
TOWARDS A COMPREHENSIVE DESCRIPTIVE TOOL TO DESIGN COMPLEX SERVICES

Alexis Nicolaÿ, Sylvain Lenfle

I³-CRG, École polytechnique, CNRS, Université Paris-Saclay

Abstract

This article aims at tackling the issue of complex-services design. Such design can be apprehended from different perspectives: new service design, service production optimisation, in service improvement, and so on. Many design tools, either specifically developed for services or adapted from the “product world” exist. Some date back to the 1960. However, knowing which tool to use, for which service and when is often a challenge for practitioners. Our contribution engages in a “specification” effort towards an integrative service tool or method that could be used in any situation. We ground this effort in a literature review on the specificities of services and on the evaluation of existing service design tools.

Keywords: Service design, service improvement, blueprints, IHIP, co-production, service value

INTRODUCTION

“One of the most difficult aspects of dealing with a service is describing it” (SHOSTACK, 1992). Used as the introductory sentence in one of the most cited service-related contributions, this more than twenty years-old premiss did not lose an ounce of truth today. Since then, service description has been the object of an accelerating stream of research spanning various domains: service marketing, service operations management, service engineering and so on. With service design seen as “perhaps the most crucial factor for quality” (GUMMERSON, 1993), the need to accurately describe services is a growing concern. This is particularly true in light of the “servitization of manufacturing” (NEELY, 2007), with services expanding rapidly from a highly-dominant business-to-consumer (B2C) paradigm to include an increasingly important business-to-business (B2B) logic.

The way we will define a complex service is not through some extra characteristic but by the **combination of rather classical service constraints**. The aim of this contribution is to identify, describe, characterize and evaluate the main tools currently available from a complex-service design perspective.

To do so, we will first examine the literature in order to extract the whole set of constraints inherent to service description. In the purpose of clarity, we structured this literature review around five main service-design constraints. They translate into necessary **service-design attributes**:

- **Non-linear design;**
- **Dynamic design;**
- **Co-production-oriented design;**
- **Multiple-actors design;**
- **Value-oriented design.**

Our hypothesis is that a service-design tool presenting all five attributes would be suitable for a comprehensive description of complex services. On the other hand, all complex services may not require the full extent of all five attributes to be thoroughly described. More, some attributes may be more critical than others, for the same service, depending on service maturity and the purpose of the design. For instance, the most critical attributes for a new service design may not be the same as the most critical ones for the same service in a service improvement perspective (once the service has

reach maturity). The aim of our five attributes is therefore to provide a “specification”, in the engineering sense of the term, for a comprehensive service design tool, capable of accurately design potentially all complex services and suit all design purposes: future service design, new service analysis, mature service improvement, service recast, and so on. The value of such an integrative service design tool would be, for service practitioners, to spare the effort of navigating between the variety of available tools in order to find the one that best fit their needs at the moment. By having an integrative tool, we believe that practitioners would avoid the risk of selecting a tool that would not have been optimal, improve communication within the company and towards the customers and, most importantly, be able to benefit from previous modelling throughout the life of the service.

In our “specification” effort, we will first provide a definition for each attribute. Secondly, drawing from the prominent literature, we will aim at justifying the need for the attribute. Thirdly, in the perspective of providing an evaluation grid for existing service-design tools, we will gather a list of Evaluation Criteria (EC) for each attribute. Finally, we will illustrate each evaluation criterion using a simplified case of military-aircraft repair service as a running example throughout the section.

Our second step will be to identify and describe the available service-design tools. In order to construct a base of comparable tools, our focus will be on process-based service-design tools. Other service visualisations may take on different approaches. Among those are (cf. SEGELSTRÖM & HOLMLID, 2011): Customer Journeys, Storyboards, Desktop Walkthroughs, Personas (PRUITT & ADLIN, 2006), System Maps, Characteristics-based models (GALLOUJ & WEINSTEIN, 1997; GALLOUJ & TOIVONEN, 2011/2), or Business Ecosystems (CHESBROUGH, 2011). Even though the tools above present undeniably interesting features, they were deliberately excluded from the perimeter of this review. The reason behind this voluntary bias towards process-based models is twofold. Firstly, process-based can be used to address a wider range of design purposes. Secondly, from our servitization of manufacturing perspective and particularly with respect to service design in traditionally product-oriented firms, process-based models are more likely to fit in the structuration of a broader service-production process.

Our panel of design-tools will comprise:

- **Blueprints and blueprint-based models** (SHOSTACK, 1992; BITNER *et al.*, 2008; EICHENTOPF *et al.*, 2011; WREINER *et al.*, 2009; PATRICIO *et al.*, 2008, 2011);
- **Process Chain Networks (PCN)** (SAMPSON, 2012);
- **Structured Analysis and Design Technique (SADT)** (CONGRAM & EPLEMAN, 1995);
- **Feedback Control Systems (FCS)** (DI MASCIO, 2002, 2003);
- **Business Process Modelling Notation (BPMN)** (DECKER *et al.*, 2008).

For each of them we will provide an illustration and a summary of the model highlighting its key features.

The design tools in the above list come from various academic affiliations and state different objectives for the service design process. The following table summarises this first introduction to the different service tools that we will further on evaluate.

Service design tools	Origins	Objectives		
		Initial design	Delivery	Improvement
SHOSTACK, 1992	Logistics, decision theory and computer system analysis. Marketing roots.		X	X
BITNER <i>et al.</i> , 2008	Directly based on blueprints with emphasis on customer experience design, service design and innovation	X	X	X
EICHENTOPF <i>et al.</i> , 2011	Based on blueprints with an emphasis on value co-creation from the Service-Dominant Logic (VARGO & LUSCH, 2004, 2008) and new institutional economics	X	X	?
WREINER <i>et al.</i> , 2009	Based on blueprints. Addresses the need for more the two participants in the service production through a case study (car park)	No specific perspective, contribution empirically grounded in the case study		

Service design tools	Origins	Objectives		
		Initial design	Delivery	Improvement
PATRICIO <i>et al.</i> , 2011	Claims a multidisciplinary approach. Aims at synthesizing contributions from new service development, interaction design and service design. Reference to blueprints	X	X	X
SAMPSON, 2012	Affiliation with Service Operations Management (SOM). Draws from a review of prior visualisation frameworks (including many discussed in this article)	X	X	X
CONGRAM & EPLEMAN, 1995	The authors discuss the benefits of using SADT (a product engineering tool) for services. Points out to the limits of blueprints.		X	X
DI MASCIO, 2002	Aims at answering the "call for more research in the application of engineering principles to the design and delivery of services, an area coined 'service engineering'" (BROWN <i>et al.</i> , 1996)	X	X	X
DECKER <i>et al.</i> , 2008	The authors present their combination of tools (originating in computer sciences) to describe complex services. The article does not make any reference to other service design tools	X	X	?

In looking at the “origins” of each tool, we aimed at identifying both the academic affiliations stated by the authors; and the need they identified as the grounds on which to build their new or improved models. Looking at the “origins” column in the table above, it is quite clear that blueprints have a very strong dominance. All but one article (apart, obviously from L. Shostack herself) see blueprints as the pioneering tool to design services. Most position their new or improved models as an answer to a particular weakness of blueprints. Also noteworthy is the origins of “non-blueprint-based” models. All last three models in the list are product engineering tools used for services.

Having a look at the “objectives” of the different service design tools, we wanted to identify to what purpose the tools were (explicitly) meant by their authors. To do so, we looked for explicit references in the articles, to three generic instances of service design: new service design (often linked to innovation), service delivery (often linked to operational performance) and service improvement (the recast of mature services to improve their performance or adapt them to an environment that evolved). We were rather surprised to realise that most authors positioned their models across all three instances. Moreover, although explicit, the references to the objectives of the tools were often limited to a few general introduction sentences. This last point at least partially explains the confusion around which tool to use in which instance of service design. It also reinforces of objective of “specifying” a comprehensive service design tool.

Once we will have formally introduced our five attributes, their associated evaluation criteria and the main features of the different service tools, we will present an initial evaluation of the tools against the evaluation criteria and discuss what the main difficulties in building an integrative service-design tool might be. This constitutes the first step of a larger research project that aims at testing this tool with on-going case study at a large defence firm. Therefore, we encourage academics and service practitioners to use our evaluation matrix (be it on the tools we presented or others) and challenge our findings..



1. THE 5 ATTRIBUTES OF A SERVICE DESIGN TOOL

The aim of this section is to highlight the different attributes that a modelling tool should have, in order to fully describe complex services. Based on our literature review five attributes were identified; we thereafter justify the need for these attributes with regards to complex services design. Finally, for each attribute, we identified a series of 5 Evaluation Criteria (EC) by which we will further-on evaluate the service design tools presented in section 2.

1.1 Non-linear design

Definition of the attribute

The non-linear attribute of a service design tool refers to the ability of the tool to **depict the variety of proceedings and outcomes expected to happen when running a service**. As stated by Faiz Gallouj and Olivier Weinstein (1997) "Each Service transaction may give rise to a certain set of characteristics"¹. In other words, unless the modelling is to be repeated for each instances of the service performance, the modelling tool must be able to apprehend the variability which occurs not only at the level of overall-process outcome, but also at each production-stage's input and output levels. Even considering that the modelling can be repeated each time the service is to be performed, a linear tool would either assume that the precise succession of process-steps as well as their inputs and outputs can be predicted. Such predictability is rendered impossible by the notion of service heterogeneity.

Justification for the attribute

In the literature (cf. BALIN & GIARD, 2006), this impossibility to predict the sequence of inputs, process-steps and outputs in a service production is captured by the notion of **heterogeneity**². Heterogeneity is defined as "variability between services" (KOTLER, 1977) meaning that the same service can be performed in various manners. The same notion is found under Aruna Shekar's (2007) "variability", stating that "[the process] varies from one service to another within the same category". The reason behind this heterogeneity is the infinite number of situations that can happen before, during and after a service is produced. In this regard, Carole Congram and Michael Epelman identified a "source of frustration" when "a service manager develops a process model and attempts to make it cover every conceivable purpose. This "fallacy of completeness" invariably leads to failure because employees and customers generate an inexhaustible variety of situations that is impossible to cover within any one comprehensible model" (CONGRAM & EPELMAN, 1995). This "fallacy of completeness" poses the question of the range of possible variations to be depicted by the design tool. In our view, the trade-off between the readability and the accuracy of the service description set its outer perimeter. In other words, rather than trying to foresee every possible variation in the service production at the detriment of readability, the description should focus on the most likely, impactful ones.

Attribute's evaluation criteria

The heterogeneity, described above, can manifest itself in different manners during the service production. First, the outcomes of the overall service-production process or of individual process-steps may vary. The first level is to apprehend such variations in a binary success / failure manner. This assumes that if a failure point happens, the production process stops and the service fails (corresponding to Evaluation Criterion-A1, see Table 1.).

Another, more refined way of apprehending outcomes variations is to allow for different series of process-steps to lead to success of the service production (EC-A2). An example would be, for a "payment" sub-process if success can be achieved if one of the steps "use credit card", "use cash" or "use bank check" is successful.

Still considering outcomes variations, the service production result may not be described in a binary manner (EC-A3). For instance, when taking your car for a routine check in a garage, the result of such service can as well be (among an infinite panel) "all is fine" or "a problem was diagnosed and can be repaired" or "your car will hopelessly break down the next time you turn the contact key".

The same line of reasoning can be extended from the final service-production result to the outcomes of each individual sub-processes and steps (EC-A4). In other words, individual process-steps would no longer be described as having a single possible outcome (or two if considering failure as an outcome) but a range of possible results, leading to different subsequent sub-processes or steps.

Lastly, until here, we have considered that a sub-process or a process-step can only have one possible input. To account for service heterogeneity, it is to be considered that multiple or alternative inputs might need to be described (EC-A5). The combination of multiple and/or alternate inputs and multiple and/or alternate outputs for each sub-process or process-step in the service production,

¹ The word "characteristics" here refers to technical artefacts, competences and processes composing the service.

² Here, heterogeneity is to be understood in the sense of variability

makes for a fully non-linear description. In that case, it is to be noted that a possible output of a process-step can be the input of a preceding one. This allows iteration loops in the service design.

The following table (Tab. 1) presents the five evaluation criteria for the non-linear design attribute.

Non-linear design		
Evaluation criteria (EC)		Description
A1	Does the representation show service-production failure points in the process?	The representation shows failure points in the process. Materialisation of a failure point means failure of the service production.
A2	Does the representation allow for alternate chains of binary events leading to a given outcome?	The representation shows failure points in the process. Materialisation of a failure point triggers an alternate chain of process-steps / sub-processes leading to service "success".
A3	Does the representation allow for multiple and/or alternate outputs of the service production process?	The representation shows multiple and/or alternate outcomes of the service production (beyond binary success / failure outcomes).
A4	Does the representation enable multiple and/or alternative outputs for a given process-step?	The representation shows multiple and/or alternate outcomes at the process-step / sub-process levels leading to multiple and/or alternate chains of process-steps / sub-processes and service production outcomes.
A5	Does the representation allow for multiple and/or alternative inputs for a given process-step?	The representation allows for multiple and/or alternate inputs for a process-step / a sub-process

Tab. 1 – Evaluation criteria for the non-linear attribute of a service design tool

To illustrate those criteria, let us examine the example of a military-aircraft repair service (see Figure 1 below).

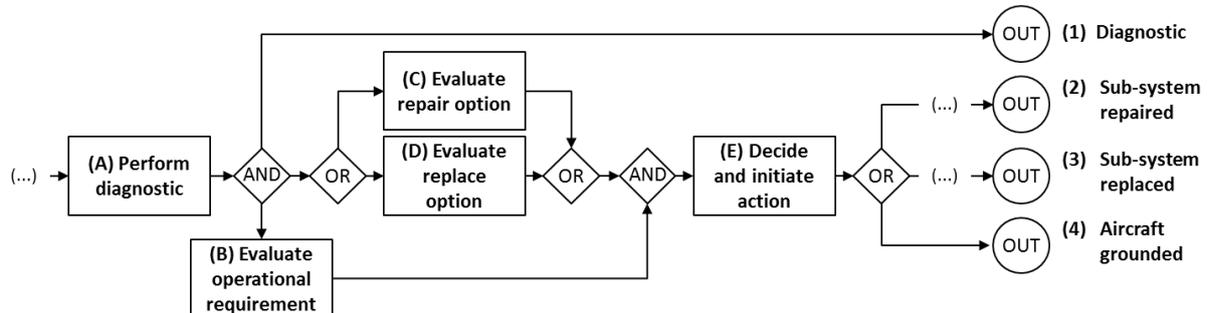


Fig. 1 – Simplified example of a military-aircraft repair service

A simplified way of looking at the outcomes of such a service would be to consider the first outcome (1) as the diagnostic itself. It has value in itself for military authorities and the aircraft-manufacturer even though it is not the final value of the service. Alternate outcomes in addition to and based on the diagnostic can be either the faulty sub-system being repaired (2), replaced (3) or the aircraft being grounded (4) in a more or less permanent manner. This illustrates EC-A3 in the sense that the service has both multiple and alternate outcomes and cannot be described in a binary success/failure manner. The example in Fig. 1 also illustrates EC-A4 and EC-A5. The outputs of **sub-process (A)** "Perform diagnostic" are (B) "Evaluate operational requirement" for the aircraft (based on the operational environment, available aircrafts in the fleet and so on) and either (C) or (D) "evaluate repair or replace options"³. This illustrates EC-A4 in the way that multiple and alternate outputs are represented at the sub-process level. Finally, (B), (C) and (D) are inputs to **sub-process (E)** "decide and engage action". The decision to ground the aircraft the engine or engage a repair / replacement of the faulty sub-system is to be based both on operational rationales (from (B)) and technical input (from (C) or (D));

³ In this example, we assume that the diagnostic eliminates one of the options (either repair or replace) for the faulty part. Otherwise, the logical gate between C and D would be AND instead of OR. Evaluation of the option (C) or (D), means identification of delays, costs, availability or spares and so on.

this shows alternate and multiple inputs to a sub-process (EC-A5). Note that this diagram could also present iteration loops.

1.2 Dynamic design

Definition of the attribute

We define the dynamic attribute as the **capacity of the design tool to describe the service in a time-dependant manner**. In other words, the tool must be able to represent the behaviour of the service over time.

Justification for the attribute

Two main widely accepted service specificities justify a time-dependant approach. The first one is **intangibility**. Consistently found in services definitions and descriptions across the literature, intangibility has been given many different meanings (cf. BALIN & GIARD, 2006). Although small distinctions appear, the most common definition is the physical intangibility (KOTLER, 1977; BATESON, 1977; ZEITHAML et al., 1985; BOWEN, 1989; BITNER, 1992). Variations around this physical intangibility include the concepts of “immaterial, not corporal” (RATHMELL, 1966; SHOSTACK, 1977, 1982; DE BANDT, 1995) and “untouchable, impalpable” (BATESON, 1977; SHOSTACK, 1977; FLIPO, 1985; SCHMENNER, 1995). The most explicit definition of intangibility is the one made in comparison with goods: “goods exist in both time and space, services exist only in time” (HILL, 1977, 1999; SHOSTACK, 1982).

These views alone seem to justify our assumption that a time-dependant description of services is needed. However, a second widely accepted characteristic of services reinforces this justification: the notion of **perishability** of services. Again, Savas Balin and Vincent Giard (*ibid.*) identified two main definitions. The first one is that “services can’t be saved, stored for reuse at a later date, resold or returned (thus the fundamental role of yield management)” (KOTLER, 1977; ZEITHAML et al., 1985; ZEITHAML & BITNER, 2003; EDGETT & PARKINSON, 1993; BOWEN & FORD, 2002; SHEKAR, 2007). The second definition of perishability is that “unused service capacity of one time period cannot be stored for future use (which yields capacity management problems)” (SASSER et al., 1978; LOVELOCK, 1983; LOVELOCK & GUMMESSON, 2004; DARMON et al., 1996; PRIDE & FERREL, 2003; FITZIMMONS & FITZIMMONS, 2004).

The combined implications of these two definition in our service design perspective is that neither the resources used to produce the service, nor the actual output of such service can be described independently from the timeframe in which they appear.

Attribute’s evaluation criteria

Several characteristics of a service design tool are necessary to fully account for time-dependency of the service description. The first one is the presence of a unique start point and of clear end point(s) to the service production process (corresponding to Evaluation Criterion-B1, see Table 2.). Multiple start points would mean that several timelines coexist in the service production, which is incompatible with a clear production process. This postulate is to be understood for the actual service-production only. Indeed, anterior actions might be necessary to enable the service production and, as such, should be included in the description (e.g. procurement of technical artefacts). In such cases, the representation should clearly state that such actions are not part of the service production itself. Multiple end-points are possible if the service description is non-linear.

The second essential trait of a time-dependant service-representation is the chronological order by which sub-processes and process-steps should be arranged (EC-B2). The process-steps should be shown in the order they will follow during the service production (rather than under a non-sequential list for instance).

Furthermore, the representation of the service should be able to highlight any alteration in the process timeline (EC-B3). We define such alterations as any element, exterior or inherent to the chain of process-steps, impacting positively or negatively the timeliness of the service production. This notably includes waiting times.

Still for the sake of accurately describing the time flow in the service description, the representation should formally differentiate between immediate actions and lengthy sub-processes (EC-B4). For instance, “print a copy of annual report” and “write annual report” have very different impacts on the

service production timeline. The first is merely a process-step, where the other is a complex sub-process (composed of many process-steps).

Finally, very much like in the production of products, concurrent engineering might apply to services. In other words, several sub-processes and steps might be designed to be performed simultaneously. Such simultaneity should be depicted in the service representation, while still maintaining a coherent timeline (EC-B5).

The Evaluation Criteria for the dynamic-design attribute are summarized in the table below (Table 2).

Dynamic design	
Evaluation criteria (EC)	Description
B1 Does the representation of the service – production have clear start and end points?	The reading of the service description start at one point and ends at another (several end points are possible if the service description is non-linear).
B2 Are the different process-steps arranged in a chronological manner?	The representation shows the successive process-steps in the order by which they will be performed during the service delivery.
B3 Does the representation show alterations in the process timeline?	The representation is able to show speed-up or slow-down instances in the service process.
B4 Does the representation distinguish between immediate actions and lengthy processes?	Even though no precise duration is attached to each action, the representation allows the reader to immediately identify (near) instantaneous actions from complex and lengthy processes.
B5 Does the representation allow for simultaneous actions or events?	The representation is able to show simultaneous actions or events within the overall service delivery while still maintaining a clear timeline.

Tab. 2 – Evaluation criteria for the dynamic attribute of a service design tool

In our previous representation of the military-aircraft repair service (Fig. 1), the time-dependency is fairly apparent. There are a clear start point (before sub-process A), multiple end points (the outcomes) and the different steps are arranged in chronological order (EC-B1 and B2 are satisfied). In addition, by using a logical gate “AND”, the representation shows that (B) and either (C) or (D) are simultaneous and that completion of both is necessary to start (E) (EC-B5). What is not apparent in Fig.1 is the hierarchy of events (EC-B4). In this sense, it is reasonable to think that (C) “evaluate repair option” may have a far stronger time-impact of the service production than (B) “evaluate operational requirement”; a different representation might apply. If there is a large duration gap between (B) and (C), the addition of a waiting point (EC-B3) before or after (B) should also be considered. Another refinement, not included in the list of evaluation criteria, could have been to add time constraints for one or several sub-processes. For instance, if the service is to be produced in urgency, a twelve-hour deadline for (C) or (D) could apply. This should be reflected in the representation as well as the consequences if the deadline is not met.

1.3 Co-production-oriented design

Definition of the attribute

We define the co-production-oriented attribute of a service design tool as its **capacity to describe customers-related elements in conjunction with and at the same level of granularity as suppliers-related elements in the service production**. Such elements notably include front and back-office sub-processes, support sub-processes and technical artefacts.

Justification for the attribute

The implication of customers’ actions relates directly to the notion of **co-production** of services. This notion itself derives from the classical concept of **inseparability** of services, a notion consistently found in the literature. Three main definitions of inseparability are identified. The first one, also the most widespread, relates to the “inseparability of customers and providers in the service production” (HILL, 1977; GRONRÖOS, 1984, 1988; CZEPIEL et al., 1985; BITNER, 1992; SCHMENNER, 1995; LOVELOCK, 1983; LOVELOCK & YIP, 1996; LOVELOCK & GUMMERSON, 2004) and therefore

directly describes a co-production. In other words, as services are produced “inseparably” by the provider and the customer, their respective roles in the design of the service should be set on an equal footing. This first conclusion goes against the tendency of many of the available design tools to centre the service description on a provider’s perspective and to only imply most of the customers’ actions. In the Service-Dominant Logic, “The customer is always a co-creator of value” is the “Foundational Premise” number 6 (VARGO & LUSCH, 2008).

The second definition of inseparability is the “simultaneity of production and consumption” (KOTLER, 1977; SASSER et al., 1978; ZEITHAML et al., 1985; DE BRANDT, 1995; BOWEN & FORD, 2002; SHEKAR, 2007). In our perspective of service design, this second definition implies that one could not describe separately (even very thoroughly) the actions of the provider from the actions of the customer. The third definition of inseparability is the complementarity of front-office and back-office in the service production (CHASE, 1978). In this regard, both should appear in the service description, on the providers’ side as well as on the customers’ one.

Attribute’s evaluation criteria

In light of the above, the Evaluation Criteria for the co-production-oriented attribute are quite straightforward (see Table 3). The design-tool must allow both co-producers to co-exist in the service description (EC-C1). Criteria C2 to C5 relate to the completeness of what is described for both co-producers: front-office activities, back-office activities, support processes and technological artefacts.

Co-production-oriented design		
Evaluation criteria	Description	
C1	Are both the customer and the provider present in the service description simultaneously?	The representation identifies both the customer and the provider as participating actors in the service delivery. Actions from both actors pertain to the same service process
C2	Are front-office actions of both the customer and the provider described?	Joint actions or actions of both the customer and the provider happening in direct interface are represented in the service description.
C3	Are back-office actions of both the customer and the provider described?	Actions that are specific to the service described but are not front-office (in direct interface) on both the customer’s and the provider’s side are represented in the service description.
C4	Are support processes / actions of both the customer and the provider described?	Processes and actions that are not specific to, but enable, the delivery of the service (on both the customer’s and provider’s sides) are represented in the service description.
C5	Are technical artefacts enabling the service for both the customer and the provider described?	The customer’s and provider’s technical artefacts necessary for the service delivery represented in the service description.

Tab. 3 – Evaluation criteria for the co-production-oriented attribute of a service design tool

Our running example in Fig. 1 does not present this co-production of the service. It is rather clear though, that a military aircraft repair service requires very strong involvement of the customer. The customer’s back office, support and technical artefacts are critical for instance in managing the stock of spares and repairs or providing the appropriate logistics.

1.4 Multiple-actors design

Definition of the attribute

The introduction of the multiple-actors design attribute aims at depicting the rupture with the classical view of services as relationships between two actors only (a provider and a customer) which denotes the strong B2C orientation of the literature. This rupture manifests itself at two levels. The first one is that both the customer and the provider may not be (very rarely are) unipersonal entities. In that sense, there very often are multiple points of contact between various entities within the organizations of the provider and / or the customer. The second level of rupture is that the production of the service may not be (very rarely is) strictly confined to a pure provider – customer relationship. Indeed, many other actors such as suppliers of the provider or exterior control / legal entities, may be critical to the

production of the service and should therefore be an integral part of the description. This is particularly the case in B2B environments.

In light of the above, we define the multiple-actors attribute of a service design tool as its **capacity to describe the entire system of actors that is relevant to the production of the service, as well as all the relevant inputs, processes and outputs inside the system.**

Justification for the attribute

To clarify the terms of system of actors, we turn to the notion of **servuction** developed by Pierre Eiglier and Eric Langeard (1987). They state that a service is “the result or the output of the servuction system”, which, in turn, is defined as “the process of creating a service by linking up various elements: the customer, physical medium, contact personnel, the service, the system of internal organisation and other customers [to which we add, “and/or other related entities”]” (EIGLIER & LANGEARD, 1987). As stated by Elina Jaakkola and Matthew Alexander (2014), “value co-creation takes place in the context of complex and dynamic network structures, or service systems” (JAAKKOLA & ALEXANDER, 2014). They define such service systems as “a value creation configuration comprising the exchange parties (providers and customers) and their networks that indirectly influence value co-creation”. The Multiple-actors attribute aims at capturing the “complex and dynamic” nature of such service systems. In the following, we use the term “actor” to indifferently refer to the “exchange parties (providers and customers)”, separate entities within them or external entities within their “networks”.

At this point, a precision should be made as to what is to be described. To accept this notion of multiple actors, inevitably raises the question of the relevant perimeter. Indeed, a balance between the comprehensiveness and the readability of the description is to be found. There are two main pitfalls in this regard. The first one is what one could call a “cascading effect”, where, in the sake of completeness, the description sets about developing an endless chain of actors, therefore diluting the truly relevant actors into unnecessary complexity. A symptom of such cascading effect could be the introduction of suppliers of suppliers of suppliers of (...) into the description. The second pitfall is the micro-division of actors, where, in the sake of accuracy, each actor is treated in the description as a separate point of interaction. Such micro-division multiplies the number of interfaces and renders the description difficult to understand. To avoid such pitfalls, the right levels of comprehensiveness and accuracy must be set in the service design process. In the perspective of defining the multiple interfaces attribute, we complement our initial definition by saying that the tool must be able to describe all of the relevant actors in the system, and only those.

Attribute’s evaluation criteria

The first four Evaluation Criteria (see Table 4.) relate to the service system network complexity. The first degree is the possibility for an actor, within the service description, to be in interface with more than one other actor (corresponds to Evaluation Criterion-D1). To satisfy this criterion, the representation must depict at least three actors but only one may be in interface with multiple other actors (e.g. centralised networks, see Figure 2a).

The second criteria captures networks where all actors can be in interface with more than one other actor (EC-D2) but not all actors can be in relation with each other (e.g. decentralised or fractal networks, see Figure 2b).

The third degree of complexity is reached when all actors can be (but not necessarily are) in interface with all other actors within the system (EC-D3) (e.g. distributed networks, see Figure 2c).

To satisfy the fourth criterion, the tool must be able to represent all actors relevant to the service production (EC-D4). This means that the tool must be extensible enough to accommodate a relatively large number of different actors.

Finally, to fully enable a multiple-actors design, the tool must be able to describe all actors within the service system as co-producers (EC-D5). The same elements than in the co-production-oriented

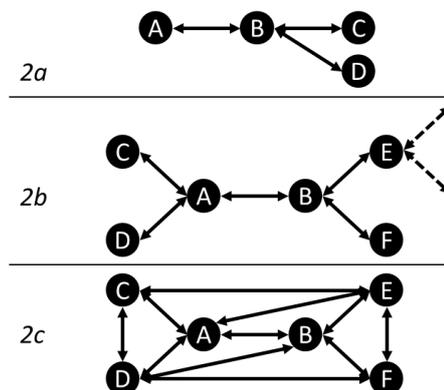


Fig. 2 – Service System network description

attribute apply: front and back-office process-steps, supporting sub-processes and enabling technical artefacts must be described.

The Evaluation Criteria for the dynamic-design attribute are summarized in the table below (Table 4).

Multiple-actors design		
Evaluation criteria		Description
D1	Can an actor be in interface with more than one other actor?	The representation allows for more than one interface for an actor (dual or multiple front-ends).
D2	Can all actors be in interface with more than one other actor?	The representation allows for all actors to have more than one interface (dual or multiple front-ends).
D3	Can any actor be in interface with any other actor?	The representation allows for any actor to have an interface (front-end) with any other actor.
D4	Can all actors relevant to the service description be represented?	The representation can allow for a large number of actors if relevant to the service description.
D5	Can all actors be described as co-producers of the service?	The representation allows the description of all actors as co-producers, including front and back-office actions, support processes and enabling technical artefacts when necessary.

Tab. 4 – Evaluation criteria for the multi-actors attribute of a service design tool

In our running example of the military-aircraft repair service (cf. Fig. 1), the need for the multiple-actors attribute is particularly visible. To illustrate it, let us take the example of sub-process (A) “establish diagnostic”. When faced with a failure, the first people involved are the users themselves: the maintenance crew at the airbase. Bearing the technical authority over the aircraft, the system integrator (the provider of the service) is also involved. In addition to this basic user – provider relationship, a number of actors may have a crucial part in establishing the diagnostic. A non-limitative list of them include: maintenance teams in other airbases which faced the same issue, the air force maintenance command, subsystems providers, procurement agencies, international support organisations (if the aircraft is a multinational project), and so on. Since there is not only one focal point (for instance, subsystems manufacturers may have direct interactions with the user and the system integrator), the network has to be distributed (EC-D3). Additionally, as we already saw with the co-production-oriented design attribute, support processes and technical means have a strong role in the service production (EC-D5).

1.5 Value-oriented design

Definition of the attribute

We define the value-oriented attribute as the capacity of the design tool to **make value creation apparent in the representation of the service production process.**

Justification for the attribute

The notion of value for a service is complex to apprehend. There are two main reasons for that. One is apparent in Aruna Shekar’s (2007) definition of “**intangibility**”: “[A service’s value] cannot be examined before purchase” (SHEKAR, 2007). This means that value is not inherent to the service but can only be appreciated in view of its output. This complexity is reinforced by a largely accepted particularity of services, i.e. the concept of **heterogeneity**⁴. This concept has three main acceptations in the literature. The first one, “the variability in personnel performance” (RATHMELL, 1974; SASSER et al., 1978; ZEITHAML et al., 1985), is one of the direct causes of the second one: “the variability of service quality” (EIGLIER & LANGEARD, 1975; GRONRÖOS, 1984). The third classical definition of service heterogeneity is “the inability to standardize the service output” (LOVELOCK, 1983; BOWEN

⁴ Note that heterogeneity has another acceptance, as a synonym of “variability” (mentioned earlier).

et al., 1989; VARGO & LUSCH, 2004). In all of the definitions above, the heterogeneity of services generates an impossibility to evaluate a service beforehand and once and for all.

The second source of complexity in understanding service value comes when trying to delimit what it encompasses. In the light of the work of Jean Gadrey (1991) a distinction could be made between immediate service (*service immédiat*) and rendered service (*service rendu*). This distinction is adopted by Gallouj & Toivonen under “a division between direct and indirect final characteristics” of the service, where the former “refer to utilities that manifest themselves during the service process”, whereas the latter are “utilities that manifest themselves over the longer term” (GALLOUJ & TOIVONEN, 2011).

The example of the medical diagnosis service by a general practitioner, developed in their article, illustrates this distinction. The prescription delivered at the end of the service represents the immediate service or direct characteristic. On the other hand, the improvement of the health of the patient may manifest itself long after the service and represents the rendered service. As noted by Jean Gadrey (*ibid.*), the value of rendered services is much more difficult to evaluate than the value of immediate services as its realisation is highly dependent on the specificities of the customers, on their ability to take advantage of the rendered service and on the general environment (e.g. the health and social context for medical services). Because such external factors are difficult to represent on a graphic description of a service, we will limit our acceptation of value to immediate benefits of the service production.

Attribute's evaluation criteria

The most common entry point to service value is the “value proposition”. In the famous Service-Dominant Logic (VARGO & LUSCH, 2004, 2008), one of the 10 Foundational Premises (FPs) is “FP7. The enterprise cannot deliver value, but only offer value propositions”. Value propositions are the common purpose of the actors involved in the service production. In this sense, making the value proposition explicit in the service description is a first good approach to service value (corresponds to Evaluation Criterion-E1, see Table 5.).

Despite a shared value proposition, one must keep in mind that the value determinants for the provider might differ from, and possibly be antagonists to, the value determinants for the customer. To illustrate such possible dichotomy, let us turn to our continuing example of military-aircraft repairs. Here we examine the service in an emergency situation (e.g. the aircraft is involved in a military operation abroad). The main value determinant of such service for the customer is time, which is to be minimized. In other words, the longer it takes to perform the service, the lower its value. On the other side, the main value determinant for the provider is costs, which are driven by the use of resources and also to be minimized to increase profits. If it takes more of the provider's resources to reduce the time to completion of the service, then the value determinants of the customer and of the provider are antagonist. In our views, such understanding of the different participants' value determinants is critical in depicting value for a service (EC-E2, E2+). Furthermore, the consequence of the inability to “standardise the service output”, as stated above, is that value is better approached at the process-step or sub-process levels than at the end of the service production (EC-E3, E3+).

Ideally, the tool should also be able to show the mechanisms by which the value is balanced between the actors (EC-E4). In our previous example, this value balance might be achieved through a time-limit-for-price target. In concrete terms, the provider agrees on a maximum time-to-completion for the service in exchange for a given price paid by the customer.

Finally, a fully value-oriented service-design tool should be able to present the control mechanism by which the value balance is maintained throughout the service production (EC-E5). Such control mechanisms may include adjustments in the sequence-of-events or in the levels-of-inputs during production. Continuing our previous example, such control mechanism could be the following. Assuming the agreed time-limit-for-price target was unlikely to be met, the control mechanism could adjust the service production in two ways. Firstly, it could modify the input: e.g. add more personnel to the lagging task. Secondly, it could adjust the chain of events by: shifting priorities, activate emergency procedures or on-call duty for instance. At the very least, if the production cannot be adjusted, the control mechanism should show how a new balance can be found (e.g. loop back to contractual arrangements with regards to penalty fees).

The 5 Evaluation Criteria presented above are summarized in Table 5.

Value-oriented design		
Evaluation criteria		Description
E1	Does the representation explicitly present a common value proposition?	The representation highlights the statement of the purpose of the service applicable to all participants in the service production (common value proposition).
E2	Does the representation show the value determinant(s) for the customer?	The representation highlights what the customer values in the service (the value determinant(s)).
E2+	Does the representation show the value determinant(s) for all actors?	The representation highlights what all actors value in the service (value determinants).
E3	Does the representation show the impact of each process-step on the customer's value determinant(s)?	The representation shows the impact (positive or negative) of each process-step / action on the customer's value determinant(s).
E3+	Does the representation show the impact of each process-step on all value determinants?	The representation shows the impact (positive or negative) of each process-step / action on all the value determinants.
E4	Does the representation show the balance mechanism between the different value determinants?	The representation shows the mechanism by which the (possibly antagonist) value determinants of the different actors / entities are balanced to every participant's satisfaction.
E5	Does the representation show a value control mechanism during the production of the service?	The representation shows the mechanism by which the process chain-of-events is adapted to preserve the balance of the value determinants during the service production.

Tab. 5 – Evaluation criteria for the value-oriented attribute of a service design tool

2. AN OVERVIEW OF EXISTING SERVICE DESIGN TOOLS

In the first section we elaborated an evaluation canvas, detailing attributes and criteria necessary for a comprehensive complex-service description tool. In this second section, we aim at presenting the main process-based service-design tools. By highlighting their main features, we pave the way for section three, where we will present an evaluation of the tools described in this section against the Evaluation Criteria in section one.

2.1 Blueprints

Blueprints are undeniably one of the pioneering, most widely acknowledged and most often used service-design tools. First introduced by Lynn Shostack (1982, 1984, 1987, 1992), they have been used as a building block for countless subsequent researches (FLIEß & KLEINALTENKAMP, 2004). There are, therefore, many adapted versions of Shostack's initial blueprints. In this section, we will first succinctly present the original model in its most mature version of 1992. We will then introduce a selection of subsequent improvements to the original model.

Original blueprint

Initially, blueprints were thought to highlight “three basic areas” of services (SHOSTACK, 1991): “First are the steps, tasks and activities necessary to the rendering of the service; in other words the service *process*. Next are the *means* by which the tasks are executed, typically some combination of people and goods. Finally, is the *evidence* presented to the customer” (*ibid.*). Figure 3, presented aside, shows a part of the article's summary blueprint on office supplies distribution. The blueprint is structured by the very top part, showing the sequence of events followed in performing the service (selling, ordering, delivery order, billing, statement & reports, payments). To each of these events, are linked the evidences

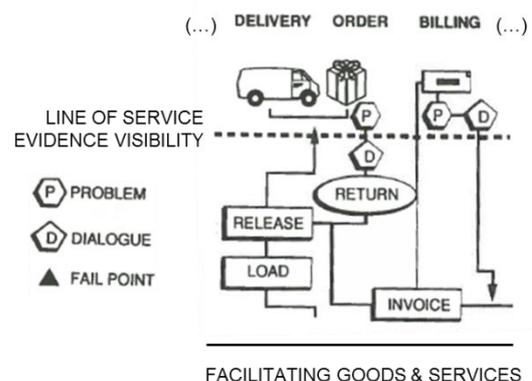


Fig. 3 – Original Blueprint (SHOSTACK, 1991)

presented to the customer (above the “Line of service evidence visibility”) and the process necessary to complete the event. Under the hard line at the bottom of the representation, are the facilitating goods and services (none appear in our detail in Fig. 3). The blueprint also introduces additional factors requiring the service manager’s attention. “Fail points represent tasks that are statistically known to have a high potential error rate. Problem points represent situations which require diagnosis, judgment and selection among several situations in order to achieve resolution” (*ibid.*). Finally, it is important to note that “(...) transaction flows, steps and sequences [are represented] regardless of where they may occur in the [provider’s] organisation”.

Improved blueprint

Over the years, successive waves of researches on blueprints altered the structure of the original model. These successive stages in blueprints development are well documented in S. Fließ and M. Kleinaltenkamp (2004). One of the most widely used developments around blueprints is the version of M.J. Bitner *et al.* (2008) (see Figure 4). Bitner’s canvas retains the Physical Evidence as the top space. The most crucial supplement is the introduction, below the physical evidences, of customers’ actions. Therefore, the service is no longer seen as a succession of steps imposed on the customer, but rather as the customer driving the rolling out of the service.

Whereas, in the original model, the actions and processes were represented “regardless of where they may occur in the organisation” (SHOSTACK, 1991), Bitner’s canvas divides actions that are:

- Onstage / visible contact employee actions, below the “line of interaction” and are face-to-face encounters (a strong emphasis is put on the “moments of truth” happening each time the line of interaction is crossed);
- Backstage / invisible contact employee, below the “line of visibility”, and therefore invisible to the customer but still performed by the contact employee in preparation for the encounters;
- Not performed by contact employees, along with support processes, below the “line of internal interaction”. As explained by Bitner (*ibid.*), “These are all of the activities carried out by individuals and units within the company who are not contact employees but that need to happen in order for the service to be delivered”.

This canvas is used, in the article, to depict an overnight hotel stay service.

Co-production blueprint

One step further in the description of customers’ actions, is the canvas presented by Thomas Eichentopf *et al.* (2011). Their main focus is to depict the fact that “customers are considered co-producers or co-creators of value” (EICHENTOPF *et al.*, 2011). They emphasize that “even during the interaction, customers might perform activities that are not visible to suppliers”. They therefore suggest the combined use of scripts and blueprints, “mirroring the service blueprint at the line of interaction” (see Figure 5).

Service Blueprint Components	
Physical Evidence	
Customer Actions	LINE OF INTERACTION
Onstage / Visible Contact Employee Actions	LINE OF VISIBILITY
Backstage / Invisible Contact Employee Actions	LINE OF INTERNAL INTERACTION
Support Processes	

Fig. 4 – Blueprint Components (BITNER *et al.*, 2008)

Co-production blueprint	
Facility activities	Line of implementation
Preparation activities	Line of order penetration
Support activities	Line of internal interaction
Backstage activities	Line of visibility
Onstage activities	Line of interaction
Onstage activities	Line of visibility
Backstage activities	Line of internal interaction
Support activities	Line of order penetration
Preparation activities	Line of implementation
Facility activities	

Fig. 5 – Co-production (EICHENTOPF *et al.*, 2011)

Apart from the duplication of the canvas for customers' activities, two main differences appear when compared to Bitner's blueprint. The first one is the suppression of the "Physical evidence" space. The second is the division of Bitner's "Support processes" space into "Support activities" and "Potential activities" on each side of a "Line of order penetration". "Potential activities" are themselves split by the "Line of implementation" between "Preparation activities" and "Facility activities". Such representation comes directly from previous adjustments of the original blueprints.

Multiple front-ends blueprint

Also based on Bitner's blueprints, Wreiner's *et al.* (2009) work takes on the question of multiple interfaces in a service blueprint. The backbone of their work is a case study on car park services, which "explores how blueprints can be applied in a situation with three key actors, all with different motives and wishes" (WREINER *et al.*, 2009). Figure 6 presents their "multiple front-ends blueprint". Here, the blueprint is seen from the park operator's perspective with two distinct front-ends: the motorist (the user of the car park) and the owner of the car park. This double front-end led to the duplication of Bitner's canvas on each side of the "supporting process" space (the owner of the car park is considered a customer of the operator). Practically, this duplication caused the dissociation of the onstage and backstage spaces of the operator, facing two lines of interaction (even though the term does not appear), one with the motorist and one with the owner. In their representation, the authors showed "how actions of the operator as well as actions of the owner can directly influence the onstage experience of the motorist" (*ibid.*). In this respect, emphasis is put on the contract binding the operator and the owner of the car park, as the mechanism used to define and distribute responsibilities towards the motorist.

Apart from an original blueprint canvas, Wreiner's *et al.* case study offers an interesting opening on two fronts. The first one is their aim to go beyond the traditional customer / provider relationship and recognize the role of third parties in the creation of services. The second interesting opening is the introduction of Business-to-Business (B2B) relationship. This constitutes an important breakthrough since, all of the models presented above, as well as many of the models to follow, are used exclusively in Business-to-Consumer (B2C) settings.

The Multilevel Service Design (MSD)

The last blueprint-based model we will present here, is the one developed by L. Patricio *et al.* (2008, 2011). More than an improvement of the blueprint canvas, the Multilevel Service Design (MSD) is presented as "a new interdisciplinary method for designing complex service systems" (PATRICIO *et al.*, 2011). The premises of the article are that "Technology trends have enabled the emergence of multi-interface [or multichannel] service systems through which companies manage relationships with their customers" (*ibid.*). With these changing interfaces, value can no longer be considered through tangible offerings (physical evidences in the blueprinting classical

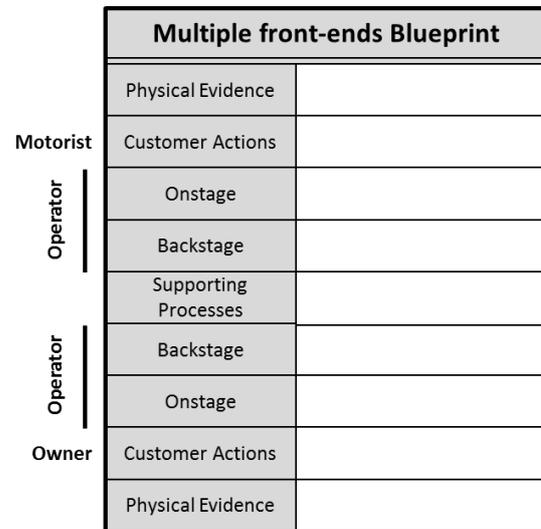


Fig. 6 – Multiple front-ends Blueprint (WREINER *et al.*, 2009)

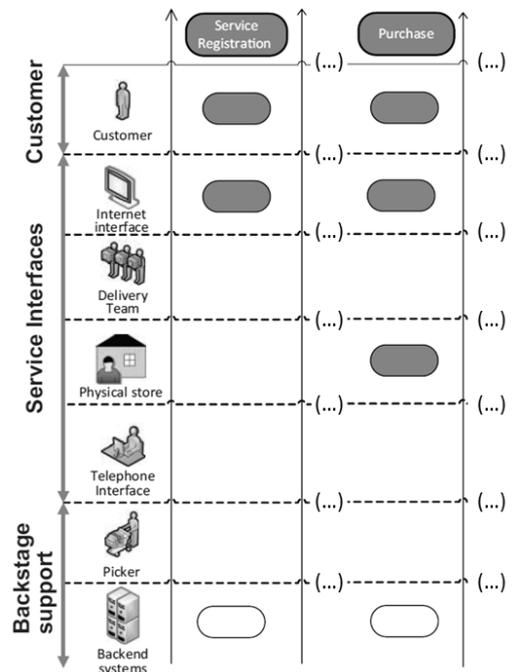


Fig. 7 – Service System Architecture (PATRICIO *et al.*, 2011)

vocabulary) but “co-created with customers through relational exchanges in interaction experiences”. To identify the customer value associated with each possible interface (examples of alternate interfaces include physical store, internet, telephone, etc.) the authors use what they call “Customer Value Constellation (CVC)” (PATRICIO *et al.*, 2011) and “Goal-Oriented Analysis (GOA)” where value for the customer is analysed in correlation with the channel by which the service is rendered (PATRICIO *et al.*, 2008). From this analysis, they derive a “Service System Architecture” (See Fig. 7) and a “Service System Navigation” charts. In the Service System Architecture, the top row represents the sequence of events in the service production (very much like in Shostack’s original blueprint); below, are the customer’s actions. The originality of the model comes from the multiplication of the “Service Interfaces” rows with several interfaces possible for one customer action. In the example in Fig. 7 of a “new retail service”, the purchase can be made either *via* the internet interface or in the physical store. The Service System Navigation reproduces the same structure but establishes explicit links between the boxes in order to describe the end-to-end service. The final stage of the Multilevel Service Design method is to create, for each step of the service sequence, a “Service Experience Blueprint (SEB)”⁵.

2.2 Process-Chain-Network (PCN)

Together with blueprints, the Process-Chain-Network developed by Scott Sampson (2012), are the only two models that were specifically designed for services and do not derive from product engineering. Referring to the Multilevel Service Design (MSD) presented above, “[PCN] will take an integrated approach by simultaneously depicting the network [of entities] and the interactions, (...) combining useful features of supply chain diagrams with useful features of Service Blueprinting to allow us to clearly and easily depict complex interactive processes that span networks of entities” (SAMPSON, 2012).

Figure 8 presents the basic features of the PCN model. Each entity participating⁶ in the service process chain is represented with a “process domain” divided into three types of “regions”. These are dependent of the degree of control the entity has on the process. The “**direct interaction**” region presents the lowest degree of control and is in direct interface with another entity. Processes taking place in these regions involve face-to-face, interactive actions between the two entities, such as “taking order” or “negotiating contract”. The “**surrogate interaction**” regions present a higher degree of process control by the entity. In these regions, “the entity is performing process steps that involve a nonhuman resource of another entity”. An example of that would be “ordering supplies via a supplier website”. The “**independent processing**” region covers all processes not involving interaction (direct or surrogate) with another entity. They are of the sole responsibility of the entity itself. For instance “travel to the restaurant”, falls into the customer’s independent processing region in the case of the pizza place developed in the article. Processes in the independent processing region are considered “non-service”. In the PCN, processes are represented as basic flowcharts.

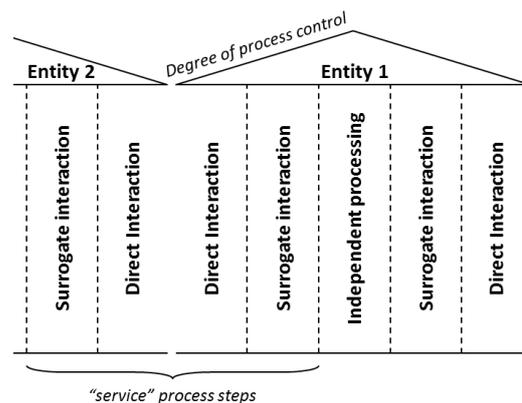


Fig. 8 – Process-Chain-Network (SAMPSON, 2012)

One of the main focuses of PCN is to identify “the value proposition and elements contributing to that value proposition” (*ibid.*). To do that, the tool identifies three main drivers associated with each process within the service: (1) “steps where the customer receives benefits”, tagged “☺” or nonmonetary costs, tagged “☹”; (2) “steps where the provider firm/firms incurs costs”, tagged “-\$” or receives monetary compensation, tagged “+\$”; (3) “Environmental conditions”, described adjacent to the process label (e.g. “décor”), which may foster customer benefits or cause nonmonetary costs. As

⁵ Formally, SEBs are represented as simplified blueprints showing only a front-stage space divided by a “line of interaction” between customer’s and interface’s actions and separated from the back-stage space by a “line of visibility”. Their aim is to thoroughly describe each of the processes composing the service. It is to be noted that in the SEBs, only one of the interfaces is described (internet interface for purchase for instance, the alternate retail store interface would be described in another SEB).

⁶ These are defined as including “firms, departments within firms, customers, agents of customers, and so forth” (*ibid.*)

noted by the author, the latter “accomplishes the same purpose as a “physical evidence” row that is included in some service blueprints [...], except in PCN diagrams, the evidence is noted by the step” (*ibid.*).

2.3 Structured Analysis and Design Technique (SADT)

The roots of the Structured Analysis and Design Technique (SADT, also known as IDEF – Integrated computer aided manufacturing DEFinition) extend back to the 1960s and early 1970s. It was originally designed to describe complex systems and has been used in very diverse industries such as defence, aerospace or telecommunications. It is also a widely used tool in software development (together with a variant called Event-driven Process Chain (EPC)).

In their article published in 1995, Carole Congram and Michael Epelman promote the use of SADT for service description. They see three main reasons why “SADT seems tailor-made for services” (CONGRAM & EPELMAN, 1995). First, SADT “focuses on activities, the building blocks of services”. Second, it is accurate to describe “who or what performs the activity; and what guides or limits the activity”. Lastly, it improves communication within the service provider’s organisation by implicating a large spectre of actors in the modelling process. The authors describe the modelling result as “a set of interrelated diagrams that collectively describe a system. The top diagram summarizes the diagrams below, which are arranged hierarchically and become increasingly more detailed at each successive level” (*ibid.*). The typical SADT activity box is shown in Figure 9. Apart from the title of the activity, the activity box itself presents a code (A0 in Fig. 9), which shows the place of the box in the hierarchy of activities (e.g. A0 decomposes into A1, A2, and A3; A1 decomposes into A11, A12, and so on). Each activity box has one or several input(s) and output(s) as well as mechanism(s) (who or what performs or help performing the activity) and control(s) (guides and limits used in performing the activity). Each arrow has a “strictly prescribed meaning” and is labelled in consequence. As an integral part of the modelling, “all terms used in labels and activities must be from the firm’s dialect, with their meaning explained by the diagram author. The firm’s definitions are compiled into a glossary of terms, developed in tandem with the diagrams” (*ibid.*). Finally, a strong emphasis is put on the modelling preparation phase consisting in three steps: (1) “formulate the questions” to be answered by the model (e.g. “where in the process do quality checks occur?”); (2) “state the purpose of the model” ,which is derived from the questions and (3) “determine the viewpoint of the model” (e.g. “sales manager”). The aim of this preparatory phase it to determine the scope and the granularity level of the description. As stated by the authors “it is preferable to develop a library of small models that relate with each other and make the complexities of the process or system comprehensible”.

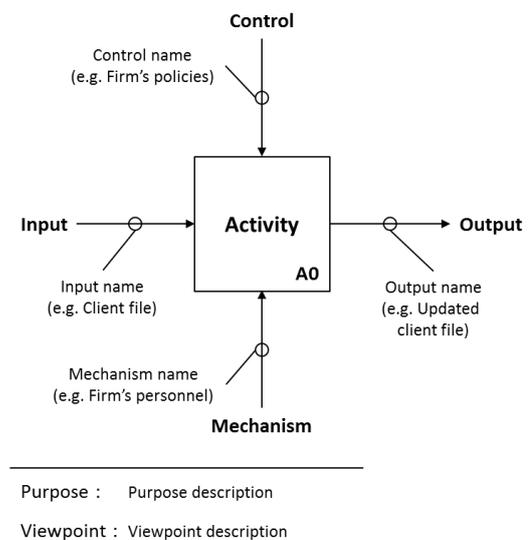


Fig. 9 – Generic activity box (SADT) (CONGRAM & EPELMAN, 1995)

2.4 Feedback Control System (FCS)

The aim of Rita Di Mascio’s (2002, 2003) work is to promote the use of “engineering principles to the design and delivery of services, an area [...] coined ‘service engineering’” (DI MASCIO, 2002). In this sense, the author proposes to recast services as feedback control systems. She applies this frame to a patient-treatment process in a public hospital emergency ward and compares it with the traditional use of FCS in a chemical plant. The choice of FCS is justified by the fact that “researchers have found that customers value a service by its reliability [...] and responsiveness [...]. These requirements are similar to the requirement of stability and performance despite uncertainty in process control systems” (*ibid.*).

A typical feedback control system is showed in Figure 10, where **P** represents the process block, **C** the controller block and **M** the measurement block. Simply put, the controller (**C**) adjusts the manipulated variables (**u**) so that the results of the process (**P**), i.e. the controlled outputs (**y**), are as close as possible to their desired values (or set points – y^{sp}). To do so, the controller relies on measurements (**M**) of the controlled outputs (**y**) taking into account external disturbances (**d**). It is important to highlight the fact that this chain of events is to be seen as a continuous process.

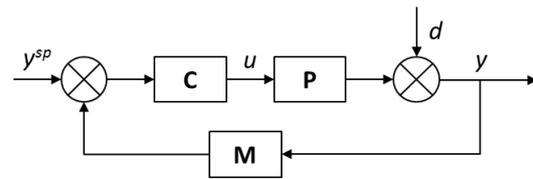


Fig. 10 – Classical feedback control structure (DI MASCIO, 1995)

Adapted to services, the different elements described above are as follows. As noted by the author, “the controller in a service process is often the service manager, who observes the performance of the service and adjust manipulated variables as necessary” (*ibid.*). The latter are all the factors that can be freely adjusted by the controller. They may have upper, lower and rate-of-change limits. In the example of the emergency ward, the manipulated variables identified are the number of staff and opening hours. These variables are manipulated so that the controlled outputs are in line with the set points. Such set points are the result of the trade-off between the needs of the different stakeholders. In the medical service example, the patients and the medical staff are two “stakeholders”. The ones need rapid medical attention, whereas the others value an “even pace of work”. The measured outputs are, therefore, time and work-pace. Finally, disturbances can offset the measured outputs. Still in the example, both patients’ arrival rates and ailments have an impact on the service time (measured as a cumulated waiting time for instance). The process itself is described under a basic flowchart. Further in the article, the author uses this representation to design a controller (“off-line model-based”) in order to optimize the service (“stochastic optimal control”). Another use of FCS applied to services is to compare the “robustness of alternative service processes” (DI MASCIO, 2003).

2.5 Business Process Modelling Notation (BPMN)

The last service design tool that we will present here is the Business Process Modelling Notation (BPMN). BPMN is one of many modelling techniques and languages used in business process modelling including UML (Unified Modelling Language), xBML (extended Business Modelling Language), EPC (Event-Driven process Chain), BPEL (Business Process Execution Language) and so on. None of these languages and modelling techniques is specifically devised to design services but all are used to represent processes within companies.

The first step in the BPMN modelling, as described by Gero Decker *et al.* (2008), is the construction of a “High-level structural diagram”. This structural diagram carries out an inventory of the different “partners” involved in the production of the service and the interactions between them. Each partner is represented as a box and each interaction as an arrow. At this stage, the nature of the interactions is not defined.

The second step is the definition of a “High-level behavioural diagram” (as shown in the top section of Figure 11). Here, the diagram presents the succession of “sub-goals or milestones” (DECKER *et al.*, 2008), such as “product has been ordered”.

The link between the structural and behavioural diagrams is made by “collaboration diagrams” (as

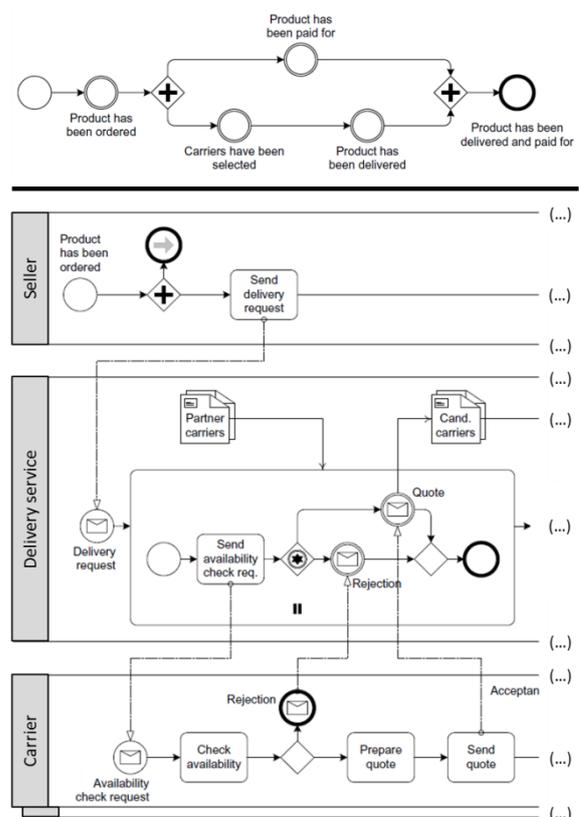


Fig. 11 – BPMN behavioural & collaboration diagrams (DECKER *et al.*, 2008)

shown in the bottom section of Figure 11). The particularity of BPMN is to present each of the partners involved in reaching a sub-goal as a “pool” or “swim lane” (the horizontal boxes with the description of the partner as header, e.g. “Seller”). All activities and sub-processes to be performed by a partner are represented in the corresponding swim lane. By convention, interactions are depicted as messages (an envelope within a circle) from one entity to the other⁷. A collaboration diagram is needed between each of the milestones. For instance, the partial collaboration diagram presented in Figure 11 represents some of the steps between “product has been ordered” and “carriers have been selected”.

3. SERVICE-DESIGN TOOLS EVALUATION

The first two sections respectively presented the evaluation canvas and the material to be evaluated. In this section, we will present our assessment of the different design tool through the use of a service-design tool evaluation matrix, grounded into our reading of the service-related literature. We first present our evaluation method, then we present the results and finally discuss them and their managerial implications.. Further validity and improvements is sought by encouraging academics and service practitioners to use our evaluation matrix, challenge our findings and, the criteria themselves. (Note that the evaluation criteria are summarized in Annex 1).

3.1 Evaluation method

To conduct the evaluation, we opted for a binary notation. Each criterion is noted “1” if the design tool satisfies it and “0” otherwise. If such notation system is somehow abrupt and does not allow nuance, it has, in our opinion, two main virtues. The first one is that it forces the evaluator into expressing an opinion. As the Evaluation Criteria were deliberately formulated as closed questions and as precise as possible, the binary notation system avoids misleading, in-between results that might arise from a more open and probably more subjective notation system. The second merit of the binary notation system is that it is easy to read and analyse.

To evaluate the different service-design tools in our panel, we based our judgement on the capacities of the tool, rather than on what is explicitly described in the afferent papers. Let us illustrate positioning with two examples. On the one hand: Evaluation Criterion-A1 “Does the representation show service-production failure points in the process?”. The original blueprint, explicitly presenting fail points (SHOSTACK, 1992), was obviously noted positive for EC-A1. Even though there is no reference to fail points in Bitner’s paper presenting her improved blueprint (BITNER *et al.* 2008), EC-A1 remains positive in our evaluation. The reason is that none of the evolutions introduced to the original canvas made it incompatible with fail points. On the other hand: EC-E2 “Does the representation show the value determinant(s) for the customer?”. Again, due to the presence of the “physical evidence” line, the initial blueprint model was noted positive for the criterion. The alterations introduced by Thomas Eichentopf *et al.* in their co-production-oriented blueprint led to the suppression of the “physical evidence” line (EICHENTOPF *et al.*, 2011). The model is therefore noted negative for EC-E2.

To minimise bias in the evaluation process, the Evaluation Criteria were formulated in the least equivocal way possible. However, due to the inherent subjectivity of any evaluation, the results only reflect the authors’ judgment. A point-by-point justification of the evaluation matrix below would therefore be necessary to support this judgment. Due to the constraints in the perimeter of this contribution and in order to avoid overloading it, we will not develop the justification within these pages.

3.2 Results and managerial implications

The completed evaluation matrix is presented in Table 6 below.

⁷ A succinct guide of BPMN conventions is available at <http://www.bpmnquickguide.com/viewit.html>.

Attributes	Evaluation criteria	Service design tools								
		Blueprints					PCN	SADT	FCS	BPMN
		SHOSTAK, 1992	BITNER et al., 2008	EICHENTOPF et al., 2011	WREINER et al., 2009	PATRICIO et al., 2008, 2011	SAMPSON, 2012	CONGRAM & EPLEMAN, 1995	DI MASCIO, 2002	DECKER et al., 2008
Non-linear design	A1	1	1	1	1	1	1	0	0	1
	A2	1	1	1	1	1	1	0	0	1
	A3	0	0	0	0	0	1	1	0	1
	A4	0	0	0	0	1	1	1	0	1
	A5	0	0	0	0	1	1	1	0	1
Dynamic design	B1	1	1	1	1	1	1	0	1	1
	B2	1	1	1	1	1	1	0	1	1
	B3	1	1	1	1	1	1	0	1	1
	B4	1	1	1	1	1	1	1	1	1
	B5	0	0	0	0	0	0	0	0	1
Co-production oriented design	C1	0	1	1	1	1	1	0	0	1
	C2	0	1	1	1	1	1	0	0	1
	C3	0	0	1	0	1	1	0	0	1
	C4	0	0	1	0	0	1	0	0	1
	C5	0	0	1	0	0	0	0	0	1
Multiple-actors design	D1	0	0	0	1	0	1	0	0	1
	D2	0	0	0	0	0	1	0	0	1
	D3	0	0	0	0	0	1	0	0	1
	D4	0	0	0	0	0	0	0	0	1
	D5	0	0	0	0	0	1	0	0	1
Value-oriented design	E1	0	0	0	0	1	0	1	1	0
	E2	1	1	0	1	1	1	0	1	0
	E2+	0	0	0	0	0	1	0	1	0
	E3	1	1	0	1	1	1	0	1	0
	E3+	0	0	0	0	0	1	0	1	0
	E4	0	0	0	0	1	0	0	1	0
	E5	0	0	0	0	0	0	0	1	0

Tab. 6 – Evaluation matrix

The analysis of the table above, allows us to draw two main conclusions.

The first one, from a design-tool perspective, is that **none of the tools in the panel satisfies all of our evaluation criteria**. In light of our hypothesis that a tool presenting all five attributes would be suitable for a comprehensive description of complex services, the implication is fairly straightforward: to our knowledge, there is currently no process-based service-design tool offering an exhaustive, ready-to-use solution to managers seeking to design complex services.

The second conclusion, from a service-design attribute perspective, is that **all of our evaluation criteria are present in at least one of the tools in the panel**. This tends to indicate that our set of evaluation criteria has a good grip on the current challenges faced by researchers interested in service design. A further implication is that there is no major gap in the literature; no crucial aspect of service design is being overlooked. From a managerial point of view, one could see it in one of two ways: either the solution to comprehensive complex-service design already exists in the use of the right combination of tools; or the bricks to a unified solution are already there and only need to be assembled in a comprehensive tool.

A slightly more detailed analysis of our evaluation matrix, looking at the least often positive evaluation criteria, allows us to pinpoint some of the most challenging aspects of complex-service design.

Overall, the **multiple-actors design attribute appears as the most challenging** with only 22% of positive Evaluation Criteria (EC) over the entire panel (EC-D1 to D5) (compared to 55% for the “non-linear” attribute, 75% for the “dynamic” attribute and 47% for “co-production”). In particular, EC-D4 “Can all actors relevant to the service description be represented?” is positive in only one of the tools. This doesn’t come as a surprise as it requires that the tool be flexible enough to accommodate a large number of actors while remaining comprehensible. Cumulated with EC-D3 and EC-D5, respectively “Can any actor be in interface with any other actor?” and “Can all actors be described as co-producers of the service?”, EC-D4 is particularly challenging as it engenders multiple and complex interfaces as well a dense network of back-office, support processes and enabling technologies to be represented. This reflects the strong B2C orientation of the literature, which mainly deals with relatively simple services. Therefore developing service design tools adapted to B2B services constitutes a major avenue for future research.

The **value-oriented design attribute comes second at the bottom of the list** with 35% of positive EC over the panel of design tools (for EC-E1 to E5). Within the different criteria, value balance and value control mechanisms (EC-E4 and E5) seem to be the most challenging: they are positive for only two and one design tool respectively. EC-E5 is particularly difficult to apprehend since it requires the design model to depict the service not only as a “design-and-forget” object but as a live process with possible disturbance along the way. Of course, when multiple actors are sharing value, such control mechanisms get even harder to design. From a managerial point of view however, it is our opinion that in-production value-control mechanisms are of utmost importance on service quality and reliability. A possible explanation for this lack of “value-orientation” is our focus on process-based design tools (they have an inherent emphasis on service production). Other types of tools (such as customer’s journeys or storyboards) may have a better grasp on service value. Combining different approaches, and related tools, constitutes a major challenge for service research.

The last service-design representation challenge that we will mention here is the **capacity of the tool to represent, in a clear timeline, simultaneous actions or events** (EC-B5). This criterion, afferent to the dynamic-design attribute, is positive for only one tool of our panel. Again, this attribute becomes both more difficult to represent and more critical to the service description when multiple actors participate in the service production. Indeed, from a service manager perspective, a clear comprehension of the interdependencies between simultaneous tasks is necessary to keep the production on-time. In this regard, the literature on project management (e.g. on the use of PERT and GANTT diagrams), is full of examples.



CONCLUSION

This contribution provokes at least as many questions as it provides the reader with answers. We will direct its conclusion towards the next ensuing steps.

In order to build on the present research, our first endeavour will be to fully present our initial evaluation. In concrete words, this shall consist in a systematic justification of each evaluation criterion against each service-design tool. In doing so, we intend to invite researchers and managers interested in complex-service design to challenge and amend our matrix in order to enrich and refine our findings. Furthermore, we believe that a survey should be conducted on a significant enough number of service practitioners, selected at various levels of responsibility (from service executives to the front and back-office employees), dealing with services of varied maturity levels (future services, new services, established services, end-of-life services), and across a variety of industrial sectors. A statistical analysis of the results of such a study would allow to firm up our initial evaluation of the different service-design tools.

Our second endeavour, directly linked to the first one, will be to build on the findings presented in our evaluation matrix. By exploring the strengths and weaknesses of each design tool, we intend to contribute to the development of a comprehensive descriptive tool to design complex services. To do so, we shall explore two main pathways: the first would be to combine the use of two or more of the existing tools into a unified method. The second would be to aggregate the most interesting features of each tool to come up with an original method.

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ANNEX

Annex 1: Summary of the Evaluation Criteria

List of Evaluation Criteria (EC) by attribute	
Non-linear design	
A1	Does the representation show service-production failure points in the process?
A2	Does the representation allow for alternative chains of binary events leading to a given outcome?
A3	Does the representation allow for multiple and/or alternative outputs of the service production process?
A4	Does the representation enable multiple and/or alternative outputs for a given process-step?
A5	Does the representation allow for multiple and/or alternative inputs for a given process-step?
Dynamic design	
B1	Does the service production-process representation have clear start and end points?
B2	Are the different process-steps arranged in a chronological manner?
B3	Does the representation show alterations in the process timeline?
B4	Does the representation distinguish between immediate actions and lengthy processes?
B5	Does the representation allow for simultaneous actions or events?
Co-production-oriented design	
C1	Are both the customer and the provider present in the service description simultaneously?
C2	Are front-office actions of both the customer and the provider described?
C3	Are back-office actions of both the customer and the provider described?
C4	Are support processes / actions of both the customer and the provider described?
C5	Are technical artefacts enabling the service for both the customer and the provider described?
Multiple-actors design	
D1	Can an actor be in interface with more than one other actor?
D2	Can all actors be in interface with more than one other actor?
D3	Can any actor be in interface with any other actor?
D4	Can all actors relevant to the service description be represented?
D5	Can all actors be described as co-producers of the service?
Value-oriented design	
E1	Does the representation explicitly present a common value proposition?
E2	Does the representation show the value determinant(s) for the customer?
E2+	Does the representation show the value determinant(s) for all actors?
E3	Does the representation show the impact of each process-step on the customer's value determinant(s)?
E3+	Does the representation show the impact of each process-step on all value determinants?
E4	Does the representation show the balance mechanism between the different value determinants?
E5	Does the representation show a value control mechanism during the production of the service?