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(Article begins on next page)

25 April 2024

A Service Network Perspective to Evaluate Service Matching in Early Design

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Abstract

Service matching is defined in this paper as the process of combining a new service with one or more existing services. A recurring problem for service designer is to match new services with existing ones. This process may be seen as the fundamental action for the development of a service network. The evaluation of the consequences that may follow from this operation is critical. To date, the attention paid to this topic has been very limited. This paper presents a new method, named Service Relationship Deployment (SRD), developed to support the process of service matching in the early design phases of a new service. Through an analogy with living organisms in natural ecosystems, SRD allows the investigation of the possible relationships between matched services introducing the service network perspective in the design of integrated solution. The description of the method is supported by some practical examples.

Keywords: *Service Relationship Deployment, Service networks, Service matching, Service Relationship, Service design, Service Network Perspective.*

1   Introduction

Service economy produces more than two-thirds of the Gross Domestic Product (GDP) of developed countries, increasing its relevance also in the manufacturing sector (The World Bank Database, 2015; Mastrogiacomo et al. 2017). Several factors explain the growth of service economy: hypercompetitive markets, rapid product and service innovation, operational excellence, and customer intimacy (Rai and Sambamurthy, 2006). Typically, companies struggle to differentiate their offer from others in a crowded market and new service-oriented strategies are often proposed to gain a competitive advantage (Karmarkar, 2004). Research from different fields has produced a relevant stock of knowledge on topics related to services (Chesbrough and Spohrer, 2006). However, some areas of the design and analysis of groups of services have as yet been little explored. Analysing the advances in service research, Ostrom et al. (2015) indicate the comprehension of service networks and systems as a key priority and

Jackson (2007) highlights the deficit of system thinking in business management and service design.

Vargo et al. (2008) define the concept of service system as "a configuration of resources (including people, information, and technology) connected to other systems by value propositions". Although this definition has opened and stimulated the interest of researchers and practitioners, few studies on the relationship between different service systems have been conducted (for example: Glushko and Nomorosa, 2013; Barile, Lusch et al. 2016, Zhang, Shi et al., 2017).

To bridge this gap, we introduce the concept of *service network* as a network of interconnected service systems which exchange resources and customers, achieving similar or different outcomes, and propose similar or different value propositions. Performances of a service system could be influenced by the other service systems that compose the network. Many cases of service networks can be observed in different contexts. A typical example is that of Ikea, which offers a service network composed of a furniture shop, a restaurant, delivery, van rental, financial services, baby parking and interior designing (Ikea, 2017).

A coherent and comprehensive approach should be implemented to address the problem of analysing and developing interconnected service systems. The service network perspective, i.e. an analysis focused on relational systems as opposed to individual actors (Galaskiewicz, 1996), may be significant in understanding how the relationships between service systems affect their functioning.

In this view, the design of a service network necessarily includes actions aimed at the assessment of the relationships resulting from the service matching process. The authors define service matching as the process of combining a new service with one or more existing services. The application of service matching strategies allows the provider to enrich and enhance its service proposal, also improving the sharing of customers, competences, resources and information. In this sense, service matching could be seen as a viable approach to increase the productivity and the sustainability of integrated service solutions (De Kervenoael et al. 2006). In order to successfully match services, systemic approaches and tools are required to identify potential service relationships from the early design phases. Relationships are the result of the interactions and synergies between services, similarly to what occurs between the symbionts in an ecosystem (Mastrogiacomo et al., 2016). When relationships result in positive impacts, service matching is appropriate, otherwise it is not.

Two fundamental issues are how a service provider can evaluate whether a service matching is convenient and what the implications of service matching are. The aim of this paper is to

present Service Relationship Deployment (SRD), a tool to support service designers when dealing with the service matching problem.

Three key factors are considered to capture the essence of the SRD method: (i) the study of service networks based on a systematic approach that considers perceived quality; (ii) the analysis of the possible effects of a service matching on customers and on operational and protection resources (iii) a step toward incremental innovations based on the optimization of service relationships and on resource integration.

The remainder of this paper is structured as follows: a comprehensive literature review aimed at positioning the content of the paper in the framework of existing theories is presented on Section 2; Section 3 recalls the close analogy between service relationships and interactions among living organisms; Section 4 illustrates the SRD method; outcomes resulting from SRD application are analysed and discussed in Section 5; SRD is applied to an applicative example in Section 6; in Section 7 implications of the proposed method for theory and practice are discussed; finally, Section 8 summarizes the contribution of this paper, the limitation of the methodology and the directions for future research.

2 Literature review and challenges in service network development

Service networks are undoubtedly a field of research of considerable interest and yet partially unexplored (Barile et Al., 2016). There are evidences that service providers are moving from focused strategies, i.e. value offerings based on specific value propositions, to the provision of extensively integrated service solutions (De Kervenoael et al. 2006; Chandler and Lusch, 2015), in order to fulfil a wider range of customer's needs (Tuli et al. 2007; Breidbach et al. 2014).

A first attempt at formalization was made by Norman and Ramirez (1993), who define service networks as "collaborative systems of multiple entities working together to co-produce value". Subsequently, many other authors have studied the role of networks in service delivery.

A service network perspective has been adopted by a number of researchers to face the problem of designing integrated service solutions (Syson and Perks, 2004; Patrício et al. 2011; Grenha et al. 2017), and analyzing the reconfiguration of service value networks (Allee, 2000; Basole and Rouse, 2008).

Reminding the Internal Service Quality Theory (Berry and Parasuraman, 1991; Heskett et al., 1990), Gittell (2002) developed a service relationship model considering several services and providers. Baron and Harris (2009) stated that customers are the pillars of resource integration in the interactions between service systems. Edvardsson et al. (2011) expanded this idea, linking the resource integration in service networks with Service-Dominant Logic (Vargo and Lush,

2004; 2008; Vargo, 2009). Scott and Lewis (2010) confirm the strategic importance of service networks for the service industry, focusing their efforts on those services delivered by a network of different providers. Hulda and Gallan (2015) deepen the understanding of impacts of service networks on quality and value generated for customers and providers and on this vein Mastrogiacomo et al. (2016) define the notion of symbiotic relationships between services.

Service companies, just like manufacturing companies, cannot neglect strategic innovation (Berry et al., 2006). Lusch and Nambisan (2015) define service innovation as "a collaborative process occurring in an actor-to-actor network". The development of a service network can be considered as a service innovation strategy: resources used in the service delivery process can be shared with consequent positive effects on the system sustainability (Glavič and Lukman, 2007; Den Hertog et al., 2010; Saviano et al. 2017). Offering customized services and the exploitation of many small markets can generate significant revenues and profits when applying network-oriented strategies in service deliveries (Anderson, 2007). Moreover, service networks can produce additional revenues exploiting mainstream markets through enhanced customer-provider relationships (Yao et al., 2012).

The concepts of service ecosystems and service networks are closely linked: Vargo and Lusch (2014) define service ecosystems as "a relatively self-contained, self-adjusting system of resource-integrating actors that are connected by shared institutional logics and mutual value creation through service exchange"; Kleinaltenkamp et al. (2012) describe a suitable innovation of service ecosystems as "the integration of multiple service systems into an innovative service ecosystem".

Several researchers focused their attention on the issue of value co-creation within service systems (Romero and Molina; 2011; Akaka et al. 2012; Vargo et al. 2012; Tommasetti et al. 2017). Breidbach and Brodie (2017) explore the effects that engagement platforms, i.e. the interfaces where a co-creational network communicates and interacts, can have on value co-creation mechanism (Prahalad and Ramaswamy, 2004). Morever, Polese et al. (2017) state that the adoption of system thinking could help in understanding the process of value co-creation through the analysis of the interaction among the system's components.

The concept of service systems, i.e. "value-creation networks composed of people, technology, and organizations" (Maglio et al. 2006) is also correlated with that of service network. Service systems combines providers and service clients, working together to co-produce value (Jaakkola and Alexande, 2014). The components of these complex systems are adaptive and jointly co-evolving (Spohrer et al. 2007). According to Vargo and colleagues (2012) service systems interact through relationships of mutual service exchange thus allowing the integration of

resources with consequent mutual benefits. In light of this definition, service systems can be seen as the essential components of service networks (Mele and Polese, 2011).

Even if important efforts have been made to develop a theoretical analysis of service networks, further steps towards a complete systematization need to be taken (Chandler and Lusch, 2015). In particular, a number of authors have pointed out the need for practical approaches and tools for the analysis, the design and the innovation of service networks (Jackson, 2007; Scott and Lewis, 2010; Den Hertog et al., 2015; Barile et Al., 2016). In this framework a specific study on service matching, interpreted as the fundamental action for the development of a service network, has been considered. The tool proposed in the following sections is formulated with the aim of practically supporting service analysts, designers and practitioners during the early design phases of a service network.

3 The analogy between service networks and natural ecosystems

In general, different service systems interact with their environment and with other service systems, co-evolving together (Spohrer et al. 2007). Through a close analogy with natural ecosystems, this section introduces a classification of possible established relationships when two different services are matched.

In a natural ecosystem "positive symbiotic interactions are those relationships between organisms that permit some species to overcome their physiological limitations by exploiting the capacities of others" (Douglas, 1994). Similar considerations may hold for services: relationships may generate positive or, in some cases, neutral or even negative impacts. We consider impact as "any change resulting from an activity, project or organisation and it includes intended as well as unintended, negative as well as positive, and long term as well as short term effects" (Wainwright, 2002).

Impacts are determined by relationships: living organisms typically exchange nutrients, transport functions and protection (Begon, Townsend, et al., 2006; Putman, 2012).

The close analogy between service networks and natural ecosystems (Vargo, Lusch, 2014), suggests that services can interact by exchanging customers, operational and protection resources. Table 1 highlights the close parallel between symbiotic relationships in natural ecosystems and service networks.

Symbiotic factors in relationships between living organisms	Symbiotic factors in relationships between service systems
Nutrition	**Customers**
Nutrition is the major source of energy for living organisms: through biological processes organic and inorganic compounds are converted into energy used by living organisms to survive and grow.	The customer is anyone that receives products or services from a provider. Customers can be either people or organizations and can be either external or internal to the supplier organization (ISO 9000, 2015). Customers are the life-blood of a service system.
Transportation	**Operational resources**
Transportation is the ability living organisms have to move. It allows them to reach sources of nutrition and to reproduce.	Operational resources are the physical and non-physical resources used by a service provider in its service delivery process. They are fundamental to deliver the service and to enable value creation.
Protection	**Protection resources**
Protection is the ability to protect a living organism from chemical, physical and biological threats arising from its habitat.	Protection resources are the physical and non-physical resources used by the service provider to protect services from threats arising from competition on markets and potential negative events. Protection resources may facilitate achievement of market success.

Table 1. Symbiotic factors in natural ecosystems and in service networks

As Table 1 suggests, symbiotic factors influence service relationships. We define as a positive relationship a service interaction where service matching improves the outcome of the single service(s). An example of a positive relationship is the one between airline and airport services. The customers of the airline company take advantage of the services offered by the airport, including the shopping facilities, banks, car rental, restaurants, and so on. The overall customer experience depends on the quality of the services provided by both the airline companies and the airport. The airline company cannot offer an adequate service level without the airport services and, conversely, the airport services may not generate profits without the airline's customers. On the other hand, negative relationships are those interactions in which service matching produces a detrimental impact on potential outcome of the service involved. For example, if an insurance company wants to combine its services with a potentially risky oil exploration service, the match could result in a negative symbiosis. The oil exploration risk would scare off most of the insurance company's customers, and oil exploration business would be subject to strict insurance balance rules.

In general, it is possible to identify six different categories of service relationship according to the type of impact: (a) three positive symbioses (mutualism, commensalism and parasitism); (b) two negative symbioses (amensalism and incompatibility) and (c) a neutral symbiosis (neutralism). Figure 1 summarizes this classification which will be considered in detail in Section 4.

	Positive	Neutral	Negative
Positive	MUTUALISM	COMMENSALISM	PARASSITISM
Neutral	COMMENSALISM	NEUTRALISM	AMENSALISM
Negative	PARASSITISM	AMENSALISM	INCOMPATIBILITY

Impact
From Service B→ To Service A (column header)

Impact
From Service A → To Service B (row header)

Figure 1. Service Relationships classification based on the analogy with natural ecosystems. A and B are two generic services.

4   The Service Relationship Deployment (SRD) method

This section describes the Service Relationship Deployment (SRD) method. This tool is aimed at supporting a structured analysis of the impact of service matching. More in detail, the goal of the SRD method is to examine the mutual impacts between two matching services in terms of customer perceived quality. The method stems from the need to evaluate the impact resulting from the elementary actions (i.e. the service matching) in the development of a service network. SRD is based on the hypothesis that, when two services are matched, the enhancement or worsening of their perceived quality may be influenced by the development of positive or negative relationships. Therefore, impacts on perceived quality are the results of symbiotic factor interactions between the matched services. Figure 2 represents the Effect Model considered in the SRD method according to which the Service Perceived Quality is the result of: (i) the *communication* actuated by the service provider and (ii) the *service delivery system* that enable the service provider to deliver a specific service (see Figure 2-A). From this perspective, potential changes in the set of resources used by the service could consequently cause a change in the perception of the service quality (see Figure 2-B). If the communication remains unchanged, it is reasonable to assume that changes identified in service perceived quality are directly influenced by some changes in the set of resources of the service delivery system (Figure 2-B).
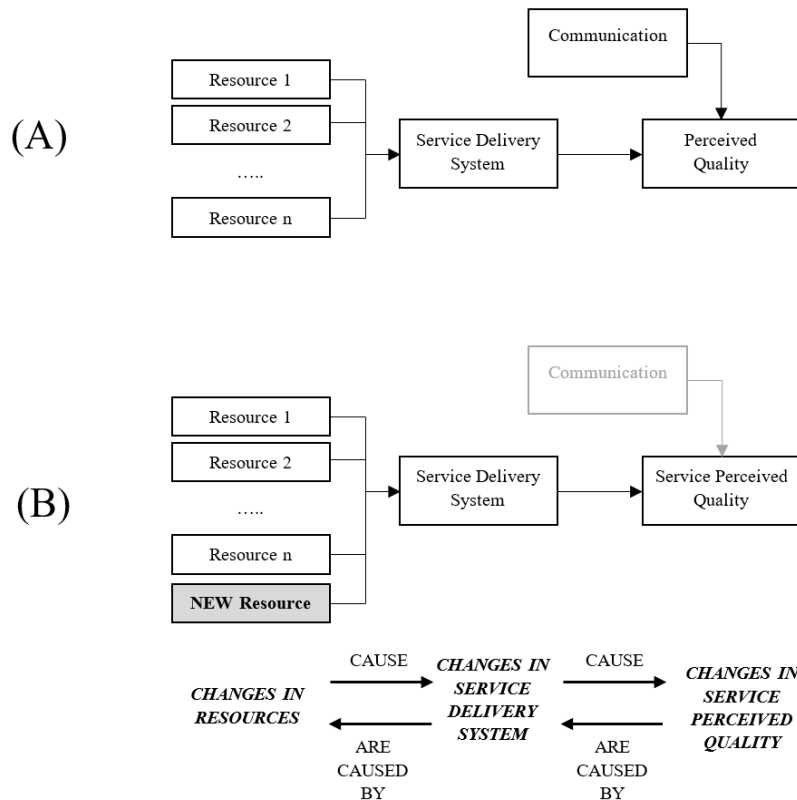
Figure 2. Effect Model on Service Perceived Quality. Service delivery system's resources and communication influece perceived quality (A). Changes in service delviery system's resources affect service perceived quality and vice versa (B). In the analysis we suppose that comunication remains unchanged (B).

The SRD method can be applied by a single service designer or by a cross-functional team with diverse expertise and perspective, also including potential service customers. When applied by a single service designer the method is a function of his biases, errors, preferences, etc. Instead, the application of the method by an inter-functional team leads to more robust results since service designers have to come to a consensus. Furthermore, the direct involvement of potential customers strengthens the outcomes of the method, including a point of view that is potentially different from that of the service designers.

The SRD method stimulates the team (or the designer) to assess which service quality determinants are (or are not) important and how a service might affect the perceived quality of the other. For these reasons, a deep understanding of the matching services is required from the people in the team.

The application of the SRD method can be described in four main steps detailed in the following sub-sections:

1. Assessment of the importance of service quality determinants (Section 3.3);
2. Assessment of the mutual influences between the analysed services (Section 3.4);
3. Total impact evaluation (Section 3.5)
4. Results analysis (Section 4).

4.1 Determinants of service quality, the SERVQUAL model

A large number of researchers and practitioners have dedicated their efforts to the modelling of service quality (Franceschini and Rossetto, 1999, Deshmukh et al., 2005; Ladhari, 2008). In particular, the SERVQUAL model (Parasuraman et al., 1988) has been widely acknowledged by academics and researchers to be a valuable approach to assess service quality (Ladhari, 2009) and has been applied by a number of academics and service companies in a large number of practical cases (Brysland and Curry, 2001; Kang, 2002; Devi Juwaheer, 2004; Badri, 2005).

Empirical evidences support the notion that service quality stems from a comparison of what customers feel service companies should offer (i.e. from their expectation) with their perceptions of the actual performance of the provided services (Parasuraman et al., 1988). In this respect, perceived service quality is viewed as the degree and direction of the gap between the customer's perception and expectation. Parasuraman et al. (1988) identified five determinants to exhaustively explain how consumers perceive service quality: tangibles, reliability, responsiveness, assurance and empathy. A description for each of the service quality determinants is given in Table 2. According to the original formulation of the SERVQUAL model (Parasuraman et al., 1988), Gap 5, i.e. the gap between service perceived and expected quality, is monitored by companies through a questionnaire that is composed of a set of questions related to each five determinants of service quality.

The SERVQUAL model has been applied successfully in a variety of practical contexts (Pariseau and McDaniel, 1997; Wisniewski, 2001; Jiang et al., 2002), and its validity and reliability has been widely tested (Bolton & Drew, 1991; Cronin & Taylor, 1992, 1994; Roy, Lassar et al., 2015; Sun and Pang, 2017).

The proposed SRD method relies on these determinants for the evaluation of the mutual impacts resulting from a service matching.

Determinants	Definition	Example of pattern of quality
Tangibles	Appearance of physical facilities, equipment, personnel, and communication materials	→ Modern looking equipment and physical facilities; visually appealing materials associated with the service; personnel with new and clean uniforms; professional business cards; etc…
Reliability	Ability to perform the promised service dependably and accurately	→ Ability to do something by a certain time; interest in solving customers' problems; performing the service right the first time; error free deliveries; etc…
Responsiveness	Willingness to help customers and provide prompt service	→ Prompt delivery of the service when requested; personnel always be willing to hel customers; personnel never too busy to respond customers' requests; etc…
Assurance	Knowledge and courtesy of employees and their ability to convey trust and confidence	→ Excellent personnel's behavior; customers feel safe during the service delivery; personnel have the knowledge to answer customers' questions; etc…
Empathy	Caring, individualized attention the firm provides its customers	→ Customers receive a customized service; provider know customers' preferences and interests; Personnel understand specific customers' needs; etc…

Table 2. Determinants of Service Quality in SRVQUAL model (Parasuraman et al., 1988).

4.2 SRD Variables and operational scheme

The SRD method was originally inspired by the first module of the Quality Function Deployment (QFD), i.e. the so-called House of Quality (Hauser and Clausing, 1988; Akao, 2004; Franceschini, 2002). The House of Quality is a tool aimed at supporting the design of a new product/service. In particular, it is able to create a structured relationship between the customer requirements and the engineering characteristics of the product/service to be designed. Although they share a similar architecture, SRD evaluates impacts on perceived quality resulting from service matching.

The operational form in Figure 3 supports the application of the first three steps of the method. Only two services, A and B, are considered in the form, but, with appropriate adjustments, the method could be applied to more complex contexts. For each service, the upper part of the form contains the importances of service quality determinants (I_{ik}), the influences (V_{ijk}) are in the

middle, while an assessment of the overall Impact (TI_{ij}) can be found in the right part of the form.

More in detail, the variables involved in the method are:

(i) I_{ik}, the importance of the *k-th* service quality determinant with respect to the *i-th* service. For instance, the "assurance" determinant is more important for a money transport than for a rail freight service.

(ii) V_{ijk}, the influence the *i*-th service has on the *j*-th service with respect to the *k-th* determinant of service quality. For instance, if a bank is matched with a real estate agency, all tangibles related to the bank service can be shared with the real estate service, and the influence on its tangible determinant is positive.

(iii) TI_{ij}, the total impact of the *i*-th service on the *j*-th service. It is the impact the *i*-th service may have on the *j*-th service if matched. It is obtained as a function of I_{ik} and V_{ijk}.
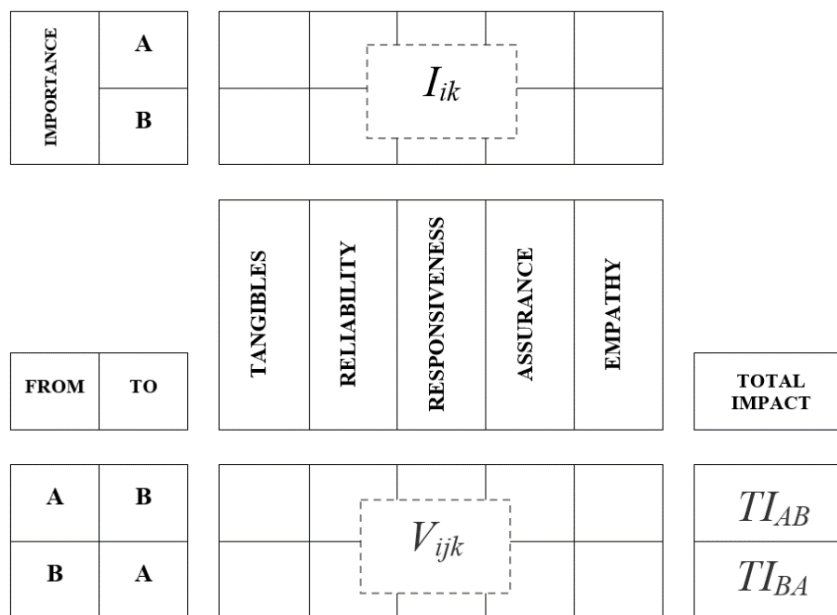

Figure 3. Operational scheme of the SRD method.

By means of an explicative example, the following sections will provide a pedagogical description of the SRD method. The example, intentionally very simple, considers a smartphone sales service (service A) analysing the opportunity to provide technical assistance for mobile devices (service B).

4.3 Step 1 - Assessment of the importance of service quality determinants

According to SERVQUAL, the contribution of each service determinant to the overall service quality is different (Parasuraman et al. 1988). In consideration of this, in this first step of the

model, SRD users are asked to provide an evaluation of their importance on a 7-level ordinal scale. Different choices of scale type are possible, however, in the early development phases, the service designer is usually unable to provide detailed assessments. The 7-level ordinal scale is in line with the findings of Miller (1969), who states that human beings prefer to express their evaluations on ordinal scales. Table 3 reports the meaning associated to each level of the scale.

Scale level	Determinant importance
L_1	*Not important at all*
L_2	*Of little importance*
L_3	*Slightly important*
L_4	*Moderately important*
L_5	*Very important*
L_6	*Extremely important*
L_7	*Absolutely essential*

Table 3. Scale levels and sematic meanings for the assessment of servce determinants importance (I_{ik}) for the SRD method.

With regard to the proposed smartphone sales service example, Figure 4 reports the evaluation the importance of each determinant for services A and B. For service A (smartphone seller) tangibles are considered *very important* ($I_{A1}= L_5$) since they directly affect customer experience; reliability is assessed as *moderately important* ($I_{A2}= L_4$); responsiveness is considered *very important* ($I_{A3}=L_5$) since providing a prompt service and helping customers during their choices are two crucial aspects; assurance is evaluated *extremely important* ($I_{A4} = L_6$) since confidence can have a direct effect on sales volume and performance. The clientele of this service is potentially heterogeneous, so empathy – intended as the ability to provide tailored services to different customers – is considered *very important* ($I_{A5} = L_5$). Similar reasoning can be applied for service B ($I_{B1}= L_4$; $I_{B2}= L_7$; $I_{B3}= I_{B4} = L_6$; $I_{B5}= L_5$).

IMPORTANCE	A	L_5	L_4	L_5	L_6	L_5
	B	L_4	L_7	L_6	L_6	L_5

TANGIBLES	RELIABILITY	RESPONSIVENESS	ASSURANCE	EMPATHY

Figure 4. Example SRD Step-1: assessment of the importances of service quality determinants. A is the smartphone sales service and B is the technical assistance service. Evaluation scale levels = {L_1,...,L_7}.

4.4 Step 2 - Assessments of mutual influences

In the second step, the users evaluate how the matching of the two services could mutually influence each service quality determinant. The method requires the user to express a positive, a negative or a neutral assessment, again using a 7-level ordinal scale. Table 4 reports the meaning associated to each level of the scale.

Scale levels	Influence levels
L_1	*Highly negative*
L_2	*Moderately negative*
L_3	*Slightly negative*
L_4	*Neutral*
L_5	*Slightly positive*
L_6	*Moderately positive*
L_7	*Highly positive*

Table 4. Scale level and sematic meanings for the assessment of service determinants influence (V_{ijk},) for the SRD method.

For our previously mentioned example, influences from service B (technical assistance service) to service A (smartphone sales service) related to reliability, responsiveness and empathy are considered *neutral* ($V_{BA2}= V_{BA3}=V_{BA5}=L_4$). Influence on tangibles is judged to be *slightly positive* ($V_{BA1}= L_5$), since a generic customer of service A can be positively influenced by the fact that the seller also provides technical assistance.

Additional technical skills improve the ability of contact personnel to promptly solve small technical problems. This have caused the evaluation of the assurance determinant as *moderately positive* ($V_{BA4}=L_6$). Influences from service A (smartphone sales service) to the service B (technical assistance service) and vice versa are illustrated in Figure 5 ($V_{AB2}=V_{AB5}=L_4$; $V_{AB1}=V_{AB4}=L_5$; $V_{AB3}=L;)$.

IMPORTANCE						
	A	L_5	L_4	L_5	L_6	L_5
	B	L_4	L_7	L_6	L_6	L_5

FROM	TO	TANGIBLES	RELIABILITY	RESPONSIVENESS	ASSURANCE	EMPATHY
A	B	L_5	L_4	L_6	L_5	L_4
B	A	L_5	L_4	L_4	L_6	L_4

Figure 5. Example SRD Step-2: evaluation of mutual influences between services. Evaluation scale levels = {L_1,...,L_7}.

4.5 Step 3 – Total impact evaluation

In the third step, the evaluations obtained from steps 1 and 2 are combined to provide a first estimation of the impact of service matching: partial impacts on determinants depend on both determinant importances and mutual influences on the services.

In order to deal with linguistic ordinal scales, we introduce the use of a variant of the Yager's ME-MCDM (Multi Expert - Multi Criteria Decision Making) method as synthesis approach (Yager, 1993).

The method was originally developed in order to integrate expert opinions – which are often vague and difficult to estimate – expressed on linguistic scales (Yager, 1995; Noor-E-Alam, Lipi, et al., 2011). This procedure can be used in SRD to combine weighted partial impacts assessed on the five service determinants.

The method addresses the general problem of aggregating individual expert evaluations to obtain an overall synthetic linguistic value (Yager, 1993). It involves max, min and negation operators to combine linguistic information provided for non-equally important criteria. The underlying logic of Yager's ME-MCDM method is that, while low-importance criteria should marginally affect the overall aggregated value, highly important determinants should significantly contribute to the definition of the aggregated evaluation. As regards the SRD method, the total impact (TI_{ij}) can then be calculated as follows:

$$TI_{ij} = \min_{k}\left[\max\left(Neg(I_{ik}), V_{jik}\right)\right]$$

$$(1)$$

being:

$Neg(L_i) = L_{m-i+1}$ the negation of L_i. For instance, $Neg(L_7) = L_1$ and $Neg(L_6) = L_2$

m is the number of scale levels

In order to increase the flexibility of the model, Yager's ME-MCDM method has been adapted to our context to obtain the following two additional effects: (i) very strongly negative influences on important determinants should not be compensated by any positive evaluation (see the example in Appendix 1) and (ii) neutral evaluations should not affect the service matching, thus concentrating the result of the aggregation on the central value of the scale (Franceschini, Galetto, et al., 2004). In detail, two additional rules have been introduced:

(i)   *Veto condition rule*: if (at least) one absolutely essential determinant ($I_{ik}=L_7$) is moderately or highly negatively influenced ($V_{jik} =L_1$ or $V_{jik}=L_2$), the total impact (TI_{ij}) is equal to the minimum value of influence among the considered determinants;

(ii)   *Neutral determinants rule*: the method applied neglects determinants with neutral influences ($V_{ijk}=L_4$).

The two additional rules are applied in sequence: the veto condition first, and the neutral determinant rule if the veto does not apply. As regards the explicative example, the application method provides the results shown in Table 5. In this case, the veto condition rule does not apply.

| | | Determinants | | | | |
		k_1	k_2	k_3	k_4	k_5
Initial data	I_{Bk}	L_4	L_7	L_6	L_6	L_5
	V_{ABk}	L_5	L_4	L_6	L_5	L_4
Elaboration	$Neg(I_{Bk})$	L_4		L_2	L_2	
	$Max(Neg(I_{Bk}); V_{ABk})$	**L_5**		L_6	**L_5**	
Result	$TI_{AB}= Min_k[Max(Neg(I_{Bk}); V_{ABk})]$			**L_5**		

Table 5. Application of the Yager's ME-MCDM variant to the estimation of TI_{AB}. Evaluation scale levels = {$L_1,...,L_7$}.

Additional details concerning Yager's ME-MCDM method and its variant are proposed in Appendix 1. The final results of the application of the SRD method are presented in Figure 6.

IMPORTANCE		TANGIBLES	RELIABILITY	RESPONSIVENESS	ASSURANCE	EMPATHY
	A	L_5	L_4	L_5	L_6	L_5
	B	L_4	L_7	L_6	L_6	L_5

FROM	TO	TANGIBLES	RELIABILITY	RESPONSIVENESS	ASSURANCE	EMPATHY	TOTAL IMPACT
A	B	L_5	L_4	L_6	L_5	L_4	**L_5**
B	A	L_5	L_4	L_4	L_6	L_4	**L_5**

Figure 6. Example Step-3: complete SRD operational scheme. Evaluation scale levels = {L_1,...,L_7}.

Depending on the properties of the evaluation data available, Yager's ME-MCDM method could be substituted by other aggregation methods. As an example, we could use the Analytic Hierarchy Process (Saaty, 2008). In this case, the information about importance (primary criteria) and influences (secondary criteria) should be provided on ratio scales. However, in the early design phases, the service designer is usually unable to provide evaluations on a ratio scale. This is the reason why we decided to use Yager's ME-MCDM method. On the other hand, an artificial "promotion" of the data, originally provided on ordinal scales, into the evaluations given on ratio scales, could determine a distortion of the final results (Stevens, 1946; Franceschini et al., 2004).

5 Results analysis

Figure 7 presents the relationship map, i.e. a map to relate the obtained values of total impacts (TI_{ij}) to the categories of service relationship introduced in Section 2. The x and y axes of the map respectively report the Total Impact from service B to service A and vice versa. Operatively, each pair of values (TI_{AB}; TI_{BA}) univocally determines the kind of relationship between the analysed services.

Figure 8 shows the relationship map related to the example of Figure 5. The analysed case falls in quadrant I: mutual impacts are both positive ($TI_{AB} = TI_{BA} = L_5$), identifying a mutualism relationship.

In the next sections we will analyse each single quadrant of the relationship map, identifying archetypal behaviours of the symbiotic factors.
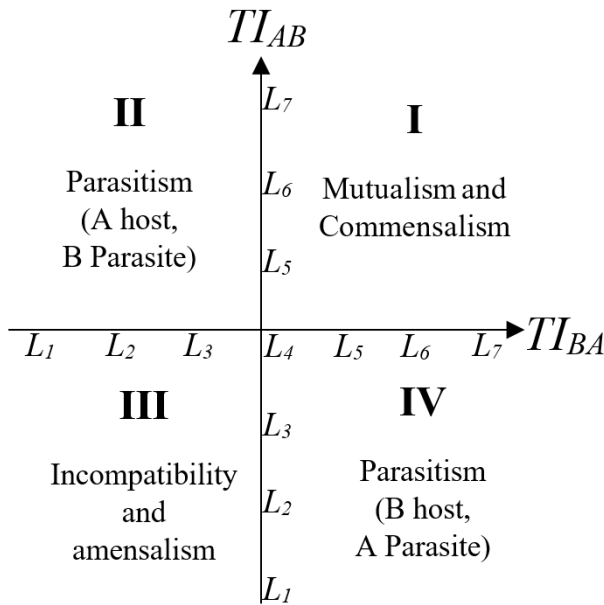
Figure 7. Relationship map. The map shows different categories of service relationship based on matching services mutual impacts
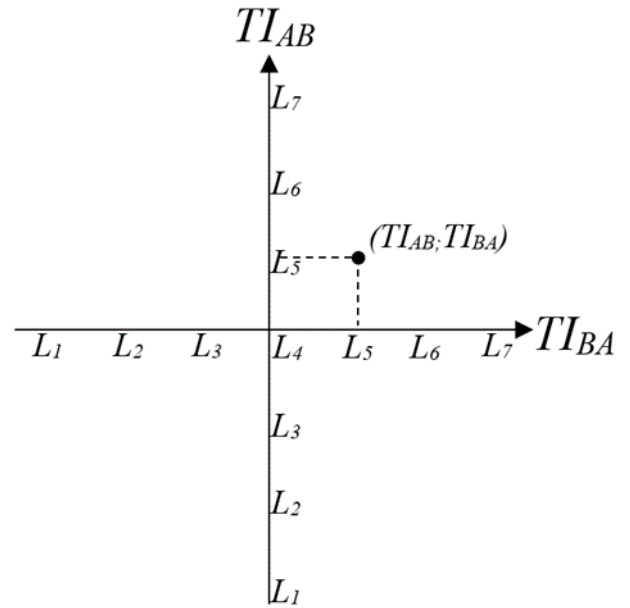
Figure 8. Relationship map for the explicative example of Figure 5.

5.1 Quadrant I: Positive Relationships

Service relationships classified as mutualism or commensalism fall in Quadrant I. This portion of the chart includes any service relationship whose total impacts are greater than the neutral level (L_4, see Table 4), i.e. a clearly positive relationship occurring when the performance of the matched services is (or would be) higher than that of the two services supplied separately.

As introduced in Section 3, the terms "mutualism" and "commensalism" are commonly used by ecologists to define relationships between two organisms of different species in which each of the two species may benefit from the activity of the other without negatively affecting it (Begon et al., 2006). Similar considerations hold for service networks: mutualism is the service relationship in which the matching generates mutual positive influences, while commensalism is the service relationship in which only one of the two services takes advantage of the matching. To effectively describe the implications of these relationships, Table 6 analyses the typical consequences encountered for each symbiotic factor (see also Table 1).

Symbiotic factors	Relationship effect
Customers	**Positive effects** Some customers of service A may be attracted by the new service B offered by the same provider and vice versa.
Operational resources	**Positive effects** Two services can share operational resources needed by their delivery processes. This determines: (i) greater efficiency; (ii) availability of more resources; (iii) use of spare capacity.

Protection resources	**Positive effects**	
	A service can share and enhance protection resources defending service B from market competition or any other negative event and vice versa.	

Table 6. Effects on symbiotic factors by Mutualism and Commensalism Service Relationships

To cite a striking case of mutualism, the relationship between music/podcast/video streaming services and telephone companies can be reported: besides offering the traditional telephone services, such companies generally offer additional subscription services that allow audio, music or video streaming to be enjoyed without paying for the internet traffic. In this example, the services share: (i) customers, fulfilling different needs; (ii) operational resources, primarily the telecommunication infrastructures, but also corporate structure and sales network and (iii) protection resources, sharing the same telephone service brand.

Correspondingly, an example of commensalism is that of some national Post Offices. In this context, conventional postal services are often matched with sale services of books and other objects. Examining this case, it can be concluded that the postal service provides customers and operational resources (personnel, customers, equipment, stores, etc.) to the book sale service which, in turn, does not provide any benefit to the postal service.

The above-mentioned relationship effects suggest that in the case of mutualism or commensalism, the main goal of a service designer is to maximise the positive influences resulting from service matching. In practice this recommendation means that customers, operational and protection resources should be shared whenever possible with the objective of improving the performances of the matched services in terms of economic efficiency, perceived quality and environmental sustainability, among others.

5.2 Quadrant III: Negative Relationships

Quadrant III is the portion of the relationship map that includes the total impacts that are below neutral level (L_4, see Table 4). Such negative relationships are herein defined as incompatibility and amensalism.

Here again, the analogy with natural ecosystems may be helpful in the understanding of the service relationships' peculiarity: two species may be defined as incompatible when their coexistence is harmful for both (Begon et al., 2006). Instead of this completely negative relationship, amensalism is that particular case in which only one of the two species is negatively affected by the coexistence, while the other does not receive any benefit (Begon et al., 2006). Similar definitions can be applied to identify relationships in service networks. Specifically, negative service relationships may be classifiable as: (i) incompatibility, when the matching generates two-ways negative effects and (ii) amensalism, when only one of the two

services involved in the matching is negatively affected. By analysing each symbiotic factor separately, Table 7 reports a comprehensive description of the most remarkable effects resulting by the matching of incompatible and amensalistic services.

Symbiotic factors	Relationship effect
Customers	**Negative effects** If services compete to fulfill the same needs, customers only get one of the two. It is also possible that some potential customers decide not to use a specific service A because another service B is offered by the same provider and vice versa.
Operational resources	**Negative effects** Two services, say A and B, can also compete to use the same operational resources. In this case, both services may not be able to manage the resources needed by their delivery processes. Weakening resource performance could happen too; it is the case in which services, A or B, create externalities that negatively affect their delivery process.
Protection resources	**Negative effects** Protection resources are not shared. Protection resources could also be negatively affected.

Table 7. Effects on symbiotic factors by Amensalism and Incompatibility

A potential example of amensalism may be the matching between a hospitality (e.g. a city hotel) and a leisure service (e.g. a disco-club). In that event, the most negative effects would concern the customers symbiotic factors: some of the hotel guests would probably prefer a quieter accommodation. Moreover, the two services will probably not be able to share any important strategic operational or protection resource.

Relationships between incompatible services do not create advantages for any of the matched services and, for this reason, cannot be long-lasting relationships. Thus, it is hard to propose a real example of such kind of relationship: one case could be the matching of a respiratory care service with the sale service of tobacco products.

In conclusion, service matching is clearly not convenient when a negative symbiotic relationship is identified. In the extreme case in which the matching is specifically required, service designers must be adept at trying to separate the two services, at least in the customers' perception.

In particular, in order to avoid losses on customers' perceived quality or to prevent internal competition caused by negative relationships, it would be recommended not to implement strategies designed to share customers. In parallel, the allocation of the operational and protection resources must follow the guiding principle of the independence between the matched services, since their sharing could produce mutual negative effects.

5.3 II and IV Quadrants: Parasitism

This section deals with relationships with opposite total impacts, i.e. the case in which one is below and the other is above neutral level ($TI_{ij} < L_4$ and $TI_{ji} > L_4$, see Table 4). These relationships fall under the definition of parasitism and are located in quadrant II or IV of the relationship map.

In the same way as parasites benefit from hosts in natural ecosystems, services may also be seen as parasites and hosts when, in a matching, one generates positive effects on the other, while the second is damaged (Begon et al., 2006). Consequently, and quite understandably, the evaluation of parasitic relationships is critical. The effects on the three basic symbiotic factors and the behaviors of parasite and host are described in Table 8.

Symbiotic factors	Relationship effect
Customers	**Parasite: Produces negative effects** The parasite service "steals" or dissuades potential host customers.
	Host: Produces positive effects A part of the host customers may choose the parasite service.
Operational resources	**Parasite: Produces negative effects** The parasite can use host operational resources, thereby reducing their availability; externalities produced by the parasite can negatively affect the delivery processes of the host.
	Host: Produces positive effects The host shares operational resources with the parasite. The operational resource performances of the parasite can be enhanced by the externalities produced by the host.
Protection resources	**Parasite: Produces negative effects** The parasite service does not share protection. Host service protection resources could be negatively influenced by the parasite.
	Host: Produces positive effects Host service can share and enhance resources by protecting the parasite

Table 8. Effects on symbiotic factors by Parasitic Service Relationships

A simple example of parasitism is the relationship between cinemas and advertising services: cinemas (host) share customers and operational resources (theatre, projectors, etc.) with advertising services (parasite). As a result, potential customers may choose other cinemas if the negative effects of advertising services are too high.

When a parasitic relationship is identified, a service designer should evaluate the convenience of the matching and, if the matching is opportune, define a strategy to increase its sustainability. This means that for each symbiotic factor, it is important to recognise the sources of positive impacts, with the goal of promoting the sharing of the resources (e.g. the well-known and reputable brand of a company). On the contrary, when negative effects are present, the service designer has to contain their impact as much as possible. For instance, in presence of a negative externality such as noise or odours, the service designer should focus on the potential actions to physically isolate the responsible service system. These synergistic actions may ensure better outcomes and more effective solutions.

5.4 Neutralism

To complete the analysis, this section considers the case in which the total impacts are both null. By analogy with the natural neutralism, i.e. the relationship involving different species living in the same habitat without exchanging any benefits, neutralism is defined as that relationship for which service matching results in neutral total impacts ($TI_{ij}= TI_{ji}=L_4$) (Begon et al., 2006).

This relationship can be exemplified as the matching of a travel agency service with a veterinary service. The two services are independent of each other and have no mutual influence. Since neutral services do not generate impacts, their matching does not lead to direct or indirect advantages or disadvantages. For this reason, service designers may proceed separately in the development process of the two services.

5.5 Service Relationship Profile

The last activity of SRD analysis is the construction of the *Service Relationship Profile*. For each symbiotic factor, this diagram shows the global effect of the service matching. Figure 9 exemplifies a Service Relationship Profile. The three axes in the diagram represent respectively the three symbiotic factors: customer; operational and protection resources. The line segments connecting the three axes are the relationship profile. This profile can be used by service designers:

a)   to globally evaluate service matching;

b)   to compare and select different alternatives for a potential service matching;

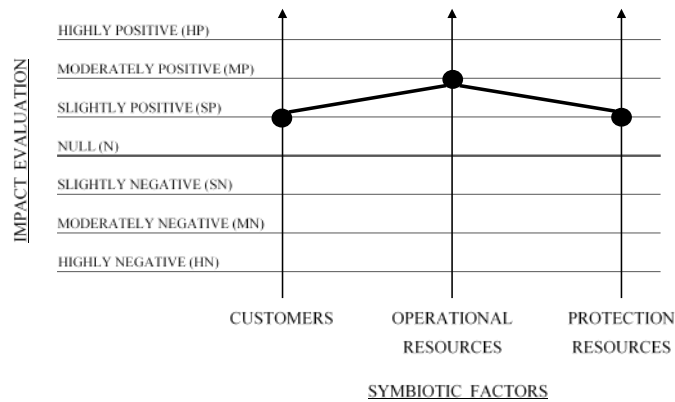c)   to identify factors to be improved.

Figure 9. Example of a Service Relationship Profile

To guide a SRD user in the construction of a Service Relationship Profile a four-phase operational approach is suggested:

(i) *Effect synthesis*: SRD user should summarize mutual effects, i.e. effects on each symbiotic factor from service A to B and vice versa. Table 9 shows this step in the fourth column (Effect synthesis) for the example of the smartphone sales service.

(ii) *Effect evaluation*: SRD user is asked to provide a final evaluation of the effects summarized in the previous phase. Effects can be evaluated using a seven-level ordinal scale as in Table 4, with negative, neutral and positive levels. These partial effects are "monodirectional", i.e. from service A to B and vice versa. With reference to the explicative example, the effect on the symbiotic factor *customers* from service A to service B (customers buying new smartphones may find a response to their potential technical problems) has been evaluated as "highly positive" (HP) by the SRD user. Similar considerations have been made for all the other factors characterizing the relationship. Table 9 shows the result of the application of this step in the "Effect Evaluation" column.

(iii)*Effect combination*: for each symbiotic factor, this phase aims at obtaining a single and univocal assessment. The effect combination is the result of the conjunct evaluation of the two ratings separately given on the monodirectional effects. In order to facilitate this activity, the authors propose the use of the so-called Effects Combination Matrix. This matrix – exemplified in Table 10 – guides SRD users in the combination of the two separate ratings. The basic structure of the Effects Combination Matrix is a table with the two reciprocal monodirectional effects on rows and columns. An example of application is the combination of the monodirectional effects of a particular symbiotic

22

factor which received a pair of evaluations equal to ("null", "slightly negative"). Using the suggested Effects Combination Matrix (Table 10), the combination result would be "slightly negative" (SN). It is clear that different matrices can be built according to each specific application case and the result of the aggregation is affected by this choice. The result of this step is presented in the "Effect Combination" column in Table 9.

(iv) *Diagram Plot*: the obtained effect values can be eventually represented on the Service Relationship Profile, i.e. on the three axes of the diagram (see Figure 9).

Symbiotic factors	From	To	Effect synthesis	Effect Evaluation	Effect Combination
Customers	**A**	**B**	Customers buying new smartphones may find a response to their potential technical problems.	**HP**	**HP**
	B	**A**	Customer experiencing technical problems may decide to buy a new smartphone.	**MP**	
Operational resources	**A**	**B**	Sales, store, cash register personnel, etc. can be shared between the two services.	**HP**	**HP**
	B	**A**	Technical equipment to analyze smartphone software problem can be used to deliver additional services like data transfer when a new device is bought.	**MP**	
Protection resources	**A**	**B**	The well-known brand of the smartphone seller can be used for the technical assistance service.	**SP**	**SP**
	B	**A**	-	**N**	

Table 9. Effects analysis of the matching of smartphone selling (service A) and technical assistance services (service B). Legend: HP= Highly positive. MP= Moderately positive. NP= Slightly positive. N=Null. SN= Slightly negative. MN= Moderately negative. HN= Highly negative.

Considering the explicative example, the two analysed services may share their customers, operational resource and protection resources. Figure 10 shows the Service Relationship Profile for the two services.

As expected, this matching is convenient: all the symbiotic factors receive positive effects from the matching (see Figure 10). The more critical factor concerns protection resources: service designers may decide to focus their efforts on this factor to maximize the positive effects of service matching.

	Effect from service B to service A						
	HIGHLY POSITIVE	MODERATELY POSITIVE	SLIGHTLY POSITIVE	NULL	SLIGHTLY NEGATIVE	MODERATELY NEGATIVE	HIGHLY NEGATIVE
HIGHLY POSITIVE	HP	HP	MP	MP	SP	SN	MN
MODERATELY POSITIVE	HP	MP	SP	SP	N	SN	MN
SLIGHTLY POSITIVE	MP	SP	SP	SP	N	SN	MN
NULL	MP	SP	SP	N	SN	SN	MN
SLIGHTLY NEGATIVE	SP	N	N	SN	SN	SN	MN
MODERATELY NEGATIVE	SN	SN	SN	SN	MN	MN	HN
HIGHLY NEGATIVE	MN	MN	MN	MN	MN	HN	HN

(Left axis label: **Effect form service A to service B**)

Table 10. Effects Combination Matrix. Legend: HP= Highly positive. MP= Moderately positive. NP= Slightly positive. N=Null. SN= Slightly negative. MN= Moderately negative. HN= Highly negative.
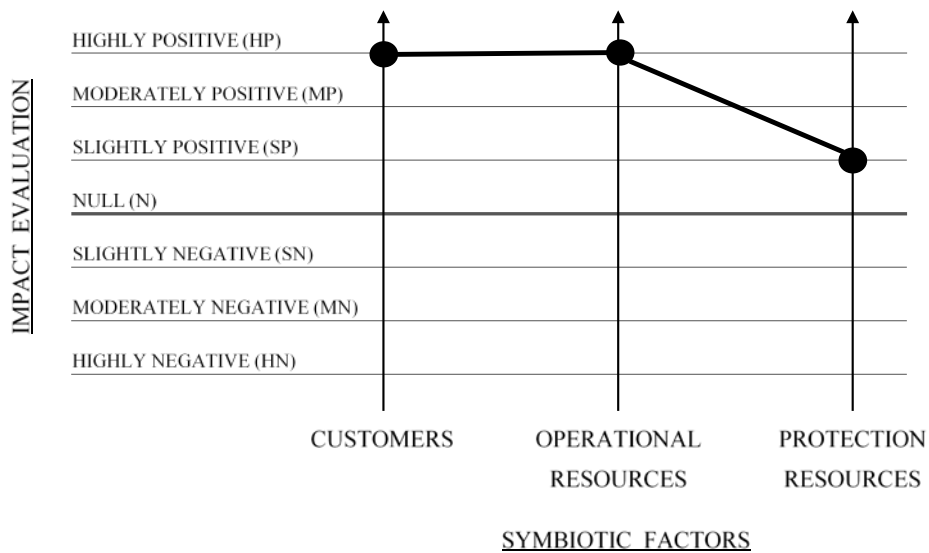

Figure 10. Service Relationship Profile for the explicative example

6 Final application example

This section discusses the application of the SRD method to a specific case of service matching. The case study is a simplified excerpt of a more complex application analyzed by the authors.

A machine-tool producer provides two complementary services: logistic (delivery and transportation) and installation, setup and training services (component assembly, testing and user training).

The management of the company is analyzing the opportunity to provide a third service. The idea is to provide a promotion service of product accessories: during the setup and training activities the technical staff, assisted by a commercial team, may show and demonstrate complementary tools for the machine sold. The management is interested in assessing the possible impacts resulting from this service matching.

The interactions between the logistic and promotion services are negligible, so the relationship can be classified as neutralism. It can be inferred that the matching does not lead to direct or indirect advantages or disadvantages.

The relationship evaluation between installation, setup and training (hereinafter referred to as service C) and promotion service (hereinafter referred to as service D) is more critical. Thus, the application of the SRD method can be of support.

As a first step, the service designer assesses the importance of each service quality determinant for the two services, as well as the potential mutual influences resulting from their matching.

Figure 11 reports the results of this assessment and the total impact values between the two services. Figure 12 shows the position of the service matching on the Relationship map. This example of service matching falls in quadrant II: parasitism. Service C and D are respectively the host ($TI_{CD}>L_4$) and the parasite ($TI_{DC}<L_4$).

Figure 11. Service Relationship Deployment applicated for the matching between the installation, setup and training service (service C) and the promotion service (service D). Evaluation scale levels goes from L1 to L7.
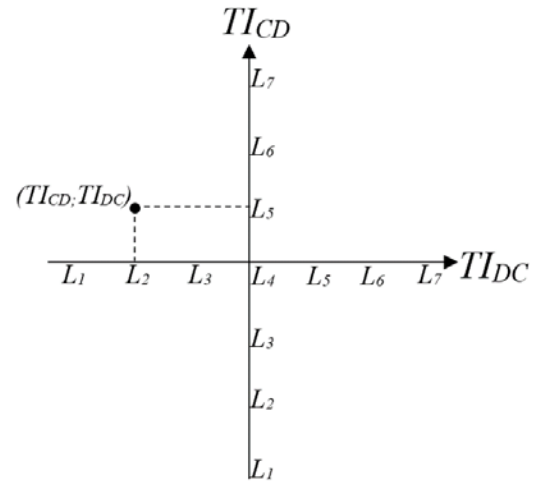

Figure 12. Relationship map ($TI_{CD} = L_5$ and $TI_{DC} = L_2$ for the matching between the installation, setup and training service (service C) and the promotion service (service D).

Table 11 shows the procedure for the construction of the Service Relationship Profile: (1) effect synthesis, (2) effect evaluation and (3) effect combination using the combination matrix (see Table 10).

Symbiotic Factors	From	To	Effect synthesis	Effect evaluation	Effect combination
Customers	**C**	**D**	User of service C are completely shared with service D.	**HP**	**SP**
	D	**C**	Potential customers of the company could be disturbed by the promotion service.	**SN**	
Operational resources	**C**	**D**	Technical staff used in the provision of service C could be shared with service D for the provision of the promotion service.	**HP**	**MP**
	D	**C**	Commercial team does not take part in the provision of service C.	**N**	
Protection resources	**C**	**D**	Name and reputation of the company could also be exploited for the promotion service.	**MP**	**N**
	D	**C**	Reputation of the company could be negatively affected by the promotion service.	**SN**	

Table 11. Analysis of the effects resulting from the matching between the installation, setup and training service (service C) and the promotion service (service D). Legend: HP= Highly positive. MP= Moderately positive. NP= Slightly positive. N=Null. SN= Slightly negative. MN= Moderately negative. HN= Highly negative.

Figure 13 shows the Service Relationship Profile related to the proposed example. The analysed service matching results in positive impacts for customers and operational resources and neutral for protection resources.

The relationship map provides a generally positive evaluation of the matching: two out three symbiotic factors are positive.
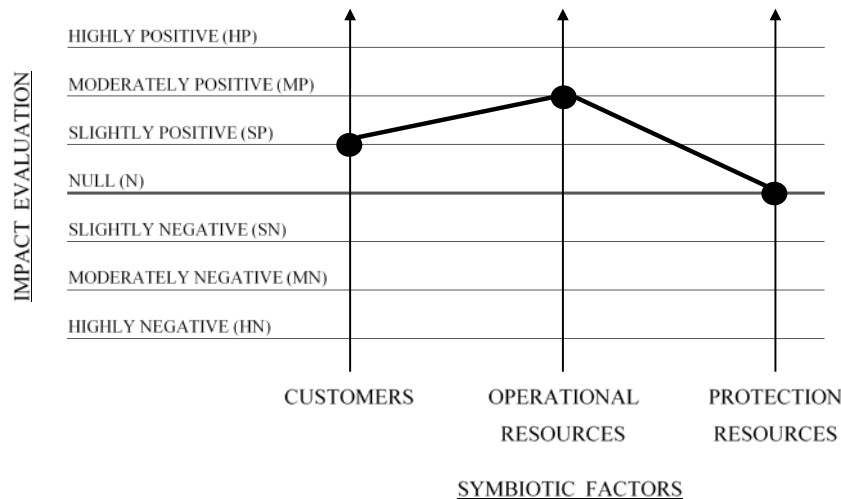
Figure 13. Service Relationship Profile for the matching between the installation, setup and training service and the promotion service.

7 Implications

In this study a novel methodology to evaluate the suitability of service matching in early design phases is presented. The method can be applied to investigate the effects of service matching when (i) a service already exists or (ii) when the matching concerns two services still to be designed. The findings of this investigation complement those of other studies in the field of service networks. New contributions on these topics are significant for many reasons: (i) the increasing diffusion of service networks (Barile et Al., 2016); (ii) the need to improve the knowledge and practices about service networks for achieving improved performances (Edvardsson and Tronvoll, 2013) and (iii) the need to support service network oriented strategies for enhancing companies revenues (Bovet and Martha, 2000) and their service flexibility (Brozovic et al. 2016).

7.1 Implications for Service Design

In practice, the application of the SRD methodology could optimize service network design from their early design phases avoiding redesign activities and wasted resources.

Identifying service relationships is an essential step for service designers during the design of a service network. In the case of a positive relationship, it would be appropriate to increase the major sources of positive impacts and consequently to intensify resource sharing between matched services. On the other hand, in the case of a negative relationship, if the matching must still be done, the goal of the designer would be to limit negative impacts. Due to the nature of the relationships it is appropriate to pursue development approaches resulting in the separation of the two service systems. When instead a potential parasitic relationship among two matched

services is identified, the concurrent minimization of negative and incrementation of positive impacts would be opportune.

7.2 Implications for innovation strategies

The SRD method can also be used as a tool to drive innovation in service networks: the search for specific services establishing positive relationships could boost radical service network innovation by providing novel architectural solutions composed of services never previously matched (Zomerdijk, 2011). On the other hand, the detailed analysis of service relationship can be used as a basis for the definition of improvement initiatives, thus pursuing incremental innovation. In addition, service matching strategies can be interpreted as a practical approach to sustainable innovation in service industries due to the integration of resources pertaining to different service systems.

7.3 Implications for Scientific research

The continuous growth of the service sector is stimulating the interest of the scientific community to study unexplored problems (Voss et al. 2016). The design of a service network falls into this category of problems.

To the authors' best knowledge, the role of service matching in service networks development has not been treated systematically in the scientific literature and no practical tools for supporting the analysis of impacts have not yet been proposed. In this sense, the aim of this study is aligned with the opinion of Ostrom et al. (2015) indicating the comprehension of service networks as a key priority for service science . The classification of service relationships and the definition of a viable set of characterizing factors represent a further step in the direction of improving the understanding of service networks (Barile et al. 2016).

8   Conclusions

The number of companies offering service networks has expanded rapidly during the past several years. These companies need to evaluate the suitability of specific service matchings to expand the range of offered services. In this scenario, service matching may be regarded as the basic process for building a service network.

A structured and systematic procedure to evaluate service matching during early design phases can be particularly useful to reduce the risk of neglecting important tasks and to avoid wasting time and effort in redesign activities. The proposed Service Relationship Deployment is intended

as a response to the demand for practical tools and approaches to assess the impact of a service matching.

Following the close analogy between natural ecosystems and *service networks*, a taxonomy of service relationships has been introduced and used as the principal outcome of the proposed SRD methodology.

The generalisability of the proposed method is subject to some limitations. For instance, in some contexts, it may not be immediate to classify service relationships and related symbiotic factors. Notwithstanding these limitations, the method represents a first attempt to address basic issues related to the service matching problem. The findings of this research provide insights for defining qualitative and quantitative frameworks in a little explored area of service research.

Future research in this field would be of great help in: (i) investigating methods for the aggregation of the assessments provided by multiple evaluators; (ii) the extension of the method to the design of *service networks* and (iii) a wider analysis of the effects of service matching.

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Appendix 1

This section provides some details about the application of the Yager's ME-MCDM method and its variant.

The Yager's ME-MCDM method has been developed for global evaluation $D(a)$ of an object (a) on a set of criteria g_j with importance $I(g_j)$.

$$D(a) = \min_j \left[\max\left(Neg\left(I\left(g_j \right) \right), g_j(a) \right) \right]$$

(2)

The importances and the evaluations refer to the same element (a). On the contrary, two elements (Service A and Service B) must be considered in the aggregation proposed in the SRD method. The aggregated value of the five partial impacts on service determinants shall be based on: (a) the influences on service quality determinants that the service A, the "origin", has on the service B, the "destination" (V_{ABk}) and (b) the importances of the service quality determinants with respect to the service B, the "destination" (I_{Bk}).

Yager's Multi Expert - Multi Criteria Decision Making (ME-MCDM) method

Table A.1 shows an example of application of Yager's ME-MCDM method: the second row contains the importance of service quality determinants (I_{ik}); the evaluations (V_{ijk}) for each determinant influence are listed in the third row; the fourth and fifth rows respectively contain the negated value of the determinants importance ($Neg(I_{ik})$) and the maximum between the negated value of the importance of service quality determinants and the relevant evaluations. The total impact minimum value is selected as aggregated value (sixth row).

		Determinants				
		k_1	k_2	k_3	k_4	k_5
Initial data	I_{ik}	L_4	L_7	L_5	L_5	L_7
	V_{jik}	L_4	L_1	L_3	L_5	L_7
Elaboration	$Neg(I_{ik})$	L_3	L_1	L_4	L_3	L_4
	$Max(Neg(I_{ik}); V_{jik})$	$\mathbf{L_4}$	L_6	$\mathbf{L_4}$	$\mathbf{L_4}$	L_7
Result	$TI= Min_k[Max(Neg(I_{ik}); V_{jik})]$	$\mathbf{L_4}$				

Table A.1.Example of application of Yager's ME-MCDM method. Legend: I_{ik} = Importance of the k-th service quality determinant. V_{jik} = Estimated influence from service j to service i for the k-th determinant. TI = Total Impact.

Although there is a highly negative evaluation on a very important determinant (k_2) the aggregated value converges to neutral level (L_4).

Yager's ME-MCDM variant

As indicated in Section 3.5, the proposed variant considers two additional rules: (i) Veto condition and (ii) Neutral determinants rules (see Section 3.5).

Table A.2 reports the same example of Table A.1 when the veto condition rule is applied. In this case, determinant k_2 has the maximum importance level (L_7) and a highly negative evaluation (L_1). This situation triggers the veto condition. The highly positive influence on determinant k_5 does not compensate the negative evaluation on determinant k_2.

Table A.3 shows the application of the neutral determinants rule. Determinants with an influence (V_{jik}) equal to the neutral level (L_4) are not considered in the aggregation. In this case, the resulting aggregated value is slightly positive (L_5).

		Determinants				
		k_1	k_2	k_3	k_4	k_5
Initial data	I_{ik}	L_4	$\boldsymbol{L_7}$	L_5	L_5	L_7
	V_{jik}	L_4	$\boldsymbol{L_1}$	L_3	L_5	L_7
Elaboration	$Neg(I_{ik})$					
	$Max(Neg(I_{ik}); V_{jik})$					
Result	$TI= Min_k[Max(Neg(I_{ik}); V_{jik})]$			$\boldsymbol{L_1}$		

Table A.2. Application of the Yager's ME-MCDM variant. Legend: I_{ik} = Importance of the k-th service quality determinant. V_{jik} = Estimated influence from service j to service i for the k-th determinant. TI = Total Impact

		Determinants				
		k_1	k_2	k_3	k_4	k_5
Initial data	I_{ik}	L_4	L_6	L_7	L_6	L_6
	V_{jik}	~~L_4~~	L_1	~~L_4~~	L_1	L_1
Elaboration	$Neg(I_{ik})$		L_2		L_3	L_3
	$Max(Neg(I_{ik}); V_{jik})$		$\boldsymbol{L_5}$		L_7	$\boldsymbol{L_5}$
Result	$TI= Min_k[Max(Neg(I_{ik}); V_{jik})]$			$\boldsymbol{L_5}$		

Table A.3. Example of the application of Yager's ME-MCDM variant in which veto condition is not applicable. Legend: I_{ik} = Importance of the k-th service quality determinant. V_{jik} = Estimated influence from service j to service i for the k-th determinant. TI = Total Impact.