material artifacts (whether industrial products, spaces, or architectures), rather than on systemic solutions including services, it also is worth remarking that PSS often are marketed as products,[4] and several aspects of the development of such systems are related to the discipline of design, from the analysis of technological potentials to the investigation of users' behavior and attitudes with respect to new products, technologies, and services. Above all, a design approach would substantially contribute to the interpretation of emerging cultural and social patterns, and to the translation of such patterns into a consistent and visible set of requirements for the definition of future PSS.

On the other hand the involvement of designers in the development of PSS would require an extension of designers' activities to areas previously covered by different disciplinary domains. Therefore, new methodological tools are required in order to support the design process.

This paper explores the disciplinary domains that may offer methodological suggestions for the design of PSS. The first part of the paper focuses on the design of PSS from a designer's perspective, emphasizing the role of designers in developing innovative PSS. The second part outlines methodological tools that can be used when dealing with specific aspects of the design activity focused on PSS.

1 This paper is one outcome of the investigation for a research project named TeleCentra funded by the Australian Research Council (ARC) within the Strategic Partnership with Industry, Research and Training (SPIRT) program. The project was coordinated by the author in cooperation with Assistant Professor Liddy Nevile, Melbourne I; CoAsIt; Virtual Moreland; and Motile Pty. Ltd. The author wishes to thank Michael Abdilla, Professor Liddy Nevile, and Andrew Donald for their critical and methodological contributions to this exploration.

2 F. Butera, *Il Castello e la Rete.* (Milano: Domus Academy, 1990) Franco Angeli and A. Bucci *L'impresa Guidata dalle Idee.* (Milano: Domus Academy, 1992); E. Manzini, "Il Design dei Servizi. La Progettazione del Prodotto-Servizio," *Design Management* 4 (1993): 7-12; D. Pilat, *Innovation and Productivity in Services: State of the Art.* (Innovation and Productivity in Services, Sydney, (2000).

3 In this paper, such solutions will be defined as product/service systems or PSS.

4 Manzini, "Il Design dei Servizi."

2 Product/Service Systems: A Definition

A definition of the main terms is essential in order to better define the cultural context for the design activity in this area. Product, service, and system refer to large disciplinary perspectives whose extension goes beyond the scope of the present paper. This paper, however, will define them from a particular perspective, which focuses on the logical domain generated by the intersection of design culture with the practice of service management.

According to Goedkoop, et al.,[5] a PSS is a marketable set of products and services capable of jointly fulfilling a user's need. A better definition of the concept is possible when considering it from different perspectives.

From a traditional marketing perspective, the notion of PSS originates from the shift of marketing focus from products (whose characteristics are related to its material components) to a more complex combination of products and services supporting production and consumption.[6]

From a service marketing perspective, the PSS represents the evolution of traditional generic and standardized services towards targeted and personalized ones.[7] This perspective reflects the trend away from mass production that characterizes several production sectors.

From a product management perspective, the notion of PSS refers to the extension of the service component around the product for business activities that are traditionally product-oriented or the introduction of a new service component marketed as a product for business activities that are usually service-oriented.[8]

The ratio between product and service components in a PSS varies from case to case, and also over time, due to technological developments, economic optimization, and the changing needs of people. Moreover, different combinations of products and services can fulfill the same needs. However, the common point of those services, Manzini[9] observes, is that they are conceived and offered as products, which are designed by taking into account a series of economic and technological criteria. This emphasizes the relevance of the designer in the definition of new PSS.

Some specific characteristics of PSS emerge when analyzing the service component in comparison with the usual characteristics of the product component. Such differences, emphasized by several authors,[10] mainly concern the relationship between users, designers, and service providers, production and consumption times, and the material intensity (tangibility, portability) of services. Such characteristics are outlined in the following paragraphs.

Relationship between users, designers, and service providers. While product manufacturers generally do not have contact with their customers, service providers usually *shape* the service together with users, who, in fact, participate in the production process. This

5 M. J. Goedkoop, C. J. G. van Halen, H. R. M. te Riele, and P. J. M. Rommens, *Product Service Systems, Ecological and Economic Basics* (Ministry of Housing, Spatial Planning and the Environment Communications Directorate, 1999).

6 Manzini, "Il Design dei Servizi."

7 Ibid., and K. Albrecht and R. Zemke *Service America!: Doing Business in the New Economy* (Homewood, IL: Dow Jones-Irwin, 1985).

8 S. Rocchi, "Towards a New Product-Services Mix: Corporations in the Perspective of Sustainability" *IIIEE* (1997) (Lund, Sweden, University of Lund). And O. Mont, "Product-Service Systems: Shifting Corporate Focus from Selling Products to Selling Product-services: A New Approach to Sustainable Development," Lund, (2000).

9 Manzini, "Il Design dei Servizi."

10 P. Eiglier and P. Langeard, *Marketing Consumer Services: New Insights by Pierre Eiglier [et al.]* (Cambridge, MA: Marketing Science Institute, 1977), 128; R. Normann, *Service Management: Strategy and Leadership in Service Business* (Chichester; NY: Wiley, 2000); and R. Ramaswamy, *Design and Management of Service Processes* (Reading, MA: Addison-Wesley Pub. Co., 1996).

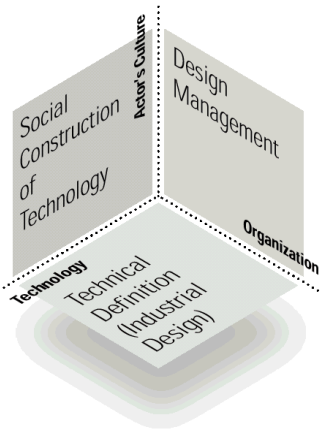


Figure 1
Multidimentional values implied in service design activities.

is particularly evident in *enabling* services, i.e., services in which customers are provided with all of the tools necessary to perform specific functions.[11] PSS are socially constructed systems, whose characteristics are determined by the different cultural, social, economic and technological frames of the actors involved in their construction.

Production and consumption times. Products are produced and consumed at different times, while services come into existence at the same moment they are being provided and used. Services are processes developed and delivered over a certain period of time and their configuration varies according to their use. On the other hand, products usually maintain a well-defined configuration (apart from general wear and tear, which usually does not affect their fundamental structure) from the time of manufacture and through the use phase.

Material intensity. While products generally are tangible objects, services are composed of intangible functionalities. Because of their immaterial components, unlike products, services cannot be stored, nor can their ownership be transferred, which happens when products are sold. Another relevant immaterial dimension in PSS is time: while products exist in time and space; services are processes which exist in time only.[12]

3 Implications for Designers

The involvement of designers in the development of PSS implies an extension of the traditional disciplinary domain of design, towards new domains that provide designers with the necessary expertise to manage the particular characteristics of PSS. The design activity is projected on new dimensions; such a redefinition of the design activity has relevant methodological implications.

3.1 New Dimensions for the Design Activity

> The design of new services is an activity that should be able to link the techno-productive dimension (What is the realm of the possible?) to the social (What are the explicit areas of demand and what the latent ones?) and cultural dimension. (What behavioral structures should one seek to influence? What values and qualitative criteria should we base our judgments on?) [13]

Manzini's definition suggests that the domain of designers' activities be expanded: in the most common view, the core of the design activity is the technological definition of industrial artifacts. The design domain, from this perspective, is described by the designer's technological knowledge and by the organizational aspects of the production and consumption system he/she is working on (see figure 1).

11 The definition of enabling services is borrowed from Normann, who makes a distinction between this category of services and the category of *relieving services*, in which the service provider replaces the customer in a particular function.

12 L. G. Shostack, "How to Design a Service," *European Journal of Marketing* 16:1 (1982): 49-63.

13 Manzini, "Il Design dei Servizi."

Conversely, because users, designers, service providers, and even technological components of a PSS are equally involved in the definition of the final configuration, the design role is projected upon two new domains: the domain of the organizational and design culture and the domain of the social construction of technology.

The first domain refers to the general attitude and capability to propose the reorganization of some core functions around innovative patterns. Such a domain is close to the discipline of design management, although it often implies a capability to understand and enhance organizational learning capabilities using PSSs as a catalyst for innovation.

The social construction of the technology domain concerns the ability of the social actors to influence innovation processes and to determine the paradigmatic context in which new technologies, products, and services can be accepted or refused. Such a context depends on the capability of the actors to interpret, enhance, and emphasize certain (sometimes weak) innovation signals.[14]

3.2 Methodological Implications

The extension of the design activity to include services requires that designers make use of new methodological tools to address the main characteristics of PSS as outlined in section 2. Consequently, the main questions designers have to face are:

What are the methodological tools available to designers for the purpose of analyzing PSS as social constructions? Designers need tools to explore, understand, and address the needs of different actors. Moreover, they have to take into account the existence of possible friction between the socio-technical frames of different authors participating in the development of a service.[15]

How can designers manage the different phases of design and planning activities? Although a service only comes into existence during the use phase, the various events characterizing the use of the service must be planned in advance in order to anticipate and organize the interaction between clients, providers, and the technological infrastructure. The designer needs to organize the flow of events in a product/service system, and to ensure that any variables are catered for as far as possible.

How can designers represent material and immaterial components of PSS? While products are easily represented through technical drawings, there are not many metaphors and graphical tools available to represent the immaterial component in services and the relationship between material and immaterial elements of a product/service system.

14 This paper does not suggest that the product design activity is concerned only with the technological definition of products, since there are aspects of product design that have relevant social and organizational implications. The distinction proposed in this paper, however, aims at emphasizing the higher social and organizational implications in the design of PSS with respect to the product design activity.

15 The typical example of a problem the designer has to solve when designing services is how to reduce the cognitive friction between complex technologies (such as information technologies) and ordinary users who may be totally unfamiliar with these technologies.

4 Designing PSS: An Interdisciplinary Exploration

The questions arising from the analysis of the methodological implications for the design activity requires an exploration in different disciplinary domains. The questions in the previous section suggest three directions for a methodological exploration:

- Analysis of the system as a social construction
- Management of the design process of a PSS through the various phases before and during the use phase
- Technical representation of PSS in the design process.

Such directions implicitly or explicitly refer to other disciplines, such as social studies, marketing and management, and information science. The following section will describe some of the methodological suggestions coming from such disciplines.

4.1 Analysis of PSS as a Social Construction

A product/service system is the result of the interaction between different actors and technological elements during the use phase. This means that the design activity should emphasize elements of convergence between several social and technological factors, including:

- The social, technological, and cultural frames of the actors participating in the development of the system, and;
- The technological knowledge embedded in the artifacts used for the service.16

The combination of such a heterogeneous mix of elements (people + cultural frames + technological artifacts) suggests that the designer has the same function as the *engineer-sociologist* described by Callon.[17] In this role, the design activity consists of linking technological artifacts to the attitudes of relevant social groups in order to accept or reject certain products and technologies.

A useful methodological tool to analyze and understand the different technological frames converging in a product/service system is suggested by Bijker,[18] who proposes a set of criteria that describes both the technological culture of the actors and the cultural and social frames embedded in technological artifacts (Table 1).

Bijker's criteria can be used to generate different profiles of the possible users of a service. The generation of such profiles requires the designer to undertake a thorough analysis of users' characteristics based on interviews, surveys, or even by generating hypothetical use cases (see table 2) within workshops held by the service design team.

16 Technological infrastructures often reveal the strong influence of the socio-technical culture of their designers/developers. Severe limitations to the development of certain characteristics of PSS emerge when such characteristics are beyond the socio-technical horizon of the developers of the technological infrastructure. Such limitations are even more evident when the PSS is based on high levels of automation.

17 M. Callon, "Society in the Making, the Study of Technology as a Tool for Sociological Analysis" in W. E. Bijker *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, MA: MIT Press, 1989), 83-103.

18 W. E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change* (Cambridge, MA: MIT Press, 1995).

Table I

The set of criteria proposed by Bijker to describe a technological frame.

Criteria	Explanation
Goals	The main needs each group wants to satisfy in relation to specific aspects of their work activities.
Key problems	The main problems to be solved or overcome for each group in order to achieve their goals.
Problem solving strategies	The strategies each group believes to be admissible and effective in solving the main problems.
Requirements to be met by problem-solving strategies	The criteria for admissibility and effectiveness of problem solving strategies.
Current theories	The theoretical knowledge supporting the activity of each group in setting goals, identifying and selecting problems, and proposing admissible problem solving strategies.
Tacit knowledge	The practice based-knowledge, upon which each group relies to set goals, identify and select problems, and propose admissible problem-solving strategies.
Testing procedures	The procedures each group uses to evaluate the effectiveness of each problem-solving strategy.
Design methods and criteria	The methods and parameters used for proposing technological solutions to emerging needs.
Users' practice	The users attitudes towards the existing solutions to the present needs.
Perceived substitution function	The products, services, or sets of functionalities each group believes is to be replaced when proposing or using innovative solutions.
Exemplary artifacts	The products and services that are used as models in developing new solutions. These often are derived from the perceived substitution function.

Technological and cultural frames also are embedded in technological artifacts and infrastructures included in PSS. Such cultural frames are intelligible through the physical and technological characteristics of the artifacts. Such frames are relevant to the development of the service, because they often enhance or limit the potential of the service. (Computers' operating systems, for instance, have a strong influence on how several information-based PSS are organized.) The interpretation and manipulation of cultural, social, and technological values embedded in artifacts are typical characteristics of design activity for which the design discipline already has developed analytical and methodological tools.

4.2 Management of the Design Process of a PSS

Shostack[19] explains the relationship between the pre-use and the use phase of a service with a dichotomy: the pre-use phase represents a *potential* state of the service, in which the service can only be described in hypothetical terms, or as a *blueprint.* The use phase represents the actualization of the service, or *kinetic* state, in which the service takes place.

19 Shostack, "How to Design a Service."

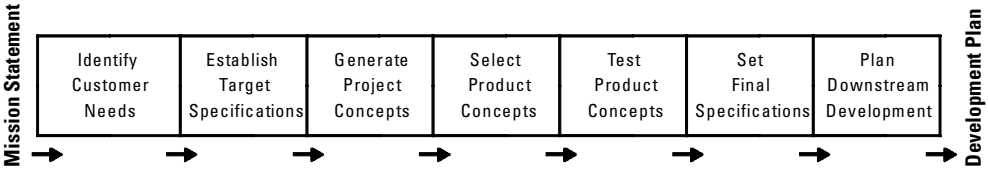


Figure 2
The concept development process in product design and development.

The actualization of a PSS consists in managing the various concurrent elements including technological infrastructure, personnel, marketing, customer relations, and communication. Management issues in this phase are determinant, while the designer's role focuses on specific aspects emerging during the use of the service. However, the designer's role is critical in the potential phase, in which all the potential elements of the system are defined. Interesting contributions to the definition of this phase are coming not only from design management and marketing disciplines, but also from the modeling methods used in the design of information systems.

Design management studies, in particular the disciplinary domain focused on product development, provides suggestions for the definition of the design process. Although the focus of this disciplinary area is on industrial products, a systemic approach is commonly used. Ulrich and Eppinger[20] analyze the design activity within the whole planning and development process of a product, from the planning phase through concept development, system level design, detail design, testing and refinement, and production ramp-up.

The phase of concept development presents several analogies with the activity of service design. This phase (outlined in Figure 2) consists in an exploration of the design concept, including phases such as the identification of customers' needs, concept generation and selection, concept testing, and final specification. Such a process would consist in an iteration of exploratory phases (identification of customer needs, selection and test of a concept) alternated with project phases (defining specifications, generating a set of concepts, and defining a final configuration). The iterative process is critical in this phase because it keeps the focus on the basic concepts to be developed in the following phases. The progressive exploration and focusing on the design concept also is a characteristic of the potential phase of the design of a PSS. Therefore, the logical sequences proposed by Ulrich and Eppinger in the concept development phase can be adapted for the design of services.

20 K. T. Ulrich and Steven D. Eppinger, *Product Design and Development* (New York: McGraw-Hill, 2000).

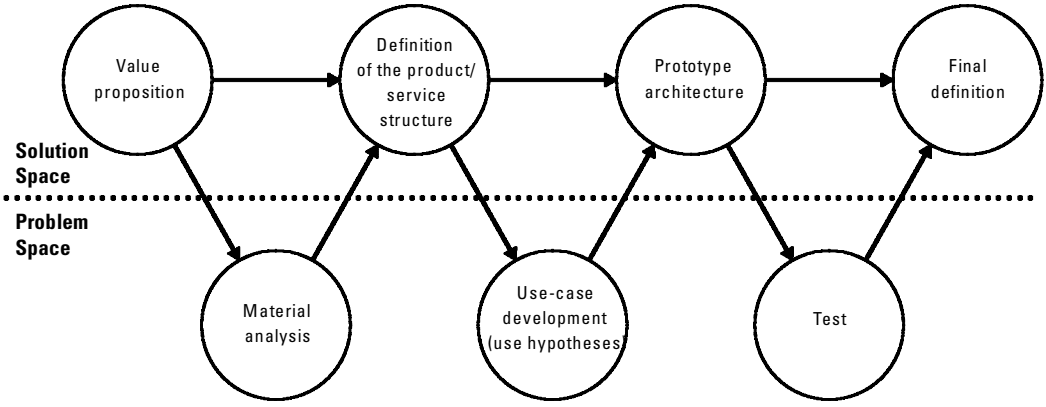


Figure 3
A model of the development of a the pre-use phase of a project (source TeleCentra).

Figure 3 represents the design process followed for the development of a support service for nomadic workers within the TeleCentra research project. The schematic representation of the sequence emphasizes two dimensions (spaces): a problem space, or behavioral space in which functional requirements are explored, and a design space or structure space in which solutions are proposed. Problem phases lead to new solutions which in turn, refocus the problems and prompt new requirements.[21]

Marketing disciplines propose a design approach focused on services. Ramaswamy[22] divides the whole design development process of a service into design and management phases (Figure 4). The design phase includes the design of products, facilities, service operation processes, and customer service processes, whereas the management phase includes design implementation, performance measurement, satisfaction assessment, and performance improvement. Ramaswamy thoroughly explores each of the eight phases outlined, using management criteria to select and measure quantitative and qualitative requirements of the service and to select design solutions. The design phase proposed by Ramaswamy synthesizes the main phases proposed by the previously mentioned studies. However, Ramaswamy analyses the whole process of service design as an integrated and iterative process, in which the management phase includes measurements and testing strategies which provide feedback for further improvements.

Ramaswamy's methodology, however, may need a more thorough exploration in the potential phase, especially for cases in which:

> The PSS proposed are totally new to the users, therefore their actual use depends on users' capability to recognize and accept the added valued provided by the PSS;
>
> The customers are supposed to use the PSS in complete autonomy; this means that in the prototyping and prelimi-

21 J. Maher, M. L. a. P.,"Modelling Design Exploration as Co-evolution" *Microcomputers in Civil Engineering* 11:3 (1996): 195-210; M. I. Maher, Josiah Poon, and Sylvie Boulanger, "Formalising Design Exploration as Co-Evolution: A Combined Gene Approach" in *Advances in Formal Design Methods for CAD* J. S. G. a. F. (Sudweeks, Chapman & Hall, 1996): 1–28.

22 Ramaswamy, *Design and Management of Service Processes*.

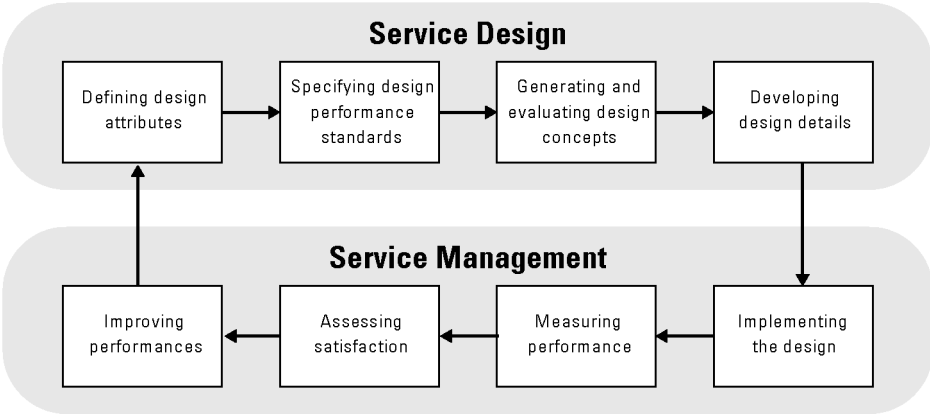


Figure 4
The service design and management model.[23]

nary definition phases the largest number of possible ways of using the PSS must be anticipated.

In such cases, some evaluation criteria are missing that would be necessary to support all of the decisions in the service design phase. (It would be difficult, for instance, to specify design attributes and performance standards if service requirements are not clearly stated.) Such criteria would emerge once events and actors of the service are better described.

Information science may provide interesting methodological suggestions to the design activity when such conditions occur. Like services, information systems are a series of events distributed in time, in which users are supposed to interact with a predesigned set of elements. The evaluation of the adequacy of the elements and their structure must be satisfactory before the system is proposed to the customers. This requires an iterative process involving the phases of project planning, analysis, design and implementation,[24] such iteration starts before the proposition of the system to the client and continues during the use phase.

Particularly relevant to the design of services are the methodologies needed to investigate the system requirements. The list of requirements for each functional element of a system is generated by the proposition of scenarios, i.e., a description of events (use cases) in which customers are likely to use the system. Use cases are described in a diagrammatic way and with a plain language description of the flow of events, actors involved, pre-and post-condition for each use case, alternative paths, and other relevant elements. The description of use cases usually is based on templates that list the relevant information required for each use case.[25] Table 1 is a simplified use case for the requirements of a specific function (organize meetings) for an online diary to be proposed to TeleCentra nomadic users. The example in Table 1 should be completed with the description of alternative use paths.

23 Ibid.

24 J. W. Satzinger, R. B. Jackson, et al. *Systems Analysis and Design in a Changing World* (Cambridge, MA: Course Technology, 2000).

25 D. Leffingwell and D. Widrig, *Managing Software Requirements: A Unified Approach* (Reading, MA, Addison-Wesley, 2000); D. Kulak and E. Guiney, *Use Cases: Requirements in Context* (New York, Boston, London: ACM Press, 2000); Addison-Wesley, J. W. Satzinger, R. B. Jackson, et al., *Systems Analysis and Design in a Changing World* (Cambridge, MA: Course Technology, 2000).

Table I

Simplified description of a use case for the definition of requirements for an online diary (TeleCentra project).

Use Case Name	**Organize Meetings**	
Actor	Meeting Inviter, Meeting Invitees	
Description	When a user decides to schedule a meeting, s/he can make use of these settings by simply stating the requirements of the meeting, and the system then can use the information in each invitee's calendar to decide on a suitable date and time, where that information is accessible. Where configured as such, the invitees can respond with an alternative proposal that is more suitable. Alternatively, a user can simply send out an invitation with a set date and time, and invitees can manually respond by either accepting or declining the invitation, with or without the option to negotiate the time.	
Preconditions		
Postconditions	1. A meeting is scheduled and recorded in the system (calendar function)	
Normal Course	**Actions**	**Actors**
	PHASE I: Construct meeting invitation	
	Enter meeting requirements into the system; these should include the intended participants, and any space requirements and timeframe constraints (between certain dates and times). For certain meetings, participants might be listed as optional or compulsory, indicating a level of flexibility in case no time meets every stated requirement.	Meeting Inviter
	Where possible (based on personal calendar settings, UC-04), the system examines the calendars of each meeting invitee in order to advise the meeting inviter of the most suitable meeting time.	Meeting Inviter, Meeting Invitees
	PHASE II: Send meeting invitations	
	Once a suitable meeting time has been suggested, the meeting inviter then can choose to send out invitations to the meeting invitees	Meeting Inviter
	PHASE III: Renegotiate meeting arrangements	
	The process then enters a negotiation phase, in which any meeting invitee that has his/her calendar configured as such may attempt to reschedule the meeting based on his/her availability (usually only necessary where visibility constraints meant that a suitable time was not chosen at step 2). This process may be repeated several times, and may involve several Invitees.	Meeting Inviter, Meeting Invitees (via the system)
	Once renegotiation is complete, the inviter and invitees are notified of the confirmed meeting time and location.	Meeting Inviter, Meeting Invitees
	PHASE IV: Confirm meeting attendance	
	Any meeting invitees who can attend the meeting then accept the invitation (manually or automatically); likewise, any invitees who cannot attend the meeting decline the invitation.	Meeting Invitees

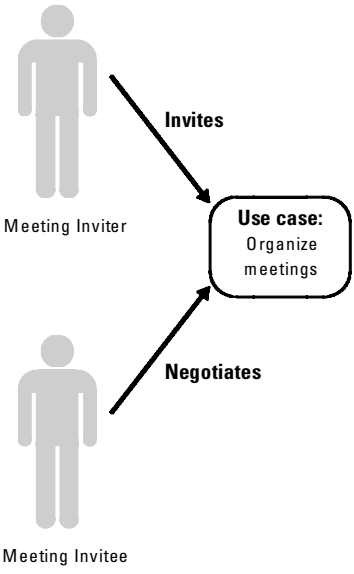


Figure 5
Example of use case diagram used in UML.

4.3 Technical Representation of Product-service Systems

The activity of design consists in the projection of a set of ideas into future configurations. Because of this, the design activity heavily relies on visual representation, which is critical in communicating a project to clients, in verifying the validity of the project, and in generating a plan that can be understood and executed by other actors involved in the design process.

Specific representation techniques have been developed for product design which highlight specific aspects of the product. Product designers are able to produce a blueprint of a product that will be unequivocally interpreted by those who will manufacture and/or buy the product, or will provide some of its components.

The blueprint of a PSS should contain indications about potential functions, interaction between actors, and functionalities and flows of events.

The diagrammatic representation of use cases (see previous section) focuses on the interaction between actors and the system. The most common method of representation used by the Unified Modeling Language (UML) in computer science consists of a simple diagram describing the actors, the use case, and the kind of relationship between them (Figure 5). This kind of representation does not contain indications about the time sequence in which the interaction occurs.

The graphic representation used in some marketing studies includes both the interaction between the elements of the system and the time sequence. In order to represent the time variable in the process, Shostack[26] considers process representation systems from different disciplines: the time/motion engineering (used to plan the manufacture and assembly of products), the PERT charting (used in management sciences to conduct time/cost trade off analysis) and the system and software design used in computer science to schedule the tasks in a software program.

The resulting technique suggested by Shostack uses elements of PERT charting (in particular the calculation of critical time), elements of time/motion engineering (in particular the representation of the flow diagram), and elements of computer system design (Figure 6).

A similar system also is proposed by Ramaswamy[27] who, in addition, proposes to specify the person or the organization responsible for each phase of the service (See Figure 7). Both of these techniques also make it possible to specify those processes that are directly visible to the customers, as well as those that are managed in the "back office."

The techniques proposed by Shostack and Ramaswamy do not take into account other variables of a PSS, whose specification would provide further information for the design process. In enabling services, for instance, it would be relevant to specify which functions are performed by the users and which by the service

26 Shostack, "How to Design a Service."

27 Ramaswamy *Design and Management of Service Processes*.

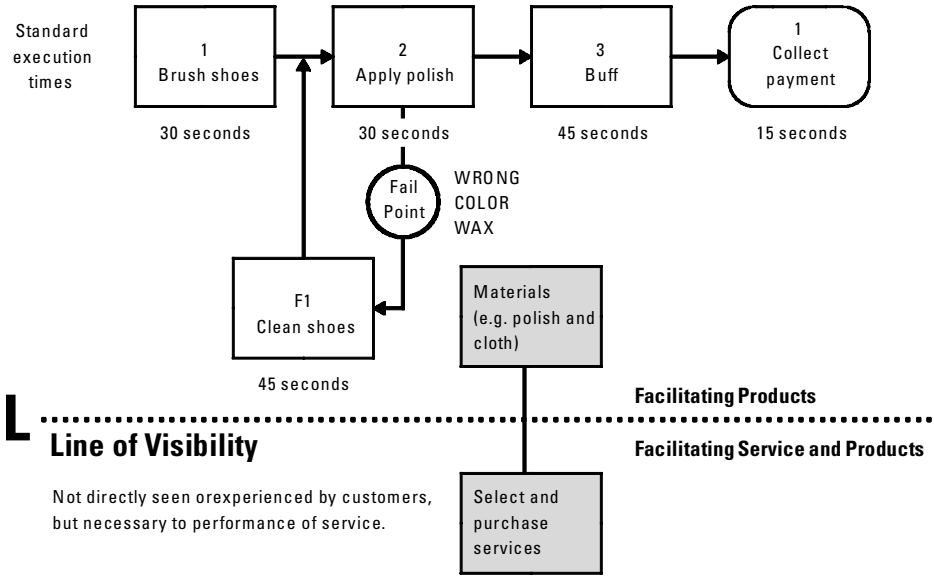


Figure 6
Representation of the flow of events in a sample service (street shoe shine) analyzed by Shostack.

provider, which functions are automated and which rely on human actions, in what kind of (physical and virtual) spaces is the service located and whether actions are based on movement between spaces or are located in a single place.

Figure 8 is the graphic representation developed for some use cases in the TeleCentra project. The project consisted in the development of a PSS (a telecenter) to support nomadic workers. The PSS included both physical spaces (reception and temporary offices) and technological infrastructures (computers, intranet, and Internet). A telecenter is an enabling service in which nomadic workers (i.e., people working away from their traditional office) can perform office-like functions with the support of technical assistance, reception services, and several automated functions.

The representation in Figure 8 includes elements of Shostack's and Ramaswamy's graphics, but also distinguishes spaces, actors performing the functions, automated tasks, and movement actions. Further additions to the representation in Figure 8 could consist in the specification of the time employed by each function, as in Shostack's graphic.

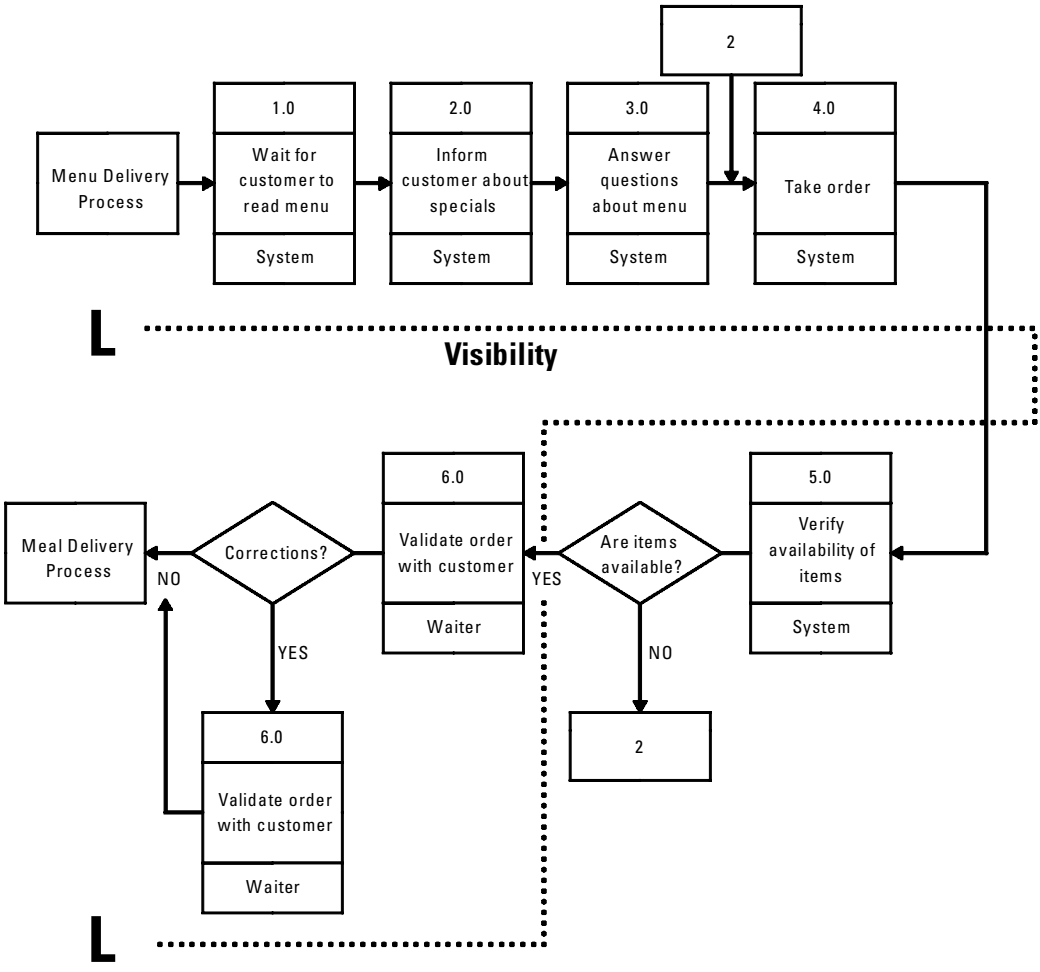


Figure 7
Representation of the process for the order-taking in a restaurant.

Other methods proposed for the graphic representation of PSS are PetriNets, used to model complex systems including the development of a series of transactions in time (proposed by Pacenti[28]) and other methods borrowed from disciplinary areas that are closer to design such as storyboards (i.e., simple graphic representation of actors and actions happening during the development of a service).[29] This method, borrowed from screenplay techniques, would prove useful not only in the design phase, but also in the use phase, to guide the customer to a correct use of the service. However, such methods can be inadequate to represent a flow of events that is not linear, such as feedback loops and multiple options.

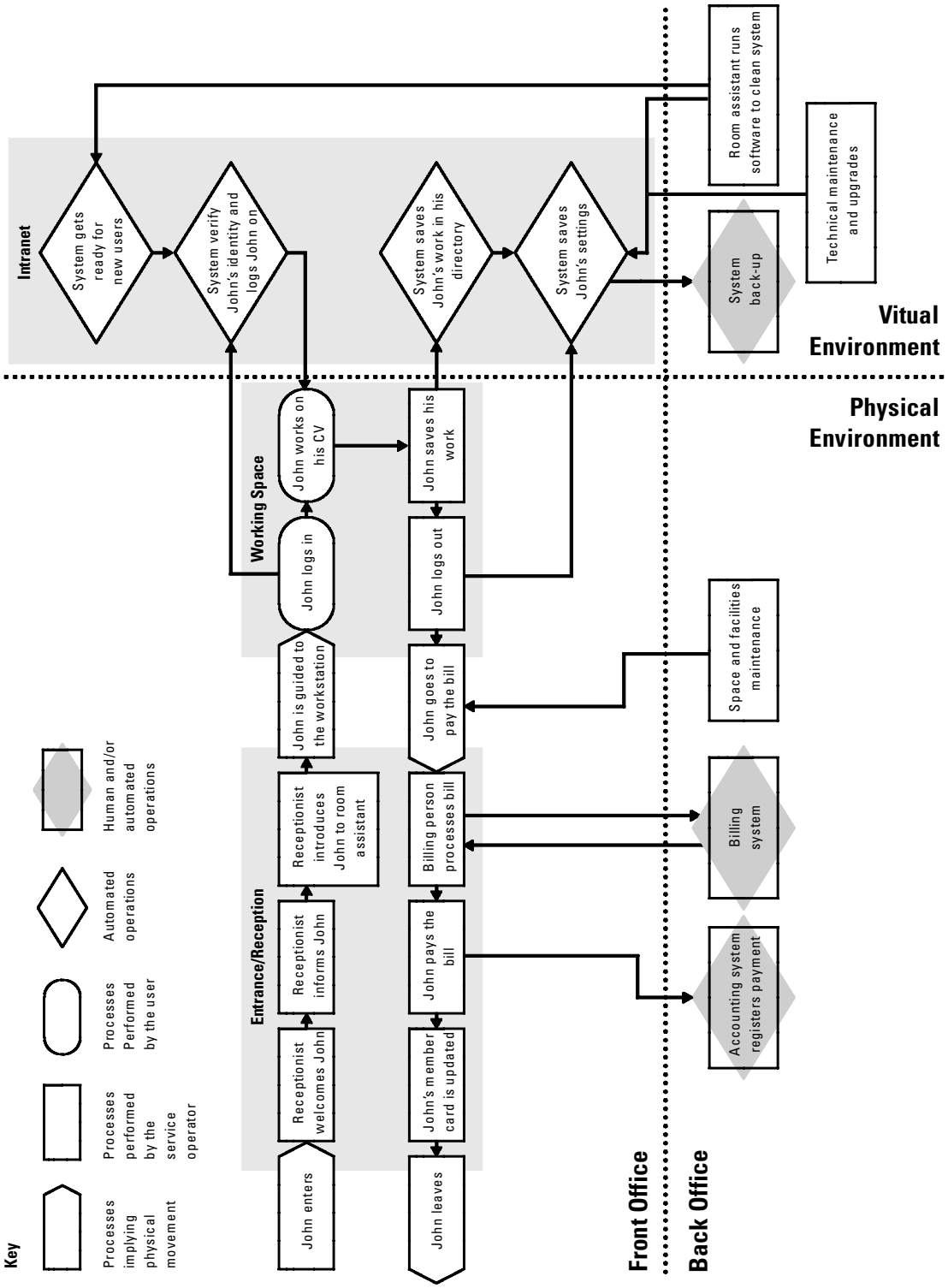
5 Conclusion

The disciplinary contributions contained in this paper cover different aspects of the application of the design discipline to PSS. Although considered as a part of the management and marketing domain, PSSs efficiency, visibility, and usability, are, in fact, heavily reliant on design aspects. More important, the design perspective

28 E. Pacenti, "La Progettazione dei Servizi tra Qualità Ambientale e Qualità Sociale" *Di Tec* (1998) Milano, Politecnico di Milano.

29 Ibid., and Shostack "How to Design a Service."

Figure 8.
Representation of a use case for the TeleCentra project.



adds critical insights related to specific aspects of the development of PSS.

The involvement of designers in the development of PSS requires the repurposing of methodological tools used in management and marketing disciplines, but also the introduction of new tools derived from other disciplinary domains such as design management and information system design. Such tools would be useful to specify aspects of the design process for PSS that sometimes are considered as complementary in marketing and management disciplines. More specifically the tools introduced by the analysis of services from a design perspective would focus on aspects related to the quality of the environment in which the service takes place, the quality of interaction between actors and technologies and the interaction between different cultural, social, and technological backgrounds derived from the actors' socio-technical frames and from the socio-technical frames embedded in technological infrastructures used in the PSS.

A designer's perspective focuses on how a PSS *takes form* in all of its phases. Indeed, understanding users' technological and cultural frames, modeling their behavior in relation to the service and representing material and immaterial aspects of a service in order to generate a service blueprint are activities that are very close to the design discipline and therefore can take advantage of several aspects of designers' existing methodological approach.

The exploration proposed in this paper, however, still is fragmentary because of the lack of a complete technological framework for the design of PSS. Such a framework should be developed on the basis of the existing contributions from the management and marketing disciplines, and in light of a debate within the design community itself. This paper hopefully provides some useful elements to help fuel such a debate.